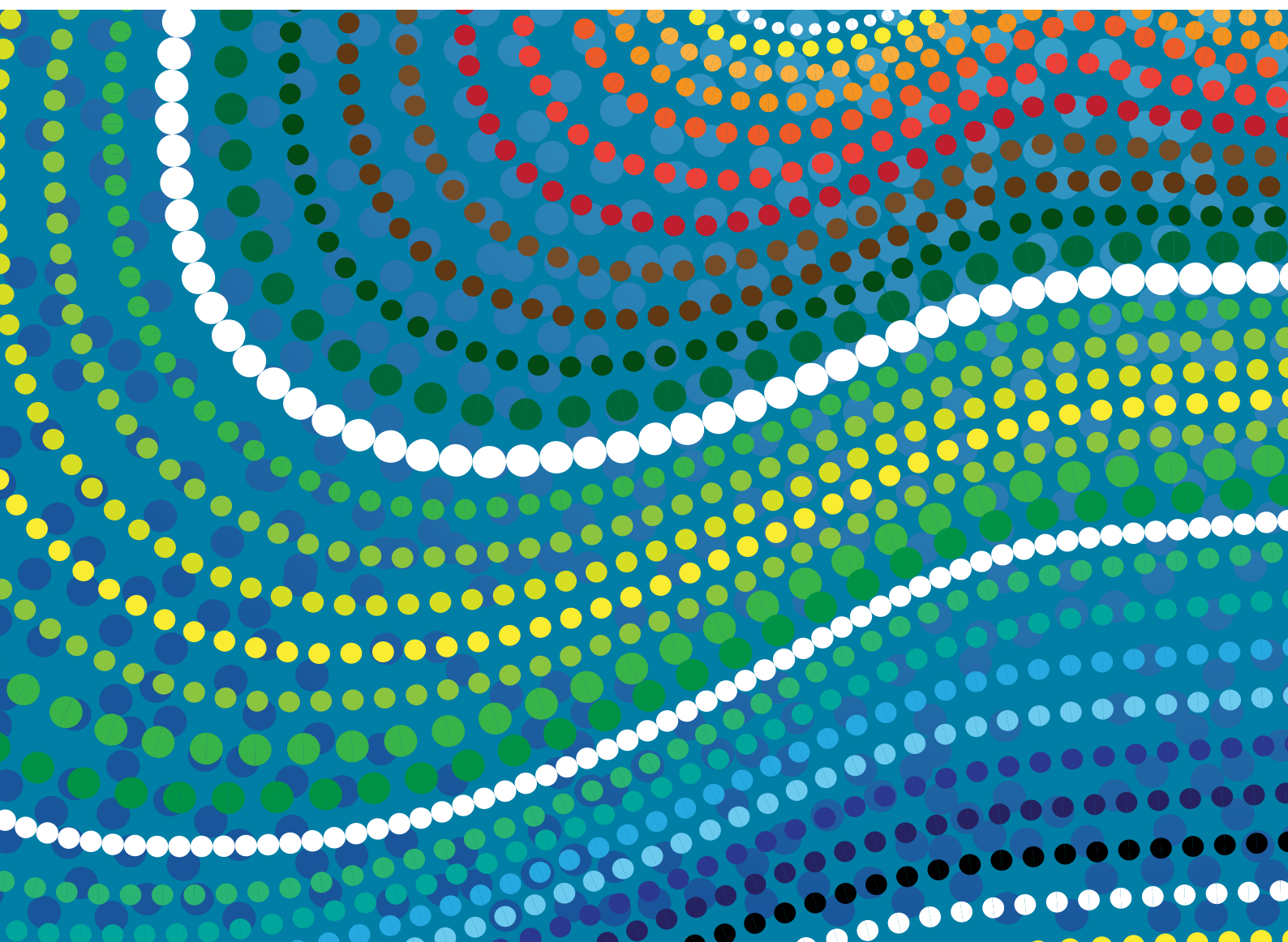# Rethinking Antitrust Tools for Multi-Sided Platforms
2018

OECD

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Foreword

Digitalisation of the economy has, it seems, arrived in waves. In the first wave, the internet allowed us to buy directly digital copies and physical products and services from online stores, rather than physical ones. The second wave has seen the appearance of online platforms, which assemble, search, review and match users with sets of products and sellers. To do so platforms recruit at least two, but often three or more sets of users, many of which value the platform not for its own qualities, but for the presence of others upon it. We currently await the third wave, said to involve the direct transfer of not just information, and hence digital copies, but also of value, in the form of unique digital products and services over the internet. As more and more physical products and services become largely digital in nature, the scale of this next change becomes ever more important. While the payment systems used by platforms may face challenges, and platforms themselves may change in nature, they seem likely to remain crucial to our ability to interact within the digital economy.

Platforms are not a new business model, but rather an old one that has been rejuvenated by the sheer scale and scope of the participants in digital economy. The complexity this creates has renewed the need for, and the value in having a simple meeting place where those interested in trading particular products and services can find one another, and perhaps be entertained while doing so. It appears that users are not looking for a particular seller, or someone that carefully selects and assures the quality of suppliers, instead they crowdsource recommendations and ask only that they be able to search for, or introduced by algorithm to, the best possible match.

Many digital marketplaces remain free to consumers, the market-makers having decided against charging for entrance or use of their platform services, and instead to use the available technology to monetise the information conveyed by users. While this was not possible in the past, it is now, largely as a result of the ability to digitalise what we know (the customer relationship), and the low value that users attach to the sharing of this information. This does not mean competition is necessarily working effectively, however nor does it mean that there is undetected anticompetitive conduct by firms. More likely, the answer lies in consumers having greater awareness of the surplus that is generated, and more effective tools to extract it from the market when prices hit zero.

To investigate whether the antitrust toolkit remains fit-for-purpose the OECD Competition Committee held a Hearing in June 2017. This asked whether the tools traditionally used to define markets, to assess market power and efficiencies, and to assess the effects of exclusionary conduct and vertical restraints, remain sufficient to address those questions in the context of these multi-sided platform markets. At the hearing a range of expert economists from agencies, academia, and private practice were invited to make practical methodological proposals on how these tools might need to be re-designed or re-interpreted in order to equip competition agencies with the analytical tools they require when analysing multi-sided platform markets. This report features each of the contributions made by those experts (and their co-authors) along with an opening synthesis chapter by the OECD.

What we heard at the hearing was that platforms were different in nature from traditional markets, and particularly that there were important demand externalities from one side of the platform to the other ('cross-platform network effects') which if ignored could lead to bad decision-making. However, we also heard that where these externalities were recognised, the existing tools could be adjusted to account for them. Therefore, where there is a plausible cross-platform network externality, the most important takeaway is for competition agencies to consider the value of adopting a multi-sided approach, and to explain the rationale when deciding not to do so.

In addition to this, there were a number of key messages. The first key message was that market definition is a less valuable tool in these markets. Nevertheless, where it is a requirement, rather than an analytical tool, the most effective framework remains the hypothetical monopolist test, even in the presence of zero prices. On market power, we heard two key messages. Firstly, that the more sophisticated tools need to be adjusted to estimate the impact that a price rise on side A of the platform would have on: the demand from users on side A; the demand from users on side B; and the price that is set on side B. So for example, surveys and demand estimations need to estimate those elasticities. Secondly, less sophisticated tools for measuring the market power of a platform also need adjusting to reflect the existence of a second or third side. For example, shares of volume on one side can only be interpreted in parallel with shares on the other side, and profitability must be taken at a platform level and not on sales to just one side of the market.

The key message on exclusionary conduct was that it should not be assumed to be harmless simply on the basis that there was another side to the market. If anything platform markets may provide particularly fertile ground for exclusionary behaviour and so merit greater scrutiny. A second key message was that while the framework for assessing the exclusionary effects of exclusivity clauses remains robust, price-cost tests as a whole are not fit-for-purpose as a tool for identifying predatory pricing in these markets. A proposed replacement was to consider whether the price would have made sense if it did not weaken its rival. This might be tested by estimating elasticities and then removing any substitution effects from the platform's optimal price setting problem.

Finally, the analytical framework and tools used to analyse efficiencies and the effects of vertical restraints on a case-by-case basis each remain effective. Indeed, there would appear to be significant scope for efficiencies to arise in platform mergers to the extent that they are necessary to combine separate user bases and increase interoperability. Similarly, where cross-platform network effects are strong there may be a real risk that if they have the opportunity, users on either side might free-ride and bypass the platform. As a result there may be significant scope for vertical restraints imposed by the platform to generate efficiencies by protecting its viability.

Frédéric Jenny

Chairman, OECD Competition Committee

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Part I. Introduction and key findings

By Chris Pike [*]

Since the turn of the century, economists have understood that multi-sided markets function in ways that are importantly different from standard markets. Since the ground-breaking work on the topic by Rochet & Tirole, huge progress has been made in modelling these markets and the way they work, and identifying the mistakes that can be made by treating them as traditional markets.[1] Naturally, this has consequences for the way in which competition agencies analyse these markets, and hence on whether, and if so how, they decide to intervene in these markets. The speed and extent of growth in the digital economy in over this same period has made this one of the most important, pressing and analytical challenges that competition agencies now face. This is because much of that digital growth has been driven by the appearance and expansion of globalised platforms that disintermediate standard markets and directly connect users, transforming them into more complex multi-sided markets.

In June 2017, the OECD Competition Committee held a Hearing that looked at whether the tools traditionally used to define markets, to assess market power and efficiencies, and to assess the effects of exclusionary conduct and vertical restraints, remain sufficient to address those questions in the context of multi-sided markets. It then invited practical methodological proposals from a range of expert economists from agencies, academia, and private practice on how these tools might need to be re-designed or re-interpreted in order to equip competition agencies with the analytical tools they require when analysing multi-sided markets.

1. What are multi-sided markets? Why are they different?

While economists typically referred to "two-sided markets" to begin with, we here follow the recent trend by referring here to "multi-sided platforms".[2] We do so for two reasons. Firstly, it helpfully distinguishes between the product of the firm (the platform), and the

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[*] This paper was prepared by Chris Pike, Competition expert at the OECD Competition Division, with invaluable comments from Antonio Capobianco, Pedro Gonzaga and Antonio Gomes. The opinions expressed and arguments employed herein do not necessarily reflect the official views of the Organisation or of the governments of its member countries. All documents related to this hearing can be found at www.oecd.org/daf/competition/rethinking-antitrust-enforcement-tools-in-multi-sided-markets.htm. The experts at the hearing were: Lapo Filistrucchi, Arno Rasek (with co-author Sebastian Wismer), Kurt Brekke, Kate Collyer (with co-authors Hugh Mullan and Natalie Timan), Michael Katz, Tommaso Valletti (with co-authors Andrea Amelio and Liliane Karlinger); Jorge Padilla (with co-author Enrique Andreu), Howard Shelanski (Samantha Knox and Arif Dhilla), Paul Johnson, and Cristina Caffarra (with co-author Kai-Uwe Kühn). Except where indicated, the conclusions reached in this paper do not necessarily reflect the views of these experts. The experts were provided with an opportunity to clarify any views that are attributed to them.

relevant market, or markets, in which the platform operates. Secondly, it accounts for the fact that while the multi-dimensionality begins with two-sidedness (in which consumers and sellers meet on a platform), this is only the beginning, and many of these markets have three sides (consumers, content suppliers, and advertisers) and some even have four (for example in payment cards) or more.

Examples of multi-sided platforms abound: TV and newspapers that connect viewers and advertisers; payment cards that connect card holders, merchants, card-issuing banks and acquiring banks; stock exchanges that connect buyers and sellers; shopping centres that connect retailers with shoppers; digital platforms that connect users, content providers and advertisers; listings magazines/directories that connect businesses and customers; estate agents that connect house sellers and house buyers; and telecom networks that connect fixed and mobile phone users. They might also be thought to include hospitals that connect physician groups with health insurers (and even health insurers that connect hospitals and patients), banks that connect depositors and savers, and supermarkets that connect producers and shoppers.

There are various definitions of the multi-sided markets in which multi-sided platforms compete, however, most share the same basic elements, and can be captured as follows: *a market in which a firm acts as a platform and sells different products to different groups of consumers, while recognising that the demand from one group of customer depends on the demand from the other group(s).*[3] Crucially, if this *cross-platform network externality* is present,[4] this implies that the structure of prices that the platform sets will determine volume, not just the level at which it sets the price across the different sides of the market.[5]

While the existence of a cross-platform network externality is binary, there was common agreement amongst experts at the Hearing that there is little value in using this as the distinguishing feature of a multi-sided platform for antitrust purposes. This is because it is the magnitude of the cross-platform network externality that determines how big a mistake it is to overlook it and treat the product as one-sided. Therefore, while a wider set of markets may exhibit small cross-platform network externalities, the externalities will only be large enough to be important for the analysis in a smaller set of markets.

Using a bright line to identify when to use a multi-sided approach therefore risks overcomplicating the assessment of what are, in effect, one-sided markets. However, the alternative conclusion that 'multi-sidedness matters when it matters' means that the multi-sidedness of a market may depend on the nature of the investigation. For example, the platform nature of a supermarket may not matter in the context of a local supermarket merger where the impact on suppliers might be minimal given the level at which supplier decisions are taken and simple quality measures such as the range of products that are offered to consumers may suffice. However, if the investigation is into the anticompetitive nature of 'slotting fees' charged by supermarkets to suppliers for greater prominence on its shelves, then a multi-sided perspective might help explain the rationale for the practice and hence be invaluable to the analysis. Therefore, where there is a cross-platform network externality, the value of adopting a multi-sided approach should at least be considered, and the rationale for deciding not to do so explained.

There are also some important differences between different types of multi-sided platforms. The first is between those platforms that can observe when a transaction is taking place on the platform and those that cannot. Where the platform can observe a transaction, it may charge a price for it if the externality derives from additional *use* of the platform by other sides, rather than solely from additional *membership.* This might be instead of, or in addition to, any subscription fee that it sets for members.

Within the category of non-transaction platforms, we can think of there being non-transaction matching platforms, and non-transaction audience-providing platforms. For example, where the cross-platform network externality is positive on both sides and the objective of the platform and all users is to find the best possible match, Rasek & Wismer describe a platform as a matching platform (Shelanski, Knox & Dhilla refer to these as service-based platforms). A matching platform can be a transaction matching platform if the transaction is observable (e.g. uber, stock exchanges), but if it is not observable then it can be considered a non-transaction matching platform (e.g. dating apps, real estate platforms, Wikipedia).

If the externality runs in just one direction, Rasek & Wismer consider the platform an audience-providing platform (Shelanski, Knox & Dhilla identify these as subsidy-based platforms). We can think of these audience-providing platforms as being either transaction or non-transaction platforms depending on whether the transaction is observable or not. Typically, an advertising platform (e.g. newspapers) will not be able to observe the transaction (whether the advert resulted in a sale to a specific customer). However this is already changing in online advertising where a purchase can be traced using the trail that is created when a consumer clicks through from an advert and makes a purchase. In that case, the effect of the advert may become observable to the platform, which in turn allows it to charge for a commission on the follow-on transaction.

While a two-sided market can be categorised using these distinctions, as Shelanski, Knox & Dhilla point out, many digital platforms are three-sided and so can be characterised both as matching two sides that each generate positive externalities (users and content providers), whilst also providing an audience for a third side that might not deliver positive externalities (advertisers). The transactions between these three sides may all be observable or none of them might be.

The nature and strength of the cross-platform network effects is therefore more important to the analysis than the category of platform. For example, the consequences of some platforms' actions can be much greater than they appear at first sight. For example, when a strong cross-platform network externality exists on more than one side of the market, this creates feedback loops. In these loops, an action can trigger a spiral of reactions, which, as in a multiplier effect, increase the magnitude of the consequences of the action. As an example, increasing the price that users pay might reduce the number of users, but this may also reduce the value of the platform to advertisers and hence reduce the amount that advertisers are willing to pay. In turn, this may reduce the return that content providers earn when their content is viewed on the platform, thereby reducing the amount or quality of content, which may reduce the number of users. Once again, this may then reduce the amount that advertisers are willing to pay, and so forth. Each action the platform takes can therefore create a series of reactions (a ripple effect). If these effects go far enough they may tip the firm towards failure on the one hand, or dominance (monopoly) on the other.

Box 1. Summary on the nature of multi-sided markets

There are various definitions of the multi-sided markets in which multi-sided platforms compete, however, most share the same basic elements, and can be captured as follows: a market in which a firm acts as a platform and sells different products to different groups of consumers, while recognising that the demand from one group of customer depends on the demand from the other group(s).

While the existence of a cross-platform network externality is binary, there is common agreement amongst experts at the Hearing that there is little value in using this as the distinguishing feature of a multi-sided platform for antitrust purposes. Nevertheless, where there is a cross-platform network externality, the value of adopting a multi-sided approach should at least be considered, and the rationale for deciding not to do so explained

There are differences between different types of multi-sided platforms. The first is between those platforms that can observe when a transaction is taking place on the platform and those that cannot. A further distinction is between non-transaction platforms that match users, and non-transaction platforms that provide content to some users and access to an audience for other users.

Despite the differences, the nature and strength of the cross-platform network effects is more important to the analysis than the category of platform. For example, a strong cross-platform network externality that exists on more than one side of the market creates feedback loops that can mean the consequences of the platforms' actions are much greater than they might appear at first sight.

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2. Market Definition

A traditional starting point for framing an analysis of the competitive effects of a merger, an action or an agreement is to define the relevant market(s) that might be affected. This can help to identify demand and a set of relevant competitors. However, when a merger, action or agreement involves either a multi-sided platform, or a firm that trades with a multi-sided platform, there is a preliminary question of how many markets to define. For multi-product or multi-location firms, the answer is the result of the market definition exercise, which identifies the scope of the market, and hence whether those different products and locations fall within the same or different markets. In contrast, for multi-sided platforms, the product that a platform provides to one side of the market does not compete with the product it provides to another side. In the case of multi-sided markets the question of how many markets to define cannot be answered within a market definition exercise, instead it is a conceptual question that requires an answer before any exercise to define the scope of the market can be carried out.

How many markets to define?

Filistrucchi suggests that one multi-sided market should be defined only in the case of platforms that compete in 'transaction markets'. In these markets, a platform sells the ability to find a match and transact with another side of the market (e.g. Airbnb). The product is the transaction, and this is the same product offered to each side (and in fixed 1:1 proportions, so one side can only transact if someone on the other side transacts with

it). In cases where platforms compete in non-transaction markets, he suggests defining two 'interrelated' markets.

However, as noted by Rasek & Wismer and others, non-transaction markets include different types of multi-sided market. There appears, for example, to be agreement that in those types of markets where the cross-platform network externality is positive for just one side (e.g. media markets), it makes sense to define two 'interrelated' markets. In those cases, the product offered to each side is very different. For example, in newspapers this might be a market for printed content (a reader market), and a market for attention (an advertising market).

In addition, there are also non-transaction matching markets. These might be funded through advertising (effectively creating a third side to the market), or they might be funded through subscription fees. The product on offer to the two sides is the opportunity to find a match, though not to transact (see for example a dating application, a social network where different user groups interact, or a marketplace application like craigslist). In this case, the platform does not offer a transaction to either side as its product (since it cannot observe whether a transaction takes place or not and hence cannot charge for it). Instead the product that it offers to both sides is the opportunity to find a match (and hence to transact off-platform). In these cases it would appear that, if a market were to be defined, it would be a single two-sided market. However, where the matching platforms are funded by advertising, this third side (advertisers) might be identified as a distinct market that is interrelated with the two-sided matching market.

One might ask whether it really matters whether we define a two-sided market or two 'interrelated' markets, as long as we identify that these each require an analysis of the interrelationship, and hence recognise that each differs from a traditional one-sided market. For the purposes of a competitive assessment that is right.[6] Analysing the interrelationship is unavoidable since running a simple one-sided market definition analysis would ignore the fact that the profit the platform loses when a reader switches is magnified by the reaction of advertisers to that decision.[7] In contrast, market definition is often unnecessary and can be counterproductive.[8] Rasek & Wismer suggest that in multi-sided markets market definition in itself may be less informative than in one-sided markets. Therefore, provided the competitive effects analysis examines the interrelationship between the different *sides* or *markets*, the framing of the market definition as a multi-sided market or as multiple interrelated markets, or indeed the absence of a market definition, need not distort the conclusion.

However, whether the relevant market is two-sided or consists of two interrelated markets may make an important difference in a legal sense in some jurisdictions. For example, as Katz notes, in the US the question of whether or not efficiencies on one side of the market are weighed against an identified loss of competition on the other side might depend crucially on whether these are considered to be two sides of the *same* market, or interrelated but *distinct* markets. Where two interrelated markets are defined, efficiencies on either market would, if verified, be relevant to the economic assessment (since they would be expected to affect the other market). However, where two interrelated markets are identified, efficiencies would typically need to accrue within the same market as the loss of competition in order to affect the outcome of the case.[9] Therefore, where cross-platform network effects are important, and a market definition is required, defining a single two-sided market would ensure that the assessment as a whole is based on the full set of possible competitive and efficiency effects, and that no effect is arbitrarily

excluded. Notably this would mean that non-transaction platforms would be defined as competing in a single two-sided market rather than two interrelated markets.

How to define the market(s)?

In principle, the framework of the hypothetical monopolist test can still be used in multi-sided markets. Filistrucchi explains that in many cases, this can still be framed as a SSNIP test (a Small but Significant Non-transitory Increase in Price).[10] For example, where a single multi-sided market for transactions is to be defined, a SSNIP test can be used to identify the scope of that market even if one side faces a zero price. This is because the zero price is just one element of a price structure that the platform sets for its single product (the transaction). A small but significant increase in the total price of the transaction is therefore still a meaningful concept (since such an increase is not infinite in the way that a lifting a zero price would be), and the profitability of such an increase can therefore still be examined.

Similarly, where two interrelated markets are to be defined, a zero price in one market does not prevent the other interrelated market being defined via a SSNIP test. It is true that the scope of the zero price market cannot itself be defined by a SSNIP since any change in price would be infinitely large. However, as Filistrucchi suggests, a SSNDQ test (Small but Significant Non-transitory Decrease in Quality) can still be applied, as indeed it might in any of the other scenarios where a SSNIP is the default tool. This is because the hypothetical monopolist test is a test of the profitability of a marginal degradation of value offered, and not of price alone.[11]

However, as is often the case in one-sided markets, the difficulty is in operationalising the SSNIP (or SSNDQ) test. In particular, Rasek & Wismer note that it may not be possible to implement the test due to reliable data being unavailable. Reformulated expressions for the SSNIP test have been developed by Filistrucchi et al (2014) to allow for application within multi-sided markets.

While these expressions appear more complex, the required inputs are in fact largely the same as those required to implement a standard SSNIP test. The additional requirement is an estimate of the cross-platform network effects[12], which is in any case required in the subsequent assessment of market power.

This effect cannot be ignored because it changes the profitability of the price increase, and can therefore change the conclusion of the SSNIP test on the scope of the relevant market. This is the case both for positive and negative cross-platform network effects. For example, if readers dislike adverts, then a price increase by a hypothetical monopolist might reduce readership and make the newspaper less attractive to advertisers, but less adverts would attract additional readers. The price increase would therefore be more profitable than if the reader were indifferent to adverts. Furthermore, even if readers are entirely indifferent to adverts, the impact that increasing the cover price and reducing readership has on profits from advertising, as well as on sales of the newspaper, need to be taken into account when the SSNIP test is applied.[13]

One important additional difficulty that is specific to multi-sided platforms is identified by Filistrucchi. This is the need to re-optimise the balance of prices across the sides of the market after the profitability of a SSNIP has been tested on each iterated candidate market. In a traditional one-sided market, the issue does not arise, as there is only one price. In contrast, on a multi-sided platform, there are at least two prices that might be changed in order to increase profitability. A hypothetical monopolist might therefore

increase one and leave one unchanged (or vice-versa), it might increase one and reduce the other (or vice-versa), or it might increase both.

The need to re-optimise means firstly that each iteration of the test on a candidate market needs to be repeated for each of the ways in which the price(s) might be raised to increase profitability. Furthermore, the optimal balance of prices might change as the scope of the candidate market is expanded so the same three options might need to be tested at each iteration.[14] This introduces considerable additional complexity, and, if not tackled, would lead, as Filistrucchi explains, to a bias that overestimates the size of the market that is defined, thereby potentially underestimating the market shares of firms within that market.

It may therefore be the case that the complexities of applying the hypothetical monopolist test are insurmountable, while the alternatives are undesirable. The first best solution in such cases would be to leave the market undefined where possible. However, if defining a market is unavoidable, and as is often the case, the SSNIP/SSNDQ test cannot be operationalised, the best option is to use the hypothetical monopolist test as a framework (or thought experiment) onto which qualitative evidence is applied (for example views on substitutability from consumer groups, industry analysts or firms that are informed by verified observations on previous experience). This prevents the exercise from slipping into a characteristics-based process, which takes no account of substitutability.

Box 2. Summary of key considerations for market definition

There might be little value in carrying out a market definition exercise in markets involving multi-sided platforms. Therefore, consider carefully whether a market definition exercise is a necessary and proportionate use of resources.

When defining markets is an unavoidable requirement, first decide how many markets to define;

- An assessment of the significance of the cross-platform network effect should be used to identify those markets that should not be treated as traditional one-sided markets.

- For the purposes of a competitive assessment there is little meaningful distinction between defining a two-sided market and defining two interrelated markets, as long as the effect of the cross-platform network effect is recognised and analysed. However, in some jurisdictions the choice may have an important effect on which efficiencies the legal analysis allows to be weighed against any loss of competition that is identified. Therefore, where cross-platform network effects are important, and a market definition is required, defining a single two-sided market ensures that the assessment as a whole is based on the full set of possible competitive and efficiency effects, and no effect is arbitrarily excluded. Notably this means that non-transaction platforms would be defined as competing in a single two-sided market rather than two interrelated markets.

When defining the scope of the market(s);

- The framework of the hypothetical monopolist test provides a discipline that helps guard against the adoption of a characteristics-based approach to market definition.

- A SSNIP test should check the profitability of an increase in price on each side of the market, as well as on the total price. Care must be taken to avoid (or at least to identify) potential bias towards overly broad markets that may arise if the hypothetical monopolist does not ensure it is setting the optimal price structure at each iteration of the test.

- Where a platform operates in a single multi-sided market and sets a zero price on one side of the market, a SSNIP test can be used (either as a conceptual tool or in some cases as a test using the reformulated expressions for the SSNIP test that have been developed).

- Where a platform operates in markets that are defined as interrelated and sets a zero price in one market, a SSNIP test would involve an infinite price increase and so a SSNDQ test can be used instead.

3. Market power

When measuring the market power held by a multi-sided platform, it is important to recognise that cross-platform network effects can magnify the competitive constraints that exist, while also raising a barrier to entry by potential rivals and restricting the emergence of new competitive constraints.[15] Consequently, as both Brekke and Collyer, Mullan & Timan explain, those tools that seek to measure market power or changes in market power by looking at consumer responsiveness (e.g. using tools based on elasticities or diversion ratios), need to ensure they collect or estimate all the relevant elasticities and diversion ratios. For example, this would need to include consumers' response to changes in participation on the other side of the market. In contrast, other tools that do not look at consumer responsiveness (for example market shares), do not in themselves require an estimate of cross-platform network effects, though they are likely to require some other adjustment or reinterpretation in order to reflect the existence of an interrelated market or another side to the market. Moreover, an assessment that relies on tools that do not look at consumer responsiveness will also need, at some stage, to reflect on the impact that strong cross-platform network effects would have on the conclusions that it draws from these tools. In any case, the interrelationship of pricing across the platform, and the need to reflect this in whichever tools are used, means that is not possible for a multi-sided platform to have market power on only one side of the market. Either it has a degree of market power as a platform, or it does not.[16] It is therefore not meaningful to conclude that a platform has market power on one-side of the platform.

Tools based on the responsiveness of demand

In a modern competitive effects analysis market power is typically assessed by looking at the responsiveness of demand. For instance the size of the competitive constraint that is lost from a merger can be seen in the strength of the cross elasticity of demand between the merging firms' products. Similarly, the own-price elasticity of demand helps inform a view of the degree of market power that a particularly product holds. Where market power is measured using tools that look at the responsiveness of demand, these will need to be adjusted to reflect the impact of cross-platform network effects. This is because, as noted, strong cross-platform network effects and feedback loops change the responsiveness of demand. Failing to account for this change may therefore lead to a

misunderstanding as to the closeness of competition between two firms. Where cross-platform network effects are strong, they therefore need to be estimated and then reflected in the assessment of market power.[17] For other types of tool, including market shares, profitability measures, and event studies, this estimation is not part of the tool, though multi-sidedness matters in other ways (see below). Instead, the cross-platform network effects might be reflected in the assessment after a preliminary analysis that recognises these other aspects of multi-sidedness has been conducted, as Collyer, Mullan & Timan suggest. In contrast, for tools based on the responsiveness of demand the estimation needs to be integrated within the analysis from the beginning.

For instance, Brekke identifies that for merger analysis, adjusted versions of the upward pricing pressure (UPP) index and generalised upward pricing pressure indicator (GUPPI) tools have been developed and are available for Competition Authorities to use.[18] These can be straightforward to use if estimates of elasticities and the cross-platform network effects are available. However, the difficulty is in obtaining such estimates.

It is worth noting that obtaining estimates of cross-platform network effects is a challenge that arises in both the market power and efficiencies assessments. It may therefore make sense in multi-sided platform cases to consider collapsing the market power and efficiencies assessments into a single exercise in which both the agency and the firm(s) seek to quantify these cross-platform network effects.

Brekke explains that to calculate the adjusted UPP indices requires an understanding of the full impact that a price rise on side A of the platform will have. This can be separated into three effects: 1) the effect on *demand from users on side A*; 2) the effect on *demand from users on side B*; and, 3) the effect on *the price on side B*. In each case the reverse is also required, meaning there are six key inputs required for calculating the adjusted indices.

- The first effect of a price rise on side A is that demand for A will fall. This effect is simply the elasticity of side A's demand with respect to the price of A, and so this first effect is likely to be negative.
- The second effect of a price rise on side A is that demand for B will fall (as those on side B respond to the reduced demand on side A). This effect is the elasticity of side B's demand with respect to the price of A. If the cross-platform network externality is positive (e.g. buyers like there to be more sellers), this second effect is likely to be negative.
- The third effect of a price rise on side A is that the price on side B will fall, which increases demand for B and hence will also increase demand for A. The reason that the price on side B falls, is that increasing the margin on side A increases the incentive to raise participation on side B, since this extra participation attracts more high-margin sales on side A. This effect is the elasticity of B's price with respect to the price of A (the rebalancing effect).[19] If the cross-platform network externality is positive, this third effect is likely to be positive, and therefore to somewhat counteract the first and second effect. Overlooking this third effect may therefore lead to overestimating the negative impact on volume of a price rise on side A.

Where data (and time) permits, the relevant elasticities can be calculated through demand estimation that looks at diversion ratios in response to small changes in price, quantity or quality.[20] The data requirements for such exercises are however, challenging, and so as Collyer, Mullan & Timan suggest, the use of surveys might present a more realistic option than demand estimation in many contexts.

However, there are also challenges to using surveys, since identifying particular effects while holding everything else constant may not be straightforward. For example, we would need to assess the three effects set out by Brekke above. To assess the first effect, Filistrucchi suggests that sellers (e.g. hotels) might be able to tell us how a change in commission would affect their demand for the platform. However, consumers are unlikely to be able to tell us how a change in the commission that sellers pay the platform would affect their demand for the platform. In order to assess this second effect, we might therefore need to ask how consumers' demand for the platform would react to the change in the number of sellers on the platform (or any change in sellers' prices that is passed through) when the commission increases. Fortunately, we should know this change from the sellers' response that we obtained when quantifying the first effect.

To estimate the third term (the rebalancing effect), a survey would also need to ask the platform how it would change the price it charges consumers (or the quality it sets), if its commission on sellers were to increase. However, there might be a question mark over the platform's incentive to provide a genuine estimate of this figure. It might therefore be necessary to validate the figure without input from the platform itself. This might be possible, but would not be straightforward. We would need, for example, to know the change in the quantity of sellers (or sales) that would maximise profits for the platform if it were charging a higher commission. We could then identify the change in consumer demand that would trigger that size of increase in the quantity of sellers. Finally, we would need to know how much lower the price to consumers would need to be to trigger the increase in consumer demand that would set this chain in action.

Where these methods are effective and elasticities are successfully estimated, these estimates can be plugged into the reformulated UPP and GUPPI expressions that Brekke identifies. However, in a non-merger context in which the authority wants to understand the level rather than the change in market power, they can also be plugged into an adjusted Lerner index to provide a measure of a platform's market power. Where these estimates are not available, a potential short-cut set out by Tremblay (2017) is to compute this adjusted Lerner index using administrative data on profits, fixed costs and revenues. Where this administrative data is available, an adjusted Lerner index can be calculated as: the total profit of the platform, plus the fixed costs of the platform, all divided by the total revenue of the platform.

Other tools

Market shares, barriers to entry and exit, measures of concentration or profitability, and patterns of use (e.g. single or multi-homing) are each also used to help assess market power. However, the traditional problems of these types of tools that are not based on consumer responsiveness, are exacerbated in a multi-sided context. Firstly, as Brekke explains, some of these tools may assume no product differentiation, while platforms are highly differentiated (e.g. strengths in different geographic areas, or amongst different types of user), and the network effects themselves drive much of this differentiation. Secondly, as Collyer, Mullan & Timan identify, a meaningful unit of measurement is not always straightforward; for example, value, capacity, volume, or volume of full priced sales might each make sense in different circumstances. In non-transaction multi-sided platforms this can be further complicated if there is no common unit that can be used across both sides, since this makes it unclear how to synthesize the two. Thirdly, these tools provide no information on substitutability, and so give no sense of how (in)vulnerable a given market share is. This is particularly problematic in multi-sided

markets since the cross-platform network effects also provide scope for the observed market shares to quickly and radically change (tip).

As Collyer, Mullan & Timan suggest, market share tools are therefore of most value when looked at over a period of time, since this indicates a degree of durability. They can be of particular value when observed over a period of time during which there was a change in the relative value of the products (e.g. a price increase). Effectively this introduces consumer responsiveness into the tool. Of course, where such observations can be identified in data, they can be turned into event studies, a more sophisticated tool that can provide insight in a multi-sided context, provided the necessary adjustments are made. For example, event studies of two-sided platforms need to consider what is happening on the other side of the market, since the consequences of a reduction in the value offered by the platform might be clear on one side but not the other.

Another tool that does not require information on responsiveness is to proceed directly to measure the platform's profitability and to compare that to a counterfactual of what a competitive return would be. Collyer, Mullan & Timan point out that in a multi-sided context this would need to recognise that costs incurred, and profits/losses on the other side of the market, are part of the profitability of the platform, and need to be assessed together. Many of the challenges faced in one-sided markets re-surface here. For example, the difficulty in accurately measuring economic profit as opposed to accounting profit, and the identification of the relevant counterfactual.

With regard to single-homing or multi-homing, both Collyer, Mullan & Timan and Rasek & Wismer suggest that it can be useful for agencies to examine patterns of use and establish whether users on one side of the market tend to single-home or multi-home on different platforms. This can be important for understanding the nature of competition in the market, for example, whether firms compete to sell each unit, or instead compete for exclusive relationships with customers. However, as Rasek & Wismer note, it is not clear whether the predominance of single or multi-homing suggests in and of itself that the platform has market power. Widespread single-homing or exclusive use might, for example, be taken to suggest that consumers do not see other platforms as good substitutes (if we were to assume that consumers would sometimes use these other platforms if they considered them a good alternative). However, it does not actually tell us anything about consumers' views on the potential substitutability of the platform; in particular, it might be expensive to multi-home and there might be fierce competition amongst platforms to be the exclusive platform used by each consumer, or at least by the marginal consumers.[21]

There is also an ambiguity to multi-homing (non-exclusive use of a platform). This might be interpreted as evidence of users switching their demand between platforms (e.g. using different supermarkets, search platforms, dating applications or advertising routes), thereby implying strong substitutability and close competition. However, it might also be interpreted as evidence that the platforms are complementary, thereby implying little competition (e.g. using two search engines but using them to search for different things, or using different advertising routes to reach different single-homing groups of users).[22]

It is also possible to take a narrower definition of multi-homing as the use of multiple platforms when making a *single* decision. For example, the use of a single platform when looking to order a takeaway pizza on a Saturday evening might be defined as single-homing, despite the fact that the consumer uses multiple platforms for food delivery over the course of a month. Adopting this narrower definition makes multi-homing a closer approximation of substitutability since it eliminates the possibility that the different

platforms were being used when making slightly different types of decision. However, information on when multiple platforms are used within the same decision is often more difficult to obtain.[23] Furthermore, even if multi-homing is common on one-side, it might not indicate that the multi-sided market itself is highly competitive. For example, it is often noted that surplus built up from multi-homing users (e.g. advertisers or callers to mobile phones) can then be competed away on attracting single-homing users (e.g. readers or mobile phone contract holders). However, if there are constraints that prevent the platform offering negative prices to single-homing users, then the platform might be able to limit the extent to which it competes away the surplus that it extracts on the other side of the market.[24]

Where tools are not based on consumer responsiveness, care is needed in interpreting what an observed pattern of use says about substitutability on that side of the market, and more generally what substitutability on one side of the market implies for the platform's market power, which needs to be judged across all sides of the market.[25] Nevertheless, these tools might, as Collyer, Mullan & Timan suggest, be used to conduct a preliminary analysis that considers the difficulties that arise as a result of the multi-sided nature of the market (see above), and which is then adjusted in a second stage of the assessment to reflect the impact of any cross-platform network effects. Where the cross-platform network effects are one-way, the preliminary analysis can be sufficient to conclude on the degree of market-power held by the platform in the provision of a product that generates no cross-platform network effects for the other side of the market. However, where products generate two-way cross-platform network effects, the preliminary view on the market power of the platform will need to be revised. This revision requires an assessment of whether the cross-platform network effects increase or decrease the degree of market power identified in the preliminary assessment, and by how much.[26]

Box 3. Summary of key considerations for market power

Where strong cross-platform network effects run in both directions, it is not possible for a multi-sided platform to have market power on one side of the market. Either it has a degree of market power as a platform, or it does not. Substitutability of demand might be different on either side, but given the interrelationship of pricing across the platform, it is not meaningful to conclude that a platform has market power on one-side of the platform.

For those tools that measure market power based on the responsiveness of demand, cross-platform network effects need to be integrated within the analysis from the start.

- There are at least six effects that need to be estimated in order to apply the UPP indices (or GUPPI) that have been adjusted for use in multi-sided markets. These include the full impact that a price rise on side A will have: 1) the effect on demand from users on side A; 2) the effect on demand from users on side B; and, 3) the effect on the price on side B. They also include the same three impacts that a price rise on side B would have. These six effects can be estimated by surveying users on each side of the platform, though the questions will need testing with the relevant audience.

- Where data and time permits, estimates of these effects can also be obtained from demand estimations that can be used to simulate the effects of a merger or to estimate an adjusted Lerner index.

- In cases where estimates of diversion ratios and elasticities are unavailable, it may be that there is adequate administrative data to compute the adjusted Lerner index using data on profits, fixed costs and revenues. Where this data is available, a generalised Lerner index can be calculated as: the total profit of the platform, plus the fixed costs of the platform, all divided by the total revenue of the platform.

- Since quantifying cross-platform network effects is a key task for the assessment of both competitive effects and efficiency effects in multi-sided platform cases, it may be worth collapsing these two stages into a single exercise in which both the agency and the firm(s) seek to quantify the cross-platform network effects.

For other tools that measure market power without reference to the responsiveness of demand, for example those that measure concentration or profitability, the impact of cross-platform network effects might be reflected in a second stage of the assessment, after a preliminary analysis has been conducted.

- The preliminary analysis might use standard tools to identify: the percentage of users that use the platform; barriers to entry and exit; and profits. It might also look at the patterns of single and multi-homing behaviour by users since these can be helpful for understanding the nature of competition in the market. Taken together, these analyses might allow a preliminary view on the market power of the platform.

- However, care is needed in interpreting what an observed pattern of use (e.g. single-homing) says about substitutability on that side of the market, and more generally what substitutability on one side of the market implies for the platform's market power, which needs to be judged across all sides of the market.

- Where cross-platform network effects are one-way, this preliminary analysis can be sufficient to conclude on the degree of market-power held by the platform in the provision of a product that generates no cross-platform network effects for the other side of the market.

- Where products generate two-way cross-platform network effects, the preliminary view on the market power of the platform then needs adjusting to reflect these cross-platform network effects. This requires an assessment of whether these effects increase or decrease the degree of market power identified in the preliminary assessment, and by how much.

4. Exclusionary conduct

It might be argued that multi-sided markets require less scrutiny from antitrust authorities and should be treated more leniently. This is because cross-platform network effects magnify competitive constraints suggesting that these platforms have less market power than first appears and because there are clear pro-competitive rationales for building volume at the expense of rivals to take advantage of network effects.

However, both Katz and Valletti, Amelio & Karlinger emphatically disagree that greater leniency is required. Katz concludes that the markets in which multi-sided platforms operate may provide particularly fertile ground for exclusionary conduct, while Valletti, Amelio & Karlinger suggest that exclusionary practices are more likely in these markets, rather than less likely.[27] In each case, the conclusion is that examination of exclusionary

unilateral conduct in multi-sided markets should be a greater priority for agencies than it is in traditional markets.

Why is exclusion a greater concern?

As standard amongst economists, both authors take the position that the effects of potentially exclusionary conduct, such as exclusivity clauses or predatory prices, should be assessed on a case-by-case basis. The question is whether the incentive or ability for firms to use these practices in ways that generate anti-competitive effects is greater or lesser in multi-sided markets than in traditional one-sided markets.

In the case of exclusivity contracts, the risk is greater because these contracts may affect users on side B of the market who are not party to a contract agreed between the platform and users on side A, and whose interests may differ. In contrast, in one-sided markets it is sometimes suggested that exclusivity agreements are not likely to harm consumers because it is not in the interests of competing retailers to make exclusivity agreements with manufacturers if the effect is to increase the price that they have to pay. However, in a multi-sided market it cannot be assumed that users on side B will consider the impact on users on side A and refuse to participate in an exclusivity agreement with a platform that excludes other platforms and harms users on side A (but not those on side B).[28]

A second factor is that cross-platform network effects may create economies of scale since platforms with more users on one side are more attractive to potential users on other sides (everything else being equal). In the presence of economies of scale an incumbent may use exclusivity contracts to shift the nature of competition from competing to sell units to competing for an exclusive relationship with the consumer, and thereby raise rivals' costs. For example, instead of allowing users to multi-home and hence to cautiously transition away from an incumbent by exploring and testing alternatives without losing membership of the established network,[29] the incumbent can make this an all-or-nothing choice between an emerging platform with few single-homing consumers and an established one with many. This can mean user expectations on the platforms future success play a key role.

In the case of predatory pricing, Valletti, Amelio & Karlinger suggest that the incentive for the incumbent to exclude is larger, the stronger the cross-platform network externality. Indeed, this holds even in markets in which a user on one side is indifferent to the number of advertisers on the second side of the market. Katz also sees greater risks from predation in multi-sided markets due to the opportunities for platforms to predate by sacrificing profit on one-side while in parallel recouping by setting a high price on the other side.

How do the tools need to change?

When assessing alleged exclusionary conduct in multi-sided markets it is inevitably a challenge to distinguish between pro-competitive efforts to capture additional benefits of network effects, and efforts to deny rivals access to these same effects. Though the benefits are likely to be exhausted at a certain point, it is unclear at which point we might suspect that such practices are less likely to reflect competition to obtain marginal benefits, and more likely to reflect an effort to deny others the opportunity to generate their own cross-platform network effects.[30] An understanding of the value of cross-platform network effects at different output levels can therefore be helpful.

To assess the effects of *exclusivity clauses* involves following a framework of inquiry that explores the impact of the clauses on rivals' costs, and then on the intensity of competition.[31] This broad framework remains applicable for cases involving multi-sided platforms. In contrast, the more specific price-cost tests and recoupment tests often used in *predatory pricing* cases no longer appear reliable.[32] A point that was made early in the development of the multi-sided platform literature was that below cost pricing on one side is more likely to be pro-competitive in a multi-sided market since it may help the platform internalise cross platform network externalities. However, both Katz and Valletti, Amelio & Karlinger here make the distinct point that not only can a platform predate by reducing its total price to unsustainable levels, but that it can also do so by changing the balance of prices across the different sides of the market. The implication is that even adjusting price-cost tests to focus on net price is insufficient.[33] Instead, these tests remain potentially misleading in multi-sided markets and should not be relied upon.

Katz also argues that the recoupment test needs to be interpreted with care. For example, he urges agencies not to interpret this as a test of the rationality of below-cost pricing. Instead, he argues that agencies should ask firstly whether below-cost pricing is profitable because it makes the platform a stronger competitor by building up its base; and secondly whether below-cost pricing is profitable because it weakens competition by preventing rivals building their own user bases. This requires an understanding of whether the below-cost pricing would have been profitable in a counterfactual world in which that pricing did not weaken its rivals (for example by reducing its volume), allowing them to continue to offer the same value product that they would have offered absent the below cost pricing.

This 'no economic sense' test would identify clearly those exclusionary cases where allegedly exclusionary conduct is harmful in multi-sided markets (while leaving a grey area for those cases where there is an efficiency rationale but also an anti-competitive effect). Unlike the as-efficient competitor test, this has the distinct advantage of protecting consumers when a more efficient platform engages in conduct that excludes a less efficient platform and reduces competition. As Katz says, there are cases where competition between an incumbent and a less efficient rival is better for consumers than facing a monopolist (even one with low costs), and this is true in both one-sided and multi-sided markets. As such, requiring an investigating competition agency to show that a firm's conduct fails the as-efficient-competitor test is inconsistent with an effects-based approach.

An additional proposal made by Katz is that the tools used to test for recoupment should consider not only future recoupment opportunities, but the prospects of simultaneous recoupment, for example on the other side of the market, or in an aftermarket.

Box 4. Summary of key considerations for exclusionary conduct

As in one-sided markets, the effects of potentially exclusionary conduct, such as exclusivity clauses or predatory prices, should be assessed on a case-by-case basis.

However, multi-sided platforms may require more scrutiny from antitrust authorities than one-sided markets, and should certainly not be treated more leniently since they may provide particularly fertile ground for exclusionary behaviour.

Assessing the effects of exclusivity clauses requires a framework of inquiry that explores the impact of the clauses on rivals' costs, and then on the intensity of competition. This broad framework remains applicable in multi-sided market setting.

Assessing the effects of predatory pricing typically involves the use of specific tools such as price-cost tests. These tests should not be relied upon in multi-sided markets.

Recoupment tests should also be interpreted with care, since simultaneous recoupment is possible in multi-sided markets.

Assessing predatory pricing therefore needs a framework that asks firstly whether the allegedly predatory price would have been profitable in a counterfactual world in which that pricing did not weaken its rivals. This counterfactual might be constructed by estimating elasticities (or diversion ratios) and then removing any substitution effects from the platform's optimal price setting problem.

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5. Efficiencies

As with competitive effects, there is a risk that efficiencies generated on another side of the market will be missed if the multi-sided nature of the platform is not recognised. Alternatively, such efficiencies might be identified but ruled to be out-of-market efficiencies and hence not relevant for the legal assessment. However, as touched upon in the market definition discussion, efficiencies or anticompetitive effects on other sides of the market will be relevant whenever cross-platform network effects are significant.

Why are efficiencies more likely in multi-sided markets?

There is a broad consensus that there is scope for efficiencies in platform mergers. This is because, as Padilla & Andreu explains, mergers between platforms might be expected to combine separate user bases, and to increase interoperability. Indeed, Chandra and Collard-Wexler (2009) have shown that under certain conditions a merged platform might better internalise the various cross-platform network externalities and therefore set lower prices to both sides of the market in order to increase participation on both sides and expand the market. Secondly, as Padilla & Andreu emphasise, where these conditions do not apply, and prices do increase, this may nevertheless reflect a better product that captures more externalities and hence delivers better value, thereby increasing consumer surplus even while the price increases. For example, a merger that better internalises externalities and builds the user base may increase prices for advertisers, however if this reflects a larger audience this might nevertheless increase the advertisers welfare.

Given the broad agreement that there is scope for efficiencies in multi-sided markets where cross-platform network effects are significant and the separate platforms are

incompatible, it is perhaps surprising that there are no cases in which efficiencies have been accepted. One answer might be that while efficiencies are more likely to be generated in multi-sided markets, there often may remain less anti-competitive ways of achieving the same efficiencies, for example by allowing interoperability or adopting shared standards. In any case, as Johnson suggests, it would appear that agencies should give particularly careful consideration to the scope for efficiency defences in multi-sided markets.

How do the tools need to change?

There is broad agreement that that the standard econometric tools for assessing efficiencies do not need to change and the existing tools can continue to be used in multi-sided markets. As an example of how these standard tools can be applied to a multi-sided market Padilla & Andreu provide a post-mortem analysis of previous mergers in the stock exchange market. This demonstrates the type of efficiency analysis that might be expected. The analysis takes data on previous mergers of stock exchanges and tests for evidence of efficiencies in the post-integration period. For example, it confronts questions over the relevant counterfactual using a placebo test, it considers alternative integration milestones and different measures of liquidity, and the possibility of an omitted trend. There remain questions over how to extrapolate the results of past mergers onto new mergers that involve firms of different sizes and of different natures, particularly where we might expect the gains to diminish as scale increases. However, where analysis of this depth can be performed within the timeframes of an investigation it would appear to provide useful insight on the likely effects of the merger.

In addition, a range of other tools also exists, for example demand modelling techniques and user surveys. These take data on either the revealed or stated choices of users on each side of the market and seek to estimate demand in order to identify the benefits to users from accessing a larger platform. Notably when using these tools the key variable to estimate is the cross-platform network effect, which as we have noted was also the focus of the market power assessment. This (again) begs the question of whether these market power and efficiency assessments might not be run as a single effects assessment in cases where the market is indisputably multi-sided.

However even a combined assessment would encounter the challenge of operationalising these tools in practice. As Shelanski, Knox & Dhilla note, while economists do have tools available for assessing the effects of conduct or mergers of platforms, all of those tools take resources, personnel, and in many cases data which can be hard to come by. He therefore suggests that a useful operational step is to prioritise analytical efforts based on the nature of relationships in multi-sided markets. The two types of relationship he identifies, service-based, and subsidy-based, are comparable to the concepts of matching and audience providing platforms that Rasek & Wismer put forward. As described earlier, Rasek & Wismer use the term matching platform to refer to a platform in which the cross-platform network externality is positive on both sides and the objective of the platform and all users is to find the best possible match. While platforms in which the externality runs in just one direction are considered to be an audience-providing platform.

The suggestion by Shelanski, Knox & Dhilla is that where conduct is targeted at a supplier or an end-user in a matching (or service-based) platform, there is likely to be a magnification of harm or of efficiencies as a result of the cross-platform network effects. In such cases, efficiencies may arise on all sides of the market and so agencies need to consider all sides. In contrast, in an audience providing (or subsidy-based) relationship

any efficiencies that accrue to advertisers are unlikely to benefit users. This means any harm to users is unlikely to be counterbalanced by efficiencies to advertisers. Agencies may therefore focus on evaluating the existence of efficiencies for advertisers in such cases – for example on efficiencies to users when users are harmed, and on efficiencies for advertisers when advertisers are harmed.

Box 5. Summary of key considerations for efficiencies

Where cross-platform network effects are strong, mergers of multi-sided platforms might be expected to generate efficiencies if they combine separate user bases and increase interoperability. There would therefore appear to be significant scope for efficiencies to arise in platform mergers.

Agencies should give careful consideration to the scope for efficiency defences in multi-sided markets. Focusing analysis on the magnitude and merger specificity of such effects, rather than their existence may therefore provide better analytical value for agencies.

Standard econometric tools such as event studies can sometimes be used to assess the efficiencies that have previously been generated by greater scale. These do not require estimates of the cross-platform network effects.

To use simulation tools to understand the likely efficiencies of a merger for users on each side of the market, agencies will need an estimate of the cross-platform network effects. Surveys or demand estimations can be used to generate these estimates, as they were in the competitive effects assessment.

Operationally there may be advantages to running the competitive effects and efficiencies assessments as a single effects assessment in those cases where the multi-sided nature of the market is undisputed.

It may also be a useful operational step to prioritise analytical efforts based on the nature of relationships in multi-sided markets. For example, in an audience providing (or subsidy-based) platform, agencies might focus on efficiencies to users when they expect users to be harmed, and on efficiencies for advertisers when they expect advertisers are harmed. In contrast, in a matching (or service-based) platform, agencies will need to consider all sides of the market.

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6. Vertical restraints

Vertical restraints in multi-sided markets can be imposed either by platforms on users (e.g. across platform parity agreements), or alternatively by users on platforms (e.g. selective distribution systems that threaten to delist platforms that do not comply). In multi-sided markets they can include: internet minimum advertised prices; resale price maintenance; across platform parity agreements, most favoured nation clauses; online sales bans, exclusive distribution systems; selective distribution systems; and exclusive supply agreements. These can all generate pro-competitive efficiencies, however concerns can also arise that they may exclude rivals (as discussed in section 4 above in relation to exclusivity clauses), soften competition, or facilitate collusion. Notably restraints agreed between platforms and users may not always be only vertical in nature if the user is also operating a traditional business model that sells directly to consumers and

hence competes with the platform. This may create some challenges as to whether a case involves price fixing amongst rivals or a vertical restraint.

Are vertical agreements a greater concern in multi-sided markets?

The assumption that downstream firms will not sign agreements with upstream firm that lead to them paying higher prices is sometimes used to dismiss concerns with exclusionary vertical restraints (this is known as the *efficiency of bilateral bargaining* that Chicago school thinkers have referred to). A key point made by Katz is that this may not apply in multi-sided markets. While it has long been understood that there are circumstances in which anticompetitive outcomes can result despite bilaterally efficient bargaining in traditional markets,[34] these circumstances might be expected to be significantly larger in multi-sided markets. This is because the bilateral bargaining does not include one or more sides of the market that might be harmed by restraints that are agreed and which mutually benefit the negotiating parties. This is true in both traditional and multi-sided platform markets. The difference is that sellers and the platform will have their incentives aligned if the platform earns a fixed commission on sales made by sellers, and so, unlike in a traditional wholesale market, the intermediary would not protect consumers by refusing to sign up to bilateral agreements that would increase the wholesale price that they pay.

For example, across platform parity agreements between a platform and a group of sellers that pay the platform commission on their sales might ensure that no rival platform can be offered a better price, thereby removing the ability for sellers to undercut the platform if it increases the commission that it charges. However if the increase in commission paid by sellers can be passed onto consumers who are not party to the vertical restraint then the agreement may still benefit the sellers.

As a result, there may be less scope for consumers to be protected by the efficiency of bilateral bargaining when a platform acts an agent for sellers on one-side of the market. This might suggest that vertical restraints in multi-sided markets may require a little more scrutiny from agencies than similar agreements in one-sided markets, and as in the case of exclusionary conduct, should not be treated more leniently.[35]

Both Johnson and Caffarra & Kühn make a plea for competition agencies to make a real effort to understand the potential efficiency rationales for such restraints. Caffarra & Kühn suggest for example that in many cases what firms are really trying to deal with is contractual incompleteness (rather than looking for ways to increase price). Johnson gives the risk of free-riding as an example. He follows Rochet & Tirole in identifying, as an example, the investments that credit card companies make in building customer loyalty through reward systems or good customer service. He notes that some of these investments might be put at risk if a merchant is able to steer consumers that are attracted by the merchant's membership of the platform to then bypass the platform and transact on a cheaper platform.

Of course, these complaints are also common in one-sided markets. However, a case can be made that efficiency rationales for vertical restraints are particularly strong in multi-sided platforms. After all, if platforms can be easily bypassed after matching buyers and sellers, then they are unlikely to be viable. For example if Airbnb does not restrict property owners from providing contact information to tenants then it will not have any transactions taking place on the platform, it will earn no commission and the platform would not be viable. More problematic however is the nature of the investments that platforms can make viable through such restraints. For example, heavy investment in

advertising may indeed no longer be viable if sellers are able to offer cheaper prices on their own website than on a platform website. However it is unclear what value consumers place on these investments (provided the platform itself remains viable), and hence how much these investments would be missed if the business case for them no longer made sense. This is particularly problematic if the restraints are at the same time likely to soften competitive incentives and lead to higher prices.

Johnson also identifies an interesting efficiency defence that might arise particularly in multi-sided platforms. He cites a paper by Lee (2013) which identifies the importance of exclusivity clauses for smaller videogame platforms that were seeking to enter into the videogame market. These platforms were able to use the restraints to counteract the strong cross-platform network effects that incumbents enjoyed which might otherwise have prevented them from entering and competing on the market.[36] While such entrants would not hold market power at the time they agreed these clauses, they may later grow into stronger positions. Therefore, the case-specific context in which the agreements apply will matter and a form-based approach will be an unreliable indicator of the effect of the restraint on consumers.

How do the tools need to change?

Assessing the effects of vertical restraints requires a framework of inquiry that:

- identifies the nature and scope of the restraint (and whether in practice it is binding);
- explores the effect of the restraint on the incentives of the firms involved (and those that are not);[37]
- considers the potential responses to any change in behaviour that do occur (e.g. defensive actions by buyers);
- tests whether these effects have been observed;
- looks at the rationale for participation by each side; and
- identifies the likely counterfactual.

Since this framework is a broad one, and each analysis should be tailored to facts of the case, it remains applicable in a multi-sided market setting. Therefore, in principle the tools that are used do not need to change. However, in practice the use of these tools to analyse the effects of a restraint is rarely conducted. Therefore, one proposal from Caffarra & Kühn was to help simplify the analysis in cases when the product on one side of the market is free, by interpreting a multi-sided market within a standard vertical framework in order to help agencies think through the standard foreclosure concerns when vertically integrated and vertically disintegrated supply chains compete with each other. For example, under this proposal the number of users on one side might be thought of as an input that is used to produce a downstream product that is sold to the users on other side of the market. The platform then decides how much to invest in increasing the quality of this input by expanding its user base on that side of the market.

By design this approach takes no account of the strong cross-platform network effects and so contrasts with the view that when analysing multi-sided markets competition agencies should recognise these effects and the difference that they can make to the analysis. For example, if users prefer a variety of sellers then treating the user base simply as an input, and ignoring the impact that feedback loops have on demand can lead to mistakes.

In the case of Across-Platform-Parity-Agreements (APPAs) for instance, it is sometimes argued, often by platforms, that sellers can choose to delist from platforms that impose

such restraints, and that this preserves a competitive constraint on the commission that is charged by the platform. If this argument is valid, it suggests that APPAs are mutually beneficial and hence more likely to exist for efficiency reasons. If however, the number of users is treated as an input into the product, then the analysis would miss the fact that users are likely to switch away from platforms if sellers choose to delist. The potential competitive threat posed by the option to delist would then be missed, and the competitive constraint on the platform's commission underestimated. As a result, the conclusions reached on the effect of the vertical restraint might be different (it might be judged harmful when it is not). This suggests that while it is certainly true that parallels can helpfully be drawn between analysis in one-sided and multi-sided markets in order to explain certain theories of harm, the analysis itself requires a recognition and understanding of the difference that cross-platform network effects make.

Box 6. Summary of key considerations for vertical restraints

As in one-sided markets, the effects of vertical restraints need to be assessed on a case-by-case basis. However, agreements in multi-sided markets may require more scrutiny from agencies than similar agreements in one-sided markets, and should certainly not be treated more leniently.

The broad framework of inquiry for assessing the effects of vertical restraints remains applicable in a multi-sided market setting.

Where cross-platform network effects are strong, use of vertical restraints by multi-sided platforms might in some cases be necessary to prevent free-riding and hence the bypass of the platform.

Where free-riding poses a threat to the viability of the platform there would appear to be significant scope for vertical restraints to generate efficiencies (though this may not be the case for other investments that might be viable as a result of the restraint).

Competition agencies should therefore give careful consideration to the scope for efficiency defences in multi-sided markets.

Notes

1   Armstrong (2002), Evans (2003), Wright (2004).

2   See for example Evans & Schmalensee (2012).

3   This is based upon Evans (2003) definition that Filistrucchi refers to.

4   This is sometimes referred to as an indirect network externality.

5   Rochet & Tirole (2006). Hermalin & Katz (2017) note that this focus on price should also be extended to terms and conditions since prices in these markets are often set at zero. Filistrucchi explains that price structure only affects volumes in transaction platforms if there is some limitation on the ability of one side to pass-through a price differential set by the platform to those on the other side of the market. Where there is no such limitation, the platform cannot control the structure of prices across the two-sides and hence their price structure cannot affect volumes.

6   The economic distinction between these categories that we have highlighted above may of course be relevant in a different context.

7   An exception which simplifies some cases is where users on other sides of the platform are indifferent to the use (or membership of) of the platform by another side. For example advertising markets might be analysed as one-sided if readers, viewers or listeners are indifferent to the quantity and nature of advertising on their product. There also remains of course the question of the scope of that one-sided advertising market: does it include television, radio, newspapers, social media and so on? Is it for ages 25-35 or 75+? And over which geographic area? However, these are traditional market definition questions, which can be answered using traditional tools.

8   See for example, Kaplow (2010 and 2013). Rasek & Wismer and others suggest that it remains useful.

9   Another example is the Vertical Block Exemption Regulation in the EU, where satisfaction of the 30 per cent market share threshold may hinge on whether one single or two interrelated markets are defined.

10   In a SSNIP test, the profitability of a small but significant non-transitory increase in price is examined for each candidate market. If a SSNIP would not be profitable then the scope of the candidate market is expanded, and the test is re-run on this next iteration of the candidate market. When a SSNIP is profitable the candidate market is identified as the relevant market.

11   A firm can reduce value and capture surplus by either increasing price, or reducing its costs by investing less in quality.

12   As Rasek & Wismer point out there is likely to be significant heterogeneity in the cross-platform network externality for different users and consumers. However, unless the platform can price discriminate it will need to optimise based on the overall elasticity. If price discrimination is possible, this might indicate the existence of distinct markets (based on the ability to price discriminate).

13   Equally, an increase in the price of advertising would reduce demand for advertising in the newspaper, which may lead to fewer adverts. This, in turn, may increase readership, which would increase demand for advertising. This feedback effect means that the price increase for advertising is more profitable than would appear if the impact on readers (and how that in turn affects advertising demand) were ignored.

14   Note this is different from the cellophane fallacy, which is a problem in one-sided markets that remains in multi-sided markets. This is the possibility that the market price from which the test begins is in fact already a monopoly price and hence any increase will not be profitable and so further increases to the price will not identify a profitable SSNIP since each iteration brings the price further away from its optimal level.

15   Strictly, however it is worth observing that the barrier to entry is not the cross-platform network effect itself, but rather the inability of users to co-ordinate their response to that effect. This means for example, that where users have effective co-ordination mechanisms available to them, this may remove the barrier to entry, even if the cross-platform network effect remains. This makes collective switching schemes a potential model for improving the way that these markets work for users.

16   However, the substitutability of demand might still be different on different sides of the market.

17   This remains the case whether a multi-sided market has been defined, or whether two interrelated markets have been defined. Though of course, strictly, we do not know if these cross-platform network effects are strong or not until they have been estimated.

18   See paragraphs 23 to 26 of Brekke, and previously in Affeldt et al. (2013) and Cosnita-Langlais et al. (2018)

19   Brekke refers to this as a "feedback effect" but we refer to it here as a "rebalancing effect" in order to distinguish it from the simple feedback loops identified in para 9. It reflects the fact that the increase in price has a rebalancing effect on the prices set across the different sides of the market (not only a direct effect on demand on each side).

20   Whilst most practical in longer investigations of unilateral conduct or in the context of market studies, these estimations are now being used in mergers within sectors that provide both data and a continuous stream of merger inquiries. For example, both the Netherlands and the UK have constructed demand models for hospital services, which can be applied in the context of individual mergers.

21   For example, rival mobile phone networks might compete to be contracted by handset owners, and would then match those handset owners with those that want to call them (from fixed or mobiles lines). The networks would then set their price for calling the consumer knowing that the caller had few good alternative options. However, it would be inaccurate to describe this as market power without reference to the intensity of competition to contract with the handset owner. Therefore, the habit of single-homing (having one mobile phone rather than two) might not tell us much about the market power of the mobile phone network. As discussed in OECD (2017) a competitive market might be followed by an uncompetitive aftermarket if consumers do not anticipate future costs (e.g. printer cartridges) or do not incur them (e.g. mobile phone termination charges under a calling party pays system).

22   For example, users might use a second platform in addition to their usual platform. For example house renting/sales platforms and general search; or different estate agent platforms for searching in different geographic areas (or at different price levels). Alternatively, sellers might use a second platform to reach buyers that single home on that platform (this is the competitive bottleneck).

23   This narrower definition of multi-homing as the use of multiple platforms in the course of a single purchasing decision is for example used in the CMA's analysis of the Just Eat / HungryHouse merger.

24   For example, investments might be required to facilitate paying negative prices and contracting for exclusive use of a platform.

25   For example, if multi-homing on one-side is interpreted as reflecting complementarity and not substitutability and hence indicates a lack of market power on that particular side, this might indicate smaller competitive incentives to compete for consumers to 'sell' to the other side.

26   For example, a one-sided assessment might suggest that platform X has a large share of sellers/advertisers but a small share of buyers. The cross-platform network effects might then reveal that buyers are relatively insensitive to the range of sellers, while sellers care a lot about the number of buyers on the platform. This might suggest that another platform with a small share of suppliers or more consumers might be a stronger constraint than first thought. Alternatively, a one-sided assessment might suggest that platform Z is in a relatively vulnerable position (e.g. low barriers to entry, low switching costs, and a small share of users). However, the cross-platform network effects might reveal that users are very sensitive to the participation of certain sellers (e.g. important brands), and the platform has a strong position in relation to those sellers (e.g. a high share or exclusive contracts). This might suggest that the platform has more market power than first thought.

27   He also notes recent work suggesting that in markets with zero-price (which is not uncommon in platform markets), anti-competitive tying strategies can be substitutes for predatory strategies.

28   If the cross platform network effect is strong enough, then harm to side A would also harm side B by reducing participation on side A. However, this may not be the case if these effects are weaker and in any case users on side B might not foresee the third order effects of their actions.

29   Shapiro (1999).

30   For example, going from 91 to 93 percent of web searches might be unlikely to improve a platform's algorithms in the same way that going from one to 3 percent might do.

31   See OECD Fidelity Rebates (2016) for details of this framework.

32   See Wright (2004).

33   See Behringer and Filistrucchi (2015).

34   See Valletti, Amelio & Karlinger citing Segal and Winston (2000) on divide and conquer strategies, Katz citing Calzolari and Denicolò (2015), and Farrell (2016) on vertical collusion.

35   Johnson is agnostic on the issue of whether restraints are more or less likely to be anticompetitive in multi-sided markets.

36   Lee (2013).

37   Including for example any contracting externality.

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Part II. Market definition

1. Market definition in multi-sided markets

By Lapo Filistrucchi[*]

Abstract

Drawing from the economics of two-sided markets, I provide methodological suggestions for the definition of the relevant market in cases involving multi-sided platforms. In particular, I provide suggestions regarding a) how to identify the two-sided nature of a market; b) when multi-sidedness should be taken into account; c) how many markets should be defined; d) how the SSNIP or HM test should be performed; e) how the relevant market should be defined when one-side of the market is free. I also discuss when and to what extent one-sided methods may be harmless, or even useful.

1. A working definition of a two-sided market

Many authors have proposed different definitions of a two-sided market. While the debate may not be fully settled, for all practical purposes a good working definition[1] is that a two-sided market is a market in which a firm acts as a platform and sells two different products or services to two groups of consumers, while recognising that the demand from one group of customers depends on the demand from the other group and, possibly, *vice versa.*[2]

Importantly, the demands on the two sides of the market are linked by *indirect network effects*[3] and the firm recognises the existence of (i.e. *internalises*) these indirect network effects.

The buyers of the two products, however, do not internalise these effects, which are therefore often called *externalities*.

Although firms' strategies in two-sided markets may be, under some conditions[4], similar to those in one-sided markets with complementary products, the fact that buyers do not internalise these externalities makes a two-sided platform different from the case of complementary products[5]. In the case of complements, both products are bought by the same

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buyer, who, in her buying decision, can therefore be expected to take into account both prices. Customers of a two-sided platform do not typically take into account both prices. [6]

Typical examples of two-sided platforms include (i) media companies, that sell content and advertising space, (ii) payment cards companies, that sell the use of a card to buyers and that of a point-of-sale (POS) terminal to shops, or (iii) online intermediaries, that sell their services to buyers and sellers.

In media markets, advertisers' demand for ads on a media outlet increases with the number of consumers of content (viewers, readers, listeners, etc.), while the latter might also be, positively or negatively, affected by the quantity of advertising. Similarly in payment cards markets, the more cardholders there are, the higher the demand from shops and vice versa. Card issuers such as American Express or VISA are well aware of this relationship between the two demands they face. Also online intermediaries such as eBay know that the more buyers visiting their website, the more likely it is that sellers will use their services and vice versa. In fact, the most common business model on the Internet, as shown by the success of Google or Facebook, is to attract users with various free services and sell their attention to advertisers.

2. A useful distinction among two-sided markets

Different classifications of two-sided markets have been proposed. Although most of them have some type of rationale, crucial for the analysis of market definition in two-sided markets is the distinction between two-sided *transaction* and *non-transaction* markets.[7] This distinction is important because it highlights a fundamental difference in the pricing strategies available to platforms in the two types of markets.

Two-sided non-transaction markets are characterised by the absence of a transaction between the two sides of the market and, even though an interaction is present, it is usually not observable by the platform, so that the platform is unable to set a per-transaction or per-interaction fee or a two-part tariff.[8] Examples of two-sided non-transaction markets are traditional media markets. Newspaper publishers, for instance, set access prices on both sides.

Two-sided transaction markets are instead characterised by the presence and observability of a transaction between the two groups of platform users. Then the platform is not only able to charge a price for joining the platform but also one for using it, i.e. it can charge a two-part tariff.[9] An example of two-sided transaction market is the market for payment cards[10].

While two-sided non-transaction markets are characterised by *membership externalities* (or indirect network effects), two-sided transaction markets are characterised also by *usage externalities*.

Membership externalities arise from joining the platform (buying a newspaper or placing an ad in a newspaper, holding a payment card or having a point-of-sale terminal, listing your product at an auction or attending an auction), whilst usage externalities arise from using the platform (paying or accepting payment with a card, selling and buying a product at an auction).

The value of joining the platform depends on the number (or more generally the demand) of customers of the other side. The benefit of using the platform similarly depends on the demand for usage by the other side.

For instance, assuming that a customer holds a card and a shop has the corresponding point-of-sale terminal, even if this customer wants to pay by card, the merchant has to be willing to accept that card for that particular transaction and vice versa. Once again these externalities are not internalised by the users of the platform, i.e. the cardholder and the merchant. For instance, suppose a given merchant would benefit from being paid by card because she would not need to go to deposit cash and she would not have to face the risk of being robbed. A cardholder would not take that into account when offering to buy in cash or by card. He would only consider his own convenience.

In a two-sided market, where two products or services are sold to two groups of customers, one can define the two distinct concepts of *price level* and price *structure*[11]. The price level is (roughly) the sum of the two prices, while the price structure is (roughly) the ratio of the two prices.

For a market characterised by a transaction between end-users to be two-sided, it is also necessary that, not only the price level, but also the price structure affects the volume of transactions.[12] For that to be the case, it needs to be impossible for the side that pays more to the platform to pass through the difference in price to the other side. If a complete pass-through were possible, the price structure chosen by the platform would not matter. The platform would not control the relative price charged to the two sides.

Clearly, a complete pass-through can only take place if there is a transaction between customers on both sides of the market. Only in those markets there may be market conditions such that the market is in fact not two-sided[13].

In markets where there is no transaction between end-users of the platform, no pass-through between the two sides can take place. Thus, the platform has perfect control of the relative prices charged to the two sides.[14]

3. Assessing the two-sided nature of the market

Before being concerned with how to perform market definition when the market is two-sided, we should assess whether the market is in fact two-sided and, if so, whether two-sidedness is likely to matter.

In order to assess the two-sided nature of the market, it is crucial to identify and characterise the indirect network effects that link the demands on the two sides of the market.

One might therefore ask whether such indirect network effects exist, whether they are one or two, whether they are both positive, or one is positive and one negative and, finally, how significant they are.

For instance, when analysing a merger in the newspapers market, one might want to know whether a larger readership of a newspaper ceteris paribus (i.e. holding constant also prices) implies a higher demand to advertise on that newspapers, whether readers dislike advertising and, if so, whether advertisers like readers more than readers dislike advertising. Similarly for a merger among TV channels.

If a market is a non-transaction market, looking at externalities is sufficient.

If instead the market is a transaction market, then one should also check if there are transaction costs or, more generally, limits to the bilateral setting of prices among buyers and sellers or if there are platform constraints on pricing between customers on the two sides.

In payment cards markets, for instance, this could be the case not only of the no-surcharge rule but also of menu costs for a shop that wishes to set a different price for its products depending on whether the buyer pays by cash, by VISA debit, VISA credit or AMEX. But it could also be the case of a shop that faces a lot of competition from shops nearby and therefore has a high probability of losing a customer when attempting to surcharge.

Only if these constraints exist then the market is two-sided, because the side charged the higher price by the platform would be unable to pass through completely the difference in prices to the other side.

Indeed, the lower the pass-through among the parties that transact, the more important the two-sided nature of the market.

In practice, in order to assess the two-sided nature of the market, both qualitative and quantitative approaches are possible.

As a first step one could use a qualitative approach and focus on checking whether there are indirect network effects and, if so, what their sign is, i.e. whether these effects are both positive or one is negative.

For instance, one might want to know not only whether advertisers base their decisions on which newspaper to place their ads on the number of readers and whether indeed they attach positive value to a higher readership, but also whether readers like, dislike or are indifferent to advertising.

If they are not present, one could then proceed considering the market(s) one-sided.

If instead indirect network effects are present, one needs to distinguish :

- If the market is a non-transaction one, since the pass-through between end-users is by definition zero, the market is two-sided.
- If the market is a transaction one, one should check to what extent transaction costs, or constraints set by the platform, limit the possibility of pass-through between the two sides. If there is scope to believe that the pass-through is high, then one could come to the conclusion, that although the market is two-sided, the two-sided nature of the market might not play a great role in practice.

The simplest way to assess qualitatively the two-sided nature of a market could in some cases be a logical argument.

For instance, in the case of newspapers or TV, it would appear evident even at first sight that advertisers value positively the number of readers of a newspaper or the number of viewers of a TV channel. Indeed, the only reason advertisers advertise in a newspaper or on TV is that they aim to reach readers or viewers with their message.

Unfortunately this approach cannot always be followed, as in some cases it is not clear whether one side cares about the other and a fortiori whether it values the other side positively or negatively.

For instance, despite some evidence for specific countries, it is not clear what the attitude of readers is towards advertising in different media.

In fact, one of the drawbacks of this deductive approach is that it may lead to different conclusions on the existence and, more importantly, the sign of the network effects.

A slightly superior way to assess qualitatively the two-sided nature of a market could be interviewing agents in the market (i.e. business people but also their customers) or making them fill-in a questionnaire with the aim of assessing whether they value, positively or negatively, the presence of more customers on the other side, and in case of a transaction market, whether there are factors limiting the platform's ability to control the price ratio.

For instance, in the case of newspapers, one could ask newspaper readers whether they like advertising on the newspaper, whether they are annoyed by it or whether they are indifferent to it.

In some cases such surveys might indeed already exist.

This is the case, for instance, in many countries where communication or social scholars run surveys with regard to the use and the perception of media.

The main drawback of this interview approach, and of any qualitative approach, is that it does not allow one to measure the size of the indirect network effects. Yet the latter is crucial to establish to what extent indirect network effects play a role in market definition[15].

Hence, as a second step, one might need to assess the two-sided nature of the market by using a quantitative approach and turn to checking not only whether there are indirect network effects and whether they are positive or negative but also on measuring their size.

For instance, in a case involving newspapers, one might want to know how much advertisers value an additional reader or, in a case involving payment cards, one might want to check whether merchants care more about one additional cardholder than a cardholder cares about one additional merchant having a point-of-sale terminal.

In order to answer these questions one can follow two different quantitative approaches: the stated preference approach (i.e. designing a survey) and the revealed preference approach (i.e. collecting actual data). Both are often more time consuming than a qualitative approach as they require the collection and analysis of data. They would thus seem more applicable in a second phase of an analysis.

In fact, having already identified two-sidedness using a qualitative approach might help in figuring out which are the relevant questions to formulate and the relevant data to collect.

4. Defining one or two markets

The main purpose of market definition is to identify the products that exert competitive pressure on the products sold by a particular firm or firms, be they firms that plan to merge, a firm suspected of anti-competitive behaviour or firms that might become the target of a regulatory intervention. Market definition is therefore an attempt to define a group of products, which are substitutable to such an extent that the firms producing them can be perceived as competing against each other, thus constraining each other's ability to increase prices.

In a two-sided market, a firm sells two distinct products on the two-sides of the market and the demands for these products are linked by the presence of indirect network effects. Firms in a two-sided market can be seen as platforms that need "to get both sides on board"[16] in order to do business.

The question then arises whether there are two (interrelated) markets to be defined or only one market encompassing the two sides.

For instance, when analysing a merger among TV broadcasters the question is whether there is a market for TV or there is a market for advertising (on TV) and a market for TV content. Similarly, in a case involving payment cards, the question is whether there is a market for payment cards services or a market for payment cards services to cardholders and a market for payment cards services to merchants.

It turns out that, whether one needs to define one or two markets, depends crucially on the type of two-sided markets. More precisely,

- In two-sided non-transaction markets, one should define two (interrelated) markets.
- In two-sided transaction markets, one should define only one market.

In fact, in a two-sided transaction market the product offered is the possibility to transact through the platform. It takes the form of two distinct products, one for each side of the transaction, because such possibility needs to be offered to both sides. Yet none of these two products is sufficient without the other. A customer on one side can consume his product only if the corresponding customer on the other side consumes his product too. In other words, the two products need to be consumed in a fixed 1:1 proportion, as perfect complements, but by two different consumers.

For example, in the purchase of a pair of shoes through a shop, the merchant cannot receive money through the POS terminal unless the client has a payment card and is willing to use it; and vice versa.

Importantly, a two-sided transaction market candidate substitute products constraining the ability of the two-sided transaction platform to raise prices are not only other platforms, which offer, to both sides, the possibility to transact but also non-intermediated transactions.

One of the consequences of defining only one market is that a firm would be either on both sides of the market or on none. Defining instead two interrelated markets would allow a platform to be on one side of the market but not on the other. Whether one or the other outcome is right depends on the type of two-sided market under consideration.

A payment card company such as Diners Club is either in the relevant market on both sides or on none, for the simple reason that either the transaction between the buyer and the merchant takes place using Diners Club services on both sides, or it does not take place through Diners Club. The analysis of a merger between two payment-card platforms should thus consider, for instance, whether cash transactions or PayPal exert competitive pressure on these payment card companies.

However, in a case involving TV broadcasters, a product might be in the relevant market on the advertising side but not on the viewers' side.[17] For instance, suppose that people do not regard TV and newspapers as substitutes because they read the latter on the metro going to work and watch TV at home in the evening. Assuming that advertisers are interested in reaching each person only once during a day, they will tend to regard TV and newspapers as substitutes. TV would then be in the same relevant market as newspapers on the advertising side but not on the viewers' side. The analysis of a case involving TV broadcasters should then be allowed to conclude that newspapers exert competitive pressure on TV in the market for advertising but not in the market for content.

Clearly, in two-sided transaction markets end-users on the two sides can be charged both a fixed fee for joining the platform and/or a per-transaction fee for using the platform. Conceptually this feature is not present also in single-sided markets where customers are charged two-part tariffs, as for instance the traditional market for fixed mobile phone services. Consistently with previous practice in these one-sided markets, one should define a single market, in which both membership and usage are sold.

The peculiarity of two-sided transaction markets is not the presence of two-part tariffs. The differences with respect to a single-sided market are the presence of indirect network effects between the membership markets on the two sides and the fact that the usage market is a transaction market linking the two-sides. These differences imply that a single market encompassing membership and usage cannot but comprise both sides of the market.

In a two-sided non-transaction market instead there is no transaction and, as a result, there is not such a strong link in the usage market. In these markets the link among the membership markets is present, because of the indirect network effects, and needs to be taken into account when defining the relevant market, but it is not so strong that it implies the necessity of a single market for the purpose of market definition.

5. Considering both sides of the market

Given the necessity to define a single relevant market ecompassing both sides, it is obvious that one should consider both sides of the market when defining the relevant in the case of two-sided transaction markets.

For instance, one should look at both buyers and merchants when one defines the market for (transactions by) payment cards. It may be that ex post, i.e. after the analysis, one concludes that one side plays a decisive role in the decision. However, a priori it is clear that both sides need to agree for the transaction to take place through the payment card company.

Also in the case of two-sided non-transaction markets, competition and regulatory authorities should take into account both sides of the market when defining the relevant market[18]. Indeed, they should consider the role of the indirect network effects and define two interrelated markets.

For instance, in a merger among newspapers, one should look also at the advertising side when defining the relevant market for readers and vice versa.

A platform in a two-sided market needs both sides "on board" and therefore competes for customers on both sides. How much competition a platform faces in getting customers on one side also depends on its competitive position on the other and *vice versa*.

It is well known in the economic literature that product differentiation, whether vertical or horizontal, relaxes price competition in a one-sided market.[19] Similarly, on each side of a two-sided market, the degree of competition faced by a given platform depends on the degree of vertical and horizontal product differentiation on that side.

For example, the level of competition faced by a TV station on the advertising side depends inter alia on the number of its viewers compared to other TV stations. For instance, if a TV station has many more viewers than its rivals, one can expect a similar price increase on the advertising side to lead to a smaller loss in advertising than if the TV stations were closer to each other in terms of number of viewers. One can argue that from the advertisers' point of view TV stations are vertically differentiated in the number of viewers.

Moreover, the level of competition faced by a TV station on the advertising side is also likely to depend ceteris paribus on the demographic composition of its viewers with respect to that of the viewers of rival TV stations. To the extent that different advertisers might value some demographic groups of viewers more than others, TV stations can also be perceived as horizontally differentiated on the advertising side.

Market definition in one-sided markets typically takes product differentiation as given. However, in a two-sided market both horizontal and vertical product differentiation is largely determined by pricing decisions.

From the point of view of advertisers, TV stations are likely to be vertically differentiated (because they have a different number of viewers) and horizontally differentiated (insofar as they have different types of viewers). Yet both the number and the type of viewers also depend on the price charged to viewers (whether positive or zero) and, to the extent that viewers are annoyed by advertising, on the price charged to advertisers, which contributes to determine the quantity of advertising in the TV station.

Thus, product differentiation on one side not only affects pricing decisions on that side (as in one-sided markets), but may also depend on pricing decisions on the other side. Pricing decisions on the two-sides are interrelated.

Hence, the competitive constraints faced by a platform in its pricing strategies can be assessed only by taking into account both sides when defining the relevant market.

Moreover, neglecting one side of a two-sided market when the product on that side is priced at zero is conceptually wrong. In fact, firms are competing also on that side.

For instance, one might think that traditional phone directories, that were distributed for free, competed only on the advertising side. Yet, if a phone directory raised advertising tariffs and experienced a drop in listings, it would likely suffer not only a direct drop in profits but also an indirect drop in usage due to people finding less information in the directory compared to competing directories. Similarly, if the phone directory experienced a drop in the number of users, possibly because of the appearance of a competing product of higher quality for users, it is likely that this would lead to a drop in demand for ad slots from advertisers. The phone directory may then be forced to lower the price charged to advertisers and/or experience a decrease in the amount of advertising and in the corresponding revenues.

By failing to consider all sides in the definition of the relevant market one would then ignore the real competitive pressure faced by the firms under consideration.

It is only in the particular case of a two-sided non-transaction market with only one externality, that one could safely perform a market definition exercise, on the side of the market that does not exert any externality, irrespective of the other side.

For example, in a case involving newspapers, if one finds that advertising has no effect on the readers' side of the market, one needs to take into account the advertising market when defining the readers' market but one can safely define the advertising market irrespective of the readers' market. In fact, in that case, whatever the pricing choices of publishers on the advertising side, they will not affect the readers' side. Hence, the platform on the advertising side of the market will not behave differently from a firm in a single-sided market facing the same advertising demand.

More generally, when defining the relevant market in the case of a multi-sided non-transaction market, it is only necessary to consider all the other sides towards which the side under consideration exerts an externality, either directly or indirectly.[20]

6. The SSNIP test and the HM test

The most rigorous conceptual tool used to define the relevant market is the so-called "Small-But-Significant-Non-Transitory Increase-in-Price Test"[21] (in short the SSNIP test), which defines the market as the smallest set of substitute products[22] such that a substantial (usually five or ten percent) and non-transitory (often one year) price increase by a hypothetical monopolist would be profitable.

Starting from a set of candidate products, the SSNIP test is implemented by first simulating a given price increase above the current level[23] by a hypothetical monopolist who owns just one product[24] and, as long as that leads to estimated losses in profits, progressively increasing the number of products owned by the monopolist and simulating a price increase of all the products the monopolist owns. When the hypothetical monopolist does not estimate profits to decline following a small but significant increase in price, the set of products owned by the monopolist in the last simulation constitutes the relevant market.

The SSNIP test is often performed by Critical Loss Analysis (CLA), for which formulas are derived under the assumptions of constant marginal costs and either linear or constant elasticity of demand.[25] Under these assumptions, performing a CLA is exactly identical to performing the SSNIP test.[26]

In any case, the idea behind the SSNIP test (and thus CLA) is that if the small but significant non-transitory increase in price is unprofitable, then there exists at least one close-enough substitute to the product whose price is raised. If so, the two products should be in the same relevant market. And so on and so forth. Thus, both the SSNIP test and CLA analysis set an implicit benchmark for substitutability between products to be in the same relevant market.

In addition, the iterative procedure described above is designed to ensure that a relevant market is defined as the smallest set of substitute products on which a monopolist would find it profitable to increase prices by a small-but-significant amount; it thus makes sure that the market is defined in such a way that a monopolist has market power, which is a basic requirement of economic theory.

If order to preserve the same logic of the one-sided test, the SSNIP test (and CLA analysis), should be modified differently according to the type of two-sided market:

- In a two-sided non-transaction market, one should check the overall profitability of a rise in price on each side of the market.
- In a two-sided transaction market, one should instead check the profitability of an increase in the price level (i.e. the sum of the prices paid for the transaction by the two sides).

Ideally, in both cases one should allow the hypothetical monopolist to re-optimise the price structure following the price increase.[27]

Furthermore, in a two-sided transaction market, the SSNIP test should take into account the changes in overall profits (i.e. the sum of the profits on both sides of the market) and

all feedbacks between the two sides of the market when judging the profitability of a price increase.

Since positive indirect network effects between the different sides of the platform reduce the profitability of any price increase, the risk of applying a one-sided SSNIP test, which does not account for these feedback effects, is that in such cases the two markets may be defined too narrowly.

Consider a two-sided platform with sides A and B linked by positive indirect network effects. The application of a one-sided SSNIP test on side A would only account for the direct effect that a price increase will have on the demand and profits of side A. It would not account for the fact that a reduction of the number of customers on side A is likely to lead to a reduction of the number of customers on side B so that, if the price on side B is kept constant, there will be a loss in profits also on side B. It would also not envisage the fact that the smaller number of customers on side B will in turn reduce the demand of side A, and so on. Hence, it would also underestimate the loss in profits on side A. The iterative procedure of the SSNIP test would then stop too early. Similarly for the application of a one-sided test on side B. On both sides the market would be defined too narrowly.

In other words, in two-sided non-transaction markets with positive network effects, a one-sided SSNIP test can provide a *lower bound* to the relevant market.

If instead one network effect were positive and one negative, the implications of applying a one-sided SSNIP test, which does not account for these feedback effects, is that in such cases the market may be defined too broadly on the side that exerts a negative externality and may be defined either too narrowly or too broadly on the side that bears the negative externality.

Consider a two-sided platform with side A exerting a negative externality on side B and side B exerting a positive one on side A. The application of a one-sided SSNIP test on side A would not account for the fact that a reduction of the number of customers on side A is likely to lead to an increase of the number of customers on side B; so that, if the price on side B is kept constant, there will also be an increase in profits on side B. It would also not envisage the fact that the higher number of customers on side B will in turn increase the demand of side A, and so on; so that, in the end, it would also overestimate the loss in profits on side A. The iterative procedure of the SSNIP test would then stop too late on side A. Hence, on that side, the market would be defined too large. Similarly, the application of a one-sided test on side B would not take into account the resulting loss in profits on side A and would overestimate the resulting loss in profits on side B. The iterative procedure of the SSNIP test may then stop too early or too late on side B.[28] Hence, on this side, the market may be defined too narrowly or too largely.

In other words, in two-sided non-transaction markets with one negative (and one positive) network effect, a one-sided SSNIP test can provide a *upper bound* to the relevant market on the side that exerts the negative externality and enjoys the positive one. It would not instead be informative on the side of the market that exerts the positive externality and bears the negative one.

Only in the presence of a single (positive) externality linking the two-sides of the market could the traditional SSNIP test (and single-sided formulas for CLA) be safely applied in a two-sided non-transaction market to define the market on the side that does not exert an externality on the other.

Some authors have proposed that the SSNIP test (and CLA analysis) be performed without allowing the hypothetical monopolist to re-optimise the price structure.[29]

While using the standard single-sided SSNIP test or CLA formulas would lead to a too-narrow or too-large definition of the relevant market, adopting a two-sided SSNIP test (or using two-sided CLA formulas) that do not allow the HM to re-optimise the price structure would lead to a too-large definition of a market. In fact, not allowing the price structure to be re-optimised would always overestimate the loss in profits due to the increase in prices, because by definition the optimal adjustment by the hypothetical monopolist will tend to reduce such a loss.

Hence, both in two-sided transaction and non-transaction markets a two-sided SSNIP test that does not allow the hypothetical monopolist to re-optimise the price structure can provide an *upper bound* to the relevant market.

Finally, it is often the case in two-sided markets that customers on one side of the market do not pay. Such a situation may arise both in transaction and non-transaction markets, but it raises different issues in the two types of markets.

In a transaction market, one mainly needs to predict the likely reaction of non-paying customers to a price increase. This can usually be done by designing an appropriate survey of existing customers to elicit their willingness to pay. Once this is measured, in a two-sided transaction market, the SSNIP test can be performed.

When the market is a non-transaction one, a two-sided SSNIP test can be safely performed on the paying side of the market. However, on the side where the price is zero it is not possible to perform a SSNIP test. Here the issue is not only that the reaction of customers to a price increase is not known, but, more fundamentally, that increasing the price by 5 or 10% has no meaning when the starting price is zero. Any price increase one would consider would be arbitrary and change the benchmark with respect to the practice in one-sided markets and the extension just discussed to the paying side of a two-sided market.

However, if the question of interest is whether the free product is in the same relevant market with a product that is sold at a positive price, one could envisage performing the SSNIP test starting from this other product and checking whether the test would lead to adding the product of interest to the relevant market[30].

If instead the question of interest is whether the free product is in the same relevant market of another free product, then one cannot resort to the SSNIP test.

In fact, it could be argued that in such a case the SSNIP test might even not make much sense[31]. In general, the price is only one dimension of competition among firms. Conventionally, competition policy has considered it to be the most important dimension of competition, leaving aside for instance choices on the variety or quality of the products. The fact that on one side of the market the price is zero most probably indicates that, on that side of the market, the most important dimension in which firms compete is not the price. Most likely, competition takes place on quality or variety.

If the relevant competitive dimension is quality, one could envisage an alternative test, similar to the SSNIP test, where the HM, rather than increasing price, would be decreasing quality. Such a SSNDQ test has been proposed already for one-sided markets[32]. The starting assumptions are both that a decline in quality leads to a loss in customers and that an HM would be more likely to find a decline in quality unprofitable if the product it sells has fewer or less close substitutes. Then the iterative procedure would be similar to the one of the SSNIP test.

The proposal of a SSNDQ test has not been very successful. In particular, it has been argued that, since product differentiation is most often multi-dimensional, it is difficult to establish what is the relevant quality dimension in practice.[33] More fundamentally, if, as it is the case in one-sided market, customers are paying for the product, it is not certain that, in the presence of substitute products, an HM would lower the quality of its product less.[34]

However, differently from a one-sided market, on the non-paying side of a two-sided market, given that the price is zero (and assuming it will remain zero), an HM would most likely lower the quality of its product less in the presence of substitute products, consistently with the assumption of the SSNDQ test.[35]

On the non-paying side of a two-sided market, one can then envisage a SSNDQ test that is performed by changing the quality and looking at profitability for an HM.

Importantly, as with the extension of the SSNIP test to two-sided markets, and for the same reasons, such a test should look at overall profitability (i.e. profitability on both sides) of the quality decrease and should take into account all feedbacks between the two sides of the market.

While also in a two-sided market it is difficult to establish what is the relevant quality dimension in practice, there is an obvious dimension that could be taken into account. In fact, in a two-sided market, one important dimension of quality is, as already argued above, the size of the network effect, i.e. the number of (some type of) users on the other side of the market. Thus, identifying the dimension of quality due to the network effect may be less contentious than in a one-sided market, once the market is established to be two-sided and the presence of the relevant indirect network effect has been confirmed.

Hence, if the non-paying side bears an externality (whether negative or positive), one can envisage a SSNDQ test that is performed by changing the quantity on the paying-side of the market and looking at the profitability of the change for an HM.

Depending on whether the externality is negative or positive, such a SSNDQ test would ask the HM to raise the network effect or lower it, respectively. For instance, in a case involving TV stations, assuming it has been found that TV advertising annoys viewers, one should ask the HM to raise advertising quantity, while in a case involving traditional phone directories, having assessed that readers are interested in the amount of listings, one should ask the HM to lower the number of listings.

Notably, the size of the network effect enjoyed or borne by customers on one side also depends on the price paid by customers on the paying side of the market. Hence, in a two-sided market in which one side does not pay, the quality on the non-paying side of the market also depends on the price paid on the paying-side.

A SSNDQ test on the network effect on the non-paying side of the market would thus be linked, albeit not equivalent, to the SSNIP test on the paying-side of the market.

More precisely, a high substitution towards a competing product on the non-paying side of the market as indicated by the above SSNDQ test would contribute to a high substitution on the paying-side of the market as indicated by a SSNIP test on the latter side, but it would neither be sufficient nor necessary.

To conclude, although the relevant benchmark would clearly change by switching from a test on price to a test on quality, such a SSNDQ test would allow competition authorities to apply the same logic as a SSNIP test.

Since in practice, the SSNIP test is rarely used in its mathematical form and is most often seen as a conceptual tool to define the relevant market, such a SSNDQ test may be a reasonable solution to adress the issue of market definition on the non-paying side of the market when the candidate substitute product on that side of the market are for free. When instead one or more of the candidate substitute products are paid for, it may be preferable to perform a two-sided SSNIP test starting from one of these candidate products, as discussed above, because in such a case it is harder to assume that price is not the relevant dimension of competition.

7. Conclusions

Drawing from the economics of two-sided markets, I provided methodological suggestions for the definition of the relevant market in cases involving multi-sided platforms. In particular, I provided suggestions regarding a) how to identify the two-sided nature of a market; b) when multi-sidedness should be taken into account; c) how many markets should be defined; d) how the SSNIP or HM test should be performed; e) how the relevant market should be defined when one-side of the market is free. I also discussed when and to what extent one-sided methods may be harmless, or even useful.

My overall conclusion is that, while two-sided markets certainly need particular attention from competition authorities, traditional antitrust tools for market definition can still be useful, provided they are implemented taking into account the two-sided nature of the market.

Notes

1   This definition is due to Evans (2003).

2   For a market to be two-sided, it is enough that one indirect network effect is present. For more discussion what makes a market two-sided and on identifying two-sidedness in practice, see Filistrucchi (2010) and Filistrucchi et al. (2013).

3   Demand is characterised by a direct network effect when consumers' willingness to pay for a product depends on the number of other consumers (or the quantity bought) of the same product; demand is characterised by an indirect network effect when consumers' willingness to pay for a product depends on the number of consumers (or the quantity bought) of another product.

4   These conditions relate to the size and sign of the indirect network effects.

5   See Rochet and Tirole (2003).

6   This distinction has important implications for the assessment of the welfare impact of these strategies.

7   This distinction was originally proposed by Filistrucchi (2008), who used however the terms "two-sided markets of the media type" and "two-sided markets of the payment cards type". It was later renamed as above by Damme et al. (2010).

8   Note that in a media market, an interaction is often present between the two sides of the market in that, for instance, a reader may read an ad placed by an advertiser. Such an interaction is even

observable online (when one clicks on an online ad to open it) and, in such a case, the platform can charge for it. However, at best only a delayed transaction is present (when someone who saw an ad buys the advertised product) and this transaction is usually not identifiable (as it is impossible to say whether someone bought a product because he or she saw an ad), so that the platform is unable to charge a fee for it. Only recently, using online tracking technologies, it has become possible to charge advertisers for online transactions between an advertiser and an internet user that buys a product online after having seen an online advertisement. The ability to track purchases resulting from an ad are currently limited but such technological developments may eventually push some media markets to become two-sided transaction markets.

9   Note however that the fact that a two-part tariff can be charged does not necessarily imply that it will be charged. Indeed both or either of a membership fee and a per-transaction fee can be charged. In fact, the crucial point is that a per-transaction fee can be charged. For example, for most payment cards in Europe and the US, cardholders pay at most an annual fee, while merchants pay a two-part tariff.

10   Other two-sided transaction platforms are virtual marketplaces, auction houses and operating systems.

11   See Rochet and Tirole (2006).

12   I write "roughly" because prices on the two sides are in different units of measurement. For instance, in the case of a newspaper, the cover price is per copy of the newspaper, while the advertising tariff is per page or per column millimetre. Thus the price level is not simply the sum of the two prices, but rather the sum of the two prices expressed in the same unit of measurement. Again, in the case of newspapers the price level is the sum of the cover price and the per-copy advertising revenues. Similarly, the price structure is the ratio of the two.

13   This will be discussed more in detail in the next section.

14   In practice, a two-sided market without a transaction is just an extreme case of a two-sided market: one where no pass-through is possible. At the other extreme, when the pass-through is complete, one finds a one-sided market. In the middle lie many different two-sided markets, those in which some pass-through is possible, although not complete.

15   This will be discussed further in the next sections.

16   Rochet and Tirole (2006).

17   See Evans and Noel (2005).

18   See also Evans and Noel (2008).

19   Two products are said to be vertically differentiated (or differentiated on quality) when, if faced with the same price, all consumers would buy one of them (the one with the highest quality). Two products are instead horizontally differentiated (or differentiated on variety) when, even faced with the same price, some consumers would buy one of them and others would buy the other (because consumers have different tastes).

20   Indeed, in a multi-sided platform, side A could exert an externality on side B when customers on side B value more customers on side A, but it could also exert an externality on side B when customers on side B care about customers on side C and customers on side C care about customers on side A. Both cases above would lead to equivalent suggestions with respect to market definition on side A.

21   In the US, the corresponding test is the "hypothetical monopolist test" (HM test). The two tests are slightly different. See Werden (2003) for a historical account of the ascent of the HM test.

22   For purely expositional reasons, I refer here only to the definition of the relevant product market and not to the geographic market.

23　In fact, the current level is assumed to be competitive. This is a drawback of the test giving rise to the so-called "cellophane fallacy" in one-sided markets. In two-sided markets the fallacy may or may not arise depending on the sign and size of indirect network effects.

24　One of those of the merging parties in a merger case, one of those owned by the potentially dominant firm in case of abuse of dominance.

25　Critical Loss Analysis works as follows: first, one calculates the so-called "critical loss", which is the maximum percentage loss in sales that can be sustained without a given price increase becoming unprofitable; second, the "actual loss" is defined as the expected percentage loss following the same price increase. If the actual loss is higher than the critical loss, it would not be profitable to increase prices. Vice versa, it would be profitable.

26　CLA formulas are different in the EU and in the US, reflecting the difference between the SSNIP test and the HM test. See Werden (2002a, 2002b).

27　This is proposed also by Emch and Thomson (2006) for two-sided transaction markets. It is instead proposed by Filistrucchi et al. (2014) for two-sided non-transaction markets.

28　These results are based on a linear specification for the demand function. Linearity, however, is often assumed in the application of the SSNIP test. As noted above, existing CLA formulas are based on such an assumption.

29　See Evans and Noel (2008).

30　In fact, the SSNIP test is not a symmetric algorithm. See Werden (2002b). Hence, this could be considered a second best solution,

31　See also Evans (2011).

32　See Hartmann et al. (1993).

33　See, for instance, OECD (2013).

34　For instance, in a vertical product differentiation like Mussa and Rosen (1978) or Shaked and Sutton (1982), the lower quality firm finds it more profitable to lower quality exactly because it has a competitor with a higher quality: by lowering quality, it differentiates more and relaxes subsequent price competition.

35　Since in this case there is no price competition, by increasing quality, a lower quality firm would steal customers from the higher quality firm.

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2. Market definition in multi-sided markets

By Sebastian Wismer & Arno Rasek[*]

1. Introduction

One-sided vs. multi-sided markets

During the last one and a half decades, multi-sided markets have been a highly debated topic among both researchers and practitioners.[1] A large part of the debate on this type of markets has been focused on internet platforms and the digital economy. However, multi-sidedness is not only an "online" phenomenon. Several traditional "offline" markets such as markets for newspapers or magazines as well as payment card markets have been identified to be multi-sided.[2]

Although the question whether a market is one-sided or multi-sided sometimes is difficult to answer, distinguishing between one-sided and multi-sided markets is a useful conceptual approach: traditional "one-sided" logic may fail if firms simultaneously serve different customer groups with interdependent demand, in particular if indirect network effects are present.[3] There is, however, no consensus on which characteristics a market must have to be defined as a multi-sided market.[4] While a firm that is active in a multi-sided market generally must serve at least two distinct customer groups (which constitute the different "sides" of the market), most definitions stipulate that there are indirect network effects between these two or more customer groups. The presence of indirect network effects between market sides affects the price setting mechanism and the competitive interaction in these markets.

It is worth noting that multi-sidedness is not strictly a "binary" but rather a gradual phenomenon. While conceptually the discussion often revolves around an adequate definition of multi-sidedness and, subsequently, whether certain types of markets or businesses are multi-sided, in practice the question of how important multi-sided issues are in a certain market seems more relevant.[5] Thus, even if indirect network effects may be present in many markets, it should be investigated case by case to what extent they influence firms' behavior and market outcomes.

The role of market definition

Due to indirect network effects, the antitrust assessment is typically more complex in multi-sided markets. This is also true for market definition. To tackle the specific challenges of market definition in multi-sided markets, it is helpful to recall the role of market definition as part of the case analysis.

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While economists often abstract from market definition within their theoretical models, practitioners need to get at least some notion about the definition of the relevant market. Market definition helps to identify customer demand and relevant competitors.[6] Market definition should inform the competitive assessment and organise it. However, market definition should not be seen as an end in itself, but a first important step that helps to assess competitive constraints, market power, and the effects of the behavior at stake.[7] Economists often struggle with the binary nature of market definition and the impact it can have on the antitrust analysis, in particular as the level of certain market power indicators depends on market definition. Thus the binary concept has been enriched by more nuanced concepts such as closeness of competition. In general, the competitive assessment in a certain case and the definition of the relevant market(s) can be seen as "communicating vessels".[8] In principle, a narrow market definition often goes along with an indication of substantial market power, e.g. a high market share, while a wide market definition tends to suggest little market power. However, such indications should always be put into perspective and may in certain cases also be refuted or confirmed by other circumstances, for instance a detailed analysis of closeness of competition, potential competition or imperfect (fringe) substitution.[9]

As multi-sided markets involve distinct groups of customers which may or may not be attributed to distinct (but interdependent) markets, these principles on the role of market definition often become even more important in multi-sided markets. In particular, due to interdependencies between markets, the (stand-alone) value of market definition may even be more limited than in one-sided markets.

Structure of the paper

In line with the request of the Chairman of the Competition Committee, we will focus on practical proposals on how agencies might deal with market definition in multi-sided markets rather than on theoretical questions or policy issues. In the following, we will first discuss the two approaches to capture the structure of multi-sided markets: defining separate markets for each market side or defining a single market encompassing all customer groups of a platform. Second, we will briefly explain how multi-homing or single-homing can affect market definition. Third, we will deal with some further challenges when applying traditional methods for market definition to multi-sided markets. Finally, we will present some concluding remarks.

Throughout this paper (and also in most of the literature on multi-sided markets) firms that are active in multi-sided markets are called 'platforms'. It should be noted that the term 'platform' in this sense also includes offline firms.

2. One single market vs. separate markets for distinct market sides

As multi-sided markets involve distinct groups of customers, there are in principle two alternative approaches to capture their specific structure: defining separate markets for each customer group or defining a single market encompassing all customer groups.

Pros and cons of the two alternatives

Both approaches have their strengths and weaknesses, which in particular depend on the individual circumstances of a sector and the nature of the services at hand.

Defining separate markets can be done straightforward by capturing the competitive landscape on each 'side' of the market one after the other. In comparing the competitive

forces identified within these separate markets, it is easy to identify whether the set of relevant product substitutes/competitors or the geographic scope differ across markets. In particular, the analysis may illustrate that a platform operator is dominant, but possibly not on all market 'sides'. For example, if one customer group predominantly practices single-homing while another one practices multi-homing, there might be fierce competition to attract customers from the single-homing group, but little competition for customers from the multi-homing group.[10] Overall, with separate markets, it seems relatively unlikely that the analysis will miss any competition issue that evolves on one of the 'sides' of the market.

However, defining separate markets for each customer group may be inappropriate if the different groups are inseparably linked by a platform interaction, in particular if a platform's service necessarily involves all customer groups. Furthermore, the competitive analysis may be done repeatedly without gaining additional insights if the set and the relevance of competitors as well as the geographic scope do not differ across market 'sides'. Moreover, the risk of missing relevant effects driven by interdependencies between different customer groups such as indirect network effects seems higher with separate markets. These aspects militate in favour of defining a single market encompassing all customer groups.[11]

In principle, both approaches seem to be in line with the concept of demand-side substitutability; in particular, defining one single market does not conflict with this concept as a platform can be understood as a provider of an intermediation service, serving linked user groups with essentially the same service. All in all, and given the role of market definition as a tool that supports competitive analysis, neither of the two approaches seems right or wrong in absolute terms as long as the analysis appropriately accounts for interdependencies –such as indirect network effects– and for all competitive forces on each 'side' of the market.

Types of platforms and types of network effects as potential guidelines

While all multi-sided markets are characterised by the presence of several groups of customers among which a certain kind of interaction takes place, the interaction's type and objective as well as the role of the platform operator can differ. The following characteristics can serve as guidelines when choosing how to capture the actual market structure.

One distinction may be drawn between transaction platforms and non-transaction platforms.[12] A *transaction platform* can be defined as an intermediary whose aim is to enable direct (observable)[13] transactions between two distinct customer groups. Both groups share the same objective, i.e. to conduct a transaction (such as the trading of a product) with the respective other side. There are positive bilateral indirect network effects between the two groups that are internalised by the transaction platform. One side by itself would not be sufficient for the service offered by the platform, i.e. multi-sidedness is not a non-mandatory option but an essential part of the service. In contrast, *non-transaction platforms* mediate a different kind of interaction and do not necessarily exhibit bilateral positive network effects. Enabling interactions is not always an integral part of their service. In particular, some non-transaction platforms may be launched with one side only, and the second side may be added at a later stage. A media platform, such as a newspaper, for example, is able to generate a wide readership by providing editorial contents, and later offer the platform to advertising companies for their purposes. In this case, the readers are interested in the editorial contents of a newspaper, while the

advertisers want to attract the readers' attention. Consequently, it is not always necessary for non-transaction platforms to bring both groups of users on board, as some of these platforms could also exist without one of the two groups. Establishing such non-transaction platforms can therefore be understood as a strategic business decision of a firm that would also serve its purpose with only one of the customer groups.[14] All in all, this suggests defining one single market in the case of a transaction platform while defining distinct markets in the case of a non-transaction platform.[15]

Another similar distinction may be made between "matching platforms" and "audience providing/advertising platforms".[16] A *matching platform* can be described by its objective to enable the best possible match between different user groups. This objective is shared by all user groups involved. Although this characterisation partly overlaps with the definition of a transaction platform, a matching platform may also enable interactions which do not necessarily imply a subsequent (observable) transaction between user groups. One example of this type are dating platforms. Although certain matching platforms also exhibit (negative) *direct* network effects,[17] they always have positive bilateral indirect network effects. Hence, transaction platforms can be seen as a sub-category of matching platforms. In contrast, *audience providing platforms* or *advertising platforms* provide one user group, e.g. advertisers, with the audience or attention of another user group, e.g. readers. The platform facilitates an interaction between users and advertisers in the form of a subsequent contact resulting from users reacting to the advertisement (for instance, by clicking on the ad). Although there might be a certain matching process involved, the characteristic indirect network effect is unidirectional, benefiting the advertisers. All in all, this suggests defining one single market in the case of a matching platform while defining distinct markets in the other cases.

Along with these potential guidelines, it can be useful to investigate the role of the platform in detail –notably, the extent to which the platform is involved in the interaction that it enables. On the one hand, this may involve legal questions such as whether the operator acts as a commission agent or trade representative or bears a substantial part of specific risks; under certain circumstances these issues are connected with further questions as to the applicability of specific competition law provisions or, in particular, the Vertical Block Exemption Regulation.[18] On the other hand, this may lead to conceptual questions such as whether it is more appropriate to interpret certain market structures as vertical (upstream and downstream market) rather than two sides of a platform.[19] However, certain aspects arising in vertical structures, e.g. demand for a wide range of products within wholesale or retail markets, can have similar implications as indirect network effects have within multi-sided markets.

Case examples

In Germany, the Bundeskartellamt has identified newspapers as well as magazines as platforms, i.e. firms that operate in a multi-sided market. However, it has defined two distinct antitrust markets for readers and advertisers.[20] This seems reasonable since newspapers and magazines usually do not enable a direct transaction between readers and advertisers, as they do not necessarily need to get advertisers 'on board' to serve readers, and as the products considered as substitutes usually differ between readers and advertisers. In contrast, in the case of a merger of two online real estate platforms, the Bundeskartellamt tended towards defining a single market including both customer groups, although it ultimately left the market definition open.[21] In a merger decision concerning online dating platforms, the Bundeskartellamt explicitly defined a common market including both user groups that are matched by a dating platform.[22] In its decision

on a merger involving a supplier of ticketing solutions and a concert promoter, the Bundeskartellamt identified the market for ticketing systems to be multi-sided, but considered the supply of a ticketing system towards event promoters as an upstream market and the supply of a ticketing system towards ticket agencies as a downstream market. Accordingly, it defined two separate markets, in particular to account for the commissioning activities provided by the ticketing system supplier.[23]

It seems that the European Commission in most cases did not explicitly address the question whether one single market including several groups of customers should be defined in cases concerning multi-sided markets.[24] However, in the merger case *Travelport/Worldspan* the Commission intensively assessed multi-sidedness, and in particular indirect network effects, in "Global Distribution Services" ("GDS"). The Commission seemed to apply a single market definition. However, the Commission considered both market sides to be in a vertical relationship – an *upstream* market for flight and travel service providers and a *downstream* market for travel agents. The Commission did not consider the intermediary service as a product, i.e., matching by the GDS platform was not considered in the context of market definition.[25]

Free-of-charge services

In multi-sided markets it can be frequently observed that the platform operator charges only one customer group while the service is offered for free to another customer group. There has been some debate as to whether free-of-charge antitrust markets should be defined. In Germany, the Düsseldorf Higher Regional Court even held that such markets cannot 'exist' in antitrust terms[26] which caused a legislative clarification.[27] It is true that where there are payments between a supplier and a customer there always exists an antitrust market. But the inverse conclusion should not be drawn.

Irrespective of whether one single market or separate markets are defined, services offered free of charge should be considered as (part of) an antitrust market if there exist indirect network effects between the group that is served without being charged and another group that is charged.[28] When ignoring one side of a multi-sided market, important competitive aspects might be missed, as there usually is competition for customers no matter whether they are paying customers or not. In fact, a customer group being not charged might be due to intense competition for these customers. However, the fact that a service is offered free of charge on its own should not justify the definition of a separate market, in particular as the (zero) pricing decision may reflect both competition and network effects, and, hence, may be associated with the strategic pricing decision towards other customer groups. Consequently, when both paid and free-of-charge services are offered in parallel, it seems reasonable to consider free-of-charge services as competing services instead of ignoring them.

The approach proposed here also offers a straight-forward answer to the currently intensely debated question of whether data should be viewed as a 'currency' in the context of internet platforms:[29] for a free-of-charge antitrust market to 'exist' it should not be a requirement that it must essentially be a bundle that comprises a good with a positive value for the customers (i.e. the platform service) and a good with a negative value for the customers (i.e. ads, use of their data) which can be viewed akin to a 'payment' for the platform service. The reason is that in multi-sided markets, setting a price of zero for one customer group may make perfect sense for the platform provider also if the service does not come along with any negative good tied to it. Instead, the relevant question for the platform provider is to what extent he can monetise the presence

of these customers on other market sides. For the purposes of market definition for internet platforms, there should thus be no need for the agency to establish that providing data is of negative value to customers or to even quantify this negative value. As free-of-charge markets may be defined due to the existence of a different customer group being charged, there is no need to find a 'currency' from the viewpoint of the customers that are not being charged.

Summarising remarks

Defining one single market seems reasonable for services which mainly aim at enabling a direct (observable) transaction between different groups, e.g. in the case of a trading platform that brings together sellers and buyers. In particular, this approach seems feasible if (i) a firm's service necessarily involves all groups and (ii) the set of substitutes and their respective relevance from the perspective of each customer group does not differ significantly across groups. Otherwise, in particular if the products or services considered as substitutes (and, hence, competition conditions) differ substantially across groups, defining a separate market for each distinct customer group seems more appropriate; in these cases, the resulting markets usually differ in product and/or geographic scope. These constellations are more likely to exist in cases with non-transaction or audience providing/advertising platforms. However, market definition and the choice between the two approaches need to be done on a case-by-case basis.

3. Product market definition with multi-homing and single-homing

While the previous section focused on the question of whether separate antitrust markets should be defined for different sides of a multi-sided market, the following section deals with the question of whether two platforms belong to the same product market(s) or not.

In principle, the factors relevant for product market definition in single-sided markets equally apply to multi-sided markets. However, there is a specific phenomenon (more) frequently found in multi-sided markets that may have significant impact on the antitrust analysis. In multi-sided markets, pricing and market outcomes depend, among other things, on whether customers choose a single platform (single-homing) or use more than one platform simultaneously (multi-homing). In particular, a relatively high degree of multi-homing within a group of customers may indicate a low level of competition for these customers, while a relatively high degree of single-homing within a customer group may indicate intense competition for those customers.[30]

Multi-homing: Substitute or non-substitute use of different platforms

In general, there can be different reasons for customers' multi-homing.[31] The most evident reason seems to be product differentiation, i.e. differences between the platforms' services, e.g. in terms of functionalities. Similar as in one-sided markets, depending on the degree of these differences and customers' preferences towards them, two platforms may be attributed to different markets. However, even platforms that offer similar services/functionalities may differ in terms of customers' usage behaviour. Furthermore, even if platforms do not differ in their customers' usage behaviour, "endogenous" differentiation may evolve, induced by the composition of their customers. Both kinds of differentiation can rationalise customers' decisions on multi-homing and may justify defining narrow product markets.

In some cases multi-homing can indicate that customers use different platforms in parallel to cover different needs, even though the platforms' services may be similar at first view. For example, in its decision concerning the merger of Microsoft and LinkedIn, the European Commission distinguished between professional and personal social networks, in particular because they are used for different purposes and in different ways, although the technical functionalities of both types of social networks feature several similarities.[32]

In practice, it is often possible for a competition agency to gain insights on the extent of multi-homing. However, it might be challenging to interpret this information. Multi-homing may be a factor mitigating the probability of 'tipping' if the two platforms are substitutes. Multi-homing also tends to reduce the relevance of indirect network effects: if all customers of one group are present on all platforms, the number of these customers does not affect the choice between platforms made by members of other groups.[33] Multi-homing may, however, also indicate that the platforms are not (direct) competitors, while multi-homing figures alone do not tell us anything about substitutability.

Although the literature on multi-sided markets analyses the impact of multi-homing on platforms' decisions and market outcomes in several facets, there seem to be no contributions that focus on the implications of multi-homing on market definition. Where one or several customer groups practice multi-homing, agencies should try to investigate the customers' multi-homing rationales and consider further splitting of the market, thus segregating platforms that are used for different purposes and, hence, are not direct competitors.

Single-homing and platforms as "bottlenecks"

As indicated above, customers' choices between single-homing and multi-homing can affect competition and there can be different reasons for customers' multi-homing. In particular, if one customer group, S, is single-homing, a distinct customer group from another 'side', M, might be interested in interacting with members of group S that are using different platforms, leading to multi-homing by M's members. I.e. customers from group M may value a certain "reach" in order to be able to (potentially) interact with many members of group S; or customers from group M are interested in reaching specific members of group S that are dispersed across several platforms. In these cases, one or more platforms can become "bottlenecks" that provide exclusive access to single-homing customers.[34] This means that one platform or even several similar platforms may possess market power vis-a-vis customers of group M. Where market power is high it might be reasonable to define a market that comprises only one platform (at least on market side M). For example, in the context of the communications sector, wholesale call termination markets are defined separately for each terminating operator's network as there are no substitutes for terminating a call to a specific subscriber's telephone line that belongs to the network of one single operator.[35] However, if a platform fiercely competes with other platforms for single-homing customers, which limits the platform's market power, it might also be appropriate to include all of these platforms in one market. Similar to cases in which platforms are used for different purposes, it would be advisable to try to investigate the customers' rationale for multi-homing.

Summarising remarks

Customers' single-homing and multi-homing behaviour can be relevant for market definition. Much will depend on the underlying rationales. Multi-homing and single-homing may both justify narrowly defined markets, but the rationale for defining markets

narrowly is quite different. 'Multi-homing' may reflect product differences, whereas 'single-homing' may indicate that platforms are bottlenecks.

4. Further challenges when applying traditional methods for market definition in multi-sided markets

In the following, we will illustrate several challenges as well as peculiarities that arise when applying traditional methods for market definition in multi-sided markets. The first part deals with the SSNIP test as a widespread framework which, however, seems difficult to apply in practice in multi-sided markets. The second part covers some other quantitative methods, while the third part addresses the role of qualitative evidence.

SSNIP test

One concept that can assist in market definition is the so called SSNIP test. The SSNIP test was originally developed for one-sided markets.[36] However, due to demanding data requirements and serious operationalisation issues, the concept should rather be viewed as an analytical framework as opposed to an easily quantifiable 'test'.

The original SSNIP test does not account for interdependencies between distinct customer groups. In a two-sided market, for example, a price increase for one customer group (side A) leads to changes in demand not only on this side, A, but also on the other side, B. Ignoring such volume changes that emanate from indirect network effects may distort the result of the SSNIP test.[37] In case of multilateral positive indirect network effects the profitability of a price increase would be overestimated, suggesting 'too narrow' markets. Furthermore, even when accounting for volume changes caused by indirect network effects, the profitability of a (unilateral) price increase also depends on whether prices for other customer groups can be adjusted.[38]

Although approaches to modify the SSNIP test to account for indirect network effects can be found in the literature,[39] the concept remains difficult to use in multi-sided markets.[40] In practice, the main issues include the lack of proper data on a specific industry (while data requirements are higher in multi-sided markets), handling of free-of-charge services as well as the identification and operationalisation of competitive dimensions besides the price (which might be even more relevant in multi-sided markets). In particular, modelling and measuring network effects is a non-trivial task, but it is crucial for the analysis of the SSNIP test as a platform's pricing leeway may be limited by multilateral positive network effects or increased by negative network effects. While the sign (positive or negative) can typically be established, possibly by using qualitative evidence, the strength as well as the shape of network effects seem difficult to quantify. Furthermore, multi-sided markets may be especially prone to a "cellophane fallacy" due to concentration tendencies that multi-sided markets may exhibit. Given these problems, it is not surprising that so far competition authorities do not seem to have applied a modified version of the SSNIP test that accounts for multi-sidedness.[41]

Other quantitative methods

Other quantitative methods such as the estimation of demand functions, elasticities or diversion ratios may involve similar issues. When explaining changes in demand triggered by variations in price or other strategic variables, indirect network effects should be accounted for. In particular, if multilateral positive indirect network effects are present, but not taken into account in the estimation of (long-run) demand reactions, the

direct effect of a variation of a strategic variable on the respective firm's demand is likely to be overestimated, as part of the demand reaction is driven by a feedback effect.[42] However, disentangling these effects in a robust way seems difficult in practice, if proper data are available at all. Data retrievable for the specific market under review will typically not contain sufficient (observable) variation with regard to the presence of indirect network effects that would allow for an econometric quantification of indirect network effects.

Less complex methods that abstract from modelling demand, such as price correlation analyses, seem to be more easily applicable. However, multi-sidedness may complicate the interpretation of calculated substitutability indicators, e.g. correlations, as additional indirect network effects interfere with substitution as a (direct) reaction on a certain variation, e.g. a price change. Furthermore, the amount of time until indirect network effects fully unfold a feedback effect may vary, so the analysis may need to comprise (different) time lags.

Beyond econometric analyses, it is often useful to apply descriptive quantitative methods. For example, the matching of customer lists of different platforms can be used to determine the degree and importance of multi-homing or to identify common customers and their characteristics. Furthermore, it can be helpful to examine the size of customer groups and the volume of new subscribers/customers over several periods, in particular if a party submits that pronounced switching has occurred between certain platforms, as this may also be reflected in the customer structure or group sizes. In addition, similar as in one-sided markets, determining catchment areas on the basis of customer locations can be meaningful when defining the geographic market; however, in multi-sided markets additional insights can be gained from analysing whether indirect network effects depend on the location of customers from other groups. If advertisers, for example, are predominantly interested in targeting customers of a platform who are resident in a certain region, this may lead to a corresponding segmentation of the market by regions, even if the advertisers themselves may be based in different regions or countries. Results of such descriptive methods are often helpful, especially when they complement qualitative evidence.

Qualitative evidence

Qualitative evidence is (more) frequently used by competition authorities. In particular, tools such as market studies or an assessment of the consumers' and other competitors' points of view can be rather helpful for defining the relevant market(s).[43] Moreover, surveys and internal documents can often be helpful, e.g. in understanding firms' rationales behind certain strategic (re)actions or identifying the set of competitors that a firm perceives and monitors.

Customer surveys in one-sided markets involve well-known problems, e.g. answers to certain questions from competition authorities might sometimes be biased strategically, and stated preferences might differ from real reactions.[44] In multi-sided markets additional issues may arise. When investigating stated preferences, in particular, an implicit or explicit assumption on "other things being equal" might be misleading, as the choice between alternative offers in presence of network effects also depends on the choices of other customers. For example, when asking customers about their hypothetical reaction to a price increase, they may respond to such a question under the (wrong) implicit assumption that the price increase will not induce any other customer to leave the platform. Hence, on the one hand it can be useful to assess how important network effects

are for the choices of each customer group, but on the other hand questions concerning the (hypothetical) substitutability of offers become complicated when both product characteristics (including price) and network effects drive respondents' real choices.

Summarising remarks

Competition authorities frequently face the challenge of choosing among investigation tools which exhibit different strengths and weaknesses and differ in their resource requirements as well as their reliability. In many cases, authorities refrain from applying complex econometric methods, in particular due to time constraints, lack of proper data or methodical complexity which often comes along with limited robustness and difficulties in interpreting and communicating results.

In multi-sided markets, the analytical complexity is higher if compared to markets without network effects. Consequently, it seems natural to lean towards simple tools with a lower degree of complexity. The extent and impact of network effects on both platforms and their customers should be assessed (at least) qualitatively, in particular to mitigate the risk of misinterpreting results from established 'one-sided' tools.

5. Conclusion

Although there seems to be no clear-cut distinction between one-sided and multi-sided markets, some specific features of multi-sided markets, especially indirect network effects, require special attention.

As in one-sided markets, market definition and the further competitive assessment can be seen as 'communicating vessels'.[45] This metaphor works very well for the different sides of a multi-sided market, too, where the interdependencies between market sides ('vessels') can be understood as a 'communicating' element.[46] Consequently, just as the market definition analysis should be closely linked with the further competitive assessment, the different sides of a multi-sided market should also be analysed in close relation to one another, especially when defining separate markets for different market sides.

Defining one single market or defining separate markets for distinct market sides are both viable and "correct" approaches as long as the further analysis appropriately accounts for interdependencies between different sides, and also for all relevant competitive forces on each side of the market.

Beyond this decision, customers' multi-homing behaviour can be relevant for market definition. Depending on the underlying rationales, both multi-homing and single-homing may justify defining narrow markets.

When applying traditional methods for market definition in multi-sided markets, further challenges may arise, especially with advanced quantitative (econometric) methods. Given the analytical complexity of multi-sidedness, a holistic look at market circumstances seems even more important in multi-sided markets than in one-sided markets.

Notes

1   Cf. e.g. Evans and Schmalensee, 'The Antitrust Analysis of Multi-Sided Platform Businesses' in Blair and Sokol (eds), *The Oxford Handbook of International Antitrust Economics*, vol. 1 (New York, Oxford University Press 2015), and OECD, 'Two-Sided Markets' (2009) Best Practice Roundtables on Competition Policy.

2   Cf. e.g. *Funke/Springer Programmzeitschriften* (Case B6-98/13) Bundeskartellamt Decision 25 April 2014, para 138; *Zeitungsverlag Schwäbisch Hall* (Case B6-150/08) Bundeskartellamt Decision 21 April 2009, para 33; *Visa MIF* (Case AT.39398) Commission Decision 26 February 2014 OJ C 168, para 16.

3   Cf. e.g. Wright, 'One-sided logic in two-sided markets' (2004) 3:1 Review of Network Economics; Schiff, 'The 'waterbed' effect and price regulation' (2008) 7:3 Review of Network Economics; King, 'Two-sided markets' (2013) 46:2 The Australian Economic Review 247-258.

4   Cf. e.g. Hagiu and Wright, 'Multi-sided platforms' (2015) 43 International Journal of Industrial Organization 162-174.

5   Also cf. Rysman, 'The Economics of Two-Sided Markets' (2009) 23:3 Journal of Economic Perspectives 125-143.

6   Also cf. OECD, 'Market Definition' (2012) Best Practice Roundtables on Competition Policy.

7   Cf. e.g. ICN Merger Guidelines Workbook, April 2006, p. 15.

8   Cf. e.g. Ewald, 'Der SIEC-Test im deutschen Recht: Grundansatz, materielle Detailfragen und praktische Auswirkungen aus ökonomischer Sicht' (2014) 3 Wirtschaft und Wettbewerb 261-281.

9   Also cf. Bundeskartellamt, 'Guidance on Substantive Merger Control' (2012) paras 77-78.

10   Cf. e.g. Armstrong, 'Competition in two-sided markets' (2006) 37:3 RAND Journal of Economics 680.

11   Also cf. Evans and Noel, 'The analysis of mergers that involve multisided platform businesses' (2008) 4:3 Journal of Competition Law and Economics 674, and Monopolies Commission, 'Competition policy: The challenge of digital markets' (2015), Special Report No 68, para 58.

12   Filistrucchi, Geradin, van Damme and Affeldt, 'Market definition in two-sided markets: Theory and practice' (2014) 10:2 Journal of Competition Law and Economics 293-339; Luchetta, 'Is the Google platform a two-sided market' (2014) 10:1 Journal of Competition Law and Economics 185-207.

13   Observability (or, more precisely, verifiability) facilitates the platform charging transaction-based tariffs, extending the space of feasible contracts.

14   Luchetta, 'Is the Google platform a two-sided market' (2014) 10:1 Journal of Competition Law and Economics 192.

15   One may also argue that a distinction based on the platforms' actual tariff system(s) should be made; in the case of purely transaction-based fees, defining separate markets might be less reasonable than defining a single market, cf. Wright, 'One-sided logic in two-sided markets' (2004) 3:1 Review of Network Economics 62.

16   Cf. Bundeskartellamt, B6-113/15, Working Paper – The Market Power of Platforms and Networks, June 2016.

17   Cf. e.g. Goos, van Cayseele and Willekens, 'Platform pricing in matching markets' (2013) 12:4 Review of Network Economics 437-457.

18   Cf. e.g. *CTS Eventim/FKP Scorpio* (Case B6-53/16) Bundeskartellamt Decision 3 January 2017, paras 101-122.

19   Cf. Hagiu and Wright, 'Multi-sided platforms' (2015) International Journal of Industrial Organization 43 162-174, and Hagiu and Wright, 'Marketplace or reseller?' (2015) 61:1 Management Science 184-203.

20   See fn. 2.

21   *Immonet/Immowelt* (Case B6-39/15) Bundeskartellamt Decision 20 April 2015, case summary available at www.bundeskartellamt.de.

22   *Parship/Elitepartner* (Case B6-57/15) Bundeskartellamt Decision 22 October 2015, paras 71-79.

23   *CTS Eventim/FKP Scorpio* (Case B6-53/16) Bundeskartellamt Decision 3 January 2017, paras 101-122.

24   *Google/DoubleClick* (Case COMP/M.4731) Commission Decision 11 March 2008 OJ C 184; *Microsoft/Yahoo* (Case COMP/M.5727) Commission Decision 18 February 2010 OJ C 020; *Microsoft/Skype* (Case COMP/M.6281) Commission Decision 7 October 2011 OJ C 341; *Google/Motorola Mobility* (Case COMP/M.6381) Commission Decision 13 February 2012 OJ C 75; *Facebook/WhatsApp* (Case COMP/M.7217) Commission Decision 3 October 2014 OJ C 417.

25   *Travelport/Worldspan* (Case COMP/M.4523) Commission Decision 21 August 2007 OJ L 314. For further case examples, see e.g. Filistrucchi, Geradin, van Damme and Affeldt, 'Market definition in two-sided markets: Theory and practice' (2014) 10:2 Journal of Competition Law and Economics 293-339.

26   *HRS* (Case VI Kart 1/14 (V)), Düsseldorf Higher Regional Court 9 January 2015, para 43.

27   In March 2017, the German Parliament passed the Federal Government Bill on the Ninth Amendment of the German Competition Act; § 18 para. 2a of this Bill explicitly clarifies that services' being offered free-of-charge does not conflict with defining an antitrust market.

28   This approach is also in line with the practice of the European Commission that dealt with several markets including services without charge, cf. fn. 24.

29   Cf. e.g. Schepp and Wambach, 'On big data and its relevance for market power assessment' (2016) Journal of European Competition Law and Practice 7:2 120-124; Körber, 'Analoges Kartellrecht für digitale Märkte?' (2015) 2 Wirtschaft und Wettbewerb 120-133.

30   Cf. e.g. Rochet and Tirole, 'Two-sided markets: a progress report' (2006) 37:3 RAND Journal of Economics 645-667, or Armstrong, 'Competition in two-sided markets' (2006) 37:3 RAND Journal of Economics 668-691.

31   Cf. e.g. *Travelport/Worldspan* (Case COMP/M.4523) Commission Decision 21 August 2007 OJ L 314 para 13-20.

32   *Microsoft/LinkedIn* (Case Comp/M.8124) Commission Decision 6 December 2016 para 103-110. However, it seems that the Commission did not consider multi-homing within the context of market definition in its decision.

33   Cf. *Travelport/Worldspan* (Case COMP/M.4523) Commission Decision 21 August 2007 OJ L 314 para 79-80.

34   Also cf. *Travelport/Worldspan* (Case COMP/M.4523) Commission Decision 21 August 2007 OJ L 314 para 77-81, and Armstrong, 'Competition in two-sided markets' (2006) 37:3 RAND Journal of Economics 668-691.

35   Cf. e.g. European Commission, 'Explanatory Note accompanying the Commission Recommendation on relevant product and service markets within the electronic communications sector' SWD(2014) 298, p.28.

36   Starting from a very narrow candidate market, the test asks whether a small but significant and non-transitory increase in price ("SSNIP") would be profitable from the perspective of a hypothetical monopolist in the candidate market. If a SSNIP is not profitable, there probably exists at least one further relevant substitute product which has not be taken into account. In this case, it is suggested that the candidate market be expanded until a SSNIP will be profitable from the perspective of a hypothetical monopolist.

37   Cf. e.g. Evans and Noel, 'The analysis of mergers that involve multisided platform businesses' (2008) 4:3 Journal of Competition Law and Economics 663-695, Evans and Noel, 'Defining Antitrust Markets When Firms Operate Two-Sided Platforms' (2005) 3 Columbia Business Law Review 667-702.

38   Cf. Filistrucchi, Klein & Michielsen, 'Assessing unilateral merger effects in a two-sided market: an application to the Dutch daily newspaper market' (2012) 8:2 Journal of Competition Law and Economics 322, for an exemplary (numerical) illustration of the application of different modified versions of the SSNIP test with and without optimal adjustment of the two-sided pricing structure.

39   Cf. Filistrucchi, Geradin, van Damme and Affeldt, 'Market definition in two-sided markets: Theory and practice' (2014) 10:2 Journal of Competition Law and Economics 293-339, and Evans and Noel, 'The analysis of mergers that involve multisided platform businesses' (2008) 4:3 Journal of Competition Law and Economics 663-695.

40   Cf. e.g. Dewenter, Rösch and Terschüren, 'Abgrenzung zweiseitiger Märkte am Beispiel von Internetsuchmaschinen' (2014) 2 NZKart Neue Zeitschrift für Kartellrecht 387-394, Kehder, 'Konzepte und Methoden der Marktabgrenzung und ihre Anwendung auf zweiseitige Märkte' (Nomos, Baden-Baden 2013), and Haucap and Stühmeier, 'Competition and antitrust in Internet markets' in Bauer and Latzer (eds), *Handbook on the Economics of the Internet* (Cheltenham, Edward Elgar Publishing 2016).

41   Also cf. Filistrucchi, Geradin, van Damme and Affeldt, 'Market definition in two-sided markets: Theory and practice' (2014) 10:2 Journal of Competition Law and Economics 339, and Kehder, 'Konzepte und Methoden der Marktabgrenzung und ihre Anwendung auf zweiseitige Märkte' (Nomos, Baden-Baden 2013) 85-86.

42   Cf. Argentesi and Ivaldi, 'Market Definition in Printed Media Industry: Theory and Practice' (2005) CEPR Discussion Paper No. 5096, for an exemplary indication of a bias that may arise from ignoring two-sidedness when estimating own-price elasticities.

43   Cf. Judgment of the General Court, *Topps Europe v Commission*, 11 January 2017, T-699/14, EU:T:2017:2, para 82.

44   Cf. e.g. Davis and Garcés, '*Quantitative Techniques for Competition and Antitrust Analysis*' (Princeton, Princeton University Press, 2009) 193ff.

45   Also cf. fn. 8.

46   Also cf. Ducci, 'Out-of-market efficiencies, two-sided platforms, and consumer welfare: a legal and economic analysis' (2016) 12:3 Journal of Competition Law and Economics 610.

Part III. Market power

3. Measuring market power in multi-sided markets

By Kate Collyer, Hugh Mullan and Natalie Timan[1]

1. Introduction

This short paper was submitted to the Hearing on "*Rethinking the Use of Traditional Antitrust Enforcement Tools in Multi-Sided Markets*", that was held by the OECD Competition Committee on 22nd June 2017 in Paris. The submission focuses on the topic of "measuring market power in multi-sided markets". It is intended to provide practical and pragmatic suggestions for economists in competition authorities. The paper draws operational conclusions on how to adapt existing enforcement and merger assessment tools to address some of the challenges posed by multi-sided markets.

The first section of the paper sets out some important features of multi-sided markets, including indirect network externalities, single-homing and multi-homing, price structure and tipping. The second section provides some practical steps in assessing market power in multi-sided markets and the final section sets out some measures of market power, and how they may need adaptation in multi-sided markets.

2. Features of multi-sided markets

Multi-sided markets are platforms that match two or more groups of customers. Evans and Schmalensee (2007) define multi-sided platforms as having (a) two or more groups of customers; (b) who need each other in some way; (c) but who cannot capture the value from their mutual attraction on their own; and (d) rely on the catalyst of the platform to facilitate value creating interactions between them.

This section sets out some key features of multi-sided markets that may be important to an assessment of market power.

Indirect network externalities

As the definition makes clear, indirect network externalities (INE) are an important feature of multi-sided markets. The benefit one side of the market derives from being on the platform depends on the number of customers on the other side of the market, and vice versa.[1] As a result, the demands of each group of customers are interlinked and this generates feedback loops between them.

INE distinguish multi-sided markets from other markets such as a vertical supply relationship. These INE go in both directions, but are not necessarily equally strong in

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each direction. When there are strong INE in both directions, the interaction between these INE on both sides can create a feedback loop that may have second and third and fourth order effects. For instance, the ultimate effect of a price increase to one side of the market could be much greater if it led to further feedback loops with participants increasingly leaving both sides of the market as the market becomes less valuable to each group of customers. The strength of these feedback loops may constrain the platform's market power and should be taken into account in any assessment.

Single-homing and multi-homing

The extent of single-homing and multi-homing by customers on each side of the market is a key competitive aspect of multi-sided platforms (Rochet and Tirole, 2003). If customers on one side only join one platform, then customers on the other side can only access those customers by joining the same platform. Armstrong (2006) shows that this creates "competitive bottlenecks" - with single-homing customers on one side and multi-homing customers on the other, the platform competes aggressively for the single-homing customers and once they are on board it earns profits from customers on the other side who multi-home.[2] Below, we suggest some practical ways to identify the extent of single and multi-homing and thereby assess market power.

Price structure

In a multi-sided market, the price structure reflects the interlinked demands of the two groups of consumers and the need to get both sides on board. This often results in complex pricing where the price to each group of consumers does not reflect the marginal cost of supplying them.

To see the importance of price structure in multi-sided markets, consider the example of a platform supplying businesses on one side of the market and consumers on the other side. Assume that in this example consumers are more sensitive to price than businesses. In order to get consumers on board, the platform allows them to use the service without charge, but the businesses pay (a fixed fee and/or commission) to be present on the platform. The platform needs to set a fee to businesses that ensures their participation and takes account of the feedback loops between both sides of the market. Fewer businesses will choose to use the services of the platform at higher prices and this will reduce the attractiveness of the platform to consumers on the other side of the market etc etc.[3]

As this example shows, the platform must be able to use the price structure to internalise the externalities arising from the INE. Platforms will always be able to control the price structure in markets where the two sides do not transact. However, in markets where the sides do transact, one side of the market can reflect some of the increased costs of doing business on the platform in the price charged for transactions. Businesses on one side of the market may pass-through the fees they are charged by the platform to the consumers on the other side of the market when transacting with those consumers through the platform. This may undermine the platform's price structure and limit its ability to internalise the externalities by facilitating value creating transactions between the two sides. For example, when a business passes through platform commissions to consumers, it will not consider how this may reduce consumers' demand for the platform's services, which then affects the demand of all business customers for the platform's services. It is only the platform which can take these externalities into account in its pricing to both sides of the market.

Therefore, in addition to the complex pricing that can be a feature of multi-sided markets, it will also be important to consider the degree of pass-through when considering the extent to which multi-sidedness affects the behaviour of the platform.

Tipping

Network externalities can lead to markets tipping to one, or a few, providers. The feedback loops that can arise when there are strong INE mean that multi-sided markets tend to be relatively concentrated. A multi-sided market may be less likely to tip the more differentiated the offering from competing platforms and the more that customers on one or more sides multi-home. [4] Scale economies and having a critical mass of consumers may also be important in determining the concentration of a market with platforms because they influence their financial viability.

Once a market tips, the joint behaviour of consumers and businesses may mean that the market power of the platform becomes well-established. It may take considerable co-ordination by both consumers and businesses to switch to another platform to restore competition. Such co-ordination may be unlikely in the absence of major technological changes in the sector. For these reasons, establishing whether there is a 'first-mover-advantage' may be important in identifying current market power and the potential longevity and sustainability of this market power.

When the multi-sided nature of the market is relevant to assessing market power

This discussion suggests that any assessment of market power in multi-sided markets should take account of these features. The standard results from one-sided markets do not apply directly to multi-sided markets and any assessment of market power needs to take this into account explicitly (as we show below). Many of our standard tools for assessing market power are more complex to apply in multi-sided markets and may need to be adapted. At a minimum, this may involve simply taking into account the impact multi-sidedness has on the platforms' business strategy and decisions. In the next section, we suggest some practical steps when considering measuring market power in multi-sided markets.

3. Practical steps when considering measuring market power in multi-sided markets

In this section, we identify some practical approaches which authorities should consider when measuring market power in multi-sided markets. We discuss these practical approaches before going on to identify measures of market power.

Understand the nature of competition and identify the market(s) where market power relevant to the theory of harm is expected to arise

As a first step, an assessment of market power should start from a solid understanding of the nature of competition in the market under consideration. It should then proceed with an analytical framework that takes account of any important features arising from the multi-sidedness of the market.

When thinking about market power and the effect of the conduct, it is important to identify clearly the nature of competition, including understanding the extent to which multi-sidedness with multiple consumer groups and interlinked demand affects market

power. This is most likely to be where there are (strong) INEs. For example, market power on one side of a market may exacerbate market power on the other side, it may support conduct on another side of the market, or it could be that the market power and conduct are within the same market, but the conduct also affects another side of the market. In addition, in multi-sided markets, competitive constraints on market power may come directly or indirectly from any and all sides of a competing platform. For example, if a platform tries to engage in exclusion on one side, a rival may be able to respond with strategies on the other side. This suggests the need to look at all sides of the market when assessing market power.

The market power we are interested in also depends on the conduct or agreement that we are interested in. Therefore, measuring market power will be specific to the conduct under investigation. It is important, at least from an economics perspective, that market power, is not considered in isolation from the conduct and the theory of harm.[5]

Take a sequential approach to measuring market power in multi-sided markets

Given the potential feedback loops between different sides of a market, a purist approach may suggest measuring market power by assessing all sides of the market simultaneously. However, this is likely to be a very challenging task and may not be practical, or even possible. When the multi-sided nature of the market appears important, then a reasonable and pragmatic approach is to start by using standard tools to assess market power for each side of the market separately and then factor in the indirect network effects by using a range of evidence and judgement. As we discuss below, care will be needed when using and drawing inferences from our standard tools.

4. Measures of market power

In this section, we focus on identifying different measures of market power and explain how these relate to the conduct considered. These measures of market power are not exclusive to multi-sided markets. However, we explain how they may need to be adapted when used in multi-sided markets and we identify some additional challenges that may arise in this context and where care will need to be taken when interpreting the results of standard measures.[6]

Any assessment of market power should be based on a thorough assessment of the competitive constraints and in multi-sided markets it will often be necessary to use multiple sources of evidence and always consider the linked nature of demand.

Market shares and concentration

Shares of supply can be a useful indicator of concentration and therefore market power, particularly for homogenous products or services. Their usefulness depends on how well the market is defined in the first place. There are challenges to using market shares as an indicator of market power in multi-sided markets, particularly for platforms.

The first challenge is how to measure market share. It is not always clear how shares should be computed to take account of the multi-sidedness of the market. The pragmatic solution would be to follow the sequential approach outlined above and to measure market shares on all sides of the platform. Market shares can then be evaluated within the overall analytical framework that takes account of the nature of the linked demands and the feedback loops. This flexible approach allows for more weight to be attached to high

market shares on one side of the market if the evidence suggests, for example, that that side is prone to single-homing.

As with all markets, it will be necessary to think through which shares one wishes to measure. For example, it will not be possible to compute value shares on both sides if one side does not pay for using the platform. It may then be necessary to measure the number or value of transactions to calculate market shares. The standard problem of interpretation also arises with, for example, concerns regarding the relevance of market shares as measures of market power in markets where services/products are differentiated.

In multi-sided markets, it may be challenging to distinguish between customers and competitors because customers on one side of the market may also be competitors to the platform. For example, hotels that list on an online travel agent platform might also compete directly for bookings. To take another example, third party sellers are customers on Amazon Marketplace and might also compete with Marketplace to attract direct sales. Care will be needed to ensure that customers and competitors are correctly identified and captured in measures of market shares.

Authorities typically aim to identify longer term measures of market power (e.g. sustained high levels of market share) rather than measures which take a snapshot of a market in flux or out of equilibrium. However, a multi-sided market with network externalities may be prone to tipping and authorities may wish to intervene earlier. In that context, care will be needed to identify whether indications of market power at a relatively early stage in the development of the market may lead to long term market power.

The challenges outlined above indicate that care needs to be taken when interpreting what market shares and, more generally, concentration, indicates about market power in multi-sided markets.

Margins, profitability and pricing

As with market shares, measures of margins and profitability can be used to assess market power. Alongside the usual pitfalls of using such measures, multi-sided markets present additional problems given the existence of feedback loops and the complexity of pricing structures. Theoretical models have been developed that explicitly take account of the linked nature of demand in multi-sided markets and could provide a basis for measuring margins or profits. However, these models are complex and may not be practical to implement.

Following the sequential approach described above, it may be more pragmatic to measure margins or profits to each group of consumers and then take account of the strength of feedback loops and the implications for inferences regarding market power. This would need to be done carefully and recognising that examining margins on one side of the market alone could give false indications of market power.

It may also be informative to consider changes in margins or profits over time. For example, it may be possible to examine whether commission levels have increased with concentration in the market, while service or quality levels, or marketing to the other side of the market, has not increased concurrently. This might provide an indication of market power.

Single-homing vs multi-homing

The extent to which customers on one side of the market single- or multi-home affects the single-or multi-homing choice of customers on the other side of the market. Examining the extent of single or multi homing on each side can provide an indication of likely market power on each side.

Businesses will benefit from listing on more than one platform if they can play-off the platforms against each other or if listing on more than one platform expands the number of consumers in aggregate. For example, a platform may be good at bringing consumers to the market who would otherwise not participate. If, on the other hand some consumers single home to platform A and others single home to platform B, then businesses will find it necessary to use both platforms to reach both sets of consumers). However, single-homing by different groups of consumers, and multi-homing by none, can lead to market power for each platform.[7]

In markets where INEs are strong it will be important to measure the extent of single or multi-homing on each side of the market before considering any feedback loops. In practice, this can be done by gathering information on the following questions:

Competition in the paid side of the market

- **What proportion of customers on the free side of the market single-home?** This will partially determine the extent of multi-homing on the paid-for-side. If there is single-homing by at least some consumers, then businesses have a strong incentive to list on that platform. Therefore, single-homing may give rise to the platform having market power.
- **What proportion of customers on the paid-for-side of the market single-home?** If all businesses single-home on one platform, it may be an indication of market power. However, multi-homing by the paid-for-side of the market does not imply the absence of market power if consumers single-home. This is because businesses may need to list on more than one platform to attract single-homing consumers.
- **How important is the platform for attracting customers to the paid side?** If a business on one side of the platform could attract consumers directly, without listing on the platform, then the platform is less likely to have market power.

Competition in the free side of market

- **How important is the platform for a consumer when choosing the product it wishes to purchase and the supplier it uses?** A platform is less likely to have market power if consumers can easily find and purchase their preferred product through other channels.
- **How loyal are consumers to one platform?**
- **How easy is it for consumers to search across competing platforms?**

Information on customer behaviour and the extent of single or multi-homing can be obtained from several sources.

- Membership data from market participants can be used to measure the extent of overlap of consumers, or businesses, between the different platforms.
- Transaction data from market participation can be used to measure the extent of overlap and the volume of transactions involved.

- A survey may provide a better understanding of customer behaviour on all sides of the market and may provide insights into how they use the platforms to search for products and therefore the true extent of multi-homing.
- Web server data might be used to analyse user behaviour within a specific domain or how consumers search across platforms. This could help the agency to understand:[8] how many platforms a consumer visits and how often; whether the consumer considers direct sales from businesses, and their websites, and in what order this search occurs; how much time the consumer spends on the search and whether the level of engagement indicates more or less market power.
- Search engine optimisation (SEO). For online platforms, a good understanding of the platforms' SEO strategy may help assess market power. This might include the use of keywords and search terms and how they affect activity on the platform. In theory, the greater the overlap in search terms, the more likely the platforms are to target the same customers, and therefore the more likely they are to be competing closely.

Conduct

Sometimes the ability to engage in the conduct may be seen as an indicator of market power, particularly for conduct that would be unachievable or unprofitable in the absence of market power.[9]

Clearly an important factor to consider is how the conduct may lead a market to tip when a market is already prone to tipping due to the INE.

Barriers to entry and expansion, including switching costs as a source of market power

As a final comment on measures of market power, we note that any assessment of market power should include an analysis of barriers to entry and expansion. A firm is unlikely to have market power in the absence of material/substantial barriers to entry, and barriers to large-scale expansion by fringe competitors.

The relevant types and extent of barriers to entry may depend on the context, but these are fairly well established. For example, one may consider the costs of entry and the extent to which these costs are likely to be sunk following entry. One may also consider how the costs of entry compare to the likely benefits of entry and how risky profitable entry would be. Profitable entry may be risky due to exogenous demand and supply shocks and/or due to strategic responses to entry by incumbents. None of these factors are unusual to multi-sided markets, but are likely to be relevant to them.

A consideration in multi-sided markets is the need for platforms to establish and market themselves to all sides of the market. The importance of this will depend on the strength of INE on the different sides of the market. The platform will need to attract all groups of customers and entry costs may differ for each side of the market. For example, it may be relatively easy to get businesses to join a new platform when they only pay usage fees and so are willing to multi-home. However, the platform may need to make significant sunk investments in advertising and content i to attract consumers to the platform.

Switching costs may also be important in multi-sided markets. Switching costs can create barriers to entry and expansion and, if there is a first-mover-advantage, can establish and strengthen a position of market power.

Switching costs may arise between platforms, or between platforms and direct sales, due to customer habits and convenience. For example, cookies used by the platform may mean that it is likely to show a consumer a selection closer to the consumer's preferences. The platform may hold the consumer's payment card details, meaning that these do not need to be re-entered every time a purchase is made. The platform has the contact details of the consumer and knows other personal information, so that the platform can contact the consumer with targeted promotions. Also, the nature of platforms is to reduce search costs and aid comparability. Therefore, consumers may be expected to prefer this to direct search across businesses' own websites.

Technological developments may weaken switching costs as they may lead to periods of intense innovation and businesses responding to technological changes, which can be destabilising to established market power. On the other hand, technological developments may also enhance market power. For example, consumers may be less willing to shop around through organic browser searches when they have a convenient app on their phone. Moreover, consumers may not be willing to have numerous apps on their phones supporting similar services.

5. Assessing the strength and impact of indirect network externalities and feedback loops

In this final section, we provide practical suggestions for assessing the strength and impact of indirect network externalities and feedback loops. We have proposed a sequential approach, looking first at the market power on each side of the market separately, and second looking at constraints from the other side via the feedback loops. This second step requires us to assess the strength of feedback loops to examine whether competition from one side of the market constrains the platform in its price setting to the other side of the market. This will help establish whether market power on one side of the market exacerbates market power on another side or whether competition from one side might constrain the other.

This second step is important because in the presence of strong INE simple one-sided measures of market power potentially underestimate the market power of the platform. For example, if the conduct in question undermined the ability of other platforms to compete effectively, then the presence of strong INE could lead to rapid concentration of the market and the exclusion of rivals. In this example, if the conduct leads to single-homing customers on one side of the market switching, the INE may simultaneously act to strengthen one competitor rapidly and weaken another rapidly. This could be the case even though static market shares, or other measures, may not indicate a position of significant market power or dominance.

It is also important to recognise that the potential benefits that a platform may gain from additional customers on one (or more) side(s) of the market may not always be large. The incremental value of gaining an additional customer is likely to vary depending on the number of customers already on the platform. Where a platform already has many potential members of the market on board, adding one additional business will not increase the value of the platform to the consumer as much as when the platform had fewer businesses on board. A platform might therefore put less effort into recruiting customers once it is more mature. This implies that the pricing structure on the platform is likely to evolve to reflect the benefit to the platform of additional customers and how this may change with the total number of customers on the platform.[10]

There are two key elements of an assessment of the strength and impact of INE and feedback loops. The first is the elasticity of demand (on all sides), which provides an indication of the sensitivity of that group of customers to a change in the relative price. The stronger the reaction to a change in price, the greater the impact of the feedback loop. The second element is the responsiveness of demand (on all sides) to participation rates on the other side(s), which provides an indication of how a response from one side of the market to a change in price will affect demand on the other side of the market.

In some circumstances, it may be possible to assess the strength of the INE by simply looking at the rate of growth of the platform and considering how growth in one side of the market appears to give rise to growth in the other side of the market.

In practice, it may be difficult to measure these elements directly. However, the following are three potential sources of evidence that may provide information on the strength and impact of the INE and feedback loops.

- **Customer data.** If it is possible to collect transaction data for market participants, it may be possible to use econometric techniques to examine past customer responses to changes in, for example, platform prices that reveal their preferences. This data would allow for the direct measurement of both the elasticity of demand and the responsiveness of demand to participation rates on the other sides. There are a number challenges with using such evidence, one being that it may be hard to ascertain the extent to which customers respond by choosing an off-platform "outside option".

- **Econometric techniques.** A combination of evidence on revealed and stated preference could be used to model choice or estimate demand econometrically. It may also be possible to measure INE directly using econometric techniques.[11] At present, the theoretical models we are aware of appear to make several simplifying assumptions and we do not know of any attempts by any competition authorities to do this.[12]

- **Survey evidence.** Surveys provide a promising source of information on the strength and impact of feedback loops. Although surveys suffer from the drawback of using stated preferences, they may have the benefit of not only providing useful insights into both elasticity of demand and responsiveness of demand to participation rates, they may also allow for the assessment of preferences for off-platform options. A survey of businesses, or customers on the paid side of the market, would allow an authority to gather information on a range of questions, including: the extent to which the businesses would pass through increases in the cost of transacting on the platform in the form of higher prices to consumers on the platform; the value to businesses of consumer participation and willingness to pay for different rates of participation; the availability of alternatives and the existence of any switching costs. This could be complemented with a survey of customers on the other side(s) of the market (i.e. consumers), which could include questions on how they would react to changes in the relative price of transactions on the platform, the value to these consumers of business participation and how different business participation rates would affect their willingness to use the platform.

These sources of information are unlikely to provide all the evidence required to assess the strength and impact of INE and feedback loops. The authority will need to make an assessment in the round and using multiple sources of evidence, including internal business documents.

6. Conclusion

Where indirect network externalities are strong, the multi-sided nature of the market will be relevant to the conduct under investigation. The pragmatic approach of assessing market power in each side of the market and then taking into account feedback loops will capture the multi-sided nature of the market and its relevance to the conduct under investigation, provided that it is possible to assess accurately the feedback loops.

We have suggested several practical ways of measuring market power in the different sides of the market, taking account of the added complexity and potential biases that arise in using these measures in multi-sided markets. We have also suggested ways of directly measuring the feedback loops. However, it will not always be possible to measure the feedback loops directly. Where this is not possible, thinking through how these loops are likely to work in practice will provide a good qualitative way of capturing the impact indirect network effects will have on market power.

Annex. Examples of cases assessing market power in multi-sided markets

This annex provides a short summary of some cases which featured multi-sided markets and were considered by the CMA (or OFT). They illustrate some of the points which have been made in the main body of the paper and show how the have been applied in practice.

Commercial radio station mergers

With commercial radio stations, advertisers pay radio stations for listeners to hear their commercials and ultimately to increase sales, and listeners purchase radio broadcasting content by listening to the commercials.

In Global/GMG the merging parties had argued that commercial radio competes with the BBC for radio audiences and that this has an indirect impact on advertising revenue of commercial stations given the two-sided nature of the market.[13] This provides an example of how competition for one side of the market, listeners, may provide a constraint that protects the other side of the market, even though this competitor does not compete for the other side of the market. Here, commercial radio stations may be constrained from increasing the volume of advertising that they allow on their radio stations or degrading the quality of their programming, because listeners may then switch to the BBC. Although the OFT considered it credible that there may be some indirect form of constraint, there was no merger-specific evidence on the extent of this constraint.[14] In addition, despite recognising the two-sided nature of the market, the OFT chose to focus primarily on the overlap in radio advertising rather than the overlap between consumers (listeners) of radio stations, or any adverse effects which may be faced by consumers due to the merger.

In Global/GCap, the OFT similarly focused its analysis on whether the merger would lead to advertisers paying more to reach listeners and/or advertisers would receive reduced value for the money they spend on adverts.[15] Nevertheless, the assessment also considered how the merger may have negative or positive effects on listeners and how this may depend on the two-sided nature of the market.

The OFT identified that a loss of competition due to the merger could lead to lower-quality programming or innovation levels, for example, less investment in paying for top DJs, presenters, research into play-lists and listeners tastes, and so forth. The OFT noted that, due to the INE, an adverse effect on listeners, for example due to a reduction in the quality of programming, would lead to listeners placing a lower value on radio and, as listener numbers fell, this would have a negative effect on the value which advertisers place on radio. In this way, the effects are mutually reinforcing, discouraging the merger parties from deteriorating their programming.

The OFT also considered listeners being "obliged to pay more for the broadcasting content they seek by being obliged to listen to incrementally more advertising - which can be considered an adverse effect based on the reasonable assumption that listeners do not listen to the radio primarily to hear adverts". The merging parties submitted that they could broadcast no more than 13 minutes of adverts per hour because this is the tolerance band of listeners – too many listeners switch off if the proportion of adverts increases beyond this to make extra advertising profitable.[16]

The OFT considered that it may be necessary to balance harm on one side of the market against benefits on the other side of the market. That is, an increase in prices that harms the advertiser side of the market may actually benefit the listener side of the market if it restricts advertising output (total airtime), to the extent that listeners do not listen to the radio primarily to hear adverts.[17]

The assessment in Global GCap also looked at how the merger may lead to efficiencies and how those efficiencies could be strengthened by to the two-sided nature of the market. The OFT considered it credible that the merging parties would seek to reposition their radio stations to make them more differentiated post-merger and this would benefit listeners and advertisers.[18] The OFT considered that brand repositioning could potentially improve programming, leading to more listeners tuning-in and as a result advertisers would be able to reach more listeners, making radio is more valuable to them.[19]

Any benefit that listeners gain from re-positioning would also need to be balanced against any direct price effect to advertisers from the merger.[20] The OFT took some encouragement from the theory around positive brand repositioning effects in radio broadcasting having been validated in empirical economic literature.[21] Nevertheless, even in the economics literature the price effects from brand repositioning can be ambiguous.[22]

In terms of measuring the potential demand-side efficiencies from brand-repositioning, the OFT considered evidence from the merging parties showing: (i) instances of brand-positioning which occurred with previous acquisitions, as demonstrated through case studies; and (ii) the merging parties' plans to reposition their brands post-merger; and (iii) evidence on the value that customers place on repositioning. Advertisers were also supportive in seeing brand repositioning as a favourable development.

Although the discussion above relates to an assessment of efficiencies, it is important to realise that these arise out of the INE in multi-sided markets and that the same considerations and measurement techniques may be applicable to measuring market power. For example, one may use previous instances of entry, expansion or increases in concentration to test the strength of INE or to assess market power more directly. Similarly, it is common to look at parties' internal documents and to understand their post-merger plans when assessing INE and market power.

Epyx – a dominance assessment

The Epyx case provides an example of how a strong preference for single-homing on one side of the market, as well as the conduct of the firm, has been used in the assessment of market power.

The CMA's dominance case related to Epyx's vehicle service, maintenance and repair (SMR) platform. This is a commercially available online platform enabling companies requiring the service, maintenance and repair of corporate vehicle fleets to procure these services electronically. It is a two-sided service, designed to facilitate the interaction of

one side of the service (buyers, also referred to as demand-side customers) with the other side (suppliers, also referred to as supply-side customers). The service offers a one-stop shop for a wide range of functionality covering a wide range of transaction types.

The CMA found that most demand-side customers would prefer to use one SMR platform only at a given time when processing SMR transactions because multi-homing brings increased complexity and operational costs of running multiple systems in parallel.[23] The CMA also found that the SMR processing choices are demand led and that the suppliers multi-home in response to the single-homing by buyers. Buyers prefer to single-home, so suppliers provide services on the platforms that buyers use.[24]

The CMA also identified how the network effects in this market may lead to barriers to entry. Demand-side customers do not see much value in joining an alternative platform unless enough suppliers are subscribed to it, while supply-side customers will only be inclined to use platforms that have demand-side customers. Therefore, the costs and lead-times to build a network on both sides of the market were identified as barriers to entry.[25] Challenges in this market were seen to be the need for any new platform to be tested with customers and the need for the co-operation of Epyx in preparing for and ultimately affecting a switch during any transitional period.[26]

The challenges faced by any potential entrant due to these barriers to entry were made particularly difficult by the conduct of Epyx, which the CMA considered to be abusive. This illustrates how the conduct itself may be relevant to the assessment of dominance. Epyx's contracts on the demand-side required customers to make all transactions through Epyx's platform. They also required customers to pay a minimum annual fee, even if the volume-related variable fees fell below this fixed fee. Many of the contracts also required demand-side customers not to 'develop, use, market or support the sale' of any alternative systems.[27] These provisions prevented demand-side customers from developing their own alternative systems or sponsoring third parties' alternative systems.[28]

Notes

[1] For example, the more businesses that join a platform, then the more consumers find that platform to be attractive; and the more consumers join a platform, then the more businesses find that platform to be attractive. In addition, the platform may allow advertisers to promote themselves to consumers (or businesses, or both), which may be a third side of the market.

[2] Firms compete aggressively on the side that uses a single network in order to charge monopoly prices on the other side that is trying to reach them. Armstrong, Mark. 2006. "Competition in Two-Sided Markets" The RAND Journal of Economics, 37(3): 668-91. As a result, competition between platforms can have large price effects on the side of the market that uses a single platform and little or no effect on the side that uses multiple platforms. Rysman, Marc. 2009. "The Economics of Two-Sided Markets" Journal of Economic Perspectives – Volume 23, Number 3: 125-143.

[3] The platform may operate at a loss-making level for some time while it seeks to build up participation on both sides of the market.

[4] However, as already noted, single-homing by customers on one side of the market but across more than one platform will tend to lead customers on the other side of the market to multi-home. If customers on one side increasingly single-home on very few platforms, then this would lead to the

market tipping to these platforms despite customers on the other side of the market multi-homing across these few platforms. Therefore, it will tend to be the increasing extent of single-homing by the side of the market with most price elastic demand for the platform's services which will drive tipping.

5   Some questions that one might ask include: (i) How does any potential market power arise in a market that has indirect network effects and aspects of multi-sidedness? (ii) How is the behaviour under investigation related to the market power in the relevant market? (iii) Are the network effects and multi-sided nature of the market important to the market power? (iv) Are the network effects and multi-sided nature of the market important to the behaviour being investigated? (v) Is the behaviour being investigated important for the network effects in the market (e.g. foreclosure which may lead to the market tipping permanently or preventing some potentially important innovation).

6   As an aside we note that the cellophane fallacy presents a particular challenge when measuring market power in multi-sided markets, outside of the context of mergers. This standard problem may arise in any market because, in the presence of market power, prevailing prices would not equate to competitive prices and the application of the hypothetical monopolist test to prevailing prices is likely to lead to the relevant market being defined too broadly (i.e. including products which are not close substitutes at competitive prices). The extent of this problem is likely to depend on the conduct being considered. In some contexts it may be possible to identify market power directly without initially defining a market (e.g. by looking at the relationship between price and concentration in comparable geographical markets). The difficulties arising with the cellophane fallacy are not particular to multi-sided markets, but may be more challenging because, as discussed earlier, the nature of these markets means that price will often have little relationship with measures of cost on either side of the market. Therefore, assessing a competitive price which is related to a measure of cost is likely to be more challenging. Nonetheless, while it is important to recognise these difficulties in assessing conduct, the measures of market power identified below should still be useful.

7   There is an open question as to whether it makes sense to find all platforms as having market power. Furthermore, do they have market power in the supply of services to businesses (on one side of that platform) due to the single-homing of the consumers (on the other side of that particular platform); or do they have market power in the supply of services to the single-homing consumers? Finally, potential market power due to consumers single-homing on platforms may not arise if some/many consumers use tools to search across platforms – effectively multi-homing without necessarily visiting each platform. For example, metasearch sites used in the online travel industry would appear to support this form of multi-homing (although they appear to account for a rather small proportion of bookings).

8   We would expect platforms to collect an array of data internally to monitor how it is performing against internal targets and against rivals. Therefore, internal documents and management information collected during the normal course of business are likely to provide useful insights.

9   For example, the use of wide MFNs by some platforms might provide some indication of market power. On the other hand, it may be that the conduct itself impacts upon other measures of market power. For example, a wide MFN reduces the incentive of businesses to pass-through a commission increase into their prices on that platform and, to the extent that it is passed though, it will be matched on other platforms. This means that the initial 'feedback loop', which one might consider in assessing market power, is no longer operational due to the wide MFN.

10   In other words, at the margin, the strength of the INE is unlikely to remain constant.

11   Through simultaneous demand estimation it may be possible to model demand on all sides of the market and back out the cross elasticities in order to measure the INEs.

[12]   See, for example, Song, M (2015) "Estimating platform market power in two-sided markets with an application to magazine advertising." Working Paper.

[13]   The BBC is a public service broadcaster which has numerous radio stations but no advertising on these stations.

[14]   https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/77575/Global_G MG_Radio_Repor_PRINT_t.pdf

[15]   Completed acquisition by Global Radio UK Limited of GCap Media plc ME/3638/08, 27 August 2008.   https://assets.publishing.service.gov.uk/media/555de372ed915d7ae5000094 /Global_GCap.pdf

[16]   In other words, the assessment considered how negative INE, arising due to listeners disliking advertising, may protect listeners from an increase in the volume of advertising.

[17]   In contrast to the mutually reinforcing competitive effects described before, the OFT noted that these competitive effects, which were initiated on the other side (the advertiser's side) of the market were inversely related. Para 31

[18]   A further demand-side merger efficiency in a two-sided market such as radio can occur as a result of post-merger product or brand repositioning. The basic proposition is that by changing radio stations format and/or programming post-merger in a way that benefits listeners (that is, by greater demographic specialisation by individual radio stations), combined radio stations can achieve a larger and more focussed total audience. The resulting airtime is therefore more valuable to advertisers seeking to reach a large, focussed demographic.

[19]   Para 30.

[20]   The OFT noted the challenges in estimating the different effects: "it is unclear to the OFT how much—if at all—listeners value each incremental reduction in advertising below the 13 minute per-hour threshold, nor does the OFT know the curvature of the relationship between price and total airtime demanded by advertisers for each relevant station affected by the merger" (para 32).

[21]   See Steven Berry and Joel Waldfogel 'Do Mergers Increase Product Variety? Evidence from Radio Broadcasting', Quarterly Journal of Economics, August 2001, pages 1009— 1025, who show that the effect of radio mergers after the US Telecommunications Act of 1996—which relaxed radio ownership restrictions to differing extents in different-sized markets, effectively running experiments on consolidation in markets of different sizes—was to increase the amount of programming variety relative to the number of stations. Other academic work suggests the same changes also improved radio stations' performance in the market, implying that format changes by smaller stations may counter the potential exercise of market power by large radio groups that acquire a substantial share of a particular audience demographic through merger. See Charles Romeo and Andrew Dick 'The Effect of Format Changes and Ownership Consolidation on Radio Station Outcomes', Review of Industrial Organisation, December 2005, pages 351—386.

[22]   See Amit Gandhi, Luke Froeb, Steven Tschantz and Gregory Werden 'Post-Merger Product Repositioning', Journal of Industrial Economics, March 2008, pages 49—67, who find that the merged firm moves its product varieties away from each other to reduce cannibalisation and its competitors move their product varieties between those of the merged firm. Post-merger repositioning therefore benefits customers by increasing product variety. However, they also find that repositioning affects post-merger prices in two countervailing ways: there is upward pressure on all prices as product varieties spread out but the merged firm's incentives to raise price are reduced as its product varieties move away from each other (as there is less competition between them to internalise).

[23]   Para 2.23

[24]   Para 2.24

[25]   Para 2.30

[26]   Para 2.31

[27]   Paras 3.11-3.12

[28]   Para 3.14

4. Measuring market power in multi-sided markets

By Kurt R. Brekke[1]

1. Introduction

Multi-sided markets are markets in which a firm serves two or more distinct groups of consumers. Classical examples include markets for newspapers (serving readers and advertisers), credit cards (serving shoppers and merchants), and taxis (serving travellers and drivers). This kind of markets has been around for decades. However, the importance of multi-sided markets in the economy has increased tremendously, mainly due to digitalisation and the rapid growth of online markets.[1] While many of these markets are offering entirely new products to consumers, they also transform traditional one-sided markets into multi-sided markets due to new business models often based on advertising as a key source of income.

A key feature of multi-sided markets is the existence of network externalities between the different sides (consumer groups) in the market, which are by definition not present in one-sided markets. Network externalities arise when the utility (or profit) obtained by a consumer (or firm) of one type depends on the number of consumers (or firms) of the other types in the market and the different consumer groups cannot internalise these externalities. While the strength of the externality depends on the size of the network, the sign of the externality can be positive or negative. In the classical newspaper example, it is quite clear that readers are imposing a positive externality on advertisers, as they are also potential buyers of the advertised products. This implies that newspapers with large circulation are likely to attract more advertising revenues. However, the externality on readers of advertising can be positive, negative or even zero, depending on how advertising is affecting readers' utility.[2]

The presence of network externalities between the different consumer groups in multi-sided markets changes the strategic nature of the market game. This has been well-documented by the large economic literature that has emerged on multi-sided markets.[3] A main reason is that network externalities affect demand from the different consumer groups, which in turn influence the firms' strategic behavior, including pricing decisions. In the newspaper market, a higher subscription fee will increase the profit margin on readership but at the same time reduce advertising revenues due to lower circulation. Thus, the positive network externality from readers to advertisers constrains newspapers in setting high prices to readers. Indeed, in many online markets, firms are charging zero user fees to maximise network effects and thus advertising revenues.

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The growing importance of multi-sided markets in the economy poses a key challenge for competition authorities. A main reason for this is the lack of appropriate tools for assessing possible anti-competitive effects of firm behavior in such markets. This has been clearly demonstrated in recent antitrust cases, including the EU cases against Google, Microsoft and Facebook.[4] While there have been major developments in antitrust analysis for traditional one-sided markets, such as price pressure tests in merger cases, these tools cannot directly be applied to multi-sided markets without any adjustments. Indeed, the nature and strength of the network externalities in multi-sided markets are likely to determine the anti-competitive effects of firm behavior in such markets. Applying tools developed for one-sided markets may therefore lead competition authorities to make wrong decision, such as stopping beneficial mergers (type 1 error) or clearing harmful mergers (type 2 error).

The purpose of this paper is to explore recent developments in the economic literature on market power in multi-sided markets, focusing on practical methods and tools that can be applied by competition agencies, especially in their assessment of horizontal mergers in such markets. The paper is organised as follows. Section 2 briefly describes the traditional measures of market power in one-sided markets and the new developments related to price pressure tests. Section 3 reviews the recent developments in the literature on merger assessment tools for multi-sided markets, whereas Section 4 discusses how these tools can be implemented in practice by competition authorities. Section 5 concludes the paper with some policy recommendations.

2. Market power in one-sided markets

Traditionally, competition authorities have measured market power by using concentration indices. The main measure in merger cases has been the post-merger Herfindahl-Hirschman-Index (HHI) and the merger-related change in the HHI. The HHI is defined as the sum of each firm's market share

$$HHI = \sum_{i=1}^{n} s_i^2,$$

where s_i is firm i's market share and n is the total number of firms in the market where the merger takes place. The higher the HHI, the more concentrated is the market, with monopoly yielding a maximum value of 10,000 (i.e. one firm having a market share of 100 percent). Since the post-merger HHI is not observed by competition authorities, this is usually computed by imputing the pre-merger market shares (i.e. assuming each firm's market share remains constant after the merger).[5] This implies that the merger-related change in the HHI, assuming firm1 and 2 merge, is simply given by

$$\Delta HHI = 2s_1 s_2$$

yielding the following post-merger HHI

$$HHI^{Post} = \sum_{i=1}^{n} s_i^2 + 2s_1 s_2$$

where s_i is firm i's (observed) pre-merger market share.

According to the U.S. merger guidelines (2010), markets in which the HHI is between 1,500 and 2,500 points are considered to be moderately concentrated, and markets in which the HHI is in excess of 2,500 points are considered to be highly concentrated.[6] Mergers resulting in highly concentrated markets that involve an increase in the HHI of between 100 points and 200 points potentially raise significant competitive concerns and

often warrant scrutiny. Mergers resulting in highly concentrated markets that involve an increase in the HHI of more than 200 points are presumed to be likely to enhance market power and will usually be investigated by the competition agencies.

However, the use of HHI as a measure of market power has been heavily criticised in recent years. First, the foundation of HHI in economic theory is based on Cournot competition with homogeneous products. In such markets firms sell identical products and compete in quantities, and the price is established by an "auctioneer" that clears demand and supply. If these are key characteristics of the industry where the merger takes place, then the HHI is likely to be an appropriate tool for competition authorities. However, in most markets firms compete in prices and sell differentiated products, which implies that the HHI can be misleading as an indicator of possible anti-competitive effects of the merger.

Second, the use of HHI requires a definition of the relevant market, which is usually done using a so-called "Small but Significant and Non-transitory Increase in Price" (SSNIP) test. Following this practice is problematic in differentiated product markets, as any HHI-based analysis neglects information on the substitutability between products, which is decisive for measuring market power in such markets. While substitutability between products is a matter of degree, market definition is conceptually different because it involves a zero/one decision of whether or not to include a given product in the relevant market.

Third, the HHI, as a measure of market power, is difficult to relate to possible efficiency gains in, say, a merger case. The reason is simply that HHI is a non-monetary measure, whereas efficiency gains usually are expressed in monetary terms. While it is possible to translate changes in HHI into price effects, this requires information about price elasticities, which usually are difficult to obtain for competition agencies. Moreover, even if it is possible to translate the HHI in monetary terms, the two above-mentioned critiques still apply, implying that the comparison with efficiency gains is misleading, as the HHI does not provide a reliable measure of anti-competitive effects, except for markets characterised by Cournot competition with homogenous products.

As a response, pricing pressure indices have been proposed as alternative measure for competition authorities when assessing horizontal mergers involving differentiated products. The framework is based on Bertrand competition with firms selling differentiated products. The price pressure indices characterise the unilateral price effects of a horizontal merger by calculating the post-merger effects of marginal price increases above the pre-merger level. The idea is that, prior to the merger, if one of the merging firms raises its price by a small amount above the observed equilibrium price, its profits remain unchanged. Post-merger, if the merged firm increases the price of one of its products, some of the lost sales will be recaptured by the second product (which used to be a competing product). Therefore, this price increase is now profitable and thus likely to occur in the absence of efficiency gains.

The concept of Upward Pricing Pressure (UPP), recently proposed by Farrell and Shapiro (2010), is based on the idea that a merger changes the firms' pricing incentives in two ways: (i) it creates upward pressure on prices due to the loss of competition between the merging parties' products and (ii) it leads to downward pressure on prices caused by merger-related efficiencies (marginal cost decreases). The difference between these two effects is the UPP. The UPP measure is derived by evaluating the merging firms' post-merger first-order conditions at the optimal pre-merger prices, granting the merging firms an efficiency credit. Considering a merger between firm 1 and 2 selling differentiated products 1 and 2, respectively, Farrell and Shapiro (2010) define the UPP on product 1 as follows:[7]

$$UPP_1 = (P_2 - C_2) D_{12} - E_1 C_1 \geq 0$$

where D_{12} is the diversion ratio from product 1 to product 2,[8] P_2 is the price of product 2, C_1 and C_2 are the marginal costs of product 1 and 2, respectively, and E_1 captures possible merger-related cost synergies in producing product 1, measured in relative terms (percentage).[9] Hence, given that the price of product 2 remains the same, the merging firm would like to increase the price of product 1 after the merger as long as $UPP_1 \geq 0$. The condition is a trade-off between downward price pressure from a lower marginal cost $E_1 C_1$, and the upward pricing pressure from the value of diverted sales $(P_2 - C_2) D_{12}$.[10]

The upward pricing pressure is explained in U.S. Horizontal Merger Guidelines (2010) as follows:

> *'Adverse unilateral price effects can arise when the merger gives the merged entity an incentive to raise the price of a product previously sold by one merging firm and thereby divert sales to products previously sold by the other merging firm, boosting the profits on the latter products. Taking as given other prices and product offerings, that boost to profits is equal to the value to the merged firm of the sales diverted to those products. The value of sales diverted to a product is equal to the number of units diverted to that product multiplied by the margin between price and incremental cost on that product.' (p. 21)*

In their comment on the U.S. merger guidelines (2010), Salop and Moresi (2009) propose to use the Gross Upward Pricing Pressure Index (GUPPI) to measure the upward pressure on post-merger prices. Differently from UPP, GUPPI does not grant an efficiency credit and then evaluates whether UPP is positive. Rather, it expresses UPP in terms of percentage margins. The GUPPI can be written as follows

$$GUPPI_1 = \frac{P_2 - C_2}{P_2} D_{12} \frac{P_2}{P_1}$$

Since GUPPI only captures the upward price pressure due to internalisation of competition between the merging parties' products post-merger, it will always be positive if the merging parties' products are substitutes. Hence, if GUPPI is to be used as a horizontal merger screening device, some threshold GUPPI level needs to be specified below which the merger is considered not to give rise to substantial unilateral effects.

A novelty of the UPP and GUPPI measures is that no assumptions are needed on the demand structure or pass-through rates. The reason is that these measures do not calculate the magnitude of the price change but only its direction (i.e. whether a price increase following the merger is likely or not). This implies that the measures can, in principle, be applied to any (one-sided) market, independent of specific market characteristics. However, it is important to be aware that the UPP and GUPPI are not direct measures of the expected price effects of the merger. Moreover, the UPP and GUPPI formulas are derived assuming prices of all other products are constant, including products of the merging parties but also rival firms. This is a main reason why the UPP and GUPPI measures are to be interpreted as indicative and not predicted price effects of the merger.

Hausmann et al. (2011) advances the price pressure tests by allowing for feed-back effects between the merging firms' products. More precisely, considering a merger between firm 1 and 2 selling differentiated products 1 and 2, respectively, they allow for prices of both products to change following the merger. However, to derive the price pressure formulas, they need to assume linear demand functions, which implies that the diversion ratios are constant and do not vary with price levels. Despite this caveat, their price

pressure test can be useful to competition agencies, especially for mergers where linear demand can be a reasonable assumption. One can also argue that linear demand implies a conservative measure as the pass-through rate to consumers is 50% of the price change.

In cases where data allow for demand estimation, competition agencies are in a position to conduct merger simulations that also account for price responses by outsiders. As prices usually are strategic complements, accounting for such price responses reinforce any price effect of horizontal mergers. While merger simulations are highly useful in predicting true price effects of mergers, they are demanding in terms of data and can be sensitive to methodological assumptions. This often implies that most competition agencies are not in a position to make use of these tools given the time constraints in merger cases. In the proceeding we therefore mainly focus on price pressure tests when considering measures of market power in two-sided markets.

3. Market power in multi-sided markets

In this section we explore measures of market power in multi-sided markets that can be employed by competition agencies. A key question is how the measures developed for one-sided markets can be adjusted to analyse merger effects in multi-sided markets. As pointed out in the introduction, multi-sided markets differ from traditional one-sided markets in that (i) firms serve more than one consumer group and (ii) there exists indirect network effects across the consumer groups. The vast economic literature that has emerged on multi-sided markets clearly demonstrates that the presence of network effects changes firms' strategic behavior and thus the nature of competition.

However, in absence of network externalities across consumer groups, there is really no difference between one-sided and multi-sided markets. In this case, the competition authorities can assess the effects of the merger on the different sides of the market separately, using the standard tools for one-sided markets, as presented above. Indeed, this is what has been done by competition authorities in many cases until recently. Below we will show that the standard tools can be misleading in the presence of network effects, and present new tools for analysing mergers in multi-sided markets.[11]

While the literature on multi-sided markets is vast, there are only a few recent studies developing operational tools for competition authorities' assessment of mergers in such markets. An important contribution is the paper by Affeldt et al. (2013) who extend the UPP measures to two-sided markets. They show that, due to the two-sidedness, the UPP measures depend on four sets of diversion ratios that can either be estimated using market-level demand data or elicited in surveys. In an application, they evaluate a hypothetical merger in the Dutch daily newspaper market. Their results demonstrate that it is important to take the two-sidedness of the market into account when evaluating UPP.

Let us briefly present the UPP measured developed by Affeldt et al. (2013) for two-sided markets. In two-sided markets, firms set two prices, one to each consumer group. Following their example, newspaper 1 set a price P_1^A in the advertising market and price P_1^R in the readership market, where each of the prices are affecting newspaper 2 in both markets. A higher P_1^R shifts readers from news-paper 1 to newspaper 2. This makes newspaper 2 more attractive for advertisers, yielding a shift in advertisers to newspaper 2 from newspaper 1. Moreover, a higher P_1^A shifts advertisers from newspaper 1 to newspaper 2. If consumers dislike (like) ads, this shifts readers to (from) newspaper 1 from (to) newspaper 2. Thus, price changes in multi-sided markets involve direct demand

effects, as in one-sided markets, but importantly also *feedback effects across sides* (consumer groups) due to network externalities.

Building on Farrell and Shapiro (2010), Affeldt et al. (2013) derive two UPP conditions for each firm, one for each side of the market. Considering a merger between newspaper 1 and 2, the UPP condition for newspaper 1 in the readership market is given by

$$UPP_1^R = (P_2^R - C_2^R)D_{12}^{RR} - E_1^R C_1^R + \left(P_2^A - C_2^A\right)D_{12}^{RA} + E_1^A C_1^A D_{11}^{RA} \geq 0$$

where the two first terms are the standard UPP measure for one-sided markets, consisting of the "upward pricing pressure" based on the value of diverted sales from newspaper 1 to newspaper 2, $(P_2^R - C_2^R)D_{12}^{RR}$, net of the "downward pricing pressure" due to merger-related cost synergies in the production of newspaper 1, $- E_1^R C_1^R$. However, it is worth emphasising that firms in multi-sided markets often set user prices below marginal costs, $P_2^R < C_2^R$, in order to capitalise on the network effect in the advertising market. In this case the first term in the UPP measure would be negative, yielding a downward price pressure, which is opposite of one-sided markets.[12]

The two last terms in the UPP condition capture the network effects in two-sided markets. The first term $\left(P_2^A - C_2^A\right)D_{12}^{RA}$ is the value of diverted sales from newspaper 1 to newspaper 2 in the advertising market of an increase in the reader price of newspaper 1, where the diversion ratio D_{12}^{RA} measures the share of advertisers that switch due to fewer readers of newspaper 1. This is likely to be positive in the case of newspapers, but generally D_{12}^{RA} can take any sign depending on the nature of the network externality. This is an additional effect, not present in one-sided markets, which yields an upward (downward) pricing pressure if the network externality is positive (negative).

The second term $E_1^A C_1^A D_{11}^{RA}$ is the synergy effect in advertising costs for newspaper 1, as a result of the change in the number of advertisers induced by the increase in the reader price. For the newspaper market, this term is likely to involve a downward pricing pressure on the reader price. The reason is that synergies in advertising costs imply a higher profit margin on advertisers, which makes newspaper 1 more reluctant to increase reader prices, as this lowers circulation and thus demand from advertisers. Thus, the "diversion ratio" D_{11}^{RA} is likely to be negative in the case of newspapers, but generally the sign depends on the nature of the network externalities across the different sides of the market.

Affeldt et al. (2013) derive an equivalent condition for the UPP on the advertising side, which is

$$UPP_1^A = \left(P_2^A - C_2^A\right)D_{12}^{AA} - E_1^A C_1^A + (P_2^R - C_2^R)D_{12}^{AR} + E_1^R C_1^R D_{11}^{AR} \geq 0$$

As for the previous condition, the two first terms are the standard UPP measures for one-sided markets. The third term is the value of diverted sales from newspaper 1 to newspaper 1 on the reader side, resulting from an increase in the advertising price P_1^A of newspaper 1. The diversion ratio D_{12}^{AR} measures the share of readers that switch newspaper as a result of less advertising in newspaper 1, where the sign depends on whether readers like or dislike advertising. Notice also that the profit margin on the user side can be, and often is, negative $(P_2^R < C_2^R)$, which further complicates the computation of the UPP condition in multi-sided markets. If the profit margin is negative, then $(P_2^R - C_2^R)D_{12}^{AR}$ is positive (negative) if readers dislike (like) ads, and zero if readers are indifferent.

The last term $E_1^R C_1^R D_{11}^{AR}$ captures merger-related synergies in the news production, where D_{11}^{AR} is the change in the number of readers relative to advertisers. A higher advertising

price P_1^A implies less advertisers, which may have an impact on the number of readers, depending on the nature of the network externality, as explained above. Lower costs in news production yield a higher (or less negative) profit margin on readership. Thus, if readers like (dislike) ads, this term implies a downward (upward) pricing pressure on the advertising price of newspaper 1.

Affeldt et al. (2013) derive also GUPPI measures, which ignore efficiency gains, for two-sided markets:

$$GUPPI_1^R = m_2^R D_{12}^{RR} \frac{P_2^R}{P_1^R} + m_2^A D_{12}^{RA} \frac{P_2^A}{P_1^R},$$

$$GUPPI_1^A = m_2^A D_{12}^{AA} \frac{P_2^A}{P_1^A} + m_2^R D_{12}^{AR} \frac{P_2^R}{P_1^A}$$

where m_2^R and m_2^A are the profit margins (in percentage) of newspaper 2 in readership and advertising markets, respectively. The first term in each of the conditions is the standard GUPPI measure in one-sided markets, whereas the second term captures the network externalities across the two sides of the market, as explained above.

A recent paper by Cosnita-Langlais et al. (2017) extends (and modifies) the UPP measures developed by Affeldt et al. (2013). A key point in their paper is that Affeldt et al. (2013), when deriving the UPP measures, fail to account for within firm feedback effects in the pricing on the two sides. More precisely, Cosnita-Langlais et al. (2017) argue that it is unreasonable to assume that the price on one side (say, advertising price P_1^A) is constant when setting the price on the other side (say, reader price P_1^R).[13] Allowing for within firm feedback effects across the two sides of the market, they derive modified versions of the GUPPI formula, though under the assumptions of symmetry and linear demand

$$GUPPI_1^R = m_2^R \left(D_{12}^{RA} + \frac{D_{11}^{RA}}{2} D_{12}^{AR} \right) + m_2^A \left(D_{12}^{RA} + \frac{D_{11}^{RA}}{2} D_{12}^{AA} \right),$$

$$GUPPI_1^A = m_2^A \left(D_{12}^{AA} + \frac{D_{11}^{AR}}{2} D_{12}^{RA} \right) + m_2^R \left(D_{12}^{AR} + \frac{D_{11}^{AR}}{2} D_{12}^{RR} \right)$$

Notice that the first term inside each bracket is the same as in Affeldt et al. (2013). The additional effect that is pointed out by Cosnita-Langlais et al. (2017) is represented by the second term in each of the brackets. As they highlight in their paper, these additonal effects can imply that a merger leading to a price increase on one (say, advertising) side of the market may lead to a price reduction on the other (say, reader) side, even if there are no efficiencies and margins are non-negative. This is not case in Affeldt et al. (2013). Notice, however, that the set of diversion ratios are the same as for the UPP measures by Affeldt et al. (2013).

4. Measurement issues in multi-sided markets

In this section we explore how competition authorities can operationalise the market power tools described above, and obtain reliable estimates of key parameters in multi-sided markets. An important feature of the pricing pressure indices is that they are based on parameters that, in principle, are observable to competition authorities, such as diversion ratios and profit margins in the pre-merger (today) situation. This is not the case for cost synergies, where the estimates usually are based on plausible "guesses" of future merger-related cost savings.

The price pressure indices for two-sided markets suggest that competition authorities need to (i) look at both sides of the market, as an upward pricing pressure on one side can imply a downward pricing pressure on the other side, and (ii) obtain estimates for diversion ratios across sides (readers and advertisers) both within and across the merging firms (newspaper 1 and 2). Following Affeldt et al. (2013), competition authorities, when assessing mergers in two-sided markets, have to obtain estimates of the following diversion ratios for the merging parties:

1. Across products diversion ratios on each of side of the market: D_{12}^{RR} and D_{12}^{AA}
2. Across products and sides diversion ratios: D_{12}^{AR} and D_{12}^{RA}
3. Within products but across sides diversion ratios: D_{11}^{AR} and D_{11}^{RA}

Estimates of the six diversion ratios can be obtain by using market or survey data from the different consumer groups on each side of the market. To illustrate the importance of accounting for network externalities in two-sided markets, Affeldt et al. (2013) consider a hypothetical merger in the Dutch daily newspaper. Using estimates for demand elasticities, prices and marginal costs based on market data, as derived by Filistrucchi et al. (2012), they compute different UPP measures. Their exercise demonstrates significant differences between the UPP measures for one-sided and two-sided markets. In particular, the merger effect in the advertising market is only detected when allowing for network externalities in the UPP formula.

However, estimates for demand elasticities and marginal costs are usually not available, and competition authorities need to collect information on diversion ratios using customer surveys. In a multi-sided market, the survey would need to be more comprehensive, as one would need to survey consumer groups on all sides of the market. Moreover, one need to ask the different consumer groups not only how they would react to a price increase but also how they would react to a change in participation on the other side.[14] A further complication is that survey results are sensitive to the design of the survey.

Before concluding, let us briefly describe a merger case in the newspaper market in Norway that was investigated by the Norwegian Competition Authority (NCA).[15] In late 2011 the NCA assessed a proposed merger between the second and the third largest media houses in Norway. While the parties had several overlapping activities, the concern for competition was related to local newspapers in overlapping geographical areas. In the merger assessment, the NCA examined the effects of the merger in both the reader and advertising markets. The assessment was based on customer surveys of subscribers and advertisers in six local newspapers. The samples of readers and advertisers were based on a randomised selection from the actual customer lists of the newspaper, with the final sample consisting of 200 subscribers and 25 percent of the advertisers for each of the six newspapers. Information on the consumer groups' second choice of newspaper was collected through telephone surveys, asking the question of which newspaper the subscribers and advertisers would choose if their first choice did not exist. Table 1 summarises the diversion ratios on the two sides of the market.

Table 1. Merger A-pressen - Edda Media, Diversion ratios

		Subscribers	Advertisers
Telemark county	Telemarks avisa → Varden	60%	84%
	Varden → Telemarks avisa	51%	49%
Ostfold county	Fredrikstad blad → Demokraten	20%	37%
	Demokraten → Fredrikstad blad	20%	58%

To capture the network externality across the two sides of the newspaper market, the NCA conducted a survey among the subscribers on how they would respond to more advertisement in the newspaper. The survey showed that consumers were more or less indifferent towards advertising, suggesting only a one-way network externality from readers to advertisers. The latter was not measured. The NCA proceed by considering the two sides of the market independently, but with a discussion of the network externality from readers to advertisers. The merger was eventually approved in June 2012, with the remedy that the parties divested two newspapers, one in each of the local markets.

While this case is an early attempt to account for network externalities of mergers in two-sided markets, the analysis by the NCA has, in light of the UPP measures described above, analysis several shortcomings. First, the NCA did not estimate the profit margins, which is important in two-sided markets. As shown above, if the newspaper profit margin on the reader side is negative, the network externality effect is likely to impose a downward pricing pressure on the reader price, whereas the opposite is true if this profit margin is positive. Second, the NCA did not estimate diversion ratio related to the network externality from readers to advertisers, which would be a necessary input in the computation of the UPP measures accounting for the two-sidedness, as shown by Affeldt et al. (2013).

5. Concluding remarks

In this paper we have reviewed the recent literature on market power measures in multi-sided market, and based on this described operational tools that can be employed by competition agencies, especially in the assessment of mergers in such markets. The paper has focused mainly on the recent developments of pricing pressure indices, which is probably the most likely tools to be used by most com-petition authorities, as full merger simulations are quite demanding due to tight time constraints in merger cases. The key lessons from this review can be summarised as follows:

1. Upward pricing pressure on one side of the market may result in downward price pressure on the other sides due to network externalities;
2. Upward pricing pressure can be reinforced or weakened depending on the nature of the network externality, i.e. whether the externality is positive or negative.
3. In case of one-way network externalities (say, only from readers to advertisers), then standard UPP measures can be employed on the side that benefits from network externality (advertising side) but not on the other sides causing the network externality (reader side).

Thus, using standard market power measures developed for one-sided markets yield misleading estimates of anti-competitive effects of firm behavior. In the case of mergers, we have shown that competition agencies cannot assess each side of the market separately, but need to adopt tools that account for possible network externalities across

the different sides of the market. In particular, we have described recent developments in the economic literature that suggest modified versions of UPP and GUPPI that can be adopted by competition agencies.

By way of conclusion, we should stress some limitations with the UPP measures. First, the general critique that applies to using pricing pressure indices in one-sided markets remains valid also for multi-sided markets. In particular, the fact that no assumption on demand systems are needed (which determines pass-through) is because both UPP and GUPPI only calculate the incentive to increase prices unilaterally post-merger but not the actual price increase. However, what one is ultimately interested in is the change in total welfare and consumer surplus due to the merger, which is determined by the merger-induced price change.[16]

Second, the UPP measures ignore responses by competitors. If the merging parties increase their prices post-merger, competitors have an incentive to also increase their prices in response. This is turn gives the merging parties the incentive to raise prices further. Hence, UPP and GUPPI tend to underestimate the incentive to increase prices post-merger in a one-sided market. In a two-sided market, depending on the sign and size of the indirect network effects, prices on one side might be strategic complements (as in one side markets) and strategic substitutes on the other side. Therefore, UPP and GUPPI may either underestimate or overestimate the incentives to increase prices.

Notes

1   See, for instance, Evans and Schmalensee (2016) who clearly demonstrates the importance new markets related to multi-sided platforms (matchmakers).

2   See, Kaiser and Wright (2006), Kaiser and Song (2009), and Wilbur (2008), for empirical evidence on this relationship.

3   See, for instance, Anderson and Jullien (2015) or Evans and Schmalensee (2016).

4   Google/DoubleClick (Case COMP/M.4731) Commission Decision 11 March 2008 OJ C 184; Microsoft/Yahoo (Case COMP/M.5727) Commission Decision 18 February 2010 OJ C 020; Microsoft/Skype (Case COMP/M.6281) Commission Decision 7 October 2011 OJ C 341; Facebook/WhatsApp (Case COMP/M.7217) Commission Decision 3 October 2014 OJ C 417.

5   This is obviously a simplification, as it is well known from the economic literature that both merging and non-merging firms are likely to change their behaviour as a consequence of the merger.

6   See U.S. Department of Justice & FTC, Horizontal Merger Guidelines § 5.2 (2010).

7   There is, of course, an equivalent UPP condition for product 2.

8   The diversion ratio is formally defined as follows

$$D_{12} := \frac{\partial Q_2 / \partial P_1}{-\partial Q_1 / \partial P_1},$$

where $Q1$ and $Q2$ are the demands for product 1 and 2. Thus, the diversion ratio measures the share of consumers of product 1 that switch to product 2 due to a price increase of product 1.

9   Formally, the merger-related efficiency gain of product 1 is defined as follows:

$$E_1 := (C_1 - C_1^N) / C_1,$$

Where C_1^N is the post-merger marginal cost of product 1. It is assumed that $C_1^N \leq C_1$ such that $E_1 \in [0, 1]$.

10   Schmalensee (2014) provides an alternative version of the UPP by allowing for also efficiency gains in the production of both products, yielding the following condition

$$UPP_1 = [P_2 - (1 - E_2) C_2] D_{12} - E_1 C_1 \geq 0$$

E_2 is the merger-related efficiency gain in production of product 2, which evidently increases the upward pricing pressure by increasing the value of diverted sales.

11   See, for instance, Rochet and Tirole (2006) who derive a modified version of the Lerner index for two-sided markets.

12   Note, however, that if $P_2^R < C_2^R$, this must imply that $P_2^A > C_2^A$, otherwise the firm is running deficits.

13   When deriving the UPP formula, Affeldt et al. (2013) assume that all other prices are constant.

14   This has already been done by competition agencies in some merger cases, there are no example, to our knowledge, of these being used to compute UPP measures accounting for the network externalities in multi-sided markets.

15   This case (Case 2011/0925: A-pressen AS – Edda Media AS) is described in OECD report (2016) on the Roundtable on Market Definition in Two-Sided Markets.

16   See, for instance, Fan (2013) for a full merger simulation in the US newspaper market.

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Part IV. Exclusionary conduct

5. Exclusionary conduct in multi-sided markets

By Michael L. Katz[1]

1. Introduction

The topic of this paper lies at the intersection of two concepts: multi-sided markets and exclusionary behaviour. This is a challenging topic for at least two reasons. First, there is a lack of consensus as to what constitutes a multi-sided market. Second, there is considerable disagreement about what constitutes exclusionary behaviour —whether or not one is examining a multi-sided market.

The lack of a consensus definition of multi-sided markets is somewhat easier to address (or, at least, to hold to one side). Suppliers in multi-sided markets are often referred to as "platforms" because they serve as bases on which users from different sides of the markets can interact with one another. For antitrust purposes, a useful definition of a multi-sided market is that there are cross-platform network effects (i.e. the presence of members of group *A* as users on one side of the platform makes the platform more attractive to members of group *B* on the other side) in at least one direction for a platform that facilitates interactions between two or more groups of users, can set distinct prices to different user groups, and has market power with respect to those groups.[1] This definition captures the sorts of situations that are commonly labelled as platforms or multi-sided markets in recent antitrust litigation.

The lack of agreement regarding what constitutes exclusionary behaviour is more problematical. There is a broad consensus that conduct is exclusionary when it harms the competitive process by weakening the ability of rival firms to compete and the conduct does not constitute competing on the merits. However, there is considerable disagreement regarding what it means to "harm competition" or to fail to "compete on the merits". Consequently, the discussion below begins, in Section 2, with an examination of broad conceptions of exclusion, without focusing specifically on multi-sided markets.

The paper then turns to the question: How should antitrust enforcers and the courts identify whether the conduct of a firm operating in a multi-sided market is exclusionary?[2] As Rochet and Tirole (2006, p. 646) have observed, multi-sided markets combine elements of multi-product pricing and network effects. As a result, the issues are not entirely new or unique, but they are challenging nonetheless. Specifically, multi-product pricing and network effects raise several issues for competition policy's treatment of exclusionary behaviour:

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- By giving rise to demand-side economies of scale, network effects can create mechanisms by which a supplier can successfully weaken or eliminate rival suppliers through conduct that denies them scale. Indeed, at least in theory, a weakened rival may enter a "death spiral," whereby it loses users, which then triggers the loss of more users due to the loss of network effects, which then leads to the loss of still more users, which then... Thus, the existence of network effects may heighten concerns regarding the possibility of exclusionary behaviour.

- In the presence of demand-side economies of scale, "innocent" competitive conduct intended to improve a supplier's ability to create value for its users may also weaken or even eliminate rivals, which can greatly complicate the identification of exclusionary behaviour. The potentially critical role of users' expectations -which can be hard to measure and predict- further complicates the analysis.

- Cross-platform network effects raise the danger of examining effects too narrowly. One possible error from an overly-narrow analysis is that important feedback loops among different sides of the platform may be missed.

- In the presence of network effects, the linkage between competition and economic welfare can be complex. For example, entry by an incompatible platform may splinter users and lead to a loss of realised network effects, lowering total surplus.

- The linkage between competition and economic welfare can also be complex when suppliers produce multiple products at least some of which are subject to joint production, as is often the case with platforms that facilitate transactions among users. In the presence of joint production, changes in the nature of competition to serve one group of users can affect the economic welfare of other groups of users.

- The combination of multi-product pricing and cross-platform network effects can give rise to situations in which certain forms of platform conduct or changes in the nature of competition can benefit some user groups while harming others. The possibility of differential effects on different user groups makes it necessary to have a more refined sense of the overall policy objective than is often the case.

In order to sharpen the discussion of the implications of these facts for competition policy, the paper addresses these issues in the context of specific types of potentially exclusionary conduct. One can categorise exclusionary conduct generally as falling into one of two categories[3]:

- *Predation*. Under a predatory strategy, a seller offers buyers excessively good deals in order to deny business to rivals and weaken their abilities to compete.

- *Raising Rivals' Costs*. Under a raising-rivals' costs strategy, a seller takes actions to make it more costly for rival sellers to serve buyers, thus weakening the rivals' abilities to compete.

One example of each type of behaviour is examined below. Section 3 considers predatory pricing and identifies several potential pitfalls in relying on bright-line price-cost tests to identify predatory pricing. It also discusses the importance of understanding the specific mechanism by which a firm recoups its investment in below-cost prices rather than focusing solely on whether the firm rationally anticipated recouping its investment. Section 4 examines conduct that directly or indirectly limits a user's ability to participate on multiple platforms simultaneously (a practice known as "multi-homing"). It is shown that, in the presence of certain asymmetries, this conduct can weaken competition. The paper closes with a few broad observations on competition policy in multi-sided markets.

2. Conceptions of exclusionary behaviour

Several approaches to distinguishing exclusionary behaviour from competitive behaviour have been proposed and applied. This section briefly describes and assesses three leading approaches in turn.

Harm to social welfare due to harm to competition

One approach is to label conduct as exclusionary if it both: (a) harms competition, and (b) reduces some measure of social welfare (e.g. consumer surplus or total surplus) relative to a baseline in which the conduct is not undertaken.[4] An appealing feature of the test is that it can be directly linked to the ultimate objective of competition policy, either consumer surplus or some broader measure of economic welfare. However, this test also has several weaknesses.[5]

One weakness is that the test relies on the (undefined) notion of harming competition. In the case of a merger, there may appear to be natural sense in which competition is reduced, but in many other cases there is not. In a predatory pricing case, for example, the plaintiff will allege that competition is being harmed while the defendant will argue that it is simply "competing on the merits." By failing to define harm to competition, this standard ducks one of the most critical issues.

One might attempt to argue that problem would go away if one eliminated prong (a) of the standard or, equivalently, defined any conduct that reduces social welfare to be exclusionary. However, such an approach would be inconsistent with U.S. law[6] and, more broadly, would equate competition policy with regulation. Attempting to regulate a firm's conduct to ensure that it maximises some measure of social welfare -particularly if it is a long-run, forward-looking measure- imposes very strong informational and computational demands on the regulator, which is one of the reasons why modern market economies generally limit pervasive regulation to a relatively small subset of markets. A harm-to-competition screen serves to limit the set of circumstances in which the difficulties of determining welfare effects have to be confronted.

Of course, even with a screen in place, these difficulties will have to be confronted in some cases. Hence, a second weakness of a social-welfare test is that it can be difficult to administer and can distort the behaviour of both potential excluders and their targets. Melamed (2005, p. 1254) argues that, at the time it is choosing its course of conduct, a potential defendant would lack the information necessary to make a reliable prediction of the effects of its actions on a social welfare measure based on consumer surplus and/or the profits of rival suppliers. The potential defendant's uncertainty could create a status-quo bias because conduct that led to significant changes in the market outcome might be more likely to be found to be exclusionary. Moreover, what is ostensibly a total-surplus standard could, in practice, become a competitor-surplus standard because a seller might be concerned that its behaviour would generate complaints from rivals when the firm's conduct lowered their profits and they perceived a chance of prevailing under this standard.[7] Melamed (2005, p. 1254) also argues that the test could create economically perverse incentives for the defendant's rivals to refrain from competing vigorously in order to enhance their claims that the defendant's conduct had harmed consumers and/or the rivals.

Equally-efficient-rival test

A second test asks whether an equally efficient rival could compete successfully in the presence of the challenged conduct. If the answer is yes, then by this test the conduct is not exclusionary.[8] This test builds on an intuitive notion of harming competition under which, if a firm is competing on the merits, then an equally matched rival should find itself capable of competing successfully as well. Unfortunately, this approach suffers from both practical and conceptual shortcomings.

A severe practical shortcoming is that, in actual markets, it can be very difficult to determine what it means to be an equally efficient rival. When each supplier offers a single product that is undifferentiated from those of its rivals, the determination is straightforward: a rival offering the same product to consumers is equally efficient if it has costs lower or equal to those of the firm in question. However, when products are differentiated, it is necessary to account for the differences. It can be extremely difficult to determine whether a competitor is equally efficient when product characteristics and business strategies are multidimensional and vary across firms. For example, given the many differences in their business models, it might be very difficult to assess whether American Express and MasterCard are equally efficient credit and charge card platforms.

In markets with network effects, additional issues arise. Should the size of a rival's installed base be taken into account in defining what it means to be equally efficient? If it is, then there may be a risk that this test will become extremely weak because it would find any conduct that leveraged a dominant firm's installed base advantage to be non-exclusionary regardless of how it affected competition and consumer welfare. However, not taking installed bases into account might have the effect of forcing a firm with a large installed base to refrain from competing vigorously with a smaller rival.

In summary, the equally-efficient-rival test can be very hard for the courts to apply, and it can thus create uncertainty for potential defendants and lead to some of the problems associated with application of a social-welfare standard as discussed above.

An even deeper shortcoming of the equally-efficient rival test is that its focus on an as-efficient competitor lacks a sound grounding in economics. Specifically, there is not a tight linkage between: (a) the consumer and total-welfare effects of competition between two firms, and (b) whether the two firms are equally efficient suppliers. For example, in the presence of production economies of scale, the entry of an equally efficient rival can lead to higher industry costs to produce a given amount of output, and -from the perspective of total surplus- these higher costs may dominate any benefits of the additional competition due to entry. A similar problem can arise with network effects, which give rise to demand-side economies of scale. In the other direction, consumer surplus will often rise following entry even if the entrant is less efficient than the incumbent. Indeed, given the effects on prices and consumption, entry by an inefficient entrant can raise total surplus in some instances.

The equally-efficient-rival test broadly underlies the European Commission's assessment of price-based exclusionary behaviour and whether it might give rise to consumer harm.[9] However, the Commission recognises that excluding a less efficient competitor can harm competition in some circumstances.[10] The Commission also recognises that, in the presence of network effects, a rival's efficiency can be affected by exclusionary conduct.[11]

The no-economic-sense test

A third, widely proposed test for exclusionary behaviour is the no-economic-sense test. In broad strokes, the no-economic-sense test limits the concept of exclusion to conduct that makes no economic or business sense but for the likelihood of harming competition.[12] The U.S. Department of Justice has used this test in several cases alleging exclusionary behaviour.[13]

The no-economic-sense test is related to what is sometimes referred to as a profit-sacrifice test.[14] Although there does not appear to be complete agreement on the definition of a profit-sacrifice test, one form considers the conduct in question to be exclusionary only if it involves a short-run profit sacrifice in order to obtain long-run benefits from the weakening of competition.

Melamed (2005, p. 1255) argues that, because the no-economic-sense test focuses on the economic welfare of the potential defendant, it does not suffer from some of the problems associated with tests based in whole or part on consumer or rival welfare. It is plausible that a potential defendant will better be able to predict how its actions will affect its own profits rather than consumer or competitor welfare. However, one should not minimise the difficulties of making the relevant determinations. A critical element of applying the no-economic-sense test is to estimate the "but-for world" (i.e. what would happen absent the challenged conduct). This counterfactual situation serves as the benchmark for whether the challenged conduct would be profitable if it had no effect on the strength of competition. Estimating the but-for world can be very difficult. For example, it can necessitate estimating the future effects of alleged predatory pricing or determining what the market equilibrium would have looked like had rivals not been weakened by the imposition of exclusivity requirements.

Lastly, it should be noted that reliance on the no-economic-sense test is not equivalent to requiring the firm to maximise either consumer or total surplus. For example, for a firm that faces no competition, charging profit-maximising, monopoly prices makes economic sense even though charging prices closer to marginal cost would raise both consumer and total surplus. And there can be situations in which entry reduces total economic surplus but the dominant incumbent supplier will find it profitable to undertake conduct that excludes the entrant only if the incumbent can count as profits the benefits of eliminating competition. However, the no-economic-sense test would not allow the use of such benefits as a justification for the (welfare-improving) conduct.

3. Predatory pricing in a multi-sided market

Next consider the definition of exclusion for the specific practice of predatory pricing. Following the U.S. Supreme Court in Brooke Group, U.S. courts apply a two-part test for predation. "First, a plaintiff seeking to establish competitive injury resulting from a rival's low prices must prove that the prices complained of are below an appropriate measure of its rival's costs."[15] "The second prerequisite to holding a competitor liable under the antitrust laws for charging low prices is a demonstration that the competitor had a reasonable prospect, or ... dangerous probability, of recouping its investment in below cost prices."[16] The European Union standard has a multi-band price-cost prong: (a) if price is below average variable costs, then there is a presumption of predatory pricing that the defendant can then attempt to rebut, and (b) if price is above average variable cost but below average total cost, then the plaintiff must establish that the pricing is intended to eliminate competitors.[17] The European Union standard does not have a required

recoupment prong[18], although the European Commission sometimes considers recoupment.[19] Moreover, the Commission examines whether market conditions are such that predation could successfully harm competition, which entails looking at many of the same factors as would a recoupment analysis (e.g. entry and re-entry barriers).[20] Indeed, one interpretation of the recoupment prong is that it is a test of whether the allegedly predatory pricing would significantly harm competition.

Pricing below some measure of cost

The leading variant of the price-cost prong of the Brooke Group approach -the Areeda-Turner rule- compares price to marginal cost or to average variable cost as a proxy.[21] Average variable cost also plays a central role in the European Union's analysis. There are, however, several issues regarding use of this comparison as part of a test for predation that arise even when it is applied to markets that do not entail the complications of a multi-sided platform.

A first issue is that, under the no-economic-sense test, pricing above cost can be exclusionary. Under this test (or even a short-run profit sacrifice test), one should compare marginal revenue (MR) with marginal cost (MC). If MR < MC, then the firm is not charging a profit-maximising price. For firms of interest to competition policy authorities, firm-specific demand curves are downward sloping and marginal revenue is less than price (p). Consequently, there is a range of prices for which MR < MC < p. Depending on the overall fact pattern, such prices could be predatory in that they make sense only because they weaken future competition.

Observe that the possibility of such above-cost predation is not unique to markets with network effects, cross-platform or otherwise. What is necessary is that there be some mechanism such that the firm's lowering its price weakens competition. Although network effects provide one such mechanism (i.e. lower prices can reduce the user bases of rival platforms, thus reducing their ability to offer users value), there are others. Whatever the mechanism, the predator weighs the reduction in its profits due to low current prices -which occurs for any price such that MR < MC- with the gains from weakening rivals. Stated in terms of the no-economic-sense test, the incumbent is engaged in predation if it would have priced even higher if not for the value of weakening its rivals.

Even though above-cost pricing can be deemed predatory in some circumstances, this approach has been rejected by some of the antitrust literature as undesirable because such a rule would be hard to implement and could be subject to high rates of error.[22]

A second issue with the Areeda-Turner test is that, under the no-economic-sense standard, pricing below marginal cost can constitute competition on the merits. In non-network, non-platform markets, such competition can take the form of temporary, "introductory" offers or the permanent offering of menus, where a free version is offered as a "gateway" to paid versions (known as a freemium model)[23].

Network effects can also provide a mechanism for below-cost competition on the merits.[24] To see why, consider a market in which there are network effects with only a single type of user (as can arise, for example, with a communication network in which everyone both sends and receives messages) but different user cohorts over time. A supplier may find it profitable to charge lower prices early on in the product's life in order to build up its installed base, which then makes its network more attractive to future user cohorts and, thus, allows the supplier to charge higher prices. This type of initial

below-cost pricing can be profitable even for a monopolist facing no threat of entry, which demonstrates that such pricing can be motivated by considerations other than exclusion. In addition to benefiting the supplier, this type of pricing can benefit consumers by internalising what would otherwise be externalities across user cohorts (i.e. early users do not take into account the benefits of a larger network size that their purchases confer on later user cohorts). However, as discussed above, a supplier can also be motivated by an exclusionary desire to deny its rivals the benefits of increasing their own installed bases. Indeed, both types of incentives can be present simultaneously.[25]

The fact that above-cost prices are predatory in some circumstances, and below-cost prices constitute competition on the merits in others, strongly suggest that there is no good price-cost test in the presence of network effects. Using a formal model of same-side network effects with two user cohorts, Farrell and Katz (2005) have shown that price floors that fully promote total surplus would have to depend on user expectation and co-ordination processes that are unlikely to be observable in practice. In many respects, the two user cohorts in a two-period model of same-side network effects play the same role as the two user groups on opposite side of a platform.[26] Hence, these results strongly suggest that price-cost test is problematical when applied to a multi-sided platform.

Suppose that, despite the issues inherent in the use of marginal cost as a bright line for identifying predatory pricing, one attempts to extend the Areeda-Turner price-cost test to multi-sided markets. Consider a platform that facilitates exchanges between members of user group A and user group B. A naive application of the Areeda-Turner test might focus on the pricing to users on one side of the platform, say side A, in isolation. That is, the price-cost prong would examine whether p_A is less than c_A, where p_A is the price charged to members of user group A, and c_A is the marginal cost of providing a unit of platform services to a member of user group A.

As has long been emphasised by contributors to the academic literature on multi-sided platforms, this naive approach can be highly misleading.[27] To see why, consider a platform that: (a) facilitates one-to-one transactions; (b) charges fees to users solely on a per-transaction basis (i.e. it does not charge subscription fees); and (c) incurs only fixed costs or per-transaction costs (i.e. there are no marginal costs associated with changes in the number of platform subscribers if ones holds the total number of transactions fixed). Let x_J denote quantity of platform services consumed by users on side J. For such platforms, $x_A \equiv x_B$ and there may be no sound basis for assigning costs to one side or other. Let c_T denote the total marginal costs associated with a transaction. Because costs are associated with transactions -not one side of the market or the other- and because transactions only occur if both sides participate, it also makes sense to think of revenues at the transaction level. That is, the firm earns $p_A + p_B$ per transaction. Applied at the transaction level, the two-sided market version of the Areeda-Turner test compares $p_A + p_B$ with c_T.

This comparison highlights the fact that a simple, one-sided price can be misleading. Under the naive approach, policy enforcers would have to assign some share of the total transactions costs to one side of the market. Let λ denote the percentage of the cost of a transaction allocated by the competition authority to side A. It could well be the case that the naive, one-sided version of the test indicates below-cost pricing (i.e. $p_A - \lambda c_T < 0$) while the two-sided version does not (i.e. $p_A + p_B - c_T > 0$). Because the one-sided version would rely on arbitrary allocations of costs and revenues, it is difficult to see why it would be preferred to the two-sided version, which examines costs and revenues at the transaction level.

Another way to see the dangers of focusing solely on one side of a multi-sided market is to recognise that there is an important sense in which a multi-sided market is no different than any other -in each case, it is necessary to compare prices and costs. For some purposes, it is not too much of stretch to consider any firm as a platform that facilitates transactions between input suppliers and output buyers, where the input suppliers pay negative prices to participate on the platform. From this perspective, looking at the price paid by buyers minus the price paid to input owners amounts to taking both sides of the market into account at once. Moreover, in the presence of network effects, users on one side of platform can be viewed as inputs to the supply of services to users on the other side, and the cost of that input has to be taken into account.

Behringer and Filistrucchi (2015) derive the two-sided analog of the Areeda-Turner test for platforms that are not pure transaction facilitators. One example of this type of platform is a media company that sells subscriptions to households and advertising to firms seeking to reach households. A critical point of distinction from the pure-transactions situation discussed above is that the platform's unit sales to the two sides of the market need not be equal to one another (i.e. it may be the case that $x_A \neq x_B$. Although they need not be equal, the unit sales on the two sides of the market will affect one another when there are cross-platform network effects. It is thus necessary to account for the fact that an increase in sales on one side of the platform generates costs and benefits on the other side of the platform.

Behringer and Filistrucchi (2015) consider a monopolist facing demand $x_B = x_B(x_A, p_B)$. In the presence of positive cross-network effects, an increase in x_A leads to increased demand by side B, holding the price charged to side B constant. Behringer and Filistrucchi propose a two-sided test under which a necessary but not sufficient condition for finding predatory pricing is that at least one of the following amounts is negative:

$$(p_A - c_A) + (p_B - c_B)\frac{\partial x_B}{\partial x_A}$$

and

$$(p_A - c_A)\frac{\partial x_A}{\partial x_B} + (p_B - c_B).$$

There are several points worth noting about this test. First, as in traditional markets, the Areeda-Turner rule lacks a tight linkage to welfare. Even using Behringer and Filistrucchi's formulas to determine whether prices are above or below costs, there can be above-cost pricing that lowers welfare by weakening rivals and below-cost pricing that raises welfare.

Second, these formulas can be interpreted in ways that implement the no-economic sense test of predation. However, one must be careful about the calculation of the margin and demand terms in these formulas in order to ensure that one does not count as benefits any gains that the platform might obtain by reducing the number of users on the other platform or by inducing that platform to raise its prices.

In order to understand the need for caution with respect to the demand terms, $\partial x_B/\partial x_A$ and $\partial x_A/\partial x_B$ above, it is helpful to expand the notation slightly. Label the platform under scrutiny by i and a rival platform by $–i$. Using notation that accounts for the presence of the competing platform, the demand faced by platform i can be expressed as $x_B^i = x_B^i(x_A^i, x_A^{-i}, p_B^i, p_B^{-i})$. One would expect group-B users' demand for platform i to fall as

either the rival's price falls or its group-*A* user base rises. The demand of users on the other side of the platform can be defined similarly. The no-economic-sense logic implies that the appropriate value of $\partial x_B / \partial x_A$ to use for platform *i* in the pricing formula above is $\partial x_B^i / \partial x_A^i$ because this term does not represent any weakening of the rival.

It is important to recognise that one cannot estimate $\partial x_B^i / \partial x_A^i$ simply by looking at how sales to group-*B* users rise when the platform lowers its price to group-*A* users and the number of group-*A* users rises in response. The reason is that the price change will also affect the number of group-*A* users on platform $-i$. Specifically, by making platform *i* more attractive to side-*A* users, lowering p_A^i will raise x_A^i and lower x_A^{-i}. Both of these changes in the numbers of users will raise x_B^i, but only the first effect should be counted under a no-economic-sense standard; the latter constitutes a weakening of the rival.[28]

Another way to see this point is to consider a situation in which there are multiple cohorts of users over time. As discussed above, a network might charge lower prices to early cohorts in order to: (a) build up its own installed base to offer greater network benefits to later cohorts of users, and/or (b) prevent rivals from becoming stronger future competitors by building up their own installed bases. Adopting a multi-sided perspective, one might be tempted to take both types of benefits into account because the core of the approach is to account for the platform's gains and losses associated with all users (here, different cohorts), rather than focusing on one group in isolation. But notice that, the more successful the firm is in weakening rivals (and, thus, generating future sales), the more this form of the test indicates that the firm is not engaged in predation. Intuitively, this form of the price-cost test mistakenly treats recoupment as covering costs.

In addition to the demand terms, the price-cost margins must also be interpreted with care. In some circumstances, charging lower prices to the *A* side of a market may weaken competition on the *B* side and, thus, allow the platform to charge higher prices to *B*-side users. Critically, in these circumstances, the higher prices are due to the loss of competition rather than an increase in cross-platform network effects. A naive test would count the elevated prices as offsets to the predatory prices rather than recognising them as a form of recoupment occurring at the same time as the predatory pricing.

A recent case brought by the United Kingdom's Director General of Fair Trading illustrates this issue.[29] Napp Pharmaceutical Holdings Limited and subsidiaries sold oral sustained-release morphine to two market segments: hospital (i.e. patients in hospital) and community (i.e. patients under the care of a general practitioner). The Director found that, due to switching costs and reputational effects, purchase decisions of the community segment were strongly influenced by purchase decisions of the hospital segment. This influence gave rise to form of cross-platform network effect: all else equal, greater hospital sales could be expected to lead to greater community sales. Moreover, a supplier lacking substantial hospital sales would have difficulty effectively competing in the community segment.

The Director found, in part, that Napp charged predatory, below-cost prices to the hospital segment in order to prevent entry and weaken competition in the community segment. In its defense, Napp argued that its prices to the hospital segment were not predatory because they generated profitable sales in the community segment. Letting *A* denote the hospital segment and *B* the community segment, Napp's argument can be stated in terms of the formulas above. Napp's position was that, even if $(p_A - c_A) < 0$, the prices were justified because

$$(p_A - c_A) + (p_B - c_B)\frac{\partial x_B}{\partial x_A} > 0.$$

The Director argued -and the Competition Appeal Tribunal agreed- that Napp earned "high compensating margins in the community segment... precisely because its discount policy in the hospital segment has hindered competition in the community segment."[30] The Tribunal explained that:[31]

> the fact that Napp's below-cost pricing in the hospital sector enables it to make money from 'follow-on' sales in the community sector merely signifies that the particular form of 'recoupment' available to Napp is more direct and more immediate than it is in other cases of predatory pricing.

Stated algebraically, the Tribunal found that the term $(p_B - c_B)\frac{\partial x_B}{\partial x_A}$, particularly the size of the margin $(p_B - c_B)$, represented successful recoupment and could not be used to justify the fact that $(p_A - c_A) < 0$.

Some readers might assert that Napp is not a platform because it does not facilitate interactions between the two sides. But whatever label one attaches to it, the logical structure of the analysis is identical to that of a two-sided market. Moreover, this type of effect could arise in settings that are widely agreed to constitute multi-sided markets when platforms have sufficiently different characteristics from one another that the price structure affects the ability of some firms to compete. For example, competing media platforms may have very different business models (e.g. subscriber versus advertising-supported business models), and a dominant firm might deviate from its otherwise optimal business model (say by giving away subscriptions rather than charging for them) precisely to harm rival platforms relying on different business models.[32]

Recoupment as a test of exclusionary behaviour

Successfully detecting predation and distinguishing it from beneficial competition is extremely difficult, particularly in markets with network effects. The discussion above suggests that the relying on price-cost tests alone is unlikely to produce reliable results. The economics of network effects indicates that observing two-sided prices below marginal or average variable cost very likely tells us little when platforms are in a growth stage. Moreover, as discussed in the context of Napp, by itself a price-cost test may fail to detect what many would consider to be successful predatory pricing. Can a recoupment test help overcome these difficulties?

Some commentators view the question of whether a firm can recoup the losses suffered from below-cost prices as a test of whether predation is rational. Under this view, one asks the following question: Given that one sees the firm pricing below cost in the short run, will its profits be higher in the long run because of the lower short-run prices? A fundamental problem with this view is that, in this form, the recoupment prong is a test that any economically rational investment -predatory or otherwise- would have to meet. Hence, if one observes that a firm is pricing below cost and is expected to recoup its investment in below-cost pricing, the only conclusion that one can reasonably draw from these facts alone is that the firm is economically rational. This naive form of the recoupment test fails to distinguish rational predation from rational competition on the merits. The problem with the naive test is that it does not address differences in the mechanisms by which an investment in below-cost pricing might be recouped.

The logic of the no-economic-sense test does address such differences, and it indicates that a pair of different questions should be posed with respect to recoupment: Is below-cost pricing profitable for the platform because it makes the platform a stronger competitor by building up its user base? Or is the below-cost pricing profitable only because it also weakens competition by preventing rivals from building their own user bases?

In answering these questions, it is important to recognise that, in the presence of network effects, exclusionary behaviour can significantly harm competition and consumer welfare without driving competitors from the market. As illustrated by in the Napp case, weakening a rival can allow a dominant firm to charge higher prices and earn greater profits even if the rival is not driven from the market entirely.[33] One might argue that having a bright-line test based on exit would be useful because it provides greater certainty and is easier to apply. However, the use of a bright line also raises the possibility of gaming: a platform engaging in exclusion may seek to weaken its rivals just up to the point that they are about to exit, while rivals might exit in order to trigger the possibility of receiving damages that would be unavailable to them if they remained in business.

It can be very challenging to determine whether below-cost pricing is profitable only because it also weakens competition by preventing rivals from building their own user bases. To do so, one might have to determine whether the firm's conduct would be profitable in a counterfactual world in which competitors were not weakened (i.e. that rivals could continue to offer the same surplus that they otherwise would have). In the presence of inter-temporal network effects, it becomes necessary to project the future industry equilibrium in order to apply the test. Doing so can be very difficult given role of consumer expectations and potentially complex business strategies.

Economists frequently assert that effects -rather than intentions- are what matter for welfare and, thus, intentions are irrelevant. However, if one expects business people to know what they are doing, then their views (expressed in ordinary-course-of-business documents) may shed light on facts that are otherwise hard for an outsider to observe (e.g. whether particular conduct made economic sense for non-exclusionary reasons). Of course, there are issues relevant for competition policy that executives may be unqualified to analyse, and there is a risk that companies will create documents solely with potential litigation in mind. Hence, evidence of intention alone is insufficient to establish anticompetitive effect or its absence. But neither is such evidence entirely uninformative.

As a general matter, it may be easier to determine when to find that a firm is not liable. For example, it may be possible to rule out predatory pricing when it is clear that there could have been little prospect of significantly weakening rivals (e.g. when rivals have ready access to capital, the costs of multi-homing are low, and users are not locked-in to a platform as the result of platform-specific investments or the inability of users to co-ordinate on switching to another platform if it would benefit them collectively).

It is useful to discuss these issues in the context of an example. The following discussion takes at face value certain claims made by the Initiative for a Competitive Online Marketplace (ICOMP), an organisation funded by Microsoft.[34] According to ICOMP, Google France neither charged map users (either consumers or the users of Google's map API) nor sold advertising.[35] Hence, at least according to ICOMP, the issue was not that Google was pursuing a misunderstood two-sided market strategy. Instead, Google was allegedly engaged in predation whereby, in the short run, it charged zero prices to both sides of the platform and, in the long run, it would raise prices to both sides once it had

weakened or eliminated competition. This is what is known as a "deep pockets" theory of harm: Google had greater financial resources than its rivals and could outlast them in a war of attrition.

If these were the facts, then Google would fail the static version of the two-sided Areeda-Turner test described above. However, even accepting these claims regarding pricing as facts, it is not evident that such behaviour is predatory under the no-economic-sense test once one takes into account inter-temporal considerations. Under the no-economic sense test, it is necessary to determine whether zero pricing would make sense as an investment in building an installed base even if it did not weaken Google's rivals.[36] It is important to observe that the potential error can run in either direction: predatory pricing could mistakenly be identified as an innocent investment in future sales, and below-cost pricing to enhance installed base for innocent reasons could be misdiagnosed as predatory pricing.

In the appellate decision regarding a case against Google France brought by a rival map application provider, the court accepted that data for 2007-2009 were not available but that Google might have failed to cover its costs.[37] However, the court reasoned that Google must not have engaged in predation because market conditions were such that Google had no chance of recoupment through the mechanism of driving rivals from the market.[38]

One price or two?

Although looking solely at one-sided prices and margins in isolation can be misleading, so too can looking at a single, net two-sided price. In thinking about price-cost tests, recoupment, or whether conduct makes economic sense, one should take a comprehensive, multi-sided view of revenues and costs. But there is a tendency among some commentators to do so by focusing solely on net, two-sided prices while ignoring the underlying price structure.[39] Doing so ignores the critical lesson of the research literature that, in multi-sided markets, the price structure, as well as the price levels, matter for competition and welfare. Looking solely at a single, net two-sided price is generally insufficient for assessing predation. First, any attempt to define a single, net two-sided price that is compared to a single measure of cost will fail to yield the same answer as Behringer and Filistrucchi's (2015) two-part price-cost test in at least some circumstances. And attempts to utilise a single measure of price become even more strained when platforms charge their users both subscription and transaction fees. Second, focusing purely on the net, two-sided prices can miss predation by mistaking recoupment for two-sided pricing.

4. Creating barriers to multi-homing

This section examines the treatment of exclusivity strategies with which a platform with substantial market power seeks to weaken competition by demanding that some or all user groups refrain from patronising competing platforms.

There are several different means by which a platform might limit multi-homing. The most direct means is the imposition of contractual terms that prohibit a user from participating on a platform if the user participates on any competing platform.[40] Exclusivity can also be indirectly induced by utilising price structures that make it economically unattractive for a platform user to multi-home. Examples include quantity discounts (such as volume-insensitive, or lump-sum, charges for platform use), as well as

discounts based on the percentage of a users' patronage that is over a given platform (so-called loyalty discounts).[41] Technological choices can also influence the cost of multi-homing. For instance, a video game console manufacturer might adopt technical standards that make it more costly for games created for one console to be ported to a different brand of console.[42] Lastly, Hermalin and Katz (2006) show that the equilibrium extent of multi-homing can be affected by the allocation of the authority to choose the platform over which a transaction takes place when a pair of users on the two sides of the market are on multiple platforms in common. Specifically, the side that lacks formal authority may single home in order to force the hand of the side with formal authority.

As Lee (2013) points out, in order to understand the effects of imposing multi-homing restrictions on users on one side of a platform, it is necessary to account for the reactions of users on the other side of the platform. A reduction in multi-homing by users on one side might lead to greater multi-homing by users on another. For example, if video game developers are blocked from simultaneously offering their games on multiple brands of video game console, then some gamers may respond by purchasing multiple brands of consoles.

Before considering the effects of platform exclusivity, several leading theories of harm to competition that have been developed in non-platform settings are reviewed. The application of these theories to platforms and the implications for policy enforcement are then discussed.

(Non-platform) theories of exclusionary exclusivity

Exclusivity requirements have received considerable attention outside the context of platforms operating in multi-sided markets. In a typical exclusive dealing case, for instance, a plaintiff alleges that a manufacturer possesses substantial market power and - because of some asymmetry relative to other manufacturers- benefits when dealers are forced to choose between distributing that manufacturer's products alone or distributing those of all other manufacturers.[43] For example, the U.S. Department of Justice applied a no-economic sense test and alleged that Dentsply International, Inc. (Dentsply) had violated antitrust laws by refusing to sell its Trubyte brand of artificial teeth to dealers that carried certain lines of competing artificial teeth.[44]

Judge Robert Bork, among others, argued that exclusivity provisions must be efficient because otherwise a party seeking exclusivity would not find it profitable to compensate the parties from which it seeks agreement to be exclusive.[45] The fundamental flaw in this argument is that it implicitly assumes there is frictionless, efficient bargaining among all parties affected by the exclusivity agreement -an assumption that is unlikely to be satisfied in practice. There are two broad ways in which the nature of actual negotiations undermines Bork's argument.

First, there often are contractual externalities, whereby the welfare of parties that do not participate in the bargaining over exclusivity are affected by the outcome of the bargaining. For example, consumer interests may not be fully represented when a manufacturer bargains with dealers regarding exclusivity. Similarly, the interests of firms that might later enter the market as manufacturers typically are not represented when an incumbent manufacturer bargains with dealers.[46] Moreover, there can be contractual externalities among dealers. For example, when dealers neither co-ordinate among themselves nor can easily co-ordinate with alternative manufacturers, any given dealer may reason that, because its decision with regard to exclusivity will not affect any potential manufacturer's decision whether to enter the industry, the dealer may as well

accept a proposal that harms dealers collectively even if that dealer receives very little compensation for doing so.[47,48] As long as no one buyer is large enough to allow an entrant to achieve a viable scale, a similar pattern can hold with respect to buyers agreeing to exclusive relationships with an incumbent seller.

The second way Bork's pay-for-exclusivity argument breaks down is more subtle. Calzolari and Denicolò (2015) demonstrate that, even without contractual externalities, it may be possible to attain exclusivity at no cost. Specifically, they analyse the consequences of the fact that sellers typically face heterogeneous buyers and are unable to engage in perfect price discrimination, so that, even under monopoly pricing, all but the marginal buyers typically earn strictly positive surplus, or information rents. Calzolari and Denicolò (2015, p. 3332) show that there is a sense in which this surplus can be used as payment to buyers for agreeing to be exclusive. Because buyers would have received this surplus in the form of information rents absent exclusivity, the exclusivity is purchased by the seller at no cost.[49]

Of course, the absence of a general proof that exclusive dealing is efficient does not prove that exclusive dealing harms competition. There are, however, several theories under which exclusive dealing can harm competition and consumers. All of these theories rely on the existence of some asymmetry among manufacturers, but the nature of those asymmetries, and the mechanisms by which competition is harmed, are very different.

The first two theories of harm are based on the assumptions that a manufacturer's profits are an increasing function of its rivals' costs and that exclusivity arrangements can serve as a means of raising those costs. The core difference between these two theories is source of asymmetry among firms and the role of long-term contracts. The first theory relies on temporal asymmetries. Specifically, it applies to situations in which an incumbent supplier can "tie up" dealers or other trading partners (e.g. buyers) before a competing supplier is able to enter the market. The supplier induces the other parties to agree to long-term, exclusive contracts such that, if a competing supplier later entered the market, it would be unable to trade with the parties under contract. If the contracts have staggered expiration/renewal dates, then there will be no date on which an entrant could freely compete for all potential trading partners. In the presence of economies of scale, the entrant's resulting level of activity might be too small to be economically viable even if some trading partners remained available.[50]

The second theory of harm is also based on the assumption that a manufacturer benefits from increases in its rivals' costs. If there are economies of scale and scope in distribution, then a system of exclusive dealers will raise the distribution costs of all manufacturers but will do so more for smaller ones than larger ones. The net effect may be to raise the profits of the largest manufacturer, even though its costs of distribution are raised.[51] Hence, if there is some source of asymmetry that results in one manufacturer's having much larger sales than others, then that manufacturer can have incentives to seek exclusivity. Notice that contracts do not play a commitment role under this theory - dealers can be free to switch to other manufacturers. The relevant asymmetry is with regard to the manufacturers' sizes (and thus their abilities to generate sales to support exclusive dealer networks) rather than the order in which they enter into contractual negotiations with dealers.

The third theory is not based on raising rivals' costs through the denial of scale. Calzolari and Denicolò (2015) examine competition between duopolists offering differentiated products, where one of the firms -the "dominant" supplier- has a cost or vertical quality advantage. Because products are differentiated and buyers have a taste for variety, the

higher-cost firm can still compete for sales at the margin if buyers are able to patronise both sellers simultaneously. As Calzolari and Denicolò (2015, p. 3322) explain, this fact can create an incentive to impose exclusivity[52]:

> [If] exclusive contracts are banned, firms are forced to compete for each marginal unit of a buyer's demand. Excluding rivals thus requires a limit pricing strategy, which in turn entails a sacrifice of profits. When exclusive contracts are permitted, on the other hand, firms compete for the entire volume demanded by a buyer—i.e., competition is in "utility space." In utility space, the dominant firm can exclude rivals by leveraging on the information rents left on inframarginal units. If the competitive advantage is large, the dominant firm can keep charging monopoly prices and exclude rivals by means of exclusivity clauses only. If the competitive advantage is more limited, exclusive prices cannot be set at the monopoly level, but the discount required to foreclose is smaller than it would be in the absence of exclusive contracts. [Emphasis added, internal footnote omitted.]

It is widely recognised that, in addition to harming competition, exclusive arrangements can also create a new dimension of competition: competition for exclusivity. Moreover, Calzolari and Denicolò identify a specific mechanism through which exclusivity can strengthen, rather than weaken completion overall. As Calzolari and Denicolò (2015, p. 3323) explain:

> Whereas product differentiation softens competition for marginal units, it does not soften competition in utility space. In utility space, product diversity is in fact irrelevant: all that counts is the amount of rent left to buyers. When firms [have comparable cost or vertical quality levels], this tends to make competition in utility space tougher than competition for marginal units.

Thus, when the suppliers are differentiated but have relatively similar costs or (vertical) quality levels, the effect of exclusivity can be to intensify competition by switching it from differentiated competition for marginal units to undifferentiated competition in utility space.

Applicability to platforms

Several features of platform markets make them susceptible to the use of exclusive agreements to harm competition. First, the cross-platform nature of network effects gives rise to the possibility of contractual externalities when there is no mechanism for users on one side of a platform to make financial transfers to users on the other side in order to influence their choice of platform. Absent such mechanisms, a user on one side of a platform might have little concern for the effects of a decision to single-home on the welfare of users on another side of the platform.[53]

Second, cross-platform network effects give rise to demand-side economies of scale that allow a platform to benefit if it can use exclusivity as a means of limiting participation on rival platforms and, thus, raising rivals' costs (i.e. weakening their ability to provide user benefits). Moreover, the provision of multi-sided platform services may be subject to strong production economies of scale in addition to demand-side economies of scale, reinforcing these effects. Hence, if there is some initial asymmetry, the leading or dominant platform may be able to benefit from imposing conditions that drive most users in one or more groups to single-home on that platform when they would otherwise have multi-homed. The dominant platform can benefit from increases in its rivals' average

costs if the higher costs drive the rivals from the market. And -because the rivals will be weaker competitors- the dominant platform can benefit from increases in its rivals' marginal costs of generating user benefits even if the rivals remain in the market.

Shapiro (1999, p. 677) presents a dynamic theory of these effects and argues that multi-homing can serve as a transitional user strategy that facilitates entry by new platforms. The logic of this argument is that, faced with an all-or-nothing choice between an emerging platform and an established one, there are conditions under which users will choose the established platform. However, given the option of multi-homing, some consumers might do so, allowing the emerging platform to begin to build an installed base that will then attract further users. By imposing an exclusivity requirement, an incumbent platform can eliminate this path to entry. Shapiro (1999, pp. 680 and 683) also argues that exclusivity can lead to pessimistic consumer expectations regarding the entrant's prospects, which reinforce this effect.[54]

Turning to the sources of asymmetries, platforms may have different production costs, product attributes, or market entry dates. As a result of these differences, platforms may differ in terms of their existing installed bases and/or users' expectations regarding the number of users who will patronise the platforms in the future. There can also be feedback effects that reinforce initial asymmetries (e.g. if there are expected to be more side-A users on a platform, then more side-B users are attracted, which then leads more side-A users to patronise the platform and starts a new round of feedback).[55]

Four legal cases illustrate how the courts have treated platform exclusivity agreements. These cases also demonstrate that the issues are not new.

The earliest of these cases involved media platforms. The Lorain Journal was the only daily newspaper in Lorain, Ohio.[56] In 1948, the radio station WEOL began broadcasting in an area that included the Journal's subscribers. The Journal demanded that advertisers single-home (i.e. it refused to sell advertising to any business that purchased advertising from WEOL). The U.S. Department of Justice alleged (and the Supreme Court agreed) that this conduct was exclusionary and intended to harm competition by driving WEOL out of the local market for advertising. This case fits Calzolari and Denicolò's (2015) theory. The key asymmetry was that, because of the nature of radio advertising and the fact that Journal had a much larger audience than did WEOL, advertisers wanted to use advertising on WEOL only as a supplement to advertising in the Journal.[57] Calzolari and Denicolò's theory indicates that the Lorain Journal was able to weaken competition, which resulted in greater unit sales of advertising by the Journal and higher advertising prices, to advertisers' detriment.

The next two cases also build on the idea that, if faced with an all-or-nothing choice, users will choose to patronise the platform with the largest user base but otherwise would multi-home. One case involved floral delivery platforms, which create value by bringing together florists receiving orders for flowers with florists fulfilling orders. Specifically, if a consumer desires to send flowers to someone in another city, the consumer can place an order with a local florist that is a member of a floral-delivery platform and that order will be fulfilled by another platform member that is located near the recipient of the flowers. In the mid-1950s, FTD was by far the largest such platform in the United States and had a policy directly prohibiting its member florists from participating in competing floral platforms.[58] In 1956, the U.S. Department of Justice filed a complaint against FTD alleging that its exclusive membership restriction eliminated competition and preserved FTD's market dominance. FTD and the Department entered into a consent decree enjoining conduct that had the purpose or effect of imposing exclusivity.[59] In 1995, the

Department alleged that FTD had violated the consent decree by offering financial rewards to florists that were members of only FTD and that FTD did so in order to weaken rival platforms' ability to compete.[60] FTD agreed to cease offering the rewards.[61] The case thus illustrates an asymmetry based on florists' expectations of platform size and the use of both direct and indirect measures to induce single-homing.

In the late 1980s, the then-leading video game console manufacturer Nintendo used a direct measure by requiring companies developing games for its Nintendo Entertainment System console to release those games exclusively on that platform for a period of two years. Rival console maker Atari sued Nintendo, alleging that this practice harmed competition and preserved its market position.[62] Although Atari lost the case, Nintendo ceased the practice before the verdict was reached.[63]

Lastly, in 2001, the U.S. Department of Justice successfully argued that the MasterCard and Visa credit card networks harmed competition by prohibiting certain forms of multi-homing.[64] MasterCard and Visa both had policies that limited member banks' abilities to issue cards on competing credit and charge card platforms, namely American Express and Discover/NOVUS. Because of asymmetries in coverage and the card products supported by the platforms, banks were reluctant to forego card issuing on MasterCard and Visa entirely in order to issue credit and charge cards on American Express and/or Discover/NOVUS. However, there was evidence that some banks issuing cards on MasterCard and Visa would be interested is issuing cards on the American Express or Discover/NOVUS networks if multi-homing were permitted.[65] American Express's and Discover/NOVUS's inability to attract these card-issuing banks weakened platform competition because the two platforms were less attractive both to cardholders and -on the other side of the platforms- merchants. After the rules were dropped, several banks began issuing cards on the American Express and Discover platforms.

In several respects, this case, too, is a good match for Calzolari and Denicolò's (2015) theory. At the time, both American Express and Discover/NOVUS were seen more as niche networks (with American Express supporting cards aimed at high-end consumers and Discover supporting cards aimed at low-end consumers), while MasterCard and Visa supported cards aimed at a broad range of consumers. Hence, American Express and Discover were better positioned to compete for marginal business than compete in utility space.

Implications for enforcement

The theories described above have several implications for competition policy.

First, a platform seeking exclusive arrangements need not reach them with all -or even most- potential users for such a policy to harm competition. Exclusivity can be used to raise rivals' costs even if there are users that choose to patronise rival platforms: those users may be too few or may lack the necessary characteristics to allow rivals fully to realise network effects and production economies of scale. Moreover, the use of exclusive relationships to eliminate competition at the margin identified by Calzolari and Denicolò (2015) does not rely on denying rivals scale. Instead, exclusivity is used to shift the nature of competition to exploit existing asymmetries among competitors. Hence, enforcement guidelines that focus on the percentage of users that are subject to foreclosure can be misguided.[66]

Second, as is also the case with predatory pricing, exclusivity that significantly raises rivals' costs can significantly harm competition even if that conduct does not drive rivals

from the market. Moreover, the mechanism of harm identified by Calzolari and Denicolò (2015) relies on shifting the nature of competition rather than eliminating competitors.[67]

Third, enforcers should be careful not to place undue weight on contract length. Contractual lock-in is important under a theory of harm in which the asymmetry facilitating the use of exclusivity is temporal and the incumbent uses long-term, staggered contracts signed before the entrant is present to make entry more costly. However, the other theories of harm discussed above do not rely on contracts as commitments and, thus, contract length is unimportant. Instead there has to be an asymmetry among suppliers in terms of costs, product quality, user bases, or user expectations. In the U.S at least, courts have moved away from reliance on contract length. For example, the Dentsply appellate court focused on "the nature of the relevant market and the established effectiveness of the restraint" rather than contract length.[68]

Fourth, Calzolari and Denicolò (2015, 3345-46) find that, when exclusivity shifts the market from competition for marginal units to competition for a user's entire volume, it can strengthen or weaken competition, depending on the degree of asymmetry between different suppliers. The authors also indicate that exclusives are less likely to harm competition when rivals also impose exclusivity (Id.). This logic suggests that, when platforms are similar and all impose exclusivity, they are doing so for reasons other than harming competition by weakening some firms' abilities to compete relative to others'.[69]

Fifth, as discussed above for non-platform markets, exclusivity can create new avenues of competition (e.g. competition for exclusivity), which complicates enforcement. This is also true of platform markets. When users on one side single home and users on the other do not, the single-homing side chooses the platforms over which interactions will occur. Hence, platforms engage in price competition to attract users on the single-homing side, but not users on the multi-homing side. Indeed, each platform has a monopoly for access to its single-homing users.[70] By contrast, when multi-homing is blocked, platforms will compete for users on both sides.

Building on this observation, Armstrong and Wright (2007) show that exclusivity requirements can have very strong implications for the distribution of economic surplus between two sides of platform users. Inter alia, Armstrong and Wright analyse a model of competition between two platforms that facilitate interactions between buyers and sellers in which the authors reach the following findings. Platforms compete solely for buyers (who single-home) and extract all of the surplus from sellers (who multi-home) when platforms cannot require sellers to be exclusive. By contrast, platforms compete to attract sellers to exclusive relationships and extract all of the surplus from buyers when exclusive contracts are permitted.

The possibility of such dramatic differences in the effects of exclusivity on the welfare of different user groups raises an important question for competition policy. How should the shift in surplus be treated? One view is that a user-welfare standard should weigh all users equally and focus solely on the net effects. An alternative view is that each user group is entitled to the benefits of competition and that harm to one user group due to harm to competition cannot be offset by gains to another user group that are a consequence of the loss of competition. It would be useful to have greater clarity regarding policy objectives.

Although the case did not involve exclusivity, recent litigation between the U.S. Department of Justice and American Express has brought this issue to the fore.[71] The Department of Justice argued that American Express's conduct harmed competition in the market for credit and charge card acceptance services sold to merchants and that

demonstrating harm to merchants was sufficient to shift the burden to American Express to show that it had an offsetting, pro-competitive rationale. Although the Department of Justice prevailed at trial, the appellate court overturned on the grounds that the government should have proven that the losses suffered by merchants as a result of American Express's conduct were not outweighed by gains to American Express's card holders.[72]

Sixth, as is well known, network effects can give rise to natural monopoly conditions. A potentially challenging question for competition policy enforcers is whether the greater realisation of network effects due to the elimination of rival networks and the consequent coalescing of all users on the same network could be considered to be an efficiencies defence. For example, Armstrong and Wright (2007) consider a model of competition between undifferentiated platforms and find that exclusivity can be used to eliminate a rival. However, exclusion is efficient in their model. More generally, exclusion could also occur with a small degree of product differentiation, in which case, it could be inefficient if the loss of differentiation benefits exceeded the costs of multi-homing (which -absent direct or indirect restraints- could serve as a means of fully realising cross-platform network effects).

Seventh, traditional types of efficiencies should also be credited, where valid. For example, translating the leading pro-competitive justification for exclusivity to platforms, a platform might argue that exclusivity increases its willingness to make investments that benefit users. Segal and Whinston (2000) find that exclusivity has this effect only if the platform's investments raise users' value of transacting with rival platforms, so that a commitment from the user is needed to prevent free riding. Thus, a platform would have to demonstrate that it is investing in its users in ways that raise the value those users would generate if they were to patronise a rival platform.

Lastly, the lack of an efficiency rationale justifying the imposition of exclusivity can be informative. In the Dentsply, Lorain Journal, and Visa cases, for example, the defendants were unable to produce credible efficiency rationales for their challenged conduct.

5. Conclusion

Distinguishing exclusionary from competitive behaviour in multi-sided markets can be complicated and difficult. Depending on the circumstances, the practices at issue may raise or lower welfare and may strengthen or weaken competition. This is a reason for caution in assessing potentially exclusionary conduct. But it is not a reason for giving up on competition policy enforcement. Although the issues are particularly difficult, there are also reasons to believe that two-sided markets may be particularly fertile ground for exclusionary behaviour.

Appendix

The following highly stylised model illustrates why what is ostensibly a total-surplus standard could, in practice, become a competitor-surplus standard. Suppose the actual change in total surplus due to certain conduct is: $\Delta W = \Delta \pi^I + \Delta \pi^R + \Delta S$, where the three components of the change in welfare are the change in the incumbent's profits, the change in a rival's profits, and the change in consumer surplus, respectively. In addition, suppose both the decision-making firm and its rival know all of the values with certainty but the court observes only $\Delta W + \varepsilon$, where ε is a random observation error. Let $\rho(\Delta W) \equiv Prob\{\Delta W + \varepsilon < 0\}$ denote the probability that firm will be found liable.

Now, consider the rival's incentive to initiate an enforcement action. Suppose that, *conditional* on the defendant's being found guilty, the expected change in the rival's profits is equal to $\gamma \Delta \pi^R$, where $\gamma > 0$ is a factor that accounts for both the expected amount of monetary damages awarded by the court for past harm and the net present value of not being subject to the defendant's adverse conduct in the future. Ignoring any litigation costs, the expected change in the rival's profits is $\rho(\Delta W)\gamma \Delta \pi^R$.

The rival will bring a complaint if and only the expected benefits are greater than the costs. Letting L denote the rival's cost of litigation, it will bring a complaint if and only if $\rho(\Delta W)\gamma \Delta \pi^R > L$. This rule is equivalent to bringing a complaint if and only if $\Delta \pi^R < 0$ and $\Delta W < \delta$, for some constant δ which may be greater or less than 0, depending on the values of γ and L and the distribution of ε.

Given this decision rule, the potential defendant has incentives to avoid actions that harm its rivals -whether through exclusion or competition on the merits. Such an implicit rule is not entirely bad if there is a positive correlation between the amount of harm to the rival and the amount of harm to consumers. However, the correlation might well be negative because stronger competition by one supplier typically will benefit consumers but lower the profits of a rival supplier. Indeed, the sign of the correlation might be seen as a measure of whether the harm to rival is the result of competition or exclusion.

Notes

1   This is similar to the definition suggested by Weyl (2010). For a discussion of issues concerning the definition of multi-sided platforms and markets, see Hermalin and Katz (forthcoming).

2   Given space constraints, this paper does not address issues of market definition and the assessment of market power, which are often critical in litigation and the determination of whether the defendant's conduct can cause material harm. These issues are addressed by other contributions to this workshop. That said, there is a risk of error when making this separation because the various issues interact with one another and should be addressed in an integrated analysis. For example, market definition is not an end in itself, and it should be closely tied to the specific questions at hand with respect to the conduct at issue.

3   The distinction between the two concepts is not an entirely sharp one. For example, in markets with learning-by-doing, predatory pricing may raise rivals' costs by denying them sales that would have otherwise led to learning and lower costs. Similarly, in markets with network effects, predatory pricing can result in rival platforms' having fewer users and—because network benefits are reduced—higher costs of providing any given level of user benefits.

4   Various forms of this test have been advocated by Steven Salop. (See, e.g., Salop (2006).)

5   For a discussion of other problems, see Melamed (2005) and references therein.

6   For example, the U.S. Supreme Court has stated that: "The mere possession of monopoly power, and the concomitant charging of monopoly prices, is not only not unlawful; it is an important element of the free-market system. The opportunity to charge monopoly prices—at least for a short period—is what attracts "business acumen" in the first place; it induces risk taking that produces innovation and economic growth. To safeguard the incentive to innovate, the possession of monopoly power will not be found unlawful unless it is accompanied by an element of anticompetitive *conduct.*"[Emphasis in original.] (Verizon Communications Inc. v. Law Offices of Curtis V. Trinko, LLP, 540 U.S. 398, 407 (2004).)

7   See Appendix.

8   This test is generally associated with Judge Richard Posner. (See, e.g., Posner, 2001, pp. 94–95.) For a particular application of this logic to develop a cost test for predatory pricing, see Baumol (1996).

9   European Commission (2009), ¶¶ 23 and 67. In assessing predatory pricing, the Commission also examines whether the alleged predator is engaged in short-run profit sacrifice, a variant of the next standard for exclusionary behaviour discussed below. (Id., ¶63.)

10   Id., ¶ 24.

11   Id.

12   See, e.g., Werden (2006). Ordover, J. A., and Willig, R. D. (1981) advocate a definition of predatory behaviour along similar lines but focused on exit rather than considering all degrees of harm to competition.

13   See, e.g., Brief of the Appellees United States and the State Plaintiffs at 48, United States v. Microsoft Corp., 253 F.3d 34 (D.C. Cir. 2001) (Nos. 00-5212, 00-5213); Brief for Appellant United States at 2, 30, United States v. AMR Corp., 335 F.3d 1109 (10th Cir. 2003) (No. 01-3202) (public redacted version); Brief for Appellant United States at 28, United States v. Dentsply Int'l, Inc., 399 F.3d 181 (3d Cir. 2005) (No. 03-4097) (public redacted version).

14   See, e.g., Melamed (2006).

15   Brooke Group, Ltd. v. Brown & Williamson Tobacco Corporation, 509 U.S. 209, 222 (1993). Many other national competition authorities consider price-cost tests as well. For a survey of practices, see Unilateral Conduct Working Group (2008), § II.1.

16   Id. at 224.

17   Case C-62/86 AKZO Chemie v Commission, [1991] ECR I-3359; Case C-333/94 P Tetra Pak International v. Commission [1996] ECR I−5951. The cost concepts are stated for a single-product firm. For the corresponding multi-product concepts, see European Commission (2009), ¶ 26.

18   Case C-333/94 P Tetra Pak International v Commission, [1996] ECR I-5951; Case C-202/07 P France Télécom SA v Commission of the European Communities, [2009] ECJ First Chamber.

19 Unilateral Conduct Working Group (2008), § II.2.A and B. The treatment of recoupment varies among national competition authorities within the European Union, as well as among the authorities of other nations. For a survey of individual countries' practices, see id., § II.2.

20 European Commission (2009), ¶¶ 20 and 68-71.

21 Areeda and Turner (1975).

22 For a discussion of the debate, see Elhauge (2003).

23 Although many commentators prefer to focus on two-sided platform issues, the use of the freemium model appears to have played a central role in a recent case brought against Google regarding the pricing of its mapping application. (Bottin Cartographes v. Google France, Cour d'appel, Paris Pôle 5, Chamber 4, 25 November 2015.)

24 For an early formal model of network competition with below-cost pricing, see Katz and Shapiro (1986).

25 Similar issues arise with learning by doing. See Cabral and Riordan (1994 and 1997).

26 Vasconcelos (2015) extends some of Farrell and Katz's (2005) results to platforms with one- and two-sided cross-platform network effects.

27 See, e.g., Wright (2004).

28 Algebraically, the change in x_B^i equals $(\partial x_B^i / \partial x_A^i)(dx_A^i / dp_A^i) + (\partial x_B^i / \partial x_A^{-i})(dx_A^{-i} / dp_A^i)$. The incorrect approach described in the text amounts to assuming that the observed change in x_B^i equals $(\partial x_B^i / \partial x_A^i)(dx_A^i / dp_A^i)$. This approach would thus credit the effects of weakening the rival as benefits realised due to competition on the merits.

29 This summary of this matter is based on Case 1001/1/1/01 Napp Pharmaceutical Holdings Limited and Subsidiaries v Director General of Fair Trading [2002] CAT 1.

30 Id., ¶ 51.

31 Id., ¶ 261.

32 Hoernig (2007) examines the potential for a mobile telecommunications provider to use a high differential between off-net and on-net prices to harm competition among asymmetric providers.

33 See, also, European Commission (2009), ¶ 69.

34 No representations are being made here regarding the veracity of ICOMP's factual claims.

35 Initiative for a Competitive Online Marketplace (Undated), p. 10.

36 There also was an issue whether the free version served as a promotional tool to induce map users to purchase a paid service. This is not a two-sided issue.

37 Bottin Cartographes v. Google France, Cour d'appel, Paris Pôle 5, Chamber 4, 25 November 2015, p. 8.

38 Id., pp. 8-9. Recall that, as a general matter, exclusionary conduct that weakens but does not eliminate rivals can also harm competition and consumers.

39 Using the notation introduced earlier in the text, these commentators would assert that it would sufficient to compare $p_A + p_B$ with $c_A + c_B$ to answer any relevant questions regarding market power, profitability, or harm to competition, without regard to the values of the individual prices the make up the sum.

40   Lee (2013) notes that, in some industries, a platform can impose exclusivity by vertically integrating into one side of the market. For example, video game consoles are platforms that bring together game developers and gamers. An established strategy for console manufacturers is to integrate into the development of games that are offered exclusively on their platforms.

41   For an analysis of loyalty discounts in "traditional" markets, see Calzolari and Denicolò (2013) and Klein and Lerner (2016). The earlier paper demonstrates that, under some conditions, market-share discounts and exclusivity requirements can have very different competitive effects from one another.

42   In many settings, blocking multi-homing is not the same as blocking platform compatibility. With compatible platforms, there is a single "network," and users on side *A* of one platform benefit from actions taken by another platform to increase the number of users on its *B* side. Such effects need not arise with incompatible platforms even when there is no prohibition on multi-homing and the act of multi-homing is costless. That said, there are similarities in that a dominant network can have incentives to oppose compatibility in order to weaken rivals. For an insightful early analysis, see Cremer et al. (2000).

43   Framed in terms of platforms, one could argue that a manufacturer is a platform that facilitates transactions between dealers and consumers. This view is counterintuitive but it speaks to the lack of agreement regarding what constitutes a platform. It is perhaps more intuitive to think of dealers as platforms and a manufacturer as a platform user which is demanding that other potential users be excluded.

44   Brief for the United States, Redacted -- Public Version, United States v. Dentsply International, Inc., p. 18.

45   Bork (1978, p. 309). For an excellent survey of the literature responding to this argument, see Rey and Tirole (2007, § 4).

46   Aghion and Bolton (1987) demonstrate that, by signing a long-term exclusive dealing agreement with penalty clauses, a dealer and incumbent manufacturer can force a manufacturer that later enters the market to compensate the dealer for breaking the long-term agreement. In this way, the dealer and incumbent manufacturer can appropriate some of the benefits of entry for themselves, which can reduce entry and harm consumers as well as the potential entrant.

47   This common intuition is summarised in Katz (1989, p. 708). It is formalised and more fully explored by Rasmussen et al. (1991). Segal and Whinston (2000) correct certain inconsistencies in Rasmussen et al.'s analysis.

48   Strikingly, as pointed out by Rasmussen et al. (1991, p. 1143), a manufacturer need not have market power prior to the imposition of exclusive dealing in order to be able profitably to sign most or all dealers to exclusive contracts. This finding indicates that, in applying a market-power threshold to screen potential cases, competition policy enforcers should assess what the degree of market power is when exclusivity is in place.

49   This form of exclusion need not entail any sacrifice of profits. Hence, tests based on evidence of profit sacrifice could fail to detect this type of harm to competition.

50   In this form of the theory, exclusivity is used to deter entry. As noted above, Aghion and Bolton (1987) show that exclusive contracts can also be used to extract rents from entrants rather than deter entry entirely.

51   Katz and Rosen (1985) and Seade (1985) showed that when marginal costs are increased by some action, even a symmetric (across all manufacturers) cost increase may raise a manufacturer's profits.

52   In Calzolari and Denicolò's model, the dominant firm offers both exclusive and non-exclusive pricing terms. However, their model can be extended to situations in which the seller must choose one form of pricing or the other.

53   As Rochet and Tirole (2006 , p. 646) observed, this is an important difference between multi-sided platforms and the sale of complementary goods: unlike the case of buyers who purchase complementary goods (or "systems"), the decision makers on the different sides of a platform generally are not concerned with one another's welfare.

54   Shapiro (1999) provides a verbal analysis for generic network effects. Doganoglu and Wright (2010) further explore the effects of exclusivity on entry in a formal model that explicitly examines two-sided markets.

55   These asymmetries need not always favor the incumbent. Shapiro (1999, p. 682) observes that an entrant with a sufficiently superior technology might wish to impose exclusivity to hasten users' switching to it. In other words, a technological asymmetry favoring the entrant might outweigh a temporal asymmetry favoring the incumbent.

56   This case description is based on Lorain Journal Co. v. United States, 342 U.S. 143 (1951).

57   For a range of alternative interpretations, see Lopatka and Kleit (1995).

58   This case description is based on United States v. FTD Corp.; Florists' Transworld Delivery, Inc.; FTD Ass'n, Supplemental to Civil Action No. 56-15748, Memorandum of the United States in Support of Proposed Enforcement Order, July 1, 1995.

59   United States v. Florist's Telegraph Delivery Ass'n, 1956 Trade Cas. (CCH) ¶ 68,367 (E,D, Mich. 1956).

60   United States v. FTD Corp., 60 Fed. Re. 40,859 (E.D. Mich. 1995).

61   Shapiro (1999, p. 677).

62   Atari Corp. V Nintendo, No. 89-0824 (N.D.Cal. 1992); Atari Games Corp. and Tengen, Inc. v. Nintendo of America Inc. and Nintendo Co., Ltd., 975 F.2d 832 (Fed. Cir. 1992).

63   Jonathan Weber, "Jury Sides With Nintendo in Suit Brought by Atari: * Verdict: Panel exonerates the video game giant of trying to monopolise the market and rules it had not damaged its rival." Los Angeles Times, May 2, 1992

64   United States v. Visa U.S.A., Inc., 163 F. Supp. 2d 322, 338 (S.D.N.Y. 2001); United States v. Visa U.S.A., Inc., 344 F.3d 229, 238-39 (2d Cir. 2003). I was retained by the U.S. Department of Justice as an economic expert in this matter, and I testified at trial.

65   There was also a horizontal element of harm. At the time, MasterCard and Visa were associations collectively governed by member card-issuing banks, and the policies at issue restricted the means by which they could compete with one another (i.e. it limited their choices of payment networks on which to rely).

66   The appellate court in United States v. Microsoft Corp. addressed this issue, noting that U.S. courts have "taken care to identify the share of the market foreclosed" (United States v. Microsoft Corp., 253 F.3d 34 (D.C. Cir. 2001) p. 69). While observing that "[b]ecause an exclusive deal affecting a small fraction of a market clearly cannot have the requisite harmful effect upon competition, the requirement of a significant degree of foreclosure serves a useful screening function…" (id.), the court went on to state that, "[a]t the same time, however, we agree with plaintiffs that a monopolist's use of exclusive contracts, in certain circumstances, may give rise to a § 2 violation even though the contracts foreclose less than the roughly 40% or 50% share usually required in order to establish a § 1 violation." (Id., p. 70.). The economics of network effects

67   The possibility of using exclusivity to harm platform competition without inducing exit has been recognised by the U.S. courts. For example, in United States v. Visa U.S.A., Inc., 344 F.3d 229 (2d Cir. 2003), cert. denied, 125 S. Ct. 45 (2004), the defendants were found liable even though the targets of exclusion were not forced to exit the market.

68   United States v. Dentsply International, Inc., 399 F.3d 181, 184 (3d Cir. 2005).

69   Hermalin and Katz (2013) examine a theoretical model in which exclusivity creates differentiation that relaxes price competition and benefits all suppliers. The authors find that the welfare effects are ambiguous when one accounts for investment competition. Lee (2013) conducts an empirical study of the video game industry and finds evidence that, in that industry for the period he examined, limitations on multi-homing by video game developers benefited the smaller, entrant platforms by allowing them to differentiate themselves from the incumbent with the larger installed base.

70   In telecommunications, this effect is known as the terminating access monopoly problem. For an early general analysis, see Armstrong (2006).

71   The description of this case is based on United States et al. v. American Express Company, MasterCard International Inc, Visa, Inc., No. 15-1672 (2d Cir. 2016) reversing 88 F. Supp. 3d 143 (E.D.N.Y. 2015). I was retained in this matter by the U.S. Department of Justice to serve as an economic expert, and I testified at trial. The U.S. Supreme Court has granted certiorari and will review this case in its 2017 term.

72   In my opinion, the evidence demonstrated that the harm to merchants and their customers, in fact, outweighed the gains to American Express card holders.

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6. Exclusionary practices and two-sided platforms

By Andrea Amelio, Liliane Karlinger and Tommaso Valletti[*]

1. Introduction

Two-sided platforms refer to situations where (at least) two distinct user groups (i.e. two demands) interact with each other through a common platform and the participation of at least one of these groups impact the value of participation for the other group(s). Following Evans (2003), "a platform constitutes the set of the institutional arrangements necessary to realise a transaction between two users groups".[1]

Typically, these two distinct customer groups cannot contract directly. This is because the transaction costs for customers individually reaching enforceable agreements are too high. As a result, a third party usually creates a place or space – a platform – where the different groups of consumers/users can get together. In such situations, the need to convince agents to participate on all sides of the platform creates a so-called chicken-and-egg problem, in that members of each group are willing to participate in the market insofar as they expect many members from the other side to participate.

For a market to be considered two-sided, it has to do more than just allow two or more groups "to connect or engage with each other". As expressed by Rochet and Tirole, "if the analysis just stopped there, pretty much any market would be two-sided, since buyers and sellers need to be brought together for markets to exists and gains of trade to be realized."[2] Yet two-sided markets are characterised not only by the existence of cross-side network effects/indirect network effects, but also by the feature that the platform can use its fee/pricing structure to influence the volume of transactions between users. Rochet and Tirole therefore define a two-sided platform as one in which the volume of transactions between users depends on the structure and not only on the overall level of the fees charged by the platform.

Multi-sided platforms are very common and are present in many markets including: stock exchanges, internet portals, payment card systems, newspapers, television broadcasters, directories, smartphones, mobile and fixed telecommunication networks and estate agents. These examples cover very diverse industries affecting many different aspects of consumers' lives. For antitrust authorities it is therefore essential to have a thorough understanding of these platforms to properly enforce antitrust scrutiny.

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Two-sided markets are an area of considerable recent economic research in the field of Industrial Organization. The paper does not intend to provide an exhaustive review of the two-sided market literature. The aim of the paper is two-fold. First and foremost, it focuses on the literature dealing with exclusionary pricing and discusses whether the presence of indirect network externalities makes platforms more or less prone to adopt exclusionary conducts. Often, in the public debate, it is advocated that multi-sided platforms deserve a special (typically, more relaxed) scrutiny by antitrust authorities.[3] The result of our preliminary research is not in line with this conclusion. Similar exclusionary behaviours taking place in single-sided markets also carry over to multi-sided markets. This suggests that the typical tools that one applies in the analysis of single-sided markets need not to be abandoned: it is enough to adapt them. Second, the paper discusses policy aspects that are particularly relevant in the current discussion about platform competition and on which more research would be desirable.

The views and comments put forward in this paper are intended to add to the ongoing debate on platforms and cannot be read as providing guidance on the European Commission's past or future assessment of competition cases involving multi-sided platforms. Our contribution has more modest goals and its main purpose is to contribute with some embryonic research grounded on economic principles to the discussion about the likelihood of exclusionary practices in multi-sided markets.

2. A close-up on exclusionary pricing in multi-sided platforms

A natural approach when starting to model exclusionary pricing in a multi-sided framework is to turn to the literature on exclusionary pricing in standard one-sided markets, to see how they can be adapted to fit the two-sided framework, and to what extent the results obtained for one-sided markets carry over to the multi-sided framework. There are many different avenues that one could take, and this article does not attempt to provide a full treatment of this question.

For instance, we do not consider here the rich literature on predatory pricing which builds on asymmetric information between incumbent and entrant, and thus explains the rationality of predation through signalling or reputation building on the side of the better informed incumbent. These models tend to focus on the informational asymmetry among the two suppliers, while treating the competitive interaction on the goods market in a rather reduced-form way. This is why these models do not lend themselves easily to an adaption to a two-sided context, where the exact nature of competition on either side of the market is arguably an important feature if one wants to gain further insight beyond what is known about one-sided markets.

This article therefore zooms in on two important strands of literature regarding exclusionary strategies which are not driven by asymmetric information, and which are often associated with the works of Segal and Winston (2000)[4] and Dixit (1980).[5] Segal and Winston (2000) explore the mechanism of "divide-and-conquer" strategies, whereby one group of buyers is locked in by the incumbent with very favourable offers, so as to prevent a potential entrant from reaching critical scale, thus allowing the incumbent to then monopolise the rest of the market. Dixit (1980) instead belongs to an earlier literature on entry deterrence through limit pricing, where an incumbent can discourage entry by setting a price just low enough (or producing an output just high enough) to render prospective entry unprofitable.

Both model families, "divide-and-conquer" and limit pricing, rely on the presence of scale economies to achieve foreclosure, but divide-and-conquer strategies require the existence of multiple buyers who can be played off against each other, while limit pricing models give a first-mover advantage to the incumbent in making its price (or output) choices in a way that leaves no room for entrants to establish their business alongside the incumbent in the market.

This paper builds on these seminal works and adapts these models to incorporate a multi-sided logic. We study how the presence of externalities, typical of multi-sided platforms, changes the incentive of an incumbent firm to undertake exclusion.

Extending Segal and Winston (2000) to multi-sided platforms

We start by examining the first strand of literature on "naked exclusion" strategies, which originates in the works of Rasmusen et al. (1991)[6] and Segal and Whinston (2000).[7] While the canonical naked-exclusion models are cast as an analysis of exclusive dealing contracts, the mechanism they propose can be applied to a wider set of circumstances.

The crucial concept developed in the naked exclusion literature is that of "divide-and-conquer strategies": Consider an industry where an entrant needs to reach a certain scale in order to be viable, and there are multiple buyers who choose independently from which supplier (either the incumbent or the entrant) to buy the product. To fix ideas, suppose that in order to reach the critical scale, the entrant has to serve the entire market demand. If the incumbent wishes to thwart entry, it is sufficient to convince just one out of the many buyers to buy from the incumbent instead of the entrant. A single buyer who turns away from the entrant prevents the latter from reaching the critical scale, implying that entry will not take place, i.e. the incumbent remains the only available supplier. All the other buyers will therefore be forced to buy from the incumbent as well, even if they can do so only at very high prices.

Of course final buyers are worse off in this monopoly than they would have been in a duopoly with a more efficient second supplier. But as soon as one buyer turns away from the entrant, the others no longer have a choice but to buy from the incumbent as well. The incumbent will therefore only have to compensate the first buyer for giving up the possibility to buy from the entrant. The compensation paid to the first buyer is thus the "price" that the incumbent has to pay to monopolise the entire market. This compensation is paid out of the profits that the incumbent makes from selling at monopoly prices to all remaining buyers: in this sense, the incumbent's strategy is one of "divide-and-conquer".

This strategy exploits the fact that a single buyer, when deciding from which seller to buy, only takes into account its own payoff, i.e. it compares the prices and possibly other terms (e.g. an exclusivity clause in exchange for a certain reward) offered by the two sellers to this particular buyer, and then chooses whichever offer is more favourable to itself. However, a single buyer will not typically take into account the consequences its supplier choice has on the other buyers; in particular, when the buyer decides in favour of the incumbent and against the entrant, and the entrant fails to reach the critical scale because of this one buyer, this has a negative impact on all other buyers because it deprives the latter of a second supplier.

The buyer thus exerts a "negative externality" on all other buyers. Exploiting this negative externality to its own advantage is at the heart of the exclusionary strategy deployed by the incumbent in the literature on "naked exclusion". In the following, we will examine how this concept can be applied to two-sided markets.

Is exclusionary pricing anticompetitive in two-sided markets?

The first paper to introduce naked exclusion pricing strategies into a two-sided market framework is Vasconcelos (2015).[8] It makes a number of assumptions that distinguish it from the previous literature on two-sided markets; in particular, the model studies the case of discrete buyers on each side of the market, as opposed to a continuum of massless consumers typically assumed in the traditional models of two-sided markets. Allowing consumers to have positive mass is crucial for the mechanism of "divide-and-conquer" strategies to work: A single buyer must have a sufficient level of demand to be "pivotal", i.e. to represent a sufficiently large share in the entrant's total sales so as to be decisive for whether or not the entrant reaches the critical scale.

The model assumes that there are two groups of agents, labelled $i = 1, 2$, which interact with each other via platforms. There is an incumbent platform I which already has an installed base of buyers on each market side of size $\beta^I > 0$, and an entrant platform E whose installed base is $\beta^E = 0$, but which has a lower unit cost of serving a user. The asymmetry in installed bases mirrors the entry barrier in traditional naked exclusion models, which typically assume some physical setup costs which the incumbent has sunk already, while the entrant can still avoid them by choosing not to enter the industry.

The two platforms compete for a new generation of buyers of size N on each side, whose utility from joining platform $k = I, E$ is increasing in the number of (old and new) buyers who joined the same platform on the other side (i.e. network effects are indirect here). The key assumption made about network externalities is that they are one-sided: only group 1 buyers care about the number of buyers on side 2 of the platform they join, while group 2 buyers are indifferent as to the presence (or absence) of buyers on side 1.[9] The utility function of the buyers can thus be represented as:

$$U_1^k = z\left(\beta^k + N^k\right) - p_1^k \text{ and } U_2^k = r - p_2^k,$$

where r and z are two positive parameters, and p_i^k is the price charged by platform k to an agent on side i of the market. With one-sided externalities, it is clear that, in this model, only group 2 buyers will ever be pivotal: by providing the platform they join with a critical mass N, they "lock in" the group 1 buyers with this platform as well, allowing the winning platform to charge high pric

The model rules out multi-homing, i.e. each buyer will join either platform 1 or platform 2, but not both. Thus, competition between I and E is of the "winner-takes-all" nature, i.e. the new generation of buyers will always tip to either one or the other supplier. The old generation does not buy again, so they are assumed to stay with the incumbent. This model thus generates two kinds of possible equilibria: one where the incumbent's platform is the only one, and reaches maximum size $\beta^I + N$ on side 2; and another equilibrium where the entrant serves the new generation of buyers, so that the two generations of side 2 buyers are split across the two platforms, giving rise to two smaller networks, the entrant's network of size N, and the incumbent's network of size β^I.

The model further assumes that platforms can only charge uniform prices on each side of the market, but different prices across the two sides of the market. Importantly, prices are allowed to be negative, i.e. the platform can pay agents to join the platform.[10] In the present setup, the buyer group which will benefit from low prices is group 2, the pivotal group that is decisive for whether or not entry of a new platform will be feasible.

Clearly, the fact that the entrant can serve buyers at a lower unit cost represents an important competitive advantage, as this cost differential allows the entrant to make more

aggressive price offers. However, the lack of an installed base proves to be a serious obstacle when competing against the incumbent: If the entrant wins the new generation of group 2 buyers, it will still have to compete against the incumbent for group 1 buyers, because the incumbent's platform has positive value for group 1 buyers thanks to the presence of the installed base. Thus, the profits that the entrant can recover on side 1 are capped by the presence of a competitive incumbent.

The same is not true if instead the incumbent manages to attract group 2 buyers. Then, the entrant's platform is completely worthless to group 1 buyers, so that the incumbent is effectively a monopolist on this group and can extract monopoly rents from them. The incumbent can therefore afford to be very aggressive in the fight for group 2 buyers, because it can expect to recover higher profits on the other side of the market.

The paper shows that exclusion of the entrant can arise for a broad range of parameters, namely when the cost advantage enjoyed by the entrant is relatively low compared to the importance of the installed base. However, this does not necessarily imply that exclusion is inefficient. A reader who is familiar with the literature on naked exclusion may erroneously conclude that the fact that the entrant can serve buyers at a lower cost than the incumbent automatically implies that total welfare is maximised when the entrant serves the buyers, so that any equilibrium in which instead the incumbent prevails is necessarily inefficient.

However, this conclusion does not necessarily carry over to the case of two-sided markets. Here, there is an additional effect of entry on total welfare which needs to be considered, namely the cost of splitting the two generations of group 2 buyers, old and new, across two different platforms.[11] This is inherently inefficient, because it deprives the young generation of group 1 buyers of the benefit of the network externality exerted by the old generation of group 2 buyers, and vice versa.

More specifically, when both generations of group 2 buyers reside on the same platform, the network benefits enjoyed by any buyer on the other side of the same platform amount to $z(\beta^I + N)$; if all group 1 buyers get to enjoy these network effects (recall that the total population of group 1 buyers is $\beta^I + N$), the total benefit will be $z(\beta^I + N)(\beta^I + N)$. If instead the two generations are fragmented across the two platforms, then the incumbent platform generates network benefits of $z(\beta^I)^2$, while the entrant's platform generates zN^2. This is clearly smaller than the total benefits when both cohorts are on the same platform, i.e. $z(\beta^I + N)^2$, because the latter also generates network benefits across cohorts, not just within cohorts.

Under the assumptions of the model, only the incumbent network can generate the full network effects of $z(\beta^I + N)^2$, while entry necessarily leads to suboptimal network benefits of $z(\beta^I)^2 + zN^2$. Overall, this model therefore exhibits an intricate set of externalities: (i) the network benefits running from side 2 buyers of any platform to its side 1 buyers, (ii) the network benefits running from the old cohort of the incumbent's platform to its buyers in the young cohort, and (iii) the "contracting externalities" running from the new cohort buyers on side 2 to those on side 1, because the side 2 buyers' choice of platform also determines the available options for side 1 buyers. It is therefore not at all obvious how these three layers of externalities will play out when the incumbent engages in divide-and-conquer type of pricing.

The paper shows that when exclusion occurs in this model, it is always socially optimal: Exclusion will occur when the entrant's cost advantage is not sufficient to outweigh the benefits from having both generations of buyers concentrated on the same platform; and

this is precisely the condition under which entry is not desirable from a social welfare point of view either. Moreover, there are equilibria where the entrant prevails but which are nonetheless inefficient; in other words, this model may exhibit excessive entry.

Two lessons can therefore be learned from this model. The first lesson is that divide-and-conquer strategies may be successfully used also in two-sided markets. As in a standard one-sided market, some buyers may not fully internalise the impact their supplier choices have on the options available to other buyers in the market, and an incumbent may take advantage of this fact to lock in one part of the market by making very aggressive offers to the other side of the market, thus preventing potential entrants from gaining a toehold in the market.

The second lesson is that the impact of exclusion on social welfare might be different in a two-sided market from a one-sided market. In this particular setup, the existence of an old cohort of buyers, who are locked in with the incumbent, generates welfare losses if the new cohort is served by the entrant instead of the incumbent, so that network externalities are not maximised. Policies such as a ban on below-cost pricing, which are aimed at preventing inefficient exclusion, may end up favouring inefficient entry instead.

A simple theory of predation

One key feature of the model by Vasconcelos (2015) is that the two platforms compete simultaneously for both sides of the market. This begs the question what happens if this assumption is relaxed and instead a sequential setup is considered, whereby the two platforms first approach one side of the market, and then the other. Exclusionary pricing under this sequence of moves is studied by Fumagalli and Motta (2013).[12] While their paper is cast as a general analysis of predatory pricing that applies to one- and two-sided markets alike,[13] their treatment assumes that the two buyers who are approached sequentially by the two suppliers belong to the same side of the market, and exert within-group externalities on each other. The incumbency advantage in this setup is that the incumbent can provide more network benefits to any single buyer than the entrant, but provides lower benefits than the entrant when serving both buyers.

In this section, instead, we think of the two buyers as representing the two sides of a platform, where the first buyer exerts a cross-group externality on the second, but not the other way round. This is quite a natural and relevant setting in practice. The following analysis illustrates the main mechanism in the specific context of a media outlet (say a newspaper) financed by advertisement.

Let there be competition over two possible user groups, the readers and the advertisers. For simplicity, assume that each group has exactly one user (or that the group has mass 1), so that co-ordination of purchases within a given group is no issue here. Advertisers care about the number of readers a newspaper has, as more eyeballs imply higher advertisement impact and hence more profits from any given ad. Readers instead care about the number of other readers the same newspaper has, for instance because reading the same newspaper allows readers to engage in an exchange with their friends about the content. In other words, readers exert a cross-group externality on advertisers, and an own-group externality on each other.

Assume that there is an incumbent newspaper, called I, with an installed reader base of size n_I. Readers' utility from buying the newspaper is an increasing function of the newspaper's reader base, $v_I(n_I)$. There is a rival newspaper, called R, which competes with the incumbent for the new cohort of readers and advertisers. The rival newspaper has

a smaller installed reader base than the incumbent, $n_R < n_I$, so that its newspaper currently provides lower utility to readers than the incumbent's, but has the potential to provide higher utility if it manages to attract the new cohort of readers:

$$v_R(n_R) < v_I(n_I) \text{ but } v_R(n_R + 1) > v_I(n_I + 1). \quad (Condition\ 1)$$

Likewise, as regards advertisers' valuation for the newspapers, denoted $a_i(\cdot)$, the rival newspaper, given its current small reader base, provides lower utility than the incumbent, but is more efficient in providing advertisement benefits, so that advertisers would prefer the rival newspaper if it managed to attract the new cohort of readers:

$$a(n_R) < a_I(n_I) \text{ but } a_R(n_R + 1) > a_I(n_I + 1). \quad (Condition\ 2)$$

Also assume that the network externalities (both own-group and cross-group) increase with a newspaper's reader base, but at a less-than-proportional rate. In order to simplify the exposition, while still showing the main insights, we will focus on the special case where the incumbent newspaper has fully exhausted all network effects, while the rival newspaper still benefits from additional readers on both sides of its platform. In other words, the readers' utility from reading the incumbent newspaper, v_I, is unaffected by whether or not the newspaper manages to attract the new cohort of readers of size 1, and the same is true for advertisers:

$$v_I(n_I) = v_I(n_I + 1) \text{ and } a_I(n_I) = a_I(n_I + 1).$$

This assumption allows us to simplify our notation, by denoting respectively as v and a the (constant) value to the readers and the advertisers when joining the incumbent platform. Instead, variables with an overbar refer to the entrant when it manages to attract the new cohort, while variables with an underbar refer to the opposite case when it fails to do so. Hence we can restate our initial conditions as:

$$\overline{v} > v > \underline{v}, \quad (Condition\ 1')$$
$$\overline{a} > a > \underline{a}. \quad (Condition\ 2')$$

We will also make the simplifying assumption that both the cost of providing an ad, and of providing the reader access to the newspaper, is zero.

Consider the following sequence of moves: first, the two newspapers compete for the new cohort of readers by setting a uniform cover price for the newspaper, denoted p_I^r, p_R^r, and then, they compete for the new cohort of advertisers by setting a uniform price per ad, denoted p_I^a, p_R^a.[14]

We can therefore apply backward induction to analyse which newspaper will prevail. Clearly, at the second stage, competition for advertisers will depend on the outcome of the first stage, i.e. whether it was the incumbent or the rival who managed to attract the new readers. We consider each case in turn.

(2a) If the new cohort of readers bought I's newspaper at stage 1, then I's reader base is of size $n_I + 1$, which provides benefits of size a to advertisers, while R's reader base remains at level n_R, yielding lower benefits of $\underline{a}$ to advertisers. The advertisers will compare the net utility they are offered by I, namely $a - p_I^a$, to the net utility offered by R, i.e. $\underline{a} - p_R^a$, and will place their ads in I's newspaper whenever:

$$a - p_I^a \geq \underline{a} - p_R^a.$$

Given that this is the last stage of the game, the lowest price R will be willing to offer its advertisers is zero, so that I wins the advertisers with a positive price of

$$p_I^a = a - \underline{a},$$

which leaves advertisers with a net utility of $a - p_I^a = \underline{a}$.

(2b) If instead the new cohort of readers bought R's newspaper at stage 1, so that R has a large reader base of size $n_R + 1$ and provides a high utility of $\overline{a}$ to advertisers, the latter will prefer I's newspaper whenever:

$$a - p_I^a \geq \overline{a} - p_R^a.$$

In this case, Bertrand competition among I and R will drive I's price offer down to zero, and R wins the advertisers with a positive price of

$$p_R^a = \overline{a} - a,$$

which leaves advertisers with a net utility of $\overline{a} - p_R^a = a$.

Let us now turn to competition for readers in stage 1. Recall that we assumed that readers are indifferent as to how many advertisers any of the newspapers will attract at stage 2, i.e. they only care about the newspaper's reader base, and its cover price. Thus, if they opt for I's newspaper, the latter will have a reader base of size $n_I + 1$, which provides net benefits of $v - p_I^r$ to readers; if instead they decide to buy R's newspaper, the latter will have a reader base is of size $n_R + 1$, which provides net benefits of $\overline{v} - p_R^r$ to readers. Readers thus buy from I whenever:

$$v - p_I^r \geq \overline{v} - p_R^r.$$

To see which of the two newspapers can make the more competitive offer to win the readers, first note that their aggregate profits over the two periods, when successful in period 1 (and ignoring discounting across the two periods), are:

$$\Pi_I = p_I^r + p_I^a = p_I^r + a - \underline{a}$$
$$\Pi_R = p_R^r + p_R^a = p_R^r + \overline{a} - a.$$

(1a) Consider first the scenario where I wins period 1 competition for readers. Bertrand style competition between I and R ensures that the lowest price R is willing to offer is the one that would drive its aggregate profits down to zero:

$$\Pi_R = 0 \rightarrow p_R^r = -(\overline{a} - a).$$

If I wants to match R's offer to win the readers in period 1, it has to offer:

$$v - p_I^r = \overline{v} - p_R^r \rightarrow p_I^r = v - \overline{v} - (\overline{a} - a).$$

Note that, given our assumptions on the parameters, this price is necessarily negative (which is equivalent to being below marginal cost in this model, as the latter was assumed to be zero). In other words, the incumbent can only attract readers by subsidising their consumption.

At this price, I can break even whenever:

$$\Pi_I = p_I^r + p_I^a = v - \overline{v} - (\overline{a} - a) + a - \underline{a} > 0.$$

(1b) If the above break-even condition is not satisfied, i.e. if instead $v + a - \underline{a} < \overline{v} + \overline{a} - a$, then I will prefer to lose readers to R, so that R will make the sales to them at the lowest price I is willing to offer, namely:

$$\Pi_I = 0 \rightarrow p_I^r = -\left(a - \underline{a}\right).$$

R will then win the readers with the following offer:

$$v - p_I^r = \overline{v} - p_R^r \rightarrow p_R^r = \overline{v} - v - (a - \underline{a}).$$

This leaves R with aggregate profits of

$$\Pi_R = p_R^r + p_R^a = \overline{v} - v - (a - \underline{a}) + \overline{a} - a,$$

which is positive by the above assumption.

We can therefore conclude that, whenever

$$v + a - \underline{a} > \overline{v} + \overline{a} - a \quad (Result\ 1)$$

is satisfied, the entrant will be excluded; otherwise, the entrant will prevail. This is the main finding of this analysis and it deserves further comments.

First, we note that exclusion is more likely to occur if

1. the difference $a - \underline{a}$ is large, i.e. the rival is strongly disadvantaged vis-à-vis advertisers because of the incumbent's installed base,
2. the difference $\overline{a} - a$ is small, i.e. the rival is not much more efficient at providing advertisement benefits than the incumbent is,
3. the difference $\overline{v} - v$ is small, so that the rival's value to readers is not much larger than that of the incumbent's.

Second, having established that exclusion can be an equilibrium, we consider its welfare properties. Whether such exclusion is socially desirable or not depends on the strength of the network externalities and the size of the respective cohorts. Under exclusion, the total welfare generated by the newspaper industry is

$$W_{excl} = (n_I + 1)v + a + n_R \underline{v}.$$

When instead the rival is successful in attracting the new cohort of readers and advertisers, total welfare is given by

$$W_{entry} = n_I v + (n_R + 1)\overline{v} + \overline{a}.$$

Comparing the two welfare expressions, we see that entry always yields higher social welfare, i.e.

$$W_{entry} > W_{excl}.$$

This result is directly implied by our (Condition 1') and (Condition 2'), i.e. our assumption that $\overline{v} > v > \underline{v}$ and $\overline{a} > a > \underline{a}$.

Thus, whenever (Result 1) is satisfied, so that exclusion will arise, we know that it is anticompetitive in the sense that welfare will be reduced. We therefore demonstrated that divide-and-conquer strategies may lead to inefficient exclusion even in a two-sided market such as the media industry. The presence of network externalities, in itself, is not sufficient to overcome the exclusionary effect exerted by divide-and-conquer pricing. On the contrary, if the advertisers' valuation of the incumbent's installed base is particularly strong, this represents a huge entry barrier for the rival newspaper.

Also note that in this model, exclusionary pricing always involves negative prices to readers:

$$p_I^r = v - \overline{v} - (\overline{a} - a) < 0 \text{ because } v + a < \overline{v} + \overline{a}.$$

Thus, a ban on negative prices would be an efficient policy tool to prevent exclusionary pricing in this model. As argued above, exclusion is socially inefficient in this model, because the entrant is more efficient than the incumbent at providing utility to both readers and advertisers, provided it can attract both sides of the new cohort of consumers; we also showed that whenever the incumbent instead manages to attract the readers (which implies that all advertisers will then turn to the incumbent as well), this requires the incumbent to set negative prices to the readers. It therefore follows that a ban on negative prices will ensure that all instances of inefficient exclusion are ruled out.

Note, however, that this policy would not make everyone better off: whenever exclusion would have occurred absent this ban on negative (i.e. below-cost) prices, buyers on the reader side of the market will now pay a higher cover price, or, more precisely, they will lose the subsidy they would have received from the incumbent. Advertisers instead will benefit from this policy, because they obtain a larger net benefit in case the entrant prevails.

Extending Dixit (1980) to multi-sided platforms

The previous section studied a rather canonical case where inefficient exclusion can happen with two-sided platforms. This possibility result, though, does not give too many insights into whether exclusionary practices are more or less likely to arise in a two-sided environment. We tackle this question more directly in this section, by building on the seminal paper of Dixit (1980). Dixit (1980) argues that the threat of predating on an entrant is not credible unless the incumbent finds a way of committing to such a course of action. Using the words of Dixit, "the prospective entrant was assumed to believe that the established firm would maintain the same output after entry as its actual pre-entry output. Then the established firm naturally acquired a Stackelberg leadership role. However, the assumption is dubious on two opposing counts. First, faced with an irrevocable fact of entry, the established firm will usually find it best to make an accommodating output reduction. On the other hand, it would like to threaten to respond to entry with a predatory increase in output. Its problem is to make the latter threat credible given the prospective entrant's knowledge of the former fact."

The analysis in this section takes this strategic behaviour described by Dixit (1980) and it applies the same logic in the context of multi-sided platforms by introducing indirect network externalities. For the purpose of this exercise, the model underlying our analysis is based on the framework developed by Armstrong (2006).[15]

We start by recalling the basic features of the framework developed in Armstrong (2006). There are two groups of agents, i.e. two demands, and two competing platforms. The utilities of the agents are defined such that utilities of a consumer on one side of the platform i increases in the participation of consumers on the other side, n_j^i, of the same platform. The parameters that capture the marginal increase in utility due to indirect network externalities are α_1 and α_2. Denote by p_1^i and p_2^i the prices paid by customers to join platform i on side 1 and 2, respectively. Hence utilities of customers are respectively

$$U_1^i = \alpha_1 n_2^i - p_1^i \qquad U_2^i = \alpha_2 n_1^i - p_2^i.$$

Following the Hotelling model, customers are located along the unit line. Under some regularity conditions, a set of demand functions that are well-behaved and a market-sharing equilibrium exist. The two platforms compete by setting prices, and consumers are bound to single-home.

In this standard setting, the analysis of Dixit (1980) is applied, with the important difference that competition is in prices, not in quantities. One platform is considered to be the incumbent and there is another platform that, if it decides to enter, will have to bear an entry cost of K. This entry cost impacts negatively the expected profit of the new entrant. The existence and the size of K is public information and therefore the incumbent platform can take advantage of it. The incumbent has thus the option to either accommodate entry becoming a Stackelberg leader, or to exclude entry and enjoy monopolistic profits, albeit under the constraint that its output must be high enough (i.e. its price must be low enough) to not leave any room for an entrant to cover its fixed cost of entry.[16] Dixit (1980) shows that above a certain level of K, the incumbent has the incentive to exclude the new entrant by expanding its capacity to a point where production of the entry-deterring output level becomes a credible threat. In the setting of the paper where platforms compete by setting prices, the analysis shows that the incumbent has the same incentive to exclude the new entrant by decreasing prices.[17]

The introduction of the indirect network externalities does not change the basic intuition identified in Dixit (1980), so that even platforms find it profitable to exclude entry. In the following, the basic results of the analysis are derived and presented.[18]

By assuming symmetric indirect network externalities, i.e. $\alpha_1 = \alpha_2 = \alpha > 0$, and solving the basic strategic game as described above, it is possible to derive the equation below that identifies the difference between the profit of the incumbent from exclusion and from accommodating entry.

$$\Delta_{symm} = \frac{1-\alpha}{8}\left(32\sqrt{K/(1-\alpha)} - 25\right).$$

By solving the equation for $\Delta_{symm} = 0$, one can find the critical threshold level for the entry cost, $K^*(\alpha)$, above which the incumbent prefers to exclude rather than accommodate the entrant. This threshold depends on the intensity of the externality, α.

$$K^*(\alpha) = \frac{625(1-\alpha)}{1024} < \frac{25}{16}(1-\alpha).$$

By studying the function, it is straightforward to see that the higher the externality, the lower $K^*(\alpha)$. This implies that for any given K, the strategy of exclusion (i.e. lowering the prices) becomes *more* attractive for the incumbent when indirect externalities are stronger. Figure 1 below is another way of presenting the result, where the shaded area represents the parameter region in the α-K space where the incumbent has the incentive to exclude entry. The dark blue middle line represents the threshold level $K^*(\alpha)$. Below this line, the fixed cost of entry, K, is too low to make it worthwhile for the incumbent to deter entry; the incumbent would rather accommodate the entrant and enjoy duopoly profits, because deterrence through low prices would be too costly.

The yellow upper line represents the second threshold for K, namely the level at which entry is "blockaded": when K exceeds the entrant's duopoly profits in the accommodating scenario, it is never profitable for a competitor to enter because its expected profit will never be positive.[19] This value also decreases with the level of the externality, meaning that as the externalities become more intense, a monopoly is more and more likely to arise even without any need for the incumbent to put an exclusionary strategy in place.

The blue wedge in Figure 1 is the most interesting from a policy point of view, because it is the parameter region where the entrant would enter absent the strategic foreclosure by the incumbent, but the incumbent finds it profitable to foreclose. It is possible to observe that for a given K the presence of indirect network externalities makes the strategy of

foreclosure more attractive for the entrant. At the same time, we see from Figure 1 that for any given level K, it is also more likely that entry will be blockaded, i.e. that entrants will not find it profitable to enter even though the incumbent sets its prices in good faith, i.e. in a way that is compatible with accommodation.

Figure 1. Exclusion arises in the shaded area
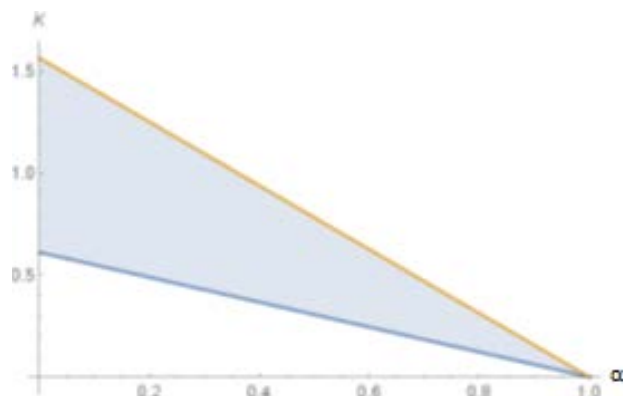
By relaxing the hypothesis of symmetry between the parameters capturing the indirect network externalities, it is still possible to derive the equation below that identifies the difference between the profit of the incumbent from exclusion and from accommodating entry (and thus the strategic incentive of the incumbent to foreclose entry). Relaxing this assumption is quite crucial given that arguably, the different sides of platforms typically show different degrees of externality, which will not change simultaneously.

$$\Delta_{asymm} = -(2 - \alpha_1 - \alpha_2) + \frac{2(\alpha_1 + \alpha_2)^2 + \alpha_1\alpha_2 - 9}{4(2 + \alpha_1 + \alpha_2)} + (\alpha_1 + \alpha_2)\sqrt{2(2 - \alpha_1 - \alpha_2)K}$$

In this framework, solving for $\Delta_{asymm} = 0$ and finding the analytical expression of $K^*(\alpha_1, \alpha_2)$ is more complex. The assessment is therefore done numerically, fixing one parameter capturing the externality, here α_1, while letting K and α_2 vary.[20] Figure 2 shows the results of this exercise. The graph confirms the existence of the critical threshold $K^*(\alpha_1, \alpha_2)$, above which exclusionary strategies become attractive for the incumbent.[21] Moreover, it is also possible to observe that if there is a positive shock to either of the parameters α_1 or α_2, the area where exclusionary strategies are desirable for the incumbent expands. In other words, even for lower entry cost K it is still profitable for the incumbent to price low in order to prevent the entrance of a competitor.

This allows concluding that it is enough to have a strong externality on one side of the platform to make exclusion more attractive for the incumbent. A preliminary assessment of these results suggests that the incumbent has the possibility to exclude entry on either of the two sides. This can be consistent with the fact that the two sides are interchangeable, and so the incumbent will always charge the lower price on the side of the market where it is least costly to do so. Therefore, this might explain why the structure of the network externalities across the two sides of the market does not seem to matter, but only their overall intensity.

Figure 2. The critical threshold level K*(α_1,α_2) when network externalities are asymmetric across the two sides of the platform
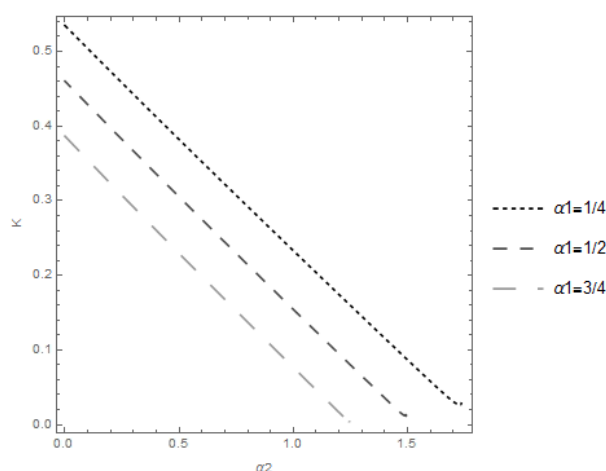
The application of these results should not be limited to the case of entry deterrence as described above. It is also conceivable to interpret the entry cost parameter K as a financial shock that can reduce the profitability of the follower. By giving this interpretation to K, the results of the model take the flavour of financial predation. Observing the financial shocks of the rival, the incumbent is taking advantage of these financial fragilities of the rival and decides to decrease its price in order to make it unprofitable for the rival to remain active in the market. This behaviour of the predator is incentive compatible given the new structure of costs of the prey. The analysis above seems to suggest that, in the presence of indirect network externalities, platforms are even more prone to pursue predatory strategies of the kind described above.

All in all, the extensions of two strands of the literature on exclusionary practices are consistent with indirect network externalities making it more likely for the incumbent to engage in exclusionary behaviour. Moreover, it is enough to have an increase in the indirect network externalities on at least one side of the platforms to make exclusionary strategies more attractive to the incumbent.

3. Policy

The increasing importance of platforms in the current economy has raised several policy debates. In this section, we select those that are the most relevant to the European Commission and on which more research should be focused in order to come to a solid understanding.

The definition of platforms and the existence of indirect network externalities

In recent years, the European Commission has been more than ever confronted with arguments related to the presence of indirect network externalities. It seems therefore that there is an increasing tendency of trying to characterise many businesses as two- or multi-sided platforms. It is worth recalling that it is very important to verify the existence of such indirect externalities. Investigating a possible existence is however not enough. Their presence has to be significant for users, and there has to be evidence that externalities affect strategic business decisions. It is submitted that only under those

circumstances it is deemed necessary to embark on an analysis that includes all the multiple sides of the platform and that tries to disentangle their relationship.

Along this line, it is important to understand when network externalities are exhausted. It is possible that beyond a certain level of adoption, a marginal increase in participation does not increase the utility of participation of the other participants anymore. In mature markets, it is conceivable that a marginal increase in the size of the network does not create any indirect network externality. The size of the platform seems then to be an important preliminary indication in order to understand whether such externalities are still present. In a similar vein, it is conceivable in certain circumstances that only a small subset of customers can generate externalities, i.e. "marquee customers". Indirect network externalities are generated as long as these particular users participate. Beyond these customers, the participation of many other customers can very well be irrelevant and may not trigger any externality on customers on the other side. Essentially, customers can be differentiated and such differentiation can be responsible for the presence or absence of indirect externalities.

One additional element to take into consideration is the cost of multi-homing by users. Typically the presence of strong network externalities is correlated with the presence of high costs of multi-homing. Given that it is difficult for customers to "home" several platforms, it is likely that those customers would value large participation on the other side. Eventually, it is also important to understand the sign of the indirect externality. Those externalities can be positive or negative and this will have an impact on the assessment of the strategic interaction of platforms.

Complexity does not imply softer antitrust scrutiny

One of the important features of multi-sided platforms is that indirect network externalities affect the pricing decisions of platforms. It is a well-known result that platforms can price one side below costs. This has often lead many commentators to argue that below-cost pricing of platforms should not be a concern for antitrust authorities. However, it seems that the evidence is not unanimous and that there are also commentators supporting a different view, including the results of this paper.

It seems conceivable that prices on both sides of the market can be set by a firm at a level that is insufficient to cover the total variable costs of the platform. In these circumstances, a competing platform may become unprofitable irrespective of how it structures its prices and will exit the market, allowing the predatory firm to raise its prices on both sides and earn economic profits sufficient to more than recoup its earlier losses. In this case the analysis might still focus on a comparison of incremental revenues versus incremental costs defined over packages of goods or services that serve the interests of customers on both sides of the platform.

Moreover, as described in Fletcher (2007),[22] a dominant platform may predate through asymmetric pricing between the two sides of the market. The issue is whether a given pricing structure can affect market structure, and specifically whether low pricing on one side of a market can prevent entry into both sides. Fletcher (2007) argues that it is conceivable to assume that in case of asymmetric platforms predatory strategies can take place. Assume competitors of the dominant platform have limited ability to turn extra business on one side of the market into incremental revenues on the other. Such firms could find it hard to compete against a very asymmetric pricing structure, and therefore may be excluded from both sides of the market. In line with the theoretical discussion developed in Fletcher (2007), the more formal results of this paper also seem to suggest

that predatory strategies typically observed in the context of standard markets carry over to markets exhibiting indirect network externalities.

It is, however, important to stress that an analysis of indirect network externalities should be part of the antitrust assessment. The typical tools applied in the analysis of single-sided markets need not be abandoned but it is crucial to adapt them in order to capture the specificity of platforms. One example of this effort is described in Behringer and Filistrucchi (2015).[23] In order to evaluate predatory strategies of platforms, they propose an augmented Areeda-Turner test that encompasses the presence of indirect network externalities. By applying this test to two real-life examples they obtain two interesting results. The first result shows that false positives might occur by applying a one-side test in a context of indirect network externalities. This is indeed a call for using the right tool when assessing platform competition. Their second result shows that a false negative might also occur by applying a one-side test. This last result is thus also consistent with the presence of predatory strategies performed by multi-sided platforms. This empirical evidence in turn supports the position of maintaining an unchanged scrutiny of antitrust authority for multi-sided platforms.

In conclusion, there seems to be convincing evidence that suggests that price structures due to indirect network externalities can be used in a predatory fashion. Above-cost predation is also possible if predation means sacrificing short-run profits to weaken rivals and doing so in a way that lowers welfare. In this framework, predation can be hard to detect: a standard price-cost test will not be reliable because there are non-predatory reasons to price below cost;[24] and using the exit of rivals as indicator is not a sufficiently solid standard of proof either, because the market may also tip absent predation. We can thus conclude that the standard tools of antitrust analysis need to be adapted to the context of two-sided markets to avoid false positives and false negatives alike.

Business asymmetries

A topic that seems to attract significant attention is asymmetric competition between the advertising supported business model (i.e. multi-sided platform) and the subscriber-based business model (traditional company). The asymmetry in the business models has a direct repercussion on the competition for customers. One possible scenario faced by consumers is that free products offered by the platform will compete with the products offered at a positive price by the traditional company. In these circumstances it is often the case that products show some degree of differentiation, either horizontal or vertical. Therefore it is likely that the obvious effect of customers consuming the free product can be significantly mitigated. However, from a policy perspective it might be important to understand whether events like market exits by traditional businesses, which are most likely to be displaced, should trigger antitrust intervention.

This is an open question and so far little effort has been put into trying to formally understand the welfare implications of the competition between these two business models.

More attention to leverage theories, for instance tying strategies

In Eisenmann at al. (2006),[25] in the context of defining strategic behaviour of platforms, the authors identify the so-called "risk for envelopment". They explain that any platform, especially the small and specialised ones, face the risk of been enveloped by a bigger platform that decides to start competing head-to-head by enlarging its bundle of offers. New entry into adjacent markets is typically welfare increasing and should be welcomed

by antitrust authority. However, the risk of a platform leveraging market power in one market into adjacent markets should not be underestimated. Recent research, like Choi and Jeon (2016),[26] focuses on the use of anticompetitive tying in order to overcome price constraints, i.e. impossibility to charge negative prices. Price rigidities can be the result of several factors, including the fear of triggering antitrust investigations for predatory pricing. What the paper then suggests is that anticompetitive tying and predation are interchangeable strategies. More attention therefore has to be put on tying and more generally leveraging given that it can mask anticompetitive entry.

4. Conclusions

The aim of the paper is two-fold. First, it has a research objective as it extends two strands of the literature about exclusionary pricing to the framework of indirect network externalities and platform competition. Our preliminary results show that traditional exclusionary practices carry over to platform competition and in some circumstances indirect network externalities accentuate the incentive to foreclose by incumbents. Second, it also discusses some of the main policy topics that are currently discussed in the public domain, complemented with some topics that so far have received little attention despite their relevance.

Notes

1   Evans, David. "The Antitrust Economics of Multi-Sided Platform Markets." Yale Journal on Regulation 20 (2003): 325-82.

2   Jean-Charles Rochet and Jean Tirole. "Two-sided markets: a progress report." RAND Journal of Economics 37, 3, (2006): 646.

3   See, for instance, Evans, David and Richard Schmalensee. "Industrial Organization of Markets with Two-Sided Platforms." Competition Policy International 3, 1 (2007): 27.

4   Segal, Ilya R., and Michael D. Whinston. "Naked exclusion: comment." The American Economic Review 90, 1 (2000): 296-309.

5   Dixit, Avinash. "The Role of Investment in Entry-Deterrence." The Economic Journal 90, 357 (1980): 95-106.

6   Rasmusen, Eric B., J. Mark Ramseyer, and John S. Wiley Jr. "Naked exclusion." The American Economic Review (1991): 1137-1145.

7   Segal, Ilya R., and Michael D. Whinston. "Naked exclusion: comment." The American Economic Review 90, 1 (2000): 296-309.

8   Vasconcelos, Helder. "Is exclusionary pricing anticompetitive in two-sided markets?" International Journal of Industrial Organization 40 (2015): 1-10.

9   The results of this paper are qualitatively similar if instead network externalities run in both directions.

10   Subsidising consumption on one side of the platform makes sense whenever a platform wishes to build an installed base of users on one side, so as to make its platform more attractive for users on the other side, who will then be willing to pay a positive price to join. In this sense, platforms may apply pricing practices that resemble divide-and-conquer strategies even without any exclusionary intention, in particular whenever the network externalities are two-sided. In the present model, however, a monopolist would not need to subsidise consumption on any side of the market: any

price slightly below *r* will ensure that group 2 buyers want to participate in this market, so that the platform will also attract group 1 buyers and can charge positive prices to them.

11   Recall the assumption that the old buyers are locked in with the incumbent and cannot switch platform in case of successful entry.

12   Fumagalli, Chiara, and Massimo Motta. "A simple Theory of Predation." The Journal of Law and Economics 56, 3 (2013): 595-631.

13   In fact, their paper discusses the applicability of the general results to two-sided markets in a subsection.

14   Competing first for readers, rather than advertisers, is a natural modelling choice here, given that advertisers care about the readers anyone of the two newspapers manages to attract, while readers are indifferent about the platform picked by the advertisers.

15   Armstrong, Mark. "Competition in two-sided markets." The RAND Journal of Economics 37, 3 (2006): 668-691.

16   It is worth mentioning that the incumbent, under the monopoly scenario, serves the entire set of customers, which in the Hotelling model amounts to a demand equal to 1, i.e. 100% of the population.

17   One way for the incumbent to achieve commitment to such a limit price is to sign long-term contracts with consumers which explicitly exclude price increases over the time horizon relevant for entry.

18   Note that the demand functions in this model also depend on the differentiation parameters in each Hotelling market, $t1$ and $t2$. For the purpose of this exercise and in order to simplify mathematical expressions, the analysis sets $t1 = t2 = 1$. This means that the degree of differentiation of the two markets involved are symmetric. For the purpose of the analysis this is irrelevant. On a more technical ground, this assumption implies that the necessary and sufficient condition to have a market sharing equilibrium becomes 4 - ($\alpha1 + \alpha2$)2 > 0 which also implies that 2 - $\alpha1$ - $\alpha2$ > 0.

19   The expression of the threshold value for "blockaded" entry is $K = \frac{25}{16}(1 - \alpha)$.

20   Results are exactly symmetric if instead $\alpha2$ is fixed and $\alpha1$ is allowed to vary.

21   Note that in this graph the area of blockaded entry is not shown but it exists. The decision of not showing was simply dictated by clarity purposes.

22   Fletcher, Amelia. "Predatory pricing in two-sided markets: A brief comment" Competition Policy International, Spring 2007, Vol. 3, No. 1.

23   Behringer, Stefan, and Lapo Filistrucchi. "Areeda–Turner in two-sided markets." Review of Industrial Organization 46, 3 (2015): 287-306.

24   See also DG Competition, "Communication from the Commission — Guidance on the Commission's enforcement priorities in applying Article 82 of the EC Treaty to abusive exclusionary conduct by dominant undertakings", OJEU 2009/C 45/02, of 24 February 2009, Recital 26, Footnote 3: "[…] in the case of two sided markets it may be necessary to look at revenues and costs of both sides at the same time."

25   Eisenmann, Thomas, Geoffrey Parker, and Marshall W. Van Alstyne. "Strategies for two-sided markets." Harvard Business Review 84, 10 (2006): 92.

26   Choi, Jay Pil, and Doh-Shin Jeon. "A Leverage Theory of Tying in Two-Sided Markets." (2016). Unpublished manuscript.

Part V. Efficiencies

7. Quantifying horizontal merger efficiencies in multi-sided markets: An application to stock exchange mergers

By Enrique Andreu and Jorge Padilla[1]

Abstract

Stock exchanges are platforms operating in multi-sided markets. Mergers between stock exchanges can produce significant efficiency benefits, some of which can accrue directly or indirectly to the users of the integrated exchange: intermediaries (brokers and dealers), final investors and issuers (listed companies). In particular, stock exchange integration can reduce the implicit costs of trading by increasing market liquidity. In this paper we investigate the liquidity implications of the integration of Euronext's cash market. We find that the series of cash mergers that led to the creation of Euronext had a positive impact on liquidity – namely, on bid-ask spreads, volatility and traded volume. This exercise illustrates how past mergers can be used to assess empirically the potential efficiencies resulting from mergers between platforms operating in multi-sided markets.

1. Introduction

Multi-sided markets are characterised by the presence of cross-platform welfare effects that users cannot internalise absent pricing and non-pricing co-ordination by a platform.[1] Those welfare effects can be *access externalities* (the benefit a user on one side of a platform generates for users on the other side of the platform) or *usage externalities* (the benefit a user on one side of a platform generates for a user of the other side of the platform when increasing the number of transactions in that platform).[2]

As explained by Wright (2004) and Evans and Schmalensee (2007), some of the standard economic intuitions that underpin antitrust policy and merger control in traditional (one-

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sided) markets need not apply in multi-sided markets.[3] In particular, mergers between platforms competing in multi-sided markets need not be anticompetitive. First, the merger may be welfare enhancing even when it leads to higher post-merger prices for both sides of the market because users on either side of the merged platform will benefit from increased access to a greater pool of users on the other side of platform.[4] Second, the merger may even result in a reduction in prices since the merged platform may internalise the cross-group externalities between the merging platforms: if the merging platforms become "interoperable",[5] then each of the merging platforms will lower prices to benefit from the increase in demand on the other platform.[6]

The empirical evidence of the price and welfare effects of mergers in two-sided markets is sparse. Some of these studies have focused on media markets, since those are considered to be good examples of two-sided markets. Chandra and Collard-Wexler (2009) investigated the price effects using data on a series of large merger in the Canadian newspaper industry in the late 1990s.[7] Chandra and Collard-Wexler employed difference-in-difference and difference-in-difference matching methods to compare price changes in newspapers which change hands with those that did not and found that these mergers did not lead to higher prices either for subscribers or advertisers. More recently, Jeziorski (2014) examines the effects of mergers in the U.S. radio industry.[8] He finds that they increase listener welfare marginally but have a more significant negative welfare effect on advertisers.

A few authors have conducted post-mortem econometric analysis of mergers (i.e. ex-post merger evaluations) among stock exchanges in order to assess their potential efficiencies, if any. Stock exchanges are widely considered to be multi-sided markets.[9] Stock exchange integration may in principle increase welfare by increasing market liquidity and, hence, reducing the implicit costs of trading. The reduction of implicit costs may in particular result from a reduction of bid-ask spreads or lower price volatility (because a larger and more stable order flow reduces the noise induced by individual orders). There are numerous mechanisms through which stock exchange mergers can increase liquidity and decrease users' implicit costs.[10] A merger between exchanges will increase liquidity if it helps intermediaries to defray the costs of access to the trading platform and of maintaining a continuous market presence. Standardised access to market data, indices and post-trading services helps also the liquidity of integrated cash markets. Also harmonised trading functionality, rules and regulations will reduce the regulatory costs of trading in different markets. In addition, liquidity will increase if the merger reduces adverse-selection costs, due to the presence of informed traders. This will happen if the merger has a positive impact on trading activity and the additional order flow comes mainly from uninformed traders or elicits more aggressive competition between informed ones. A stock exchange merger may also increase liquidity (and lead to lower bid-ask spreads) if it reduces the inventory-holding costs of market makers. This is because the merger is likely to make the order flow more predictable and lower the costs of rebalancing market-makers' inventories after the execution of large orders. Finally, liquidity may increase (and bid-ask spreads may fall) because the merger is likely to induce entry by market professionals operating elsewhere, as a result e.g. of harmonised rules and admission criteria, and thereby lead to greater competitive pressure both in quote-setting and in brokerage fees.

In the U.S., Arnold et al. (1999) studied the effects on liquidity of three successive mergers between regional U.S. stock exchanges in the 1940's and 1950's.[11] They found that the bid-ask spreads of merged exchanges were narrower than those on the remaining exchanges. The trend towards an efficient, consolidated capital markets infrastructure is

more recent in Europe than in the United States, but shows similar benefits. Pagano and Padilla (2005b) investigated the liquidity effects resulting from the integration of the French, Belgian, Dutch and Portuguese stock exchanges between September 2000 and November 2003.[12] These mergers led to the creation of Euronext. This sequence of mergers provides an extremely valuable natural experiment for the purposes of estimating the liquidity effects of cash exchange mergers. First, the multi-stage nature of the Euronext integration process – with three sequential mergers – makes it possible to better identify the liquidity impact of stock exchange mergers, as it allows the empirical estimation to deal more rigorously with spurious correlation. Second, since the timing of the three mergers was predetermined at the outset and there were no departures from the merger plan, there should be no concerns about reverse causality.

Pagano and Padilla (2005b) found that the creation of Euronext led to a reduction in the bid-ask spreads of the large-cap securities traded in Paris, Brussels, Amsterdam and Lisbon. They also found that the integration of those exchanges also led to an increase in traded volume and a reduction in volatility for those stocks. Nielsson (2009) also examined the liquidity effects of the Euronext integration process.[13] Unlike Pagano and Padilla (2005b), he analysed the impact of the merger on the liquidity of all firms' stocks listed in the Paris, Brussels, Amsterdam and Lisbon exchanges and not just large caps. Nielsson found that the Euronext mergers increased the liquidity and, therefore, reduced the implicit trading costs of large caps. However, he found no statistically significant effect of the merger on small and medium caps.

A difficulty with both studies is that their datasets are relatively limited and, in particular, the duration of the post-merger period is short. Pagano and Padilla (2005b) only had data until December 2004 – one year after the last integration event; Nielsson (2009) only until 2006. This raises the concern that the effects that they attribute to the Euronext mergers may not have been properly identified. Since the mergers took place at the time of the collapse of the dot.com bubble (2000-2002) and the recession of the European economy (2000-2001) and the U.S. economy (2002-2004), the post-merger increase in liquidity documented in these papers may simply reflect the growth of trading volumes in the aftermath of these crises.

Distinguishing between the liquidity effect of the mergers and these crises requires data on a longer post-merger period than that used in Pagano and Padilla (2005b) and Nielsson (2009). A longer post-merger period could help identify the effect of the mergers correctly because, unlike the effect of the crises, the liquidity impact of a stock exchange merger should be long lasting: the reduction in access costs, adverse selection costs, inventory costs, and the increase in the strength of competition among intermediaries resulting from the merger will likely persist indefinitely.

This paper thus revisits the analysis conducted by Pagano and Padilla (2005b) using data from December 2000 to December 2010 to test whether, other things equal, the mergers that led to the creation of Euronext had a long-lasting effect on bid-ask spreads, volatility and volume. Expanding the post-merger period requires controlling for the important changes in European cash trading that took place after the creation of Euronext. Most importantly, the Markets in Financial Instruments Directive (MiFID) led to the entry of new trading platforms (MTFs), which in a short time captured a significant market share and is likely to have had an effect on liquidity. In addition, Euronext implemented a tick size change in 2007, which is also likely to have had an impact on market liquidity.

Our results confirm Pagano and Padilla's conclusions and show that the impact on market liquidity that they identified is long lasting, as one would expect if those effects were

indeed caused by the creation of Euronext. Like them, we find that the creation of Euronext increased the liquidity of the merging exchanges. This led to a reduction in the bid-ask spreads and historical volatility of large-cap securities traded in Paris, Brussels, Amsterdam and Lisbon. The creation of Euronext also resulted in an increase in traded volume. These results are not only economically meaningful and statistically significant, they are also robust and unlikely to be explained by omitted variables and reverse causality (endogeneity).

This paper also investigates the potential liquidity impact of the merger between Euronext and the NYSE Group (NYSE). This merger took place in April 2007. Because, unlike the Euronext mergers, it did not involve the integration of the trading and clearing platforms of the merging parties, we would expect the merger to have no impact on liquidity. This is indeed what the data shows. We believe these results are consistent with our findings on the creation of Euronext and serve to confirm them, since testing for the liquidity impact of the merger between Euronext and the NYSE Group (NYSE) amounts to performing a "placebo test."

The remainder of this paper is structured as follows. Section 2 describes the integration process that led to the creation of Euronext and the subsequent changes to the industry. In Section 3 we investigate the impact of Euronext integration process on bid-ask spreads using different data sources and econometric models. Section 4 presents several robustness tests: using alternative integration dates, different measures of liquidity (volatility and traded volume) and alternative controls. In Section 5, we analyse the impact of the merger between NYSE and Euronext. Section 6 discusses the causal interpretation of the results in Sections 3 to 5. Finally, Section 7 concludes with some more general comments about the assessment of efficiencies in horizontal mergers in multi-sided industries. All tables and figures described in the text can be found in the annexes to the paper.

2. The creation of Euronext

The creation of Euronext in September 2000 resulted in the integration of the French, Belgian, Dutch, and Portuguese stock exchanges into a single trading and clearing platform. Prior to the creation of Euronext, there were four separate trading and three separate clearing platforms (Portugal had no CCP). Since November 2003, the users of the Paris, Brussels, Amsterdam, and Lisbon exchanges have operated on a single trading platform and a single clearing platform.

The integration of the cash markets that formed Euronext proceeded in stages. First, the trading platform of the Paris market –the NSC system– became the platform for the other three cash markets. In May 2001, the Brussels exchange migrated its trading platform to the NSC system. Amsterdam followed suit in October 2001. Cash trading fees were harmonised across Amsterdam, Brussels and Paris. The Lisbon exchange migrated to the NSC system in November 2003.

The exchanges that form Euronext also integrated their clearing platforms. That process took place in parallel, but with some delay, relative to the integration of the cash trading platforms. The Paris market adopted the externally sourced Clearing 21 system in September 2000. The Brussels cash market was migrated to the Clearing 21 system in March 2002, while Amsterdam migrated in October 2002. Clearing operations across the three locations were consolidated into Clearnet SA. Clearing in Lisbon was created in November 2003.

Following Pagano and Padilla (2005b) our analysis considers the liquidity impact of the migration of cash trading and clearing on the Amsterdam, Brussels, Paris and Lisbon cash markets onto common trading and clearing platforms. However, we have also analysed the potential effect of the integration of the trading platforms as a robustness test.

Since the creation of Euronext in November 2003 several events are likely to have impacted the liquidity of the securities traded in Euronext. We highlight (and control for) two such events in this paper. First, in November 2007 competitive trading platforms known as multilateral trading facilities (or MTFs) entered the European cash trading market. They have grown rapidly since then. MTFs are trading systems that make cash instruments from different exchanges or sources available for trading. Currently there are over five different pan-European blue-chip MTFs operating in Europe, the largest of which is Chi-X. Second, in 2007 the Euronext tick size (the minimum price increment at which trades may be made) was reduced and this is likely to have had an impact on liquidity. Previous empirical literature has found that a reduction in the tick size leads to a bid-ask spread reduction. This is because investors are able to tighten their quotes when the minimum price increment becomes smaller.

3. An econometric analysis of Euronext bid-ask spreads

In this section we analyse the impact of the creation of Euronext on bid-ask spreads using standard multiple regression techniques. Bid-ask spreads are the most-often used indicator of cash trading liquidity. We first describe the bid-ask spread data we use, the methodology employed and our main results.

Bid-ask spread data

We use the bid-ask spread measure calculated by Bloomberg for the main securities traded in Amsterdam, Brussels, Lisbon and Paris exchanges. The *Bloomberg's bid-ask spread* is defined as the difference between the daily closing ask price (P_A) and the daily closing bid price (P_B), normalised as follows:

$$Bid - Ask\ Spread = \frac{(P_A - P_B)}{\big((P_A + P_B)/2\big)},$$

This bid-ask spread measure has been calculated using bid and ask prices provided by Bloomberg for each of the securities included in the main indices of the Paris, Brussels, Amsterdam and Lisbon stock exchanges: CAC 40, BEL 20, AEX, and PSI, respectively. We have data on a daily basis for the period between 1 December 2000 and 31 December 2010: 362,103 observations.[14,15]

Figure A.1 in Annex A plots estimated year-month fixed effects for a model of the bid-ask spread on stock *i* at time *t* for each of the stock exchanges under analysis. It shows us the evolution of the average (across stocks, within month) bid-ask spread on each stock exchange. For the Amsterdam, Belgium, and Paris exchanges, the basic pattern in the data is: bid-ask spreads remain flat up to 2002 and fall during the post-merger era (until the crisis hits in 2007 and 2008, when bid-ask spreads rise and then subsequently decline as we move into 2010).

Econometric methodology

In order to assess the impact of the creation of Euronext on market liquidity, we conduct a multi-stage *before and after* analysis around the three key integration milestones: (1) the integration of the clearing and trading functions of the Paris and Brussels stock exchanges in March 2002; (2) the integration of the Amsterdam trading and clearing system into Euronext in October 2002; and (3) the integration of the Lisbon stock exchange in November 2003. That is, we compare the daily bid-ask spreads defined above *after* each of the integration dates with the same daily bid-ask spreads *before* integration. Our basic models relate our bid-ask spread measure with an *integration dummy* that equals 1 after integration and 0 before integration.

To isolate the impact of the creation of Euronext on bid-ask spreads, we control for other factors that may explain differences in bid-ask spreads over time and across securities traded on the different exchanges. This requires using multiple regression techniques.[16] We include in our basic regression model security fixed effects, a measure of market volatility and indicator variables for relevant macroeconomic, political, and regulatory events.[17] These variables take into account that differences in bid-ask spreads between securities may persist over time and that bid-ask spread fluctuations may be driven by factors other than the integration. We also included controls for volume and volatility from non-Euronext exchanges, domestic GDP per capita, the volume traded at MTFs, and an indicator variable to capture the effect of Euronext's tick change in 2007.

More formally, we estimated a security-level panel-data model using Bloomberg's daily, security-level bid-ask spread data and a security-level panel-data model using Euronext's security-level weighted average bid-ask spread data. We used a panel data approach because this allows us to (1) avoid complex aggregation issues, (2) estimate the impact of integration on all the exchanges of the Euronext platform in a single regression, and (3) obtain estimates for the impact of integration in the various exchanges of Euronext that can be readily compared.

Our basic security-level panel-data model can be formally written as,

$$y_{it} = \alpha + \beta_1 \, Integration_{it} + \beta_2 \, Z_{it} + \beta_3 \, X_{it} + \eta_i + \lambda_t + \varepsilon_{it}$$

where:[18]

- y_{it} is the natural logarithm of the bid-ask spread of security i at period t.
- *Integration$_{it}$* is a dummy variable that takes the value of 1 for any security i and period t after the integration of the trading and clearing platforms of the exchange where security i is traded, and 0 otherwise. The sign of the coefficient of the integration dummy characterises the relation between the bid-ask spread and the creation of Euronext. A negative sign would indicate that bid-ask spreads declined (and thus liquidity increased) as a result of the creation of Euronext.
- Z_{it} is a vector of variables that control for other determinants of the liquidity of the market. We included: the (20-day) historical volatility of the FTSE100 and DAX indices (source: Bloomberg); the traded volume on the Frankfurt exchange (source: Deutsche Börse); a tick size dummy, which takes a value of 1 after 2007 and is equal to 0 before then;[19] the per capita GDP of each of the countries with Euronext exchanges (source: Eurostat); and the volume traded at MTFs (source: Bloomberg).[20]

The first two controls are meant to capture common trends of a global or pan-European nature that could have affected the bid-ask spreads of Euronext's large-cap securities and that have nothing to do with the process of formation of Euronext. We would expect to find a positive relation between bid-ask spreads and the volatility of the FTSE100 and DAX indices, and a negative relationship between bid-ask spreads and the volume traded on the Frankfurt exchange, a proxy for market growth. The tick size dummy is meant to capture the impact on liquidity of the reduction in tick size implemented in all Euronext exchanges in 2007. We introduce a GDP per capita measure because it may drive the volume traded in each of the four Euronext exchanges. Increases in volume may have an impact on liquidity and, hence, on bid-ask spreads. Finally, the volume traded at MTFs may also have had an impact on the liquidity of the regulated exchanges that integrated Euronext and thus on their bid-ask spreads. The sign of this variable may be negative (if it proxies an increase in overall traded volume) or positive (if MTFs divert significant liquidity out of the regulated exchanges).

- X_{it} is a vector of dummy variables that controls for some relevant economic and political events. These events may have affected the liquidity of the Euronext exchanges before and after the creation of Euronext (see the list of events considered in Annex 2).
- η_i is a vector of fixed effects: one per security. These dummies are introduced to capture security-specific factors that may influence the liquidity of those securities and that are independent of the process of integration.
- λ_t is a vector of monthly fixed effects. These dummies control for monthly-specific shocks that may have affected liquidity in the stock exchange markets under consideration and that have nothing to do with the process of integration.
- ε_{it} denotes the standard statistical error.

This panel data model is estimated using ordinary least squares (OLS). We calculate robust standard errors, clustering at the security level to allow for heteroskedasticity and autocorrelation of the errors. Because the creation of Euronext was triggered by an exogenous policy decision, we can safely place a causal interpretation on the econometric estimates for the *Integration* dummy, provided other relevant changes in the economic environment are controlled for. Causality runs from the integration events to the estimated changes in liquidity.[21]

Econometric results

This Section reports the results of the econometric estimation of the basic model described above.[22] Table D.1 (Annex D) presents the results of our empirical analysis using the Bloomberg measure of the daily bid-ask spreads of the securities included in the main indices of the Amsterdam, Brussels, Lisbon and Paris stock exchanges. Column (1) describes the impact of integration on the average bid-ask spread of the securities listed in those exchanges. Columns (2) and (3) replicate the model in Column (1) controlling for changes in the volatility of the DAX index[23] and in the volume traded on the Frankfurt exchange. These controls are added to take account of potential liquidity trends that are unrelated to the creation of Euronext. Column (4) also includes the effect of the Euronext tick size reduction in 2007, and Columns (5) and (6) control in addition for the entry and growth of MTFs and changes in per capita GDP in each of the four Euronext countries. Once again, the logic behind these controls is to isolate the liquidity impact of the creation of Euronext and avoid confounding it with the effects of these other variables.

The regressions in all columns include monthly dummies, security dummies and dummies controlling for a few salient events that may have affected the behavior of bid-ask spreads in the relevant exchanges. Across all specifications we find that the average bid-ask spreads of the securities included in the main indices of the Paris, Brussels, Amsterdam and Lisbon stock exchanges fell as a result of the creation of Euronext. This effect is statistically significant in Columns (1) to (3) which include controls for changes in the volatility of the securities listed in the DAX and traded volumes on the Frankfurt exchange. Both of these control variables have the expected sign (positive for volatility and negative for traded volumes) and are statistically significant.

However, when we include the indicator for the change in the tick size, the growth of MTFs and GDP per capita as controls, the estimated impact of the integration continues to be negative but is no longer statistically significant. Each of the additional control variables has an impact on bid-ask spreads that is consistent with finance and economic theory. The tick size reduction led to a reduction in the bid-ask spread as did the increasing volume of trades on MTFs and the GDP per capita.

The loss of statistical significance of the integration dummy in Columns (4) to (6) should not be a matter of concern, as is most likely due to multicollinearity.[24] A way to test for this is to disaggregate the impact of integration to consider the changes in bid-ask spreads resulting from each of the three steps in the creation of Euronext. The sequential nature of Euronext's integration process allows the empirical analysis to control in part for spurious correlations that could bias the estimation of the impact of integration.

This can be done in two alternative ways. First, we define three different integration dummies: *Phase 1* (which equals 1 for any security i and period t after the integration of Brussels with Paris if security i is traded either in Brussels or Paris, and 0 otherwise); *Phase 2* (which equals 1 for any security i and period t after the integration of Amsterdam if security i is traded either in Brussels, Paris or Amsterdam, and 0 otherwise), and *Phase 3* (which equals 1 for any security i and period t after the integration of Lisbon if security i is traded either in Brussels, Paris, Amsterdam or Lisbon, and 0 otherwise). This approach makes it easier to disentangle the liquidity impact of the integration from the effects of other unrelated changes that may have occurred post-merger.

Table D.2 (Annex D) presents the results of this alternative modelling approach. We find a statistically significant and material decline of the average bid-ask spreads of the securities included in the main indices of the Paris, Brussels, Amsterdam and Lisbon stock exchanges as a result of the creation of Euronext under all specifications (i.e., in Columns (1) to (6)). In particular, *Phase 1* and *Phase 3* are statistically significant even when we include the indicator for the change in the tick size, the growth of MTFs and GDP per capita as controls. Note also that the estimated coefficients of all of the control variables continue to be statistically significant and have signs which are consistent with economic and finance theory. The estimated coefficients of the three phase variables in Columns (5) and (6) imply that the creation of Euronext has led to a non-transitory reduction in bid-ask spreads of approximately 50%. Columns (5) and (6) also show that the largest decline occurred when the Brussels and Paris exchanges were integrated. The subsequent integration of the Amsterdam and Lisbon exchanges had a smaller impact on the bid-ask spreads.

An alternative approach is to replace the integration dummy in Table D.1 by four country-specific integration dummies: *Paris* (which takes a value of 1 for any security i traded in Paris and period t after the integration of Brussels with Paris, and 0 otherwise); *Brussels* (which takes a value of 1 for any security i traded in Brussels and period t after

the integration of Brussels with Paris, and 0 otherwise); *Amsterdam* (which takes the value of 1 for any security i traded in Amsterdam and period t after the integration of Amsterdam in the Euronext platform, and 0 otherwise); and *Lisbon* (which takes the value of 1 for any security i traded in Lisbon and period t after the integration of Lisbon in the Euronext platform, and 0 otherwise). These variables may capture the differential effect of integration on the Paris, Brussels, Amsterdam and Lisbon markets. This is important since the liquidity impact of Euronext's creation may have been different in the various exchanges, reflecting differences, among other things, in size, depth and breadth.

Table D.3 (Annex D) presents the results of this alternative modelling approach. We find that the negative effect of integration on the average bid-ask spread identified in Table D.2 is largely driven by the effect of integration on the liquidity of the securities listed in the CAC 40 and the BEL 20. Note that this is true even after controlling for the change in the tick size in 2007, the entry and subsequent growth of MTFs, and GDP per capita. From Columns (4) and (5), we observe that the average bid-ask spread of the securities in the CAC 40 fell approximately 59% as a result of integration. The bid-ask spread of the securities in the BEL20 fell approximately 25%. These effects are material and statistically significant. The results for Amsterdam are not so clear cut, however. We find that while the impact of integration on the bid-ask spreads of the securities listed in the Amsterdam index was to reduce spreads, the relation is not statistically significant. Finally, we note that integration led to an increase of the bid-ask spreads in Lisbon.[25]

4. Robustness tests

In this section we report the results of several robustness tests.[26] First, we repeat the various analyses in Section III using different integration milestones: we employ as relevant cut offs the dates at which the trading platforms of the different exchanges were integrated, as opposed to the dates at which their clearing platforms were integrated. Second, we investigate the impact of the creation of Euronext on alternatives measures of liquidity: volatility and volume. Third, we present the results of our econometric analysis adding the price of the securities and market capitalisation as additional explanatory variables. The results of these robustness checks confirm the main findings of Section III, namely that the creation of Euronext increased the liquidity of the merging exchanges and, therefore, reduced the implicit costs of trading. The increase in liquidity is reflected in lower bid-ask spreads even after using alternative integration dates. It also results in lower volatility and higher volume.

Alternative integration milestones

Using Bloomberg's bid-ask spread data, we analyse the impact of the creation of Euronext on liquidity using the dates of trading platform integration as the cut off points that separate the three different phases of the creation of Euronext: the merger of Paris and Brussels, the integration of Amsterdam and the integration of Lisbon. We employ the same methodology and control variables as in section III, but for expositional simplicity restrict attention to the regression using the *Phase 1*, *Phase 2* and *Phase 3* dummies as dependent variables.

Table E.1 presents the results of the econometric analysis. As above we comment the results reported in Columns (5) and (6) only, because they include all relevant controls.[27] The three integration dummies have a negative sign, indicating that each of the three exchange mergers had a positive impact on liquidity and, hence, led to a reduction in the implicit costs of trading. The estimates of the coefficients for *Phase 1* and *Phase 3* are

statistically significant. While the coefficient for the *Phase 2* dummy is not statistically significant, this does not necessarily imply that the merger of Amsterdam had no liquidity impact. This is because the integration of Amsterdam into Euronext took place only five months after the integration of Paris and Brussels and, as a result, our model may not be able to estimate with sufficient precision the effect of *Phase 2* of the integration process. The largest decline in bid-ask spreads occurred at the time of the integration of the Paris and Brussels exchanges.

Alternative measures of liquidity

We analyse the impact of the creation of Euronext on two additional liquidity measures: volatility and volume.[28]

Impact on volatility

Other things equal*,* markets with a large number of traders (i.e., thick markets) are less volatile than thinner markets. Larger and more stable order flows in thick markets reduce the noise induced by individual orders, since they tend to average out and, therefore, to exert less pressure on prices. Moreover, thick markets have a tighter bid-ask spread and thus the "bid-ask price bounce" induced by large orders is smaller. In addition, the price concession necessary to execute a large order is smaller in thick markets because there is a greater likelihood of finding a trading counterparty. For all these reasons, a merger between exchanges that results in a thicker market should lead also to lower volatility.[29]

Following Pagano and Padilla (2005b), we analyse the impact of integration on volatility using 20-day historical volatility data for the securities included in the CAC 40, BEL 20, AEX, and PSI. The source of this data is Bloomberg. We have data on a daily basis for the period between 3 January 2000 and 31 December 2010. The number of observations is 365,335. We use the same econometric methodology employed in section III. We include all controls used above plus, in addition, the historical volatility of the CAC 40, BEL 20, AEX, and PSI indices. We introduce this variable as an additional way to isolate, to the extent possible, the effect of integration on volatility from other confounding factors such as shocks to the global or European economy, or shocks that are idiosyncratic to the exchanges considered but are not related to the integration process.[30]

Table E.2 presents the results of the econometric analysis of the impact on volatility of the creation of Euronext using *Integration* as the dependent variable. We find that the historical volatility of the large-cap securities traded in Paris, Brussels, Amsterdam and Lisbon fell as a result of the creation of Euronext. This effect is statistically significant in all specifications. It is also material from an economic viewpoint. According to the estimation in Columns (6) and (7), which are the ones that we prefer given that they include all relevant controls, volatility fell on average approximately 9% once the integration of the four exchanges was completed.

Impact on volume

We also analyse the impact of the creation of Euronext on traded volume, measured for the purposes of this analysis by the number of shares traded for the securities included in the CAC 40, BEL 20, AEX, and PSI. The number of shares traded for these securities has been obtained from Bloomberg. We have data on a daily basis for the period between 3 January 2000 and 31 December 2010. The number of observations is 382,146. Once again we use the same methodology and the same control variables as in section 3.

Table E.3 presents the results of the econometric analysis. We find that traded volume in the Paris, Brussels, Amsterdam and Lisbon exchanges increased as a result of the creation of Euronext. This effect is statistically significant. It is also material from an economic viewpoint. According to the estimations in Columns (5) and (6), which are the ones that we prefer given that they include all relevant controls, volume increased by approximately 25% in the period after the integration. A thicker market (i.e., a market with more traders and greater traded volume) is a more liquid market.[31] Therefore, our findings on the effect of the Euronext mergers on traded volume confirm our previous results on bid-ask spreads and volatility: the Euronext mergers increased liquidity.

Additional control variables

The regression models described above are used to estimate the impact of integration on the average bid-ask spread of the securities listed in those exchanges controlling for changes in the volatility of the DAX index, the volume traded on the Frankfurt exchange, the effect of the Euronext tick size reduction in 2007, the entry and growth of MTFs and changes in per capita GDP. These controls are included in the regression model to isolate the liquidity impact of the creation of Euronext from the effect of these other variables on the bid-ask spread. As a further robustness test on the results, we re-estimated our models including the price of the securities and market capitalisation as additional explanatory variables.[32] The detailed regression results are shown in Tables E.4 to E.9 in Annex E below. We find that the inclusion of theses variables does not alter the conclusions of the analysis reported by the Parties. In particular, we continue to find that the integration of Euronext's clearing and trading platforms led to a statistically significant and economically material increase in liquidity, as measured by the (normalised) bid-ask spread.

5. The NYSE- Euronext merger

The NYSE- Euronext merger took place in April 2007. In this section, we explore the impact of the NYSE-Euronext merger in April 2007 on the bid-ask spreads of the Euronext exchanges. We would expect to find no statistically significant impact of the merger on bid-ask spreads, given that the merger did not involve the integration of the trading and/or clearing platforms of NYSE and Euronext. We use the same methodology and the same control variables as in section 3, except that we add a dummy variable (*NYSE merger*) that takes the value of one after 4 April 2007 and zero otherwise. We restrict the sample to three years before and after the NYSE-Euronext merger to isolate the impact of this event. Estimation results are presented in Table F.1 (Annex F).[33] We find no effect of the merger once we control for the tick size reduction and the entrance of MTFs. This implies that the liquidity effects that we have identified in this paper are not due to a mere change in ownership but rather the consequence of the integration of the underlying trading and clearing platforms of the merging exchanges.

6. Identification and causality

Our econometric results show that exchange mergers that result in the integration of the underlying trading and clearing platforms produce material liquidity effects, which reduce the *implicit* cost of trading and thus ought to benefit market participants and offset the potentially adverse impact of the merger on exchange fees (i.e. the *explicit* cost of trading). However, before these results can be extrapolated to other mergers across stock changes, a few comments on endogeneity and causality are in order.

First, the multi-stage nature of the Euronext integration process –with three sequential mergers– makes it possible in our opinion to identify the liquidity impact of stock exchange mergers. In particular, we agree with Pagano and Padilla (2005b) and Nielsson (2009) that the staggered introduction of merger events across the four participating exchanges allows the empirical estimation to deal more rigorously with spurious correlation.

Second, to the best of our knowledge, the timing of the four mergers was predetermined at the outset and there were no departures from the merger plan. Therefore, we believe that there are no reasons to doubt the causal interpretation we have given to our regression results. We find no reason to be concerned about reverse causality and spurious correlation. There is no evidence that liquidity increased in the years prior to the merger. There is also no evidence that a third omitted factor triggered the mergers and the change in liquidity.

In particular, there is no evidence of a downward trend in the data,[34] as we proceed to discuss. Note first that if there was an omitted trend, we would expect the residuals of a model like those reported in Section 3 which excluded the integration dummies, $Integration_{it}$, to show a continuously declining trend. However, as shown in Figure G.1 in Annex G, this is not the case. (Dotted lines show the integration dates.) The time evolution of the residuals (the bid-ask component not explained by all relevant controls except the merger integration indicators) reveals that the main trends present in the original data are properly captured by the control variables included in the models presented in Section III. The difference between actual and predicted bid-ask spreads follow a stable pattern during the pre-merger period and then during the post-merger. However, it falls significantly below their pre-merger mean value once exchanges are integrated into Euronext, indicating the presence of a level shift following the mergers. Thus, the analysis of the difference between actual and predicted bid-ask spreads does not show a downward trend prior to the integration of the Euronext exchanges. On the contrary, the graphical analysis show a different evolution of the bid ask spreads before (fluctuating around a stable mean) and after (decreasing over time) the integration of the exchanges. In other words, it appears to require the introduction of step functions like the integration dummies in the models of Section III.

We have tested for the existence of an omitted trend indicating a general trend toward increasing liquidity that was unrelated to the Euronext integration more formally. In particular, we have modified the models in Section III above by removing the integration dummies, $Integration_{it}$, and introducing instead a series of quarter-year fixed effects for each exchange. That is, for each exchange, we have introduced as many dummy variables as quarters in the sample; each quarter dummy takes a value of 1 in that quarter and 0 otherwise. We have then estimated the exchange by exchange, instead of pooling all exchanges into a single regression. The results are consistent with those in Section III above.[35] Figure G.2 in Annex G shows the results of the estimated quarterly fixed effects of the modified. None of these estimates shows a downward trending pattern, which further confirms that the effects of the Euronext mergers are not picking up an omitted long-term trend.

Third, the mergers that gave rise to Euronext involved exchanges with a similar structure. They were all hybrid markets with limit order book emphasis. They had all introduced an order driven, electronic, continuous market at the time of the merger. Therefore, the liquidity impact we have identified cannot be attributed to changes in market structure.

Fourth, while Amsterdam had demutualised in 1997, a few years before its integration in Euronext, the other three mergers demutualised as part of the merger. This may raise doubts about whether the liquidity impact that we have attributed to the mergers is instead the effect of demutualisation. We do not believe that this alternative explanation is correct. While the economic literature has found that demutualisation is likely to have an impact on the liquidity of the newly demutualised exchange,[36] there is no evidence of effects across exchanges. However, we find evidence that each sequential merger had a positive impact on the liquidity of the Paris and Brussels exchanges. We also find evidence that the integration process increased liquidity in Amsterdam, which as noted before had demutualised prior to the merger.

Fifth, our results on the liquidity effect of the merger cannot be attributed to tick size harmonisation. This is for the following reasons: (a) the Paris exchange – which benefited most from the merger in terms of increased liquidity – introduced new tick sizes in 1999, before the start of the integration; (b) Amsterdam and Lisbon aligned their tick sizes to the Paris model in dates that did not overlap with the merger dates; (c) while changes in tick size may have an impact on the liquidity of the stock exchange where the tick change occurs, we find evidence that each merger had an impact on the other participating exchanges; and (d) we find a permanent effect of each phase of integration even after controlling for the tick change of 2007, which does not square with an alternative interpretation that attributes the liquidity effects of the creation of integration to the process of tick size harmonisation that run parallel to the integration process.

Sixth, the Euronext integrations pre-dated the introduction of MTFs. The effects that the model identifies are therefore clearly attributable to the mergers. However, our econometric analysis of efficiencies in the cash market also indicates that the introduction and subsequent growth of MTFs led to a statistically significant increase in liquidity, i.e. a reduction in bid-ask spreads and volatility and an increase in traded volume. There is no contradiction between the positive effects of exchange fragmentation, which results in increasing competition for a given security and, hence, a possible reduction in the *explicit* cost of trading and integration, and exchange integration, where different securities traded in different venues are pooled together and distributed to a wider set of traders.

7. Concluding remarks

Stock exchanges are platforms that co-ordinate traders willing to sell with those willing to buy. Because traders in either side can be inefficiently rationed and not all traders provide good matchings to their potential counterparts, stock exchanges are clear-cut examples of multi-sided platforms. Therefore, mergers between exchanges need not lead to higher prices and, on the contrary, are likely to benefits all, or some, of the market participants by increasing liquidity. In this paper we have shown that the efficiency effects of mergers in multi-sided markets, such as stock exchanges, are not merely theoretical and can be assessed using standard econometric techniques. Note finally that while some of these efficiencies might have been clawed back in the form of higher trading fees, a significant share of them must have been appropriated by the users of Euronext. This would be true in a one-sided market, since not even a monopolist would normally be able to fully appropriate these demand-side efficiencies, but is even more so in multi-sided markets, where post-merger price competition may be fiercer.

This paper illustrates how the efficiencies created by the merger of two or more platforms can be estimated empirically ex post. The so-called *post-mortem approach* to the quantification of horizontal merger efficiencies requires estimating the link between past

concentrations and platform measures which directly or indirectly capture the magnitude of the access and usage externalities benefiting users on both sides of the platform. As we have seen above, this is a complex exercise because it requires controlling for possible confounding factors, taking into account the potential endogeneity of the mergers, performing robustness tests, etc. Extrapolating the results of ex-post analyses of this sort when reviewing a new merger is also challenging, since not all mergers are equal and the market context where the past mergers took place may not resemble that applying to the new transaction. However, none of this means that this approach has no value. The alternative is to simulate the impact of the platform merger on users' utilities or profits. This requires estimating demand functions on both sides of the market, including direct and indirect network effects, which is a much more complex exercise. Besides the usual complexity in demand estimation, these simulations must take account of the degree of interoperability across the merging platforms that existed pre-merger and of the prevalence of multi-homing in one or more market sides .

Annex A. Descriptive statistics

Table A.1 provides descriptive statistics on the (normalised) bid-ask spreads provided by Bloomberg.

Table A.1. Descriptive statistics for the Bloomberg-based bid-ask spreads of large caps in Paris, Brussels, Amsterdam and Lisbon, 3 January 2000 – 31 December 2010here

Index	Number of observations	Average	Standard deviation	Minimum	Maximum
Amsterdam (AEX)	98,613	0.012	0.052	0	1.887
Belgium (BEL)	69,892	0.005	0.013	0	1.78
Paris (CAC)	114,825	0.002	0.003	0	0.479
Lisbon (PSI)	78,773	0.012	0.060	0	1.995

Source: Bloomberg e.

Figure A.1. Estimated year-month fixed effects – Bid-ask spread for AEX, BEL, CAC, and PSI securities. Jan 2000-Dec 2010
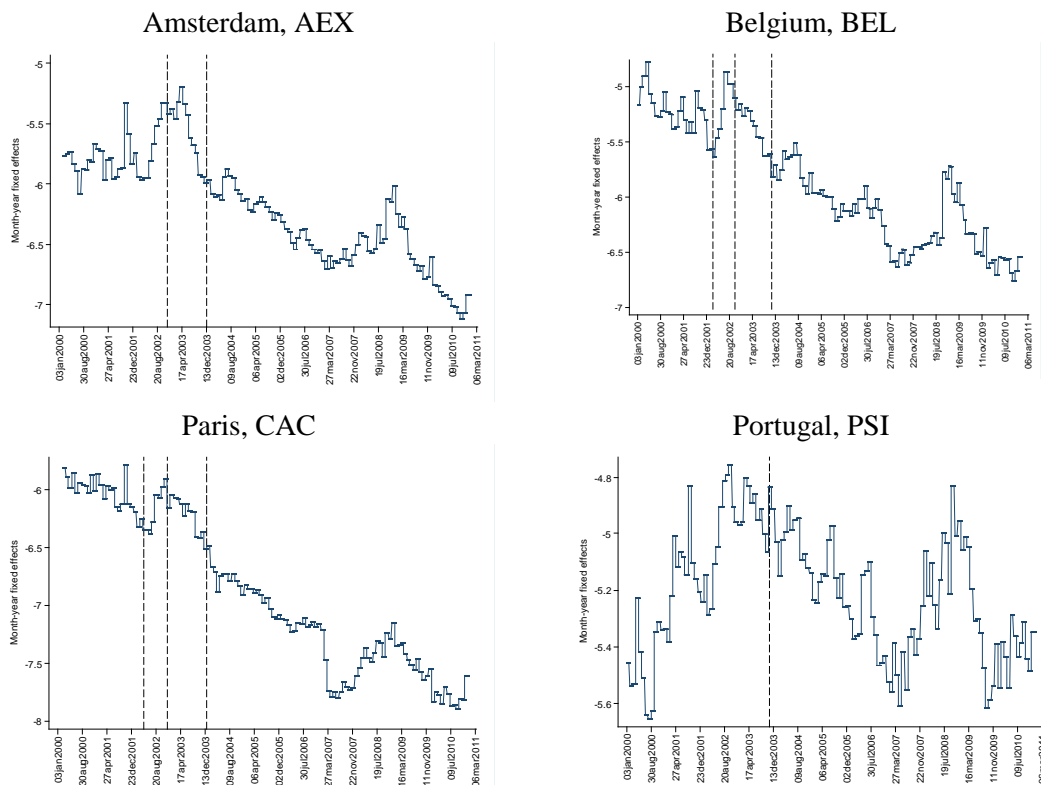
Note: The vertical lines indicate the different consolidation dates of the Paris, Brussels and Amsterdam exchanges into Euronext. The first line shows the integration of the Paris and Brussels exchanges, the second one the integration of the Amsterdam exchange and the third one, the integration of the Lisbon exchange..
Source: Bid-ask spreads calculated using price data provided by Bloomberg.

Annex B. List of events

April 18, 2000	Crash of high-tech share values
May 3, 2001	New economic regulation in France - financial, competition and enterprise regulations
September 11, 2001	Terrorist attacks in New York and Washington D.C.
October 8, 2001	Invasion of Afghanistan
December 3, 2001	Enron bankruptcy filed and Argentine financial crisis
October 14, 2002	Bali terrorist attack
March 21, 2003	Invasion of Iraq
March 11, 2004	Terrorist attacks in Madrid
May 29, 2005	Rejection of European Constitution by France
July 7, 2005	London terrorist bombings
October 27, 2005	French riots
May 2006	Bird flu outbreak
July 12, 2006	War in Lebanon
October 24, 2007	Merrill Lynch announces $8.4 billion loss
March 16, 2008	Bear Stearns acquired by JPMorgan Chase
September 6, 2008	Fannie Mae & Freddie Mac acquired by US Government
September 15, 2008	Lehman Brothers bankruptcy
September 16, 2008	Loan to AIG to avoid bankruptcy
October 3, 2008	TARP bill enacted with $700 billion in bailout funds
October 8, 2008	UK bailout package worth £500 billion
December 11, 2008	Madoff arrested for Ponzi scheme
January 18, 2009	RBS announces largest corporate loss in UK history
August, 2009	H1N1 flu
August 7, 2008	War in Georgia, Russia
November 26, 2009	Dubai defers debt
April 15, 2010	Iceland volcanic ash
May 2, 2010	Greek €110 billion loan agreement reached

Annex C. Dataset description

Table C.1. Dataset description

Variable	Description	Data Source	Mean	Std. Deviation	Min	Max
Dependent Variables						
Normalised bid-ask spread	The normalised difference between the daily closing ask price and the daily closing bid price for each of the constituent securities of the CAC 40, the BEL 20, the AEX and the PSI indices.	Bloomberg [1]	0.01	0.04	0	2.00
Number of shares (Millions of trades)	The daily number of shares traded of each of the constituent securities of the CAC 40, the BEL 20, the AEX and the PSI indices.	Bloomberg [1]	2.31	4.84	0	309.84
20-Day historical volatility	The annualised standard deviation of the daily returns of each of the constituent securities of the CAC 40, the BEL 20, the AEX and the PSI indices over a 20 day window. Returns are computed using last prices.	Bloomberg [1]	0.22	0.23	0	5.62
Explanatory variables:						
DAX volatility	The annualised standard deviation of the daily returns of the DAX index over a 20 day window. Returns are computed using last prices.[3]	Bloomberg	0.14	0.08	0.04	0.51
FTSE100 volatility	The annualised standard deviation of the daily returns of the FTSE100 index over a 20 day window. Returns are computed using last prices.	Bloomberg	0.12	0.07	0.03	0.52
Traded volume on the Frankfurt exchange (Millions of trades)	Monthly number of shares traded on the Frankfurt exchange. It corresponds to the traded volume registered at Xetra.	Deutsche Börse	771.92	252.15	328.1	1836.23
MTF volume (Millions of trades)	Daily total number of shares of CAC 40, BEL20, AEX and PSI securities traded in Chi-X and Bats.[4]	Bloomberg	44.21	36.65	0	266.03
Per capita GDP	Yearly, Euros per inhabitant	Eurostat				
		France	24,627	638	23,700	25,600
		Belgium	25,872	958	24,600	27,200
		Netherlands	27,672	1,256	26,300	29,700
		Portugal	12,627	179	12,400	12,900

Notes: (1) Data includes all securities that have composed each of the main indices at any point in time during the sample period. Ask price mnemonic: Px_Ask; bid price mnemonic: Px_Bid; volume mnemonic: Px_Volume; last price mnemonic: Px_Last.

(2) There are 17,295 observations with a zero bid-ask spread.

(3) There are no last prices for the DAX index on the 24th and 31st of December of each year.

(4) Statistics are calculated over the period with positive MTF volumes (from April 2007 onwards).

Annex D. Econometric results – Baseline

Table D.1. Impact of integration on the normalised bid-ask spreads of large caps in Paris, Brussels, Amsterdam and Lisbon, 3 January 2000 – 31 December 2010

Ln (bid-ask spread)	1	2	3	4	5	6
Integration	-0.590***	-0.530***	-0.119**	-0.071	-0.068	-0.019
	[0.000]	[0.000]	[0.024]	[0.174]	[0.193]	[0.698]
DAX volatility (log of)		0.245***	0.365***	0.406***	0.418***	0.359***
		[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Traded volume on the Frankfurt exchange (log of)			-0.911***	-0.314***	-0.307***	-0.166***
			[0.000]	[0.000]	[0.000]	[0.000]
Tick change dummy				-0.519***	-0.322***	-0.047
				[0.000]	[0.000]	[0.590]
Per capita GDP						-4.859***
						[0.000]
MTF volume (log of)					-0.012**	-0.022***
					[0.016]	[0.000]
Constant	-4.666***	-4.146***	16.643***	3.243***	3.076***	49.412***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Security fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	362,103	357,936	332,831	332,832	332,831	332,831
R-squared	0.523	0.533	0.570	0.590	0.599	0.603

Notes:

(a) Robust p-value in brackets, clustered by security to allow for heteroskedasticity and autocorrelation within securities. Estimation residuals are stationary according with the Fisher stationary test for panel regressions. See Maddala, G.S. and S. Wu (1999) "A comparative study of unit root tests with panel data and a simplified test", Oxford Bulleting of Economics and Statistics, pp. 631-652.

(b) * significant at 10%; ** significant at 5%; *** significant at 1%.

(c) The sample is composed by 158 large caps. It includes securities that have composed the main index of the Paris, Brussels, Amsterdam and Lisbon exchanges (the CAC 40, BEL20, AEX and the PSI) at any point throughout the sample period.

(d) Bid-ask spreads calculated using price data provided by Bloomberg.

Table D.2. Impact of integration on the normalised bid-ask spreads of large caps in Paris, Brussels, Amsterdam and Lisbon by phases, 3 January 2000 – 31 December 2010

Ln (bid-ask spread)	1	2	3	4	5	6
Phase 1	-0.344***	-0.356***	-0.14	-0.238**	-0.241**	-0.259**
	[0.004]	[0.003]	[0.219]	[0.031]	[0.029]	[0.016]
Phase 2	-0.155	-0.168	-0.187*	-0.174*	-0.175*	-0.125
	[0.160]	[0.120]	[0.050]	[0.065]	[0.062]	[0.115]
Phase 3	-0.570***	-0.519***	-0.310***	-0.172***	-0.164***	-0.117**
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.016]
DAX volatility (log of)		0.109***	0.225***	0.306***	0.317***	0.307***
		[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Traded volume on the Frankfurt exchange (log of)			-0.642***	-0.177***	-0.173***	-0.110***
			[0.000]	[0.000]	[0.000]	[0.002]
Tick change dummy				-0.461***	-0.332***	-0.180*
				[0.000]	[0.000]	[0.053]
Per capita GDP						-2.669**
						[0.047]
MTF volume(log of)					-0.008	-0.014**
					[0.106]	[0.018]
Constant	-4.530***	-4.304***	10.500***	0.08	0.001	25.781*
	[0.000]	[0.000]	[0.000]	[0.921]	[0.999]	[0.054]
Month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Security fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	362,103	357,936	332,831	332,831	332,831	332,831
R-squared	0.558	0.563	0.597	0.606	0.606	0.607

Notes:

(a) Robust p-value in brackets, clustered by security to allow for heteroskedasticity and autocorrelation within securities. Estimation residuals are stationary according with the Fisher stationary test for panel regressions. See Maddala, G.S. and S. Wu (1999) "A comparative study of unit root tests with panel data and a simplified test", Oxford Bulleting of Economics and Statistics, pp. 631-652.

(b) * significant at 10%; ** significant at 5%; *** significant at 1%.

(c) The sample is composed by 158 large caps. In particular, we include securities that have composed the main index of the Paris, Brussels, Amsterdam and Lisbon exchanges (the CAC 40, BEL20, AEX and the PSI) at any point throughout the sample period.

(d) Bid-ask spreads calculated using price data provided by Bloomberg.

Table D.3. Impact of integration on the normalised bid-ask spreads of large caps in Paris, Brussels, Amsterdam and Lisbon by exchange, 3 January 2000 – 31 December 2010

Ln (bid-ask spread)	1	2	3	4	5	6
Paris	-1.119***	-1.073***	-0.586***	-0.594***	-0.592***	-0.561***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Brussels	-0.757***	-0.724***	-0.247**	-0.257**	-0.256**	-0.143
	[0.000]	[0.000]	[0.017]	[0.012]	[0.012]	[0.182]
Amsterdam	-0.491***	-0.432***	-0.147	-0.085	-0.081	0.023
	[0.003]	[0.008]	[0.306]	[0.549]	[0.563]	[0.851]
Lisbon	-0.127	-0.029	0.247***	0.349***	0.356***	0.287***
	[0.101]	[0.722]	[0.002]	[0.000]	[0.000]	[0.000]
DAX volatility (log of)		0.272***	0.380***	0.426***	0.440***	0.389***
		[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Traded volume on the Frankfurt exchange (log of)			-0.900***	-0.262***	-0.253***	-0.146***
			[0.000]	[0.000]	[0.000]	[0.000]
Tick change dummy				-0.553***	-0.324***	-0.11
				[0.000]	[0.000]	[0.178]
Per capita GDP (log of)						-3.800***
						[0.001]
MTF volume (log of)					-0.015***	-0.021***
					[0.005]	[0.000]
Constant	-4.777***	-4.184***	16.449***	2.111***	1.909**	38.133***
	[0.000]	[0.000]	[0.000]	[0.008]	[0.016]	[0.001]
Month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Security fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	362,103	357,936	332,831	332,831	332,831	332,831
R-squared	0.534	0.545	0.592	0.592	0.607	0.609

Notes:

(a) Robust p-value in brackets, clustered by security to allow for heteroskedasticity and autocorrelation within securities. Estimation residuals are stationary according with the Fisher stationary test for panel regressions. See Maddala, G.S. and S. Wu (1999) "A comparative study of unit root tests with panel data and a simplified test", Oxford Bulleting of Economics and Statistics, pp. 631-652.

(b) * significant at 10%; ** significant at 5%; *** significant at 1%.

(c) The sample is composed by 158 large caps. It includes securities that have composed the main index of the Paris, Brussels, Amsterdam and Lisbon exchanges (the CAC 40, BEL20, AEX and the PSI) at any point throughout the sample period.

(d) Bid-ask spreads calculated using price data provided by Bloomberg.

Annex E. Econometric results – Robustness

Alternative integration milestones

Table E.1. Impact of integration of trading platforms on the normalised bid-ask spreads of large caps in Paris, Brussels, Amsterdam and Lisbon, 3 January 2000 – 31 December 2010

Ln (bid-ask spread)	1	2	3	4	5	6
Phase 1	-0.407***	-0.405***	-0.422***	-0.314***	-0.316***	-0.305***
	[0.001]	[0.001]	[0.000]	[0.004]	[0.004]	[0.006]
Phase 2	-0.059	-0.086	0.071	-0.098	-0.102	-0.089
	[0.576]	[0.400]	[0.402]	[0.252]	[0.235]	[0.270]
Phase 3	-0.657***	-0.610***	-0.414***	-0.264***	-0.256***	-0.179***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
DAX volatility (log of)		0.104***	0.216***	0.298***	0.308***	0.298***
		[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
DB volume (log of)			-0.659***	-0.183***	-0.178***	-0.111**
			[0.000]	[0.000]	[0.000]	[0.020]
Tick change dummy				-0.455***	-0.330***	-0.152
				[0.000]	[0.000]	[0.101]
Per capita GDP						-3.089**
						[0.034]
MTF volume(log of)					-0.008	-0.015**
					[0.120]	[0.015]
Month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Security fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-4.538***	-4.301***	10.718***	0.211	0.122	30.121**
	[0.000]	[0.000]	[0.000]	[0.745]	[0.853]	[0.032]
Observations	362,103	357,936	332,831	332,831	332,831	332,831
R-squared	0.557	0.561	0.596	0.605	0.605	0.606

Notes:

(a) Robust p-value in brackets, clustered by security to allow for heteroskedasticity and autocorrelation within securities. Estimation residuals are stationary according with the Fisher stationary test for panel regressions. See Maddala, G.S. and S. Wu (1999) "A comparative study of unit root tests with panel data and a simplified test", Oxford Bulleting of Economics and Statistics, pp. 631-652.

(b) * significant at 10%; ** significant at 5%; *** significant at 1%.

(c)The sample is composed by 158 large caps. It includes securities that have composed the main index of the Paris, Brussels, Amsterdam and Lisbon exchanges (the CAC 40, BEL20, AEX and the PSI) at any point throughout the sample period.

(d) Bid-ask spreads calculated using price data provided by Bloomberg.

Alternative measures of liquidity: volatility

Table E.2. Impact of integration on 20 day-historical volatility of large caps in Paris, Brussels, Amsterdam and Lisbon by phases, 3 January 2000 – 31 December 2010

Ln (volatility)	1	2	3	4	5	6	7
Integration	-0.187***	-0.062**	-0.122***	-0.071***	-0.085***	-0.088***	-0.085***
	[0.000]	[0.025]	[0.000]	[0.005]	[0.001]	[0.000]	[0.001]
DAX volatility (log of)		0.596***		0.589***	0.576***	0.561***	0.557***
		[0.000]		[0.000]	[0.000]	[0.000]	[0.000]
Index volatility (log of)			0.588***				
			[0.000]				
Traded volume on the Frankfurt exchange				0.211***	0.012	-0.001	0.006
(log of)				[0.000]	[0.544]	[0.979]	[0.770]
Tick change dummy					0.177***	-0.114***	-0.100**
					[0.000]	[0.003]	[0.029]
Per capita GDP (log of)							-0.251
							[0.632]
MTF volume(log of)						0.018***	0.018***
						[0.000]	[0.000]
Constant	-1.550***	-0.243***	-0.140***	-5.090***	-0.616	-0.338	2.075
	[0.000]	[0.000]	[0.001]	[0.000]	[0.193]	[0.481]	[0.691]
Month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Security fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	365,335	363,248	365,335	336,252	336,252	336,252	336,252
R-squared	0.275	0.470	0.512	0.497	0.505	0.507	0.507

Notes:

(a) Robust p-value in brackets, clustered by security to allow for heteroskedasticity and autocorrelation within securities. Estimation residuals are stationary according with the Fisher stationary test for panel regressions. See Maddala, G.S. and S. Wu (1999) "A comparative study of unit root tests with panel data and a simplified test", Oxford Bulleting of Economics and Statistics, pp. 631-652.

(b) * significant at 10%; ** significant at 5%; *** significant at 1%

(c) The sample is composed by 158 large caps. In particular, we include securities that have composed the main index of the Paris, Brussels, Amsterdam and Lisbon exchanges (the CAC 40, BEL20, AEX and the PSI) at any point throughout the sample period.

(d) 20-Day historical volatility calculated using last prices provided by Bloomberg.

Alternative measures of liquidity: traded volume

Table E.3. Impact of integration on number of shares traded for large caps in Paris, Brussels, Amsterdam and Lisbon, 3 January 2000 – 31 December 2010

Ln (number of shares)	1	2	3	4	5	6
Integration	0.607***	0.244***	0.271***	0.253***	0.253***	0.254***
	[0.000]	[0.001]	[0.000]	[0.000]	[0.000]	[0.000]
Per capita GDP (log of)		9.117***	9.359***	6.876***	5.852***	5.812***
		[0.000]	[0.000]	[0.000]	[0.005]	[0.007]
Traded volume on the Frankfurt exchange (log of)				0.403***	0.293***	0.296***
				[0.000]	[0.000]	[0.000]
DAX volatility (log of)			0.105***	0.053*	0.030	0.032
			[0.001]	[0.068]	[0.319]	[0.270]
Tick change dummy					0.149	0.182
					[0.119]	[0.216]
MTF volume (log of)						-0.002
						[0.820]
Constant	9.373***	-83.758***	-86.048***	-69.931***	-57.031***	-56.677***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.006]	[0.007]
Month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Security fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	382,146	382,146	377,403	349,152	349,152	349,152
R-squared	0.760	0.771	0.774	0.783	0.783	0.783

Notes:

(a) Robust p-value in brackets, clustered by security to allow for heteroskedasticity and autocorrelation within securities. Estimation residuals are stationary according with the Fisher stationary test for panel regressions. See Maddala, G.S. and S. Wu (1999) "A comparative study of unit root tests with panel data and a simplified test", Oxford Bulleting of Economics and Statistics, pp. 631-652.

(b) * significant at 10%; ** significant at 5%; *** significant at 1%.

(c) The sample is composed by 158 large caps. In particular, we include securities that have composed the main index of the Paris, Brussels, Amsterdam and Lisbon exchanges (he CAC 40, BEL20, AEX and the PSI) at any point throughout the sample period.

(d) Number of shares traded provided by Bloomberg.

Additional control variables

The table below presents the results of the econometric analysis of the impact of the integration by phases on the normalised bid-ask spreads when the daily market capitalisation is included as an additional control.

Table E.4. Impact of integration on the normalised bid-ask spreads of large caps in Paris, Brussels, Amsterdam and Lisbon, controlling for market capitalisation, by phases, 3 Jan 2000 – 31 Dec 2010

Ln (bid-ask spread)	1	2	3	4	5	6
Phase 1	-0.227***	-0.215***	-0.094	-0.183***	-0.193***	-0.191***
	[0.000]	[0.001]	[0.125]	[0.002]	[0.001]	[0.001]
Phase 2	-0.402***	-0.400***	-0.390***	-0.372***	-0.384***	-0.389***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Phase 3	-0.327***	-0.353***	-0.198***	-0.078*	-0.042	-0.045
	[0.000]	[0.000]	[0.000]	[0.054]	[0.290]	[0.308]
DAX volatility (log of)		-0.055*	0.038	0.114***	0.152***	0.153***
		[0.051]	[0.123]	[0.000]	[0.000]	[0.000]
Traded volume on the			-0.439***	-0.028	-0.005	-0.011
Frankfurt exchange (log of)			[0.000]	[0.319]	[0.847]	[0.690]
Tick change dummy				-0.410***	0.143**	0.131**
				[0.000]	[0.026]	[0.035]
Per capita GDP (log of)						0.234
						[0.805]
MTF volume (log of)					-0.036***	-0.035***
					[0.000]	[0.000]
Market capitalisation (log of)	-0.618***	-0.626***	-0.604***	-0.592***	-0.612***	-0.614***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Constant	0.647*	0.602*	10.522***	1.182**	0.868	-1.39
	[0.064]	[0.069]	[0.000]	[0.032]	[0.119]	[0.881]
Month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Security fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	347,837	345,605	329,145	329,145	329,145	329,145
R-squared	0.625	0.627	0.642	0.65	0.652	0.652

Notes: (a) Robust p-value in brackets, clustered by security to allow for heteroskedasticity and autocorrelation within securities; (b) * significant at 10%; ** significant at 5%; *** significant at 1%; (c) the sample is composed by 158 large caps. In particular, we include securities that have composed the main index of the Paris, Brussels, Amsterdam and Lisbon exchanges (the CAC-40, BEL-20, AEX and the PSI) at any point throughout the sample period; (d) all regressions include a set of single-day event dummies; (e) bid-ask spreads calculated using price data provided by Bloomberg.

The table below presents the results of the econometric analysis of the impact of the integration by exchanges on the normalised bid-ask spreads when the daily market capitalisation is included as an additional control.

Table E.5. Impact of integration on the normalised bid ask spread of large caps in Paris, Brussels, Amsterdam and Lisbon controlling for market capitalisation, by exchanges, 3 Jan 2000 – 31 Dec 2010

Ln (bid-ask spread)	1	2	3	4	5	6
Paris	-1.046***	-1.041***	-0.700***	-0.702***	-0.702***	-0.697***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Brussels	-0.639***	-0.636***	-0.294***	-0.301***	-0.299***	-0.285***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Amsterdam	-0.630***	-0.616***	-0.367***	-0.303***	-0.302***	-0.288***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Lisbon	0.038	0.057	0.280***	0.370***	0.392***	0.383***
	[0.586]	[0.427]	[0.000]	[0.000]	[0.000]	[0.000]
DAX volatility (log of)		0.062**	0.161***	0.208***	0.239***	0.234***
		[0.014]	[0.000]	[0.000]	[0.000]	[0.000]
Traded volume on the Frankfurt exchange (log of)			-0.636***	-0.072**	-0.038	-0.026
			[0.000]	[0.015]	[0.206]	[0.267]
Tick change dummy				-0.494***	0.147**	0.171***
				[0.000]	[0.021]	[0.004]
Per capita GDP (log of)						-0.48
						[0.563]
MTF volume (log of)					-0.041***	-0.041***
					[0.000]	[0.000]
Market capitalisation (log of)	-0.675***	-0.663***	-0.613***	-0.594***	-0.617***	-0.614***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Constant	1.020***	1.061***	15.185***	2.331***	1.764***	6.332
	[0.000]	[0.000]	[0.000]	[0.000]	[0.003]	[0.439]
Month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Security fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	347,837	345,605	329,145	329,145	329,145	329,145
R-squared	0.614	0.616	0.638	0.65	0.653	0.653

Notes: (a) Robust p-value in brackets, clustered by security to allow for heteroskedasticity and autocorrelation within securities; (b) * significant at 10%; ** significant at 5%; *** significant at 1%; (c) the sample is composed by 158 large caps. In particular, we include securities that have composed the main index of the Paris, Brussels, Amsterdam and Lisbon exchanges (the CAC-40, BEL-20, AEX and the PSI) at any point throughout the sample period; (d) all regressions include a set of single-day event dummies; (e) bid-ask spreads calculated using price data provided by Bloomberg.

The table below presents the results of the econometric analysis of the impact of the integration by phases on the normalised bid-ask spreads when the daily closing price of each security is included as an additional control.

Table E.6. Impact of integration on the normalised bid-ask spreads of large caps in Paris, Brussels, Amsterdam and Lisbon, controlling for daily closing price of the security, by phases, 3 Jan 2000 – 31 Dec 2010

Ln (bid-ask spread)	1	2	3	4	5	6
Phase 1	-0.265***	-0.247***	-0.076	-0.176***	-0.186***	-0.186***
	[0.000]	[0.000]	[0.229]	[0.004]	[0.002]	[0.001]
Phase 2	-0.442***	-0.436***	-0.412***	-0.398***	-0.415***	-0.416***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Phase 3	-0.426***	-0.464***	-0.269***	-0.129***	-0.089**	-0.090**
	[0.000]	[0.000]	[0.000]	[0.001]	[0.011]	[0.036]
DAX volatility (log of)		-0.074***	0.032	0.115***	0.157***	0.157***
		[0.010]	[0.226]	[0.000]	[0.000]	[0.000]
Traded volume on the			-0.534***	-0.061**	-0.036	-0.038
Frankfurt exchange (log of)			[0.000]	[0.017]	[0.165]	[0.149]
Tick change dummy				-0.468***	0.165**	0.162**
				[0.000]	[0.012]	[0.018]
Per capita GDP (log of)						0.056
						[0.955]
MTF volume (log of)					-0.041***	-0.041***
					[0.000]	[0.000]
Closing price of the security	-0.558***	-0.572***	-0.574***	-0.573***	-0.601***	-0.601***
(log of)	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Constant	-2.752***	-2.862***	9.425***	-1.157**	-1.614***	-2.16
	[0.000]	[0.000]	[0.000]	[0.039]	[0.005]	[0.828]
Month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Security fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	360,460	356,315	331,215	331,215	331,215	331,215
R-squared	0.607	0.611	0.635	0.645	0.647	0.647

Notes: (a) Robust p-value in brackets, clustered by security to allow for heteroskedasticity and autocorrelation within securities; (b) * significant at 10%; ** significant at 5%; *** significant at 1%; (c) the sample is composed by 158 large caps. In particular, we include securities that have composed the main index of the Paris, Brussels, Amsterdam and Lisbon exchanges (the CAC-40, BEL-20, AEX and the PSI) at any point throughout the sample period; (d) all regressions include a set of single-day event dummies; (e) bid-ask spreads calculated using price data provided by Bloomberg.

This table presents the results of the econometric analysis of the impact of the integration by exchanges on the normalised bid-ask spreads when the daily closing price of each security is included as an additional control.

Table E.7. Impact of integration on the normalised bid ask spread of large caps in Paris, Brussels, Amsterdam and Lisbon controlling for daily closing price of the security, by exchanges, 3 Jan 2000 – 31 Dec 2010

Ln (bid-ask spread)	1	2	3	4	5	6
Paris	-1.198***	-1.178***	-0.728***	-0.735***	-0.739***	-0.730***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Brussels	-0.828***	-0.814***	-0.352***	-0.363***	-0.365***	-0.337***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Amsterdam	-0.775***	-0.749***	-0.429***	-0.367***	-0.373***	-0.345***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Lisbon	-0.068	-0.042	0.245***	0.349***	0.373***	0.356***
	[0.279]	[0.523]	[0.000]	[0.000]	[0.000]	[0.000]
DAX volatility (log of)		0.079***	0.181***	0.228***	0.262***	0.251***
		[0.002]	[0.000]	[0.000]	[0.000]	[0.000]
Traded volume on the Frankfurt exchange (log of)			-0.768***	-0.114***	-0.075***	-0.050**
			[0.000]	[0.000]	[0.007]	[0.032]
Tick change dummy				-0.566***	0.166**	0.215***
				[0.000]	[0.011]	[0.001]
Per capita GDP (log of)						-0.925
						[0.273]
MTF volume (log of)					-0.047***	-0.048***
					[0.000]	[0.000]
Closing price of the security (log of)	-0.595***	-0.582***	-0.568***	-0.569***	-0.602***	-0.597***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Constant	-2.753***	-2.638***	14.880***	0.188	-0.575	8.261
	[0.000]	[0.000]	[0.000]	[0.745]	[0.335]	[0.327]
Month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Security fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	360,460	356,315	331,215	331,215	331,215	331,215
R-squared	0.590	0.593	0.628	0.644	0.647	0.648

Notes: (a) Robust p-value in brackets, clustered by security to allow for heteroskedasticity and autocorrelation within securities; (b) * significant at 10%; ** significant at 5%; *** significant at 1%; (c) the sample is composed by 158 large caps. In particular, we include securities that have composed the main index of the Paris, Brussels, Amsterdam and Lisbon exchanges (the CAC-40, BEL-20, AEX and the PSI) at any point throughout the sample period; (d) all regressions include a set of single-day event dummies; (e) bid-ask spreads calculated using price data provided by Bloomberg.

The table below presents the results of the econometric analysis of the impact of the integration by phases on the normalised bid-ask spreads when the market capitalisation and the daily closing price of each security are included as additional controls.

Table E.8. Impact of integration on the normalised bid-ask spreads of large caps in Paris, Brussels, Amsterdam and Lisbon, controlling for market capitalisation and closing price of the security, by phases, 3 Jan 2000 – 31 Dec 2010

Ln (bid-ask spread)	1	2	3	4	5	6	7	8
Phase 1	-0.241**	-0.259**	-0.193***	-0.191***	-0.186***	-0.186***	-0.185***	-0.183***
	[0.029]	[0.016]	[0.001]	[0.001]	[0.002]	[0.001]	[0.001]	[0.001]
Phase 2	-0.175*	-0.125	-0.384***	-0.389***	-0.415***	-0.416***	-0.403***	-0.410***
	[0.062]	[0.115]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Phase 3	-0.164***	-0.117**	-0.042	-0.045	-0.089**	-0.090**	-0.051	-0.057
	[0.000]	[0.016]	[0.290]	[0.308]	[0.011]	[0.036]	[0.175]	[0.201]
DAX volatility	0.317***	0.307***	0.152***	0.153***	0.157***	0.157***	0.143***	0.144***
(log of)	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Traded volume on the Frankfurt	-0.173***	-0.110***	-0.005	-0.011	-0.036	-0.038	-0.009	-0.017
Exchange (log of)	[0.000]	[0.002]	[0.847]	[0.690]	[0.165]	[0.149]	[0.723]	[0.522]
Tick change Dummy	-0.332***	-0.180*	0.143**	0.131**	0.165**	0.162**	0.184***	0.166***
	[0.000]	[0.053]	[0.026]	[0.035]	[0.012]	[0.018]	[0.004]	[0.006]
MTF volume	-0.008	-0.014**	-0.036***	-0.035***	-0.041***	-0.041***	-0.040***	-0.039***
(log of)	[0.106]	[0.018]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Per capita GDP		-2.669**		0.234		0.056		0.337
(log of)		[0.047]		[0.805]		[0.955]		[0.709]
Market capitalisation			-0.612***	-0.614***			-0.436***	-0.438***
(log of)			[0.000]	[0.000]			[0.000]	[0.000]
Last price of the					-0.601***	-0.601***	-0.200*	-0.200*
security (log of)					[0.000]	[0.000]	[0.064]	[0.064]
Constant	0.001	25.781*	0.868	-1.39	-1.614***	-2.16	0.05	-3.2
	[0.999]	[0.054]	[0.119]	[0.881]	[0.005]	[0.828]	[0.947]	[0.724]
Month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Security fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	332,831	332,831	329,145	329,145	331,215	331,215	327,529	327,529
R-squared	0.606	0.607	0.652	0.652	0.647	0.647	0.651	0.651

Notes: (a) Robust p-value in brackets, clustered by security to allow for heteroskedasticity and autocorrelation within securities; (b) * significant at 10%; ** significant at 5%; *** significant at 1%; (c) the sample is composed by 158 large caps. In particular, we include securities that have composed the main index of the Paris, Brussels, Amsterdam and Lisbon exchanges (the CAC-40, BEL-20, AEX and the PSI) at any point throughout the sample period; (d) all regressions include a set of single-day event dummies; (e) bid-ask spreads calculated using price data provided by Bloomberg.

This table presents the results of the econometric analysis of the impact of the integration by exchanges on the normalised bid-ask spreads when the market capitalisation and the daily closing price of each security are included as additional controls.

Table E.9. Impact of integration on the normalised bid-ask spreads of large caps in Paris, Brussels, Amsterdam and Lisbon, controlling for market capitalisation and closing price of the security, by exchanges, 3 Jan 2000 – 31 Dec 2010

Ln (bid-ask spread)	1	2	3	4	5	6	7	8
Paris	-0.592***	-0.561***	-0.702***	-0.697***	-0.739***	-0.730***	-0.713***	-0.708***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Brussels	-0.256**	-0.143	-0.299***	-0.285***	-0.365***	-0.337***	-0.316***	-0.302***
	[0.012]	[0.182]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Amsterdam	-0.081	0.023	-0.302***	-0.288***	-0.373***	-0.345***	-0.331***	-0.318***
	[0.563]	[0.851]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Lisbon	0.356***	0.287***	0.392***	0.383***	0.373***	0.356***	0.385***	0.376***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
DAX volatility	0.440***	0.389***	0.239***	0.234***	0.262***	0.251***	0.233***	0.228***
(log of)	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Traded volume on the Frankfurt	-0.253***	-0.146***	-0.038	-0.026	-0.075***	-0.050**	-0.04	-0.029
exchange (log of)	[0.000]	[0.000]	[0.206]	[0.267]	[0.007]	[0.032]	[0.159]	[0.196]
Tick change dummy	-0.324***	-0.11	0.147**	0.171***	0.166**	0.215***	0.184***	0.207***
	[0.000]	[0.178]	[0.021]	[0.004]	[0.011]	[0.001]	[0.004]	[0.000]
MTF volume	-0.015***	-0.021***	-0.041***	-0.041***	-0.047***	-0.048***	-0.045***	-0.045***
(log of)	[0.005]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Per capita GDP	-3.800***		-0.48		-0.925		-0.443	
(log of)		[0.001]		[0.563]		[0.273]		[0.569]
Market capitalisation		-0.617***	-0.614***			-0.467***	-0.464***	
		[0.000]	[0.000]			[0.000]	[0.000]	[0.000]
Last price of the				-0.602***	-0.597***	-0.170*	-0.171*	
security (log of)					[0.000]	[0.000]	[0.084]	[0.083]
Constant	1.909**	38.133***	1.764***	6.332	-0.575	8.261	1.053	5.271
	[0.016]	[0.001]	[0.003]	[0.439]	[0.335]	[0.327]	[0.164]	[0.500]
Month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Security fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	332,831	332,831	329,145	329,145	331,215	331,215	327,529	327,529
R-squared	0.607	0.609	0.653	0.653	0.647	0.648	0.651	0.651

Notes: (a) Robust p-value in brackets, clustered by security to allow for heteroskedasticity and autocorrelation within securities; (b) * significant at 10%; ** significant at 5%; *** significant at 1%; (c) the sample is composed by 158 large caps. In particular, we include securities that have composed the main index of the Paris, Brussels, Amsterdam and Lisbon exchanges (the CAC-40, BEL-20, AEX and the PSI) at any point throughout the sample period; (d) all regressions include a set of single-day event dummies; (e) bid-ask spreads calculated using price data provided by Bloomberg.

Annex F. Impact of the NYSE-Euronext merger

Table F.1. Impact of the NYSE-Euronext merger on the normalised bid-ask spreads of large caps in Paris, Brussels, Amsterdam and Lisbon, 2 January 2004 – 31 December 2010

Ln (bid-ask spread)	1	2	3	4	5	6	7
NYSE merger	-0.351***	-0.471***	-0.328***	-0.039	-0.011	-0.004	0.012
	[0.000]	[0.000]	[0.000]	[0.327]	[0.779]	[0.924]	[0.777]
DAX volatility		0.247***	0.291***	0.272***	0.276***	0.272***	0.290***
(log of)		[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Traded volume on the Frankfurt			-0.414***	-0.243***	-0.244***	-0.215***	-0.243***
exchange (log of)			[0.000]	[0.000]	[0.000]	[0.002]	[0.001]
Tick change				-0.374***	-0.347***	-0.320***	
Dummy				[0.000]	[0.000]	[0.000]	
Per capita GDP						-0.582	-1.549
						[0.640]	[0.152]
MTF volume					-0.003	-0.005	-0.023***
(log of)					[0.602]	[0.521]	[0.000]
Constant	-5.122***	-4.483***	5.065***	1.183	1.22	6.514	17.068*
	[0.000]	[0.000]	[0.000]	[0.267]	[0.244]	[0.574]	[0.085]
Month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Security fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	243,373	242,051	242,051	242,051	242,051	242,051	242,051
R-squared	0.625	0.633	0.635	0.637	0.637	0.637	0.636

Notes: (a) Robust p-value in brackets, clustered by security to allow for heteroskedasticity and autocorrelation within securities. Estimation residuals are stationary according with the Fisher stationary test for panel regressions. See Maddala, G.S. and S. Wu (1999) "A comparative study of unit root tests with panel data and a simplified test", Oxford Bulleting of Economics and Statistics, pp. 631-652. (b) * significant at 10%; ** significant at 5%; *** significant at 1%. (c)The sample is composed by 158 large caps. It includes securities that have composed the main index of the Paris, Brussels, Amsterdam and Lisbon exchanges (the CAC 40, BEL20, AEX and the PSI) at any point throughout the sample period. (d) Bid-ask spreads calculated using price data provided by Bloomberg.

Annex G. Possible omitted variables

Figure G.1. Average residuals by stock exchange
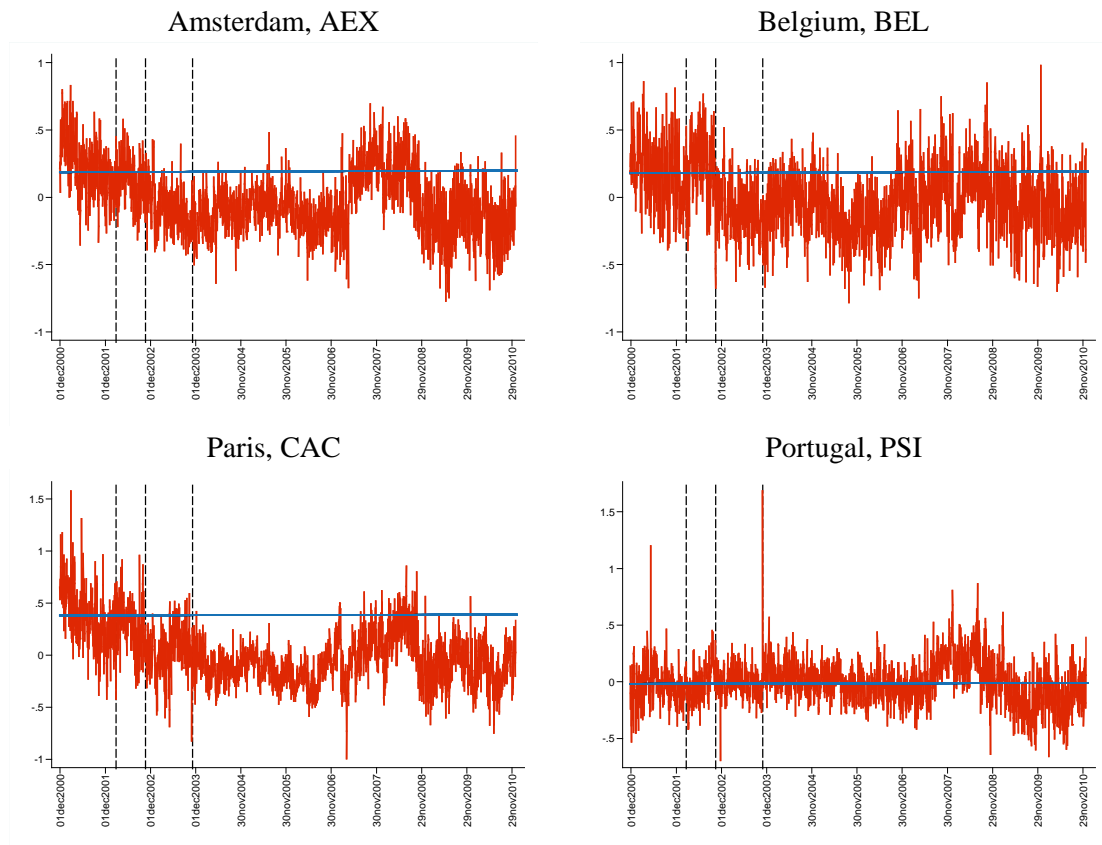
Note: (i) the horizontal line represents the average residual before the integration of Paris; (ii) dotted vertical lines shows dates of integration: Paris and Brussels on 1 March 2002; Amsterdam on 25 October 2002; and Lisbon on 1 November 2003.

Table G.1. Regression results using a specification without integration variables and adding quarter-year index fixed effects, Paris (CAC) securities only, 1 December 2000 – 31 December 2010

Ln (bid-ask spread)	[1]	[2]	[3]	[4]
DAX volatility	0.030**	-0.001	-0.003	-0.004
(log of)	[0.010]	[0.923]	[0.806]	[0.716]
Traded volume on the	-0.036	-0.026	-0.022	-0.024
Frankfurt exchange (log of)	[0.170]	[0.298]	[0.367]	[0.334]
Tick change	-0.538***	-0.577***	-0.628***	-0.602***
Dummy	[0.000]	[0.000]	[0.000]	[0.000]
Per capita GDP	-10.980***	-8.708**	-8.807**	-8.594**
(log of)	[0.003]	[0.020]	[0.019]	[0.022]
MTF volume	-0.013***	-0.013***	-0.014***	-0.013***
(log of)	[0.000]	[0.000]	[0.000]	[0.000]
Market capitalisation		-0.453***		-0.274***
(log of)		[0.000]		[0.000]
Last price of the			-0.464***	-0.216***
security (log of)			[0.000]	[0.001]
Constant	105.009***	86.076**	84.377**	83.964**
	[0.005]	[0.023]	[0.026]	[0.027]
Quarter-year fixed effects	*Yes*	*Yes*	*Yes*	*Yes*
Month fixed effects	No	No	No	No
Security fixed effects	Yes	Yes	Yes	Yes
Observations	106,153	106,061	106,152	106,060
R-squared	0.39	0.412	0.411	0.413

Notes: (a) Robust p-value in brackets, clustered by security to allow for heteroskedasticity and autocorrelation within securities; (b) * significant at 10%; ** significant at 5%; *** significant at 1%; (c) the sample contains securities that have composed the main index of the Paris exchange (the CAC 40) at any point throughout the sample period; (d) all regressions include a set of single-day event dummies; (e) bid-ask spreads calculated using price data provided by Bloomberg.

Table G.2. Regression results using a specification without integration variables and adding quarter-year index fixed effects, Belgium (BEL) securities only, 1 December 2000 – 31 December 2010

Ln (bid-ask spread)	[1]	[2]	[3]	[4]
DAX volatility	0.133***	0.106***	0.109***	0.109***
(log of)	[0.000]	[0.000]	[0.000]	[0.000]
Traded volume on the	0.083**	0.093**	0.081*	0.083**
Frankfurt exchange (log of)	[0.048]	[0.029]	[0.051]	[0.049]
Tick change	-0.457***	-0.559***	-0.601***	-0.601***
Dummy	[0.006]	[0.000]	[0.000]	[0.000]
Per capita GDP	-11.477**	-9.262**	-9.395**	-9.425**
(log of)	[0.018]	[0.026]	[0.023]	[0.024]
MTF volume	-0.012**	-0.012**	-0.013**	-0.013**
(log of)	[0.029]	[0.028]	[0.023]	[0.023]
Market capitalisation		-0.406***		0.009
(log of)		[0.000]		[0.897]
Last price of the			-0.420***	-0.425***
security (log of)			[0.000]	[0.000]
Constant	109.343**	89.804**	89.699**	89.912**
	[0.025]	[0.033]	[0.031]	[0.032]
Quarter-year fixed effects	*Yes*	*Yes*	*Yes*	*Yes*
Month fixed effects	No	No	No	No
Security fixed effects	Yes	Yes	Yes	Yes
Observations	64,160	63,985	64,140	63,965
R-squared	0.421	0.437	0.448	0.448

Notes: (a) Robust p-value in brackets, clustered by security to allow for heteroskedasticity and autocorrelation within securities; (b) * significant at 10%; ** significant at 5%; *** significant at 1%; (c) the sample contains securities that have composed the main index of the Brussels exchange (the BEL 20) at any point throughout the sample period; (d) all regressions include a set of single-day event dummies; (e) bid-ask spreads calculated using price data provided by Bloomberg.

Table G.3. Regression results using a specification without integration variables and adding quarter-year index fixed effects, Amsterdam (AEX) securities only, 1 December 2000 – 31 December 2010

Ln (bid-ask spread)	[1]	[2]	[3]	[4]
DAX volatility	0.148***	0.081***	0.076***	0.079***
(log of)	[0.000]	[0.000]	[0.000]	[0.000]
Traded volume on the	0.058**	0.050*	0.033	0.04
Frankfurt exchange (log of)	[0.038]	[0.066]	[0.230]	[0.154]
Tick change	-0.371*	-0.633***	-0.704***	-0.652***
Dummy	[0.084]	[0.000]	[0.000]	[0.000]
Per capita GDP	0	0	0	0
(log of)	[.]	[.]	[.]	[.]
MTF volume	0.003	0.002	0.001	0.002
(log of)	[0.424]	[0.540]	[0.700]	[0.606]
Market capitalisation		-0.747***		-0.576***
(log of)		[0.000]		[0.000]
Last price of the			-0.814***	-0.202
security (log of)			[0.000]	[0.207]
Constant	-7.522***	-1.125	-4.934***	-1.807*
	[0.000]	[0.141]	[0.000]	[0.057]
Quarter-year fixed effects	*Yes*	*Yes*	*Yes*	*Yes*
Month fixed effects	No	No	No	No
Security fixed effects	Yes	Yes	Yes	Yes
Observations	89,720	86,388	89,394	86,062
R-squared	0.618	0.737	0.732	0.737

Notes: (a) Robust p-value in brackets, clustered by security to allow for heteroskedasticity and autocorrelation within securities; (b) * significant at 10%; ** significant at 5%; *** significant at 1%; (c) the sample contains securities that have composed the main index of the Amsterdam exchange (the AEX 25) at any point throughout the sample period; (d) all regressions include a set of single-day event dummies; (e) bid-ask spreads calculated using price data provided by Bloomberg.

Table G.4. Regression results using a specification without integration variables and adding quarter-year index fixed effects, Portugal (PSI) securities only, 1 December 2000 – 31 December 2010

Ln (bid-ask spread)	[1]	[2]	[3]	[4]
DAX volatility	0.112***	0.091***	0.090***	0.089***
(log of)	[0.000]	[0.000]	[0.000]	[0.000]
Traded volume on the	0.047	0.054*	0.042	0.041
Frankfurt exchange (log of)	[0.108]	[0.065]	[0.107]	[0.108]
Tick change	-0.141	-0.298	-0.403**	-0.408**
dummy	[0.334]	[0.119]	[0.027]	[0.029]
Per capita GDP	0	0	0	0
(log of)	[.]	[.]	[.]	[.]
MTF volume	0.013***	0.013***	0.014***	0.014***
(log of)	[0.002]	[0.002]	[0.001]	[0.001]
Market capitalisation		-0.366**		-0.128
(log of)		[0.021]		[0.583]
Last price of the			-0.358***	-0.264
security (log of)			[0.001]	[0.142]
Constant	-6.244***	-3.926***	-5.727***	-4.957***
	[0.000]	[0.002]	[0.000]	[0.002]
Quarter-year fixed effects	*Yes*	*Yes*	*Yes*	*Yes*
Month fixed effects	No	No	No	No
Security fixed effects	Yes	Yes	Yes	Yes
Observations	72,798	72,711	71,529	71,442
R-squared	0.489	0.501	0.494	0.495

Notes: (a) Robust p-value in brackets, clustered by security to allow for heteroskedasticity and autocorrelation within securities; (b) * significant at 10%; ** significant at 5%; *** significant at 1%; (c) the sample contains securities that have composed the main index of the Lisbon exchange (the PSI 20) at any point throughout the sample period; (d) all regressions include a set of single-day event dummies; (e) bid-ask spreads calculated using price data provided by Bloomberg.

Figure G.2. Estimated quarter-year-index fixed effects by exchange, 2000Q4-2010Q4
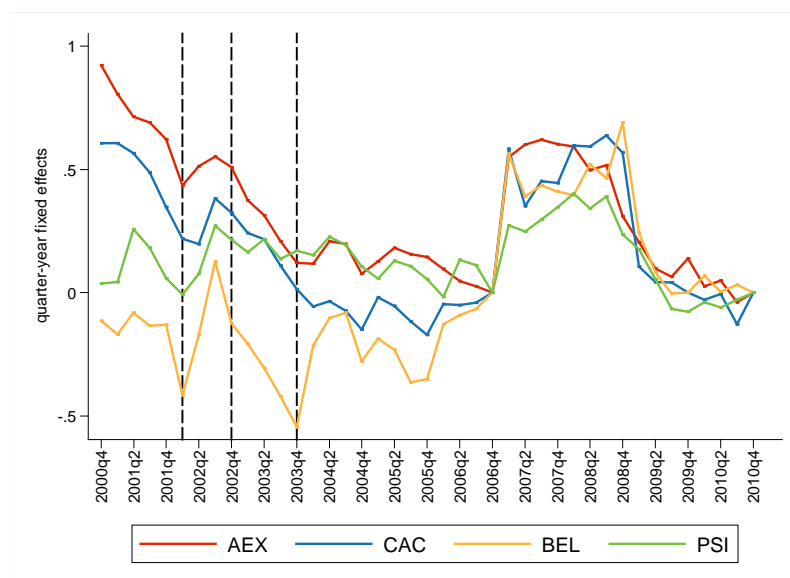
Note: (i) Estimated time fixed effects are fitted under specification 4 in the tables in Annex G; (ii) The sample used begins on 1 December 2000 as volumes traded on the Frankfurt exchange are available from that date on.

Notes

1   See, e.g. Rochet, J.C., and J. Tirole (2006) "Two-sided markets: a progress report," *RAND Journal of Economics*, 37(3): 645-667

2   Professors Hermalin and Katz note that in these markets the sum of the socially optimal prices for the platform services will be above or below marginal cost, either because a reduction in the number of users on one side has an infra-marginal impact on the surplus derived from the users of the other side, or because the reduction in the number of users on one side may affect the probability that a user on the other side finds a suitable partner with whom to transact. See Hermalin, B.E, and M. L. Katz (2017) "What's so special about two-sided markets?," forthcoming in *Economic theory and public policies: Joseph Stiglitz and the teaching of economics*, Columbia University Press.

3   See, e.g., Wright, J., (2004) "One-sided logic in two-sided markets," *Review of Network Economics*, 3(1): 44-64, and Evans, D.S., and R. Schmalensee (2007) "The industrial organization of markets with two-sided platforms," *Competition Policy International*, 3(1): 151.

4   Evans, D.S. (2003) "The anti-trust economics of multi-sided platform markets," *Yale Journal on Regulation*, 20(2): 325-382.

5   That is, if users on one side of one the merging platforms can transact with users on the other side of the other merging platforms.

6   See Chandra, A., and A. Collard-Wexler (2009) "Mergers in two-sided markets: an application to the Canadian newspaper industry," *Journal of Economics and Management Strategy*, 18(1), 1045-1070; Fillistrucchi, L., Klein, T., and T. Michielsen (2012) "Assessing unilateral merger effects in a two-sided market: an application to the dutch daily newspaper market", *Journal of Competition Law and Economics*, 8(2): 297-329; and and Baranes, E., Cortade, T. and A. Cosnita-Langlais

(2016), "Merger control on two-sided markets: is there need for an efficiency defense?," NET Institute, available at www.NETinst.org.

7   See Chandra, A., and A. Collard-Wexler (2009), *op. cit*. note 6.

8   See Jeziorski P. (2014) "Effects of mergers in two-sided markets: the U.S. radio industry," *American Economic Journal: Microeconomics*, 6(4): 35-73.

9   See Cantillon, E., and P.L. Yin (2011), "Competition between exchanges: a research agenda," *International Journal of Industrial Organization*," 29 (3): 329-336.

10   See Pagano, M., and J. Padilla (2005a), "The economics of cash trading: an overview", report prepared for Euronext, and references therein.

11   See Arnold, T., P. Hersch, J.H. Mulherin, and J. Netter (1999) "Merging Markets", *Journal of Finance*, 54(3): 1083-1107.

12   Pagano, M., and J. Padilla (2005b), "Efficiency gains from the integration of exchanges: lessons from the Euronext "natural experiment," report prepared for Euronext.

13   Nielsson, Ulf (2009) "Stock exchange merger and liquidity: the case of Euronext," *Journal of Financial Markets,* 12(2): 229-267.

14   Data includes all securities that have composed each index at any time throughout the sample period.

15   Annex A provides descriptive statistics on the bid-ask spreads provided by Bloomberg. Note that these are normalised bid-ask spreads.

16   These techniques make it possible to estimate the relationship between two variables when the variable under investigation is potentially influenced by many other factors.

17   A list of these events is reported in Annex B.

18   See Annex C for further description of the variables and data used in this paper.

19   See Euronext (2007), "Further information following the info-flash of 5 January 2007 regarding new trading hours and tick size on the Euronext Cash Market.

20   We include the daily volume of securities listed in the CAC 40, BEL 20, AEX and PSI indices traded on Chi-X and Bats.

21   See also Nielsson (2009, page 12) for further discussion of this issue.

22   The main econometric results in this paper are included in Tables 3 to 5 and can be found in Annex D.

23   Results are unchanged if we replace this volatility measure for the volatility of the FTSE index. See Annex E.

24   Multicollinearity occurs when some of the control variables are linearly related. When this linear relationship is strong, the variation in the explanatory variables is insufficient to accurately calculate the effect of these explanatory variables on the dependent variable. See Kennedy P. (2003), *A Guide to Econometrics* 5th edition, Cambridge: MIT Press, Chapter 11.

25   This could be consistent with Pagano (1989) and Chowdry and Nanda (1991) who argue that liquidity will tend to concentrate in a few markets if transaction costs are limited. See Pagano, M. (1989), "Trading volume and asset liquidity", *Quarterly Journal of Economics*, 104(2), 255-274 and Chowdry, B. and V. Nanda (1991), "Multimarket trading and market liquidity", *Review of Financial Studies*, 4(3), 483-511.

26   The tables discussed in this Section can be found in Annex E.

27   Note however that the results reported in Columns (1) to (4) are qualitatively similar.

28   See Annex C for precise definitions of these measures.

29   Pagano, M. (1989a) "Endogenous market thinness and stock price volatility", *Review of Economic Studies*, 56: 268-288.

30   Results including this additional control can be found in Column (3) in Table 7. Because of the addition of this additional variable we have seven columns in Table 7.

31   Pagano, M. (1989b) "Trading volume and asset liquidity", *Quarterly Journal of Economics*, 104: 255-274.

32   The models were estimated including as control variables the price of the securities and market capitalisation variables separately and including both variables jointly. Note that floating market capitalisation data from Bloomberg is only available as of January 2005, and therefore, it is not possible to include this variable as an additional control variable. Our results remain qualitatively unaltered irrespective of whether the price of the securities and market capitalisation variables are included separately or jointly.

33   See Annex F.

34   ee next Section for further discussion on this issue.

35   See Tables 16 to 19 in Annex G.

36   Aggarwal, R., (2002), "Demutualization and corporate governance of stock exchanges", *Journal of Applied Corporate Finance,* 15(1): 105-113.

8. Network effects and efficiencies in multi-sided markets

By Howard Shelanski, Samantha Knox and Arif Dhilla[1]

This paper examines the relationships among parties in a multi-sided market and discusses how those relationships should affect the analysis of competitive effects and efficiencies when competition agencies review conduct or transactions by multi-sided platforms.

1. Relationships and network effects across multi-sided platforms

Defining multi-sided markets and network effects

A rapidly growing literature has produced several definitions of a multi-sided market or platform (this paper will use these terms interchangeably). Some of these definitions focus on pricing structure, others highlight the platform's role in connecting multiple groups, and still others stress the existence of network effects.[1] That said, there is a general consensus that multi-sided markets share two defining features: distinct groups that interact with each other across the platform, and cross-platform externalities or network effects among those distinct groups [2]

Distinct groups. Multi-sided markets have at least two distinct groups or sides that rely on the platform to connect them directly or indirectly to each other.[3] For example, YouTube is a three-sided on-line video market connecting three distinct groups: (i) users (i.e. subscribers or end-user consumers), (ii) content/service providers, and (iii) advertisers. While the three sides are distinct, members of one side may participate in multiple facets of the market simultaneously. Users that share content are also content providers to other users, and content providers might also be advertisers if they pay the platform or other content providers to carry their ads to users with whom they are not yet connecting.

Cross-platform network effects. The different sides of a platform market are interdependent to the extent their decisions affect each other, even indirectly.[4] Network effects are the cross-platform externalities that result when the actions of participants on any side of the platform, or of the platform itself, affect participants on other sides of the platform (or the functioning of the platform itself). The externality can be direct, as when an increase in content providers makes the platform more valuable to content consumers, or indirect, as when a platform's provision of better terms for users makes the platform more attractive to content or service providers and to advertisers. For ease of exposition, this paper will refer to all cross-platform externalities simply as "network effects."

A positive network effect occurs when "the value that a customer on one side realizes from the platform increases with the number of customers on the other side."[5] For example, eBay—through which individuals can buy and sell goods on line—becomes more valuable to buyers as the number of sellers increases because there are more items available for sale. At the same time, eBay becomes more valuable to sellers as the number of buyers increases because there are more potential customers available. Network effects need not be symmetric or even run in the same direction between two sides of a market. Advertisers probably benefit from an increase in users more than users benefit from an increase in advertisers, and in some cases users may even suffer detriment from increased advertising.[6]

Because network effects create interdependencies among the groups on a multi-sided platform, a feedback loop may develop when membership of one side of the platform grows or shrinks. To illustrate, assume a platform raises the price of platform access for suppliers of some good or service. If some of those suppliers leave, the platform becomes less valuable to customers on the other side of the market, who in turn also leave, further reducing the platform's value to the remaining suppliers, and so forth.[7] These dynamics need not be perpetual or irreversible, but at some point they can go far enough to tip a platform market toward failure or dominance. As discussed below, the effects of this feedback loop may have important implications for both conduct and merger analyses.

Relationships on multi-sided platforms: Service-based and subsidy-based

As defined above, a multi-sided market consists of at least two distinct groups that rely on a platform to interact. The relationship between the two groups can be categorised as either service-based or subsidy-based.

In a service-based relationship, the supply side (the "suppliers") provides a service or good to the demand side (the "users"). Service-based relationships are common in platforms such as:

- Airbnb – connecting people searching for a place to stay with homeowners renting their properties;
- Amazon.com – connecting shoppers with merchants selling their goods;
- Uber – connecting riders with drivers offering rides;
- OpenTable – connecting diners with restaurants;
- Shopping Malls – connecting shoppers with stores selling their goods; and
- Apple App Store – connecting Apple product users with application developers offering applications.

In contrast, a subsidy-based relationship exists when one side indirectly defrays another side's costs of using the platform but does not offer an additional service that directly attracts users to that platform.[8] Facebook, Twitter, YouTube, Snapchat, Pandora, the New York Times, and television and radio stations are examples of multi-sided markets involving subsidy-based relationships. Each of these entities connects users (or readers, viewers, and listeners) with advertisers, and each gives users below-cost (and often free) access to the platform and its services because of payments from advertisers.

Where a subsidy-based relationship exists, the larger multi-sided market will have at least three sides: subsidisers (e.g., advertisers), suppliers (e.g., content/service providers), and users (e.g. subscribers). Subsidisers do not typically attract users to a platform on their own because they do not usually offer a good or service that users specifically seek out. A distinct service-based relationship is therefore required to bring users into the market.[9]

Supply of such content or services might come from third parties (e.g., journalists and musicians), the platform itself (e.g., Amazon and Netflix), or other platform users (e.g., Facebook, Twitter, Snapchat).

Relative strength of network effects

The nature of a relationship across a multi-sided platform is significant because it affects the direction (i.e. positive or negative) and strength of network externalities among the sides of the market. As discussed above, all sides of a multi-sided market will usually experience some externality from the actions of other sides. The strength and direction of those network effects will, however, vary across the sides of the platform depending in part on whether the relationship is service-based or subsidy-based.[10]

Service-based relationships typically result in positively correlated and relatively balanced network effects. Consider Airbnb, which connects people searching for a place to stay with property owners offering short-term rentals, perhaps to defray their own living costs. The two parties are in a service-based relationship. Because renters are seeking properties, renters benefit when new property owners join and expand the rental inventory. Similarly, property owners benefit when new renters join and expand the pool of potential customers. The interdependent nature of the two sides' relationship causes feedback effects whereby more renters drive more owners to join and more owners drive more renters to join. The network effects between renters and owners are therefore positively correlated and relatively symmetric. This observation extends generally to service-based relationships because, as with renters and property owners, one side wants the services/goods of the other and the other side wants a larger customer base.

Network effects in subsidy-based relationships are skewed towards the subsidiser and could correlate negatively. Subsidisers—e.g., advertisers on Twitter—benefit as the number of platform users grows and more people view the advertisements. As the pool of potential customers expands, the platform becomes more beneficial for advertisers, and more advertisers continue to join. Users, by contrast, experience weaker network externalities in subsidy-based relationships. Users benefit when enough advertisers join that they can subsidise the platform's operations and investments for the benefit of users and providers. Once that subsidy has been paid, however, users might not experience additional benefits (and could experience detriment) from additional advertising, unless that advertising somehow increases the supply of services or content that has attracted the user to the platform in the first place.[11] Therefore, even though both the supplier and the subsidiser benefit as the user base increases, it is the supplier that is more likely to drive user demand for access to the platform. Subsidisers are thus highly dependent on each additional supplier while suppliers may be indifferent to additional subsidisers (assuming enough advertisers are present to subsidise the platform for the users) except to the extent that incremental advertising might lead to better terms of platform usage or higher revenues for the suppliers. The network effect of an increase in suppliers is therefore likely to be stronger for subsidisers than the network effect of an increase in subsidisers would be for the suppliers.

Platform actions that initially appear to have opposing effects on different sides of the market may have important secondary effects. The following hypothetical examples using the Uber platform[12] illustrate this fact:

1. Assume Uber increases fares. That act appears directly to harms rider and benefit drivers. If the fare hike causes riders to leave the platform (or reduce the number of rides they take), however, the fare increase could also harm drivers in the end.

2. Assume Uber maintains fares but increases the percentage of the fare it keeps for the company. That conduct appears directly to harm drivers and leave riders unaffected. If this action causes drivers to leave the platform (or reduce the number of rides they offer), however, it will also harm riders.

3. Assume Uber prohibits drivers from also driving for competing ride hailing services. That policy might harm drivers while appearing to leave riders unaffected. But if drivers leave the platform in response, the action will also harm riders.

4. Assume Uber prohibits riders from riding with competing services. The action directly harms riders but not drivers, unless riders abandon Uber in response.

While it is difficult to predict the extent of the benefit or harm caused, regulators should be aware that conduct harming one side of a service-based relationship has the potential to result in harm to the other side (and vice versa). Depending on conditions and indirect effects, conduct that at first look appears to affect parties differently may have effects that are positively correlated across different sides of the market, thereby exacerbating either the harms or the benefits.

Identifying the relationships across a platform as either service-based or subsidy-based can therefore be important to predicting the relative balance of network effects among the different sides of the market. As discussed below, the balance and direction of network effects can have important implications for how regulators should evaluate net welfare effects of conduct and transactions by multi-sided platforms.

2. Accounting for efficiencies on all sides of the platform

Careful consideration of the economic efficiencies of a course of conduct or transaction will give courts and agencies a more complete view of the impact of the conduct or transaction on competition, output, and consumer welfare. Today, U.S. courts and agencies regularly weigh the claimed efficiencies of a course of conduct or a transaction against its competitive effects. In the merger context, U.S. agencies consider efficiencies primarily as part of the defendant's justifications for a transaction, especially where such benefits of the transaction are presented to offset potential unilateral effects of the merger.[13] In unilateral conduct analyses, efficiencies are most often part of the "business justification" defense.[14] In both contexts, the defendant bears the burden of proving that the efficiencies exist.[15]

In the eyes of courts and agencies, not all efficiencies are created equal; in fact, the class of efficiencies that are credited, or "cognizable," is rather narrow.[16] In both the unilateral conduct and merger contexts, courts and agencies give more weight to efficiencies that reduce costs or boost output, particularly where those efficiencies result in reduced prices, improved quality, or new products.[17] This narrow definition may need to be expanded, however, for multi-sided platforms, which might not themselves produce a good or service apart from their critical role of providing various groups with a means to interact. Importantly, platforms minimise transaction costs by replacing countless one-to-one interactions with a single one-to-many interaction: a single buyer finds many sellers in one place, and vice versa, thereby allowing the groups to find each other more efficiently than they could absent the platform. Efficiencies that can even further reduce transaction costs among sides of the platform should count in favor of the conduct or transaction at issue. Accounting for those efficiencies requires consideration of relevant cross-network externalities.

Role of efficiencies in conduct analyses involving multi-sided markets

Both the nature of the relationships and the relative strength of the network effects among parties in a multi-sided market have important implications for evaluating the efficiencies and effects of a challenged course of conduct, as we discuss below.

The extent to which regulators should consider each side of a multi-sided market when analysing efficiencies depends on what types of cross-platform relationships are at issue. Courts in multiple jurisdictions have recognised that both sides of a two-sided market must be considered in (1) defining the relevant markets; (2) determining market power; and (3) assessing the existence of adverse effects on competition.[18] Agencies should similarly consider the extent to which the efficiencies from the conduct at issue accrue on all sides of a platform. The effects (positive or negative) of conduct will usually differ across a platform and therefore may not warrant equal scrutiny on every side of the market.

In a multi-sided market with a service-based relationship between two sides, the network effects are such that a platform's actions directed at one side will likely have a meaningful impact on the other side. As a result, regulators should consider the potential effects on the non-targeted side of a service-based relationship. This analysis should extend not just to the competitive effects of the conduct, but also to any demonstrable efficiencies. For example, an exclusive or preferential arrangement between a platform and a service provider might give the service provider better access to the platform's users but have the offsetting effect of reducing consumer choice. If, however, there are efficiencies in the form of reduced transaction costs between the platform and the service provider or increased specific investment by the service provider in the platform to improve its service offerings, benefits from those efficiencies to consumers on the other side of the market should be taken into account as well.

When a subsidiser is also part of the platform dynamics, the analysis has an additional dimension. Actions that reduce the engagement of either users or service providers with the platform could drive away subsidisers that are potentially sensitive to the number of users and the amount of time users spend on the platform.[19] The opposite is not necessarily true, however, given the asymmetry in the feedback effects inherent in a subsidy relationship. The platform's conduct toward subsidisers might have little impact on the other sides of the market, so long as sufficient subsidies remain in place. Accordingly, if the conduct is directed only at a subsidiser, agencies and courts can apply a more traditional one-sided analysis of both effects and efficiencies (so long as the conduct would not drive all subsidisers off of the platform). Put differently, where consumers and service providers on a platform do not value what the subsidiser does (e.g., advertising, data brokering), actions that harm the subsidiser are unlikely to harm other sides of the market so long as enough subsidies remain in place. Because the platform has incentives to maintain or increase the subsidies for the "free" services that keep end users on the platform, enforcers can more strongly presume that the platform's conduct toward subsidisers is beneficial for other sides of the platform.

Where efficiencies associated with conduct toward one side benefit other sides as well, they should be counted on all sides where sufficiently proven. For example, assume eBay only allows payments to be made through PayPal, an online payment system. eBay could justify its action as being efficient for: (1) eBay by reducing back-end costs associated with permitting various payment types, (2) buyers by streamlining the purchasing process, and (3) sellers by avoiding credit card transaction fees. If verifiable, regulators

should consider each of the efficiencies in determining whether the action was anticompetitive.

Workflow for conduct analyses by competition agencies. When analysing the effect of challenged conduct on a multi-sided market, regulators should first look at the relationship between the targeted side of the platform and the other sides of the platform.[20] When conduct targets a side of the market participating in a service-based relationship, regulators should closely evaluate the potential impacts on all sides of the market given the likely cross-platform network effects, regardless of which side the conduct targets. If, in contrast, a platform directs its conduct toward subsidisers, cross-platform effects are much less likely unless the action would drop subsidies to insufficient levels, which would render the conduct economically senseless and therefore unlikely to continue or to occur in the first place.

With respect to efficiencies, therefore, agencies need to take into account how efficiencies that flow directly to users or suppliers will also indirectly affect other sides of the market through cross-network effects. When the efficiencies directly benefit subsidisers, there is less likelihood of such cross-network effects benefitting users or suppliers. The implication is that if conduct is efficient for suppliers or users but might raise prices for subsidisers, the reviewing agency should consider whether the efficiencies offset that possible harm to subsidisers through cross-platform externalities. Where, on the other hand, the conduct's direct effect is to harm users or suppliers, it is less likely that efficiency gains for the subsidisers will offset those harms, unless that benefit to the subsidiser is necessary to attract or maintain necessary subsidy levels. It therefore may be more important for authorities to consider efficiency effects on all sides of a multi-sided platform when those efficiencies benefit users or suppliers than when they benefit subsidisers.

Efficiencies in merger analysis involving multi-sided markets

The nature of the relationships among parties in a multi-sided market and the relative strength of network effects also have important implications for merger analysis, particularly with regard to the consideration of efficiencies.

Mergers involving service-based platforms have particular potential to generate efficiencies. Economic theory suggests that a merger of multi-sided platforms may generate unique efficiencies that would not result from a merger of two one-sided firms.[21] Because of network effects platforms can potentially generate positive externalities just by increasing in size. Further empirical research is needed to understand the conditions under which this positive outcome will result, although the potential for a merger to amplify positive cross-platform externalities is likely greatest where network effects generate a robust positive feedback loop. As discussed above, this is more likely to occur where merging platforms mediate similar kinds of service-based relationships between users and suppliers.

Network effects can constrain price increases to consumers. At the root of most merger analysis is an initial presumption that increased concentration will lead to increased prices for consumers.[22] Several recent studies suggest that when it comes to mergers involving two multi-sided platforms, that presumption might not hold. For example, in one recent simulation of a merger to monopoly in the market for German TV magazines, the structural model predicted that post-merger, magazines would raise rates to advertisers, but lower per-copy prices to consumers (in order to drive up circulation).[23] Similarly, in another recent simulation of a hypothetical merger in the Dutch newspaper market, the

model illustrated that an increase in subscription prices was likely to have a negative effect on both subscriber demand (resulting in lower circulation) and on advertising revenue (since decreased circulation leads to less demand for advertising).[24] The authors concluded that "raising the newspaper price is likely to lead not only to a loss in readers but also to a loss in advertising, and therefore the tendency to increase prices will be lower than in the absence of network effects."[25]

Subsidisers may be more vulnerable to unilateral effects than service providers or users. The dependence of the demand for advertising on the number of platform users leads to a closely related corollary: subsidisers might be more vulnerable to the unilateral effects of a merger than other platform participants. As illustrated above, strong network effects can serve as an independent pricing constraint on a platform's incentive and ability to raise prices. Because the network effects in a subsidy-based relationship are skewed heavily towards the subsidiser, however, the relatively weak network effects experienced by users and content providers might not provide the same constraint on price increases to advertisers. Indeed, several recent studies suggest that consolidation of multi-sided platforms results in higher prices to subsidisers.[26] While more research is needed to test this observation, this apparent effect may be explained by the fact that platforms can drive user demand by increasing rates to advertisers and decreasing subscription costs or increasing quantity or quality for users.[27]

Platform mergers that result in price increases may yield net efficiencies. Even if it is true that subsidisers would be subject to price increases following a merger, the merger could nonetheless yield welfare gains—including for the subsidisers themselves. For example, Song's study finds that both the average surplus and the total surplus to advertisers went up at magazines that increased advertising prices post-merger because the lower copy prices raised the number of subscribers and in turn the audience for the advertisers.[28] The study found that although "[a]dvertisers . . . usually face higher ad prices in more concentrated markets . . . they are not necessarily worse off if lower copy prices attract a large number of readers."[29] This result does not imply that subsidisers will always gain from a merger of multi-sided platforms, but it does imply that the efficiencies analysis of such a merger should take into account the cross-platform externalities of any merger-related increase in the number of users to whom advertisers will have access. Presumably, subsidisers will always benefit from an increase in a platform's subscriber/user base.[30] A merger of overlapping multi-sided platforms will necessarily result in such an increase. It is therefore plausible that any post-merger price increase to subsidisers could be entirely offset by the increase in the subscriber/user base that results from the merger. Cross-platform network effects must therefore inform the efficiencies analysis in mergers of multi-sided markets.

3. Conclusion

This paper has examined how the nature of the relationships among the different sides of a multi-sided platform can affect the direction, magnitude, and relative balance of cross-platform network effects. Whether a platform's actions affect parties engaged in subsidy relationships or service relationships has important implications for evaluating the competitive effects and efficiencies. For example, the extent to which efficiencies that flow directly to one side of the market will have positive externalities that offset competitive harm to another side of the market will depend in part on whether the direct beneficiary is a consumer, supplier or subsidiser for the potentially harmed side of the platform. Efficiency gains to users and suppliers are more likely, through the network

effects generated through service relationships, to generate compensating externalities than are efficiency gains to subsidisers. Accordingly, the efficiency analysis for conduct by multi-sided platforms should begin by identifying the nature of the relationship between the targeted side of the platform and other sides of the platform. In the merger context, we have discussed how consolidation of two multi-sided platforms can sometimes lead to stronger constraints on price increases to consumers and generate benefits simply through scale, even if the merger also increases the ability of the post-merger platform to exercise market power. In sum, looking at all sides of a platform and taking account of the kinds of relationships and externalities that flow across the platform will allow competition authorities to develop a more complete measure not just of competitive effects, but of the efficiencies of a platform's business decisions.

Notes

1   *See* Gönenç Gürkaynak et al., *Multisided Markets and the Challenge of Incorporating Multisided Considerations into Competition Law Analysis*, 5 J. ANTITRUST ENFORCEMENT 100, 101−05 (2017) (describing various definitions of multisided markets).

2   The delegates at the 2009 OECD Policy Roundtable on Two-Sided Markets recognised that both (1) distinct groups and (2) network effects between the groups were essential elements of a two-sided market. Secretariat, *Executive Summary*, in POLICY ROUNDTABLES: TWO-SIDED MARKETS 11, 11 (Organisation for Economic Co-operation and Development Competition Committee, 2009). *See also, e.g.*, Gürkaynak et al., *supra* note 1, at 101−05; Jan Ondrus et al., *The Impact of Openness on the Market Potential of Multisided Platforms: A Case Study of Mobile Payment Platforms*, 30 J. INFO. TECH. 260, 261 (2015); David Evans, *Background Note*, in POLICY ROUNDTABLES: TWO-SIDED MARKETS 23, 29 (Organisation for Economic Co-operation and Development Competition Committee, 2009); David S. Evans & Richard Schmalensee, *The Industrial Organization of Markets with Two-Sided Platforms*, 3 COMPETITION POL'Y INT'L 151, 152 (2007); Renata B. Hesse & Joshua H. Soven, *Defining Relevant Product Markets in Electronic Payment Network Antitrust Cases*, 73 ANTITRUST L.J. 709, 714 (2006). In contrast, Andrei Hagiu and Julian Wright believe that "network effects are neither necessary nor sufficient" in defining multisided platforms. Andrei Hagiu & Julian Wright, *Multi-sided Platforms*, 43 INT'L J. INDUS. ORG. 162, 164 (2015).

3   Evans, *supra* note 2, at 29.

4   In the context of multisided markets, network effects have also been referred to as cross-group externalities or indirect externalities. *See, e.g.*, Mark Armstrong, *Competition in Two-Sided Markets*, 37 RAND J. ECON. 668 (2006); Secretariat, *supra* note 2, at 11.

5   Evans, *supra* note 2, at 29. Network effects may be either direct or indirect. "Direct network effects arise where users of the product interact with each other, so having more users makes the product more useful and valuable." Secretariat, *Executive Summary*, in THE DIGITAL ECONOMY 5, 8 (Organisation for Economic Co-operation and Development Competition Committee 2012).

6   *See, e.g.*, Evans, *supra* note 2, at 24 (referring to situations where the sides exhibit unbalanced network effects); Secretariat, *supra* note 2, at 12 (same).

7   *See, e.g.*, Evans & Schmalensee, *supra* note 2, at 159 (describing a feedback loop created by raising prices on one side of a platform).

8   Advertisers might convey information about available goods and services. *See, e.g.*, Evans & Schmalensee, *supra* note 2, at 155−156 n.10. Nonetheless, users do not join a platform seeking

advertising in the same way that they seek the platform's primary content or services (as shown by the fact that on some subsidy platforms, users opt to pay to avoid ads (e.g., Pandora Premium).

9   *See* David S. Evans & Richard Schmalensee, *The Antitrust Analysis of Multisided Platform Businesses*, *in* THE OXFORD HANDBOOK OF INTERNATIONAL ANTITRUST ECONOMICS 404, 410 (Blair & Sokol eds., 2015) (observing that most advertiser-supported media combine content with advertising to attract consumers).

10 *See* Evans, *supra* note 2, at 24 (referring to situations where the sides exhibit unbalanced network effects); Secretariat, *supra* note 2, at 12 (same).

11 *Cf.* Evans & Schmalensee, *supra* note 9, at 429 n.29 (noting that studies of the newspaper industry suggest that advertising does not produce positive or negative externalities for readers, but other forms of advertising may be valued by consumers).

12 Uber is an online platform that connects people seeking car rides ("riders") with people who are willing and available to offer rides ("drivers"). Uber sets the fare for a ride and then charges the driver a percentage of each trip's fare as a fee.

13 *See, e.g.*, U.S. Dep't of Justice & Fed. Trade Comm'n, Horizontal Merger Guidelines §10 (2010) [hereinafter 2010 Horizontal Merger Guidelines]. While merging parties have raised affirmative defenses based on efficiencies, no such defense has succeeded in saving a transaction that was otherwise found by the court to be anticompetitive. *See, e.g.*, *FTC v. Penn State Hershey Med. Ctr.*, 838 F.3d 327, 347-48 (3d Cir. 2016); *FTC v. H.J. Heinz Co.*, 246 F.3d 708, 720-22 (D.C. Cir. 2001); *FTC v. University Health*, 938 F.2d 1206, 1222-24 (11th Cir. 1991).

14 *See United States v. Microsoft Corp.*, 253 F.3d 34, 59 (D.C. Cir. 2001) (stating that greater efficiency can constitute a defendant's "procompetitive justification for its conduct").

15 2010 Horizontal Merger Guidelines, § 10 ("[I]t is incumbent upon the merging firms to substantiate efficiency claims so that the Agencies can verify by reasonable means the likelihood and magnitude of each asserted efficiency, how and when each would be achieved (and any costs of doing so), how each would enhance the merged firm's ability and incentive to compete, and why each would be merger-specific").

16 *See, e.g.*, 2010 Horizontal Merger Guidelines § 10 ("Cognizable efficiencies are merger-specific efficiencies that have been verified and do not rise from anticompetitive reductions in output or service."); 3 PHILLIP E. AREEDA & HERBERT HOVENKAMP, ANTITRUST LAW: AN ANALYSIS OF ANTITRUST PRINCIPLES AND THEIR APPLICATION ¶ 658f (4th ed. 2015) ("Thus when courts speak of the business justification defense as requiring some showing of 'efficiency,' that term should be understood to refer to the costs or output of the monopolist itself (productive efficiency), not to the market as a whole (allocative efficiency).").

17 AREEDA & HOVENKAMP, *supra* note 13, at ¶ 658f; 2010 Horizontal Merger Guidelines § 10 (efficiencies that "reduce the incremental cost of production" are more likely to be cognizable); In both the merger and the unilateral conduct contexts, courts and agencies appear to require that efficiencies increase consumer welfare in order to be cognisable. *See, e.g.*, 2010 Horizontal Merger Guidelines § 10; *Data Gen. Corp. v. Grumman Sys. Support Corp.*, 36 F.3d 1147, 1183 (1st Cir. 1994) ("In general, a business justification is valid if it relates directly or indirectly to the enhancement of consumer welfare.").

18 *United States v. Am. Express Co.*, 838 F.3d 179, 197-98, 202-05 (2d Cir. 2016) (holding that what mattered was the adverse effect on competition "*as a whole*" and that the whole market included both sides); Case C-67/13 P, Groupement des Cartes Bancaires (CB) v. Comm'n, 2014 E.C.R. 2204.

19   *See, e.g.*, Lapo Filistrucchi et al., *Assessing Unilateral Effects in a Two-Sided Market: An Application to the Dutch Daily Newspaper Market*, 8 J. COMP. L. & ECON. 297, 301 (2012) (providing example of how a newspaper that raises the subscription price should account for the "negative effect on advertising revenues as decreased circulation leads to a decline in the demand for advertising").

20   If the multisided market has more than two sides, it is possible that the side is involved in multiple relationships. For example, if Pandora, an online radio station, takes an action against users, the users will be in both (1) a subsidy-based relationship with the advertisers, and (2) a service-based relationship with the musicians providing content.

21   Evans & Schmalensee, *supra* note 9, at 428 ("[A]ll else equal a merger of multisided platforms would ordinarily increase indirect network externalities by increasing the size of all customer groups and thereby provide efficiency benefits").

22   *See* 2010 Horizontal Merger Guidelines § 1 ("Enhancement of market power by sellers often elevates the prices charged to customers.").

23   Minjae Song, *Estimating Platform Market Power in Two-Sided Markets with an Application to Magazine Advertising* 30–33 (Simon School, Working Paper No. FR 11-22, 2013), *available at* https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1908621.

24   Filistrucchi et al., *supra* note 22, at 325-26.

25   *Id.* at 326.

26   *See, e.g.*, *id.*; Song, *supra* note 29; Przemyslaw Jeziorski, *Effects of Mergers in Two-Sided Markets: Examination of the U.S. Radio Industry*, 6 AM. ECON. J. MICROECONOMICS 35, 36 (2014) (empirical study of consolidation in U.S. radio industry from 1996 to 2006 found merger wave resulted in 6% increase in prices to advertisers).

27   *See* Song, *supra* note 29.

28   *Id.* at 32.

29   *Id.* at 33.

30   *See id.*

Part VI. Vertical Restraints

9. Suggestions for competition authorities when assessing vertical restraints in multi-sided platforms

By Paul A. Johnson[1]

This note discusses some key questions that investigations should consider when assessing vertical restraints in multi-sided platforms. It is composed of three main sections. The first formulates a threshold question: when should we apply the economics of platforms to an analysis of vertical restraints? The last two sections, assuming the previous question has been answered affirmatively, address the economic assessment of anticompetitive and procompetitive effects of vertical restraints in platforms.

1. Preliminaries: when should we apply the economics of platforms?

Platforms, equivalently termed "two-sided markets" or "multi-sided markets," are *intermediaries*. While the economic literature does not provide a consensus definition, Marc Rysman takes the pragmatic view that the definition should be one of degree: "The interesting question is often not whether a market can be defined as two-sided—virtually all markets might be two-sided to some extent—but how important two-sided issues are in determining outcomes of interest."[1]

For an example that is technically a platform but where there is no need to apply the economics of platforms, Rysman provides the example of a given make of automobile where the two users are consumers and mechanics. To some extent, the more consumers purchase automobiles of the make, the more mechanics will specialise in servicing that make and vice-versa: usage by either side of the "automobile platform" increases with usage on the other side. But while an automobile may technically be a platform, an analysis of vertical restraints in the sale of automobiles can ignore the mechanic side because it is unlikely that quantities on one side significantly affect quantities on the other side.

At the other extreme is a platform where the quantity on one side necessarily increases with quantity on the other side. For example, every (non-carpooling) ride facilitated through a ride-sharing service involves *exactly* one driver and *exactly* one (paying) rider. Similarly, a payment card platform has the property that literally every purchase involves exactly one merchant and exactly one consumer. Because a merchant cannot transact without a consumer, there is no sense in which a "merchant transaction" can happen without a "consumer transaction." Nor is there necessarily a sense in which one user is more important than the other: the platform provides a transaction service jointly and indivisibly to both merchants and consumers. Similarly, while a merchant pays the

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network a "merchant price," for every merchant price it receives, the platform also receives a "consumer price" (which can be a negative price indicating that consumers are paid to use the card). By providing the transaction service, the platform retains the sum of the two prices, a property first recognised by then-US Department of Justice Assistant Attorney General Baxter.[2] Correctly defining the notion of "price" is critical when assessing whether a vertical restraint allows a payment card platform to expand or preserve its market power (i.e., charge a supracompetitive price).

Other examples lie between that of an "automobile platform" and a ride-sharing or payment card platform. For example, a newspaper can change the number of advertisements it sells without the number of subscribers automatically changing, and vice-versa. The Google search engine is similar in that advertisements do not always appear after a search. Moreover, the Google platform is broad in that it offers a number of other services to consumers beyond search. Some of these services, like Google Scholar, never appear to show advertising. Thus, Google can change the number of advertisements it shows to users without users changing the intensity of their engagement with the platform. Amazon is similar. While every transaction on Amazon Marketplace involves exactly one consumer and one third-party merchant, Amazon earns revenues from multiple products (e.g., retail offerings offered by Amazon, streaming video, an appstore, tablets). Amazon could draw more users to its platforms with these other products and thereby increase third-party merchant sales on Amazon marketplace. However, such an increase is not an automatic and necessary result of increased user participation on the platform.

The difference in these examples can be appreciated without resorting to sophisticated or nuanced economic reasoning. Instead, the difference is driven by the degree to which quantity transacted on one side changes with quantity transacted on the other side; "fixity of use" will refer to this degree. It differs from network effects, usually defined with reference to benefits of membership increasing as other users join, in that fixity of use emphasises use.[3] The importance of fixity of use may not be always appreciated. For example, some maintain that a "mature" payment card network is not two-sided based on a claim that the magnitude of network effects diminishes as a platform "matures" (i.e., as network effects diminish).[4] That conclusion incorrectly ignores a platform's need to encourage use by its members independent of its "maturity." And, at a more basic level, that conclusion incorrectly ignores the fixed-proportions nature of a payment card platform and does not recognise the price the platform receives from facilitating a transaction.

To appreciate fixity of use further, recognise the difference between *use* of a service offered by a platform and *membership* on a platform. For example, riders and drivers can choose to become members of a ride-sharing platform after which they choose how intensively to use that platform. In that sense, there is not necessarily "fixity of membership" in a ride-sharing platform: the number of riders that have an Uber account can change without the number of drivers changing. Similarly, the number of merchants that accept a particular payment card can change independent of the number of consumers who hold the card. Depending on whether an investigation centers on transaction-specific fees or on the fees paid by users that are independent of usage, that distinction is important to recognise.[5] For example, suppose that it is determined that merchant acceptance of a payment card is not affected by a small change in the number of consumers who hold the card. In that case, an analysis of any membership fees merchants pay to accept the card need not consider annual fees paid by consumers. That conclusion, however, does not change the fact that every *usage* of the payment platform necessarily

implicates exactly one merchant and exactly one consumer and that the payment platform retains the sum of the merchant and consumer prices.

The degree of fixity of use should be determinative of whether a platform's services and prices are assessed akin to a payment platform (i.e., where multi-sided principles are important) or akin to an automobile "platform" (i.e., where multi-sided principles can be ignored).[6] As a simple illustration, suppose a platform seeks to improve the match between two sets of users, who are charged very different prices and offered very different services. As a first step, one might consider whether it is meaningful to consider the terms offered to one set of users independent of the terms offered to the other set of users. The degree of fixity of use should be determinant because the analysis should reflect the platform's business realities: as fixity of use disappears, the platform treats the two sides independently.[7] In other words, if the two sides operate reasonably independently, then an analysis can reliably analyse either side independent of the others. However, when the operations of both sides of the platform are reasonably tightly linked, a reliable analysis should consider both sides jointly. That statement operates independently of, for example, how antitrust markets are defined or how strong network effects are because it speaks to the *price* that is relevant to the platform. The overall price relevant to the platform can be calculated as the quantity-weighted average of prices paid by each side.[8]

2. Assessing the anticompetitive effects of vertical restraints in platforms

By definition, vertical restraints restrain some expression of competition. This section considers only these anticompetitive effects by suggesting three questions for competition authorities to consider.

Who are the victims and beneficiaries of the vertical restraint?

A coherent theory about the anticompetitive effects of a vertical restraint should identify the victims and the beneficiaries of that restraint in a manner consistent with economic logic. That logic starts with some results associated with the Chicago school and continues by leveraging insights developed in the literature since.[9]

One application of the famous Coase theorem is that a buyer and seller will trade when the buyer's valuation exceeds the seller's cost so long as information is complete and bargaining costs are small.[10] For this reason, modern antitrust holds a presumption that when sophisticated parties negotiate, they sign agreements that maximise the joint value available to them regardless of the relative bargaining power of the parties. In other words, signed contracts are presumed to be "bilaterally efficient." A corollary to this result is that a vertical restraint will appear in a contract if and only if it is bilaterally efficient.[11] That is *not* to say that all vertical restraints, or even all agreements more generally, are competitively benign. Even if a contract is bilaterally efficient, it can affect third parties. A very plain example is a cartel whose members agree to maximise producer surplus but, because consumers are not party to the cartel negotiations, do not agree to maximise total surplus. To take another example, a platform may sign a contract with one set of users that prevents other platforms from competing. That contract can make the platform and the set of users that signed the contract better off at the expense of other users of a platform as well as competing platforms. Effects on third parties, known as "contracting externalities," are foundational to modern theories of harm from vertical restraints.[12]

Another important implication of economic logic is that a vertical restraint cannot be the source of bargaining power but is the result of bargaining power. That implication leads to the conclusion that a vertical restraint that limits one entity's actions is accompanied by prices, or other terms, that compensate for that limitation.[13] For example, if a vertical restraint moves some risk from a buyer to a seller, then the price paid to the seller must increase in compensation. The inclusion of such a vertical restraint cannot somehow endow the buyer with bargaining power because such a claim is circular (i.e., the restraint would have to create the bargaining power that was necessary for its imposition it in the first place).

The logic of the previous two paragraphs is not always explicitly recognised in economic models that study vertical restraints. That is not to say that the logic is not widely accepted—it is—rather, the omission reflects a deliberate choice to simplify and focus economic models on a small set of issues. For example, a model may analyse the effects of a vertical restraint by comparing outcomes with and without the vertical restraint while holding all else constant and imposing some restriction on the form that contracts can take (e.g., linear pricing). This analysis implicitly compares two very different settings (specifically, two very different extensive form games) where the relative bargaining power of the parties differs substantially. In richer settings, firms will react to a ban on the vertical restraint by changing aspects of their behavior that the model's restrictive assumptions do not permit. For example, if an entity has power and the ability to impose a restraint, it also has the option to exercise that power differently—say simply by charging a higher price. While economic models may abstract away from such important issues relating to the existence of a vertical restraint, that abstraction does not allow enforcement authorities to do the same.

An interesting application of the logic of vertical restraints is evident in the United States Department of Justice (USDOJ) complaint against Blue Cross Blue Shield of Michigan (BCBSM).[14] BCBSM might be viewed as a platform because it serves two separate sets of entities: hospitals and payers of health insurance. USDOJ alleged that BCBSM signed contracts that included most favored pricing terms with certain hospitals in Michigan, which committed the hospitals to sell BCBSM medical services at prices that were lower than any other entity received. USDOJ alleged that the effect of these terms was to limit competition in certain markets by limiting the competition that BCBSM faced. Notably, the complaint alleged that BCBSM obtained most favored pricing terms from some hospitals "by agreeing to increase its payments to the hospital."[15] The victims, thus, were not the hospitals who signed contracts with the vertical restraint—they received higher payments—but were third party payers of health insurance and competing health insurance providers.

This discussion implies that not only should competition authorities have a strong presumption that vertical restraints are bilaterally efficient (although not necessarily socially efficient), but that they should be cognisant that the complaints they hear may be driven by pre-existing market power rather than a legitimate harm to competition. Specifically, parties who have signed a vertical restraint may not be "happy" with the price or services they receive even if the vertical restraint is procompetitive. Ultimately, a complaint may simply reflect a perception of a lack of bargaining power and be unrelated to any anticompetitive effects of the vertical restraint. This danger is most acute when the complainants are managers whose job responsibilities are narrowly circumscribed to achieve as low (or high) a price as possible without having a broader understanding of their firm's operations.

What nature of harm does the theory imply?

A platform serves at least two distinct users and, as such, charges at least two different prices. So long as quantity provided to one user increases significantly with the quantity provided to other users (i.e., fixity of use is significant), one can define an overall level of price, which determines the profitability of the platform, and describe how that overall price is allocated to the different users. A vertical restraint may also affect prices paid by those who do not use the platform. In assessing theories of harm, a competition authority should carefully consider whether those theories imply harm through an increase in the *overall* price, the *allocation* of that price, or an increase in the price to others.

The most straightforward theory of harm implies an increase to the overall price relevant to the platform, which is equivalent to the standard monopoly distortion. For example, one such theory might involve the use of exclusive dealing provisions that limits the ability of other platforms to compete. Such a loss of competition might lessen an important competitive constraint on the platform and allow it to raise prices to all users and, thereby, the overall level of price.

A second and more subtle theory of harm considers no increase in the overall price, and hence no increase in the profits of the platform, but, instead, focuses on how that overall price is allocated among different users. More specifically, the theory holds that the vertical restraint distorts the allocation of prices among different users without leading to additional profits for the platform. This type of distortion is akin to that described in the literature on "aftermarkets," which involve complementary goods or services purchased by a single user, so are not a platform. An important question in that setting is whether antitrust should be concerned with market power in an aftermarket when competition in a "foremarket" is vigorous. Perhaps the most widely studied example of aftermarkets stems from the US Supreme Court's *Kodak* decision,[16] which analysed the effects of tying aftermarket maintenance (maintenance of copiers) to purchases in a foremarket (purchase of a copier). Carl Shapiro has shown that tying an aftermarket to a competitive foremarket causes there to be "too much" consumption in the foremarket and "too little" consumption in the aftermarket (e.g., new copiers are purchased too frequently and existing copiers are serviced too infrequently). He argues, however, that these distortions in how the overall price is allocated result in *de minimis* loss and are not worthy of attention from antitrust.[17]

A third theory of harm highlights the implications to parties not bound by the vertical restraint. While such theories adopt strong simplifying assumptions, they still face hurdles due to the complicated nature of the environments in which platforms operate.

As an example, consider the model proposed by Marius Schwartz and Daniel Vincent that investigates the welfare effects of a vertical restraint—a no surcharge rule or "NSR"—in the context of a highly stylised model of a payment card network.[18] The model imposes the NSR so cannot answer the questions highlighted above in section 0. . Some intuition can be gleaned by recognising that an NSR effectively sets a price ceiling for one good that is no higher than prices of other goods. In the Schwartz and Vincent model, the two goods are the act of purchasing with a credit card and the act of purchasing with cash. The vertical restraint limits the price consumers pay when using a credit card to be no higher than the price they would pay if they used cash. Because the cash price is a choice variable for the retailer, an NSR will cause the cash price to differ from that absent the restraint. In other words, an NSR will cause merchants to change both the cash and credit prices. In the Schwartz and Vincent model, an NSR causes the credit price to decrease and the cash price to increase.[19] (It is in this sense that Joseph Farrell has characterised an

NSR as a means for a payment network to "tax" rival payments methods.[20]) In general, the effects on consumer welfare are ambiguous. The merchant's market power distorts the credit price away from optimal levels and an NSR mitigates this effect; however, the NSR introduces additional distortions (namely an increase in the cash price as well as a distortion in the fees charged by the payment card network) that can outweigh its efficiency enhancing effects. In the Schwartz and Vincent model an NSR can either increase or decrease consumer surplus and total surplus.

How are the restraint's effects transmitted to other sides of the platform?

In assessing a vertical restraint, some jurisdictions balance any anticompetitive effects against any procompetitive effects. When a platform is not at issue, a single set of consumers feels the effects of those opposite effects. In a platform, however, those opposite effects may be felt by distinct sets of users. This dynamic suggests that competition authorities should analyse whether and how effects of vertical restraints are transmitted across different sides.

As an example, consider the United States Department of Justice's (USDOJ) case against BCBSM, which involved most favoured pricing terms and was described in section 0. . One approach might be to weigh the procompetitive and anticompetitive effects of the restraints considering *only* the relationships between hospitals and insurance companies. According to one such anticompetitive theory, those hospitals that had not incorporated the vertical restraint into their contracts would suffer from an elimination of competition among insurance companies; those hospitals that had incorporated the vertical restraint into their contracts could benefit. USDOJ, however, noted that higher prices paid to hospitals by BCBSM likely result in higher prices paid by a different set of users: payers of health insurance. Specifically, USDOJ noted that one set of payers, known as "self-funded" payers pay for their own healthcare claims.[21] Such payers would be harmed because they pay more when hospital prices increase. USDOJ also noted that state law allowed BCBSM to base the premiums of "fully insured" payers on historical healthcare costs "so increases in local hospital prices can lead directly to increased premiums."[22]

More generally, a vertical restraint on one side of a platform, by definition, restrains an expression of competition on that side. However, it can also have effects on other sides of the platform. In principle, those effects can benefit or harm the other side. USDOJ's complaint against BCBSM is an example where a vertical restraint on one side harms users on another side. Another theory might hold that a vertical restraint limits competition on one side but ultimately benefits users on another side due to a shift in the locus of competitive vigour. (In this context, it is useful to keep in mind that a vertical restraint must be bilaterally efficient before parties accept it, so it is necessary to explain why users on one side are better off by agreeing to a vertical restraint that limits one expression of competition on their side.)

The term "waterbed effect" has been used in the telecommunications literature to describe the effect of fixed-to-mobile termination rates on the prices paid by mobile telephone users.[23] Empirical analysis in that literature has exploited shifts in regulation over time to estimate how different sets of users are affected. In principle, such an approach could be used more generally to estimate how effects of vertical restraints are transmitted across platforms.[24]

3. Assessing the procompetitive effects of vertical restraints in platforms

While vertical restraints restrain, they can also enable expressions of competition. Thus, an analysis that focuses exclusively on what a restraint prevents without considering what it enables is incomplete. This section discusses two common procompetitive justifications for vertical restraints in platforms.

Is free riding a procompetitive justification?

Jean-Charles Rochet and Jean Tirole distinguish between a merchant's ex ante and ex post incentives to accept a payment card:

> *Retailers often complain that they are "forced" to accept card transactions that increase their net costs. To understand this "must-take card" argument, one must distinguish between ex post and ex ante considerations. Once the customer has decided to buy from the retailer, it is in the latter's interest to "steer" the former to pay by cash or check instead of by card whenever $p_s > b_s$. But from an ex ante point of view, the retailer must also take into account the increase in store attractiveness brought about by the option of paying by card. Because retailers ex ante can always turn down cards, the "must-take card" argument refers to the ex post perspective.*[25]

In this discussion, the merchant has an incentive to advertise acceptance of the card to generate increased custom only to steer customers away from using that card once they have started the process of a purchase. This conflict of incentives leads to a free rider problem that some claim may be resolved with a vertical restraint that restricts merchant behaviour at the point-of-sale. The fact that a merchant and a consumer may transact *off* the platform that brought the two users together in the first place is the key element of an argument about free riding on platforms. That element may be important in platform applications beyond payment cards. For example, an online travel site may match a traveller and a hotel only to have the traveller and hotel transact off-platform at a price that is more attractive to each. Similarly, drivers and riders could find each other on a ride-sharing platform only to bypass the platform and share the savings.

In assessing whether a vertical restraint can help resolve a free-riding problem, competition authorities might usefully consider three questions.

- *Is the platform responsible for bringing the users together?* If the platform did not bring the users together then the platform's investments are not susceptible to free riding. However, a finding that the platform does not affect the matches users make is a finding that the platform has no market power, which is usually a predicate to a finding that a vertical restraint has an anticompetitive effect. For example, if travellers would have booked at a particular hotel regardless of the use of any booking platform, that hotel would lose no custom by ending its participation in the platform.
- *What investments are susceptible to free riding if a transaction happens off the platform?* When users transact off the platform, the platform avoids any expense associated with the transaction; such costs are not susceptible to free riding. Nevertheless, it is possible that the platform made investments that were responsible for bringing the users together. For example, in the context of the Rochet and Tirole payment card example, customers are attracted to a merchant that claims to accept a particular payment card in the *anticipation* of rewards and services they have come to expect from using their card in the past.

- *Can free riding be resolved in other ways?* Theory allows for multiple ways to solve free riding. For example, the platform could discontinue to serve offending users. Alternatively, a platform might be able to use a fee structure that involves a lump-sum payment that eliminates any incentive to free ride. Asking whether a vertical restraint is the "least restrictive alternative" is, thus, not possible to answer generally, but an important question to answer within a specific context.

Does the restraint preserve the platform's viability? Is that a procompetitive effect?

Platforms typically exhibit network effects. And when platforms compete, such network effects may cause markets to "tip" to a single platform.[26]

In theory, platforms can use vertical restraints either to encourage or to prevent tipping. For example, a "big" platform could use an exclusivity clause with one set of users to increase industry concentration. Perhaps more surprisingly, a "small" platform could also use the same kind of exclusivity clause to decrease industry concentration. That latter possibility is not purely theoretical as Robin Lee's empirical analysis of exclusivity by video game platforms demonstrates.[27] An important result of that study is that entrant platforms leveraged exclusives in software as a means of differentiating themselves from the larger incumbent.[28]

In assessing whether a vertical restraint can help spur competition by ensuring the viability of smaller platforms, competition authorities might usefully consider a two-part test. The first part of that test asks whether the vertical restraint, in fact, ensures the viability of the smaller platform. Answering that question in the affirmative, however, is not sufficient to conclude that the vertical restraint is necessary for competition because it may protect a competitor without protecting competition. The second part of that test requires consideration of an additional question: Is the presence of the smaller platform critical to competition in the market? It bears emphasising that a vertical restraint may fail this test without being anticompetitive. In that case, obviously, a lack of a procompetitive justification should not trouble a competition authority.

Notes

1   Marc Rysman. "The economics of two-sided markets." *The Journal of Economic Perspectives* 23, no. 3 (2009): 125-143, 127.

2   William F. Baxter. "Bank interchange of transactional paper: Legal and economic perspectives." *The Journal of Law & Economics* 26, no. 3 (1983): 541-588, 545. ("Perhaps the most intuitively appealing way to resolve the difficulties posed by this market model is to redefine what we mean as one unit of the product consumed. Rather than considering the demands of [the purchaser] P and [the merchant] M as demands for separate products, define one unit of product to consist of the bundle of transactional services that banks must supply jointly to P and M in order to facilitate the execution of one exchange of goods or services between P and M. Under this interpretation, the supply price of the product is the sum of the individual charges to P and to M. Furthermore, the demand for that product is a joint demand of P and of M: in combination they must make a payment of that magnitude to the banks to induce the necessary supply, but independently neither P nor M necessarily confronts any particular price as one he must pay in order to have his demand fulfilled.")

3   Michael L. Katz and Carl Shapiro. "Systems competition and network effects." *The Journal of Economic Perspectives* 8, no. 2 (1994): 93-115, 94. ("Because the value of membership to one user is positively affected when another user joins and enlarges the network, such markets are said to exhibit 'network effects,' or 'network externalities.'")

4   For example, see Alan S. Frankel and Allan L. Shampine. "The economic effects of interchange fees." *Antitrust Law Journal* 73, no. 3 (2006): 627-673, 655. ("By its nature, a network externality is likely to become less important . . . as a network matures.").

5   For example, some credit cards charge consumers an annual fee that is independent of usage. In the United States, Visa charges some merchants a "fixed acquirer network fee" that may be independent of usage.

6   Jean-Charles Rochet and Jean Tirole have defined a platform to be "one-sided" if the volume of transaction depends only on the aggregate price level and not on the structure. But because their focus appears to be mainly on payment platforms and other platforms where fixity of use is perfect (e.g., bilateral electricity trading), their definition identifies instances when parties can negotiate bilaterally to "undo" any particular price structure and not on the extent to which quantity on one side could increase independent of quantity on other sides. See Jean-Charles Rochet and Jean Tirole. "Two-sided markets: a progress report." *The RAND Journal of Economics* 37, no. 3 (2006): 645-667, 648.

7   To be more specific, consider a platform with two sides, A and B. To simplify, suppose that use by side B is relevant to side A, but use by side A is not relevant to side B. Costs to serving either side are zero. In this case the profit of the platform can be written as $\pi = P_A Q_A\big(P_A, Q_B(P_B)\big) + P_B Q_B(P_B)$. The first-order condition of profit with respect to the side-B price is $\frac{\partial \pi}{\partial P_B} = P_A \frac{\partial Q_A}{\partial Q_B} Q_B'(P_B) + Q_B + P_B Q_B'(P_B) = 0$. The term $\frac{\partial Q_A}{\partial Q_B}$ reflects fixity of use. The first term in the first-order condition approaches zero as fixity of use disappears leaving only the latter two terms. The latter two terms represent the standard first-order condition if side B were independent of A.

8   For example, in a two-sided platform with sides A and B, the quantity-weighted average of the prices paid by each side is $P = P_A \frac{Q_A}{Q_A+Q_B} + P_B \frac{Q_B}{Q_A+Q_B}$.

       In some cases, however, the price to one side may be set to zero and platforms compete by providing services to attract users. In theory, a platform's profits are affected in the same way whether it spends a dollar on providing a service or it spends a dollar lowering the price. In practice, quantifying the costs of providing these non-price attractions may be challenging.

9   An excellent reference is Chapter 4 of Michael D. Whinston. "Lectures on Antitrust Economics." *MIT Press Books* 1 (2008).

10   The proof is easy and instructive. A buyer and seller are negotiating to trade an item. The buyer values the item at *v* dollars; the seller values the item at *c* dollars. Suppose gains to trade exist (i.e., *v-c>0*), but the parties do not trade. Either the buyer or seller could propose a price between *c* and *v* that, if accepted, would leave both sides strictly better off. Doing so is possible because *c* and *v* are common knowledge; doing so is also nearly costless because bargaining costs are small.

11   First suppose that the clause is in the contract but it is inefficient. The buyer and seller can both be made better off if the clause is taken out, so they will take it out. Next suppose that the clause is efficient but is not included in the contract. Again, by including the clause, each party can be made better off by including it, so they will include it.

12   Whinston, *supra* note 9 at 140, writes "In recent years, a number of authors have shown how sensible alterations to this Chicago School model can make exclusive contracts a profitable strategy for excluding rivals. These models all have the feature that some form of externality

arises from an exclusive contract signed by two parties onto other individuals, and this externality makes the contract jointly optimal for the contracting parties."

13   An exception involves an incumbent seller who can make sequential offers to a large number of buyers to exclude potential rival sellers. In that setting, the compensation to the buyers for signing an exclusive contract approaches zero. In this way, signatories to vertical restraints can be harmed not by their own restraints (which do not harm them but offer little compensation), but through the agreements others sign that foreclose entry. See Eric B. Rasmusen, J. Mark Ramseyer, and John S. Wiley Jr. "Naked exclusion." *The American Economic Review* (1991): 1137-1145 and Ilya R. Segal and Michael D. Whinston. "Naked exclusion: comment." *The American Economic Review* 90, no. 1 (2000): 296-309.

14   Complaint, *United States and State of Michigan v. Blue Cross Blue Shield of Michigan*. Case 2:10-cv-14155-DPH–MKM.   Available   at   https://www.justice.gov/atr/case-document/file/489536/download.

15   *Id*. ¶ 44. See also ¶¶ 40, 49, 58, 60, 68, 75.

16   *Eastman Kodak Co. v. Image Technical Services, Inc.*, 504 US 451 (1992).

17   Carl Shapiro. "Aftermarkets and consumer welfare: Making sense of Kodak." *Antitrust Law Journal* 63, no. 2 (1995): 483-511, 497. ("I am not convinced that this type of consumer injury is worthy of the attention of antitrust laws.")

Setting aside whether such a distortion ought to be worthy of attention from an antitrust authority, much of the literature has concluded that market power may create distortions of ambiguous *sign* on how platforms allocate the price among different sides. In other words, while market power may introduce a distortion in how the total price is allocated among the sides, that distortion does not necessarily favor one side or another. Glen Weyl analogises this distortion to the more familiar result, due to Michael Spence, that a monopolist may either over- or under-provide quality depending on the nature of heterogeneous consumer tastes for quality. E. Glen Weyl. "A price theory of multi-sided platforms." *The American Economic Review* 100, no. 4 (2010): 1642-1672.

18   Marius Schwartz and Daniel R. Vincent. "The no surcharge rule and card user rebates: Vertical control by a payment network." *Review of Network Economics* 5, no. 1 (2006).

19   Suppose that a merchant sells two goods that are independent in the sense that the price of one good does not affect demand for the other good. Furthermore, suppose that, without any constraint, the merchant would choose to set a higher price for good 1 than for good 2. If the manufacturer of good 1 requires that the merchant's selling price of good 1 not exceed the selling price of good 2 then, making some additional regularity assumptions, the merchant's constrained (single) profit maximising price for the two goods will fall between the unconstrained prices of the two goods. The merchant will raise the price of good 2 to some degree because it is required to do so in order to raise the price of good 1 closer to its preferred, unconstrained price.

20   Joseph Farrell. "Efficiency and competition between payment instruments." *Review of Network Economics* 5, no. 1 (2006).

21   *Supra*, note 14, ¶ 15.

22   *Supra*, note 14, ¶ 18.

23   Christos Genakos and Tommaso Valletti. "Testing the 'waterbed' effect in mobile telephony." *Journal of the European Economic Association* 9, no. 6 (2011): 1114-1142.

24   See Marc Rysman and Julian Wright. "The economics of payment cards." Review of Network Economics 13, no. 3 (2014): 303-353. section 5.2 for a discussion of some potential difficulties of estimating waterbed-type effects in the case of payment cards.

25   Jean-Charles Rochet and Jean Tirole. "Must-Take Cards: Merchant Discounts and Avoided Costs." *Journal of the European Economic Association* 9, no. 3 (2011): 462-495, 467.

      The notation *ps>bs* reflects the situation when the merchant's private benefits of accepting the card are lower than the price it pays to do so. Setting *ps=bs* reflects the "Baxter fee." Importantly, a merchant may have an incentive to accept cards even when the price exceeds the benefits due to a "business stealing" effect.

26   Michael L. Katz and Carl Shapiro. "Systems competition and network effects." *The Journal of Economic Perspectives* 8, no. 2 (1994): 93-115.

27   Robin S. Lee. "Vertical integration and exclusivity in platform and two-sided markets." The American Economic Review 103, no. 7 (2013): 2960-3000.

28   One of the most profound implications of network effects for antitrust is the implied tradeoff between quality and competition. Specifically, competition may grow with the number of competitors, but the benefits of network effects may be lost as the industry becomes fragmented. Lee argues that consumer welfare would have likely *increased* substantially with concentration in video game platforms. Marc Rysman's study of yellow pages found the opposite: despite the presence of network effects, more competition increased welfare. Marc Rysman. "Competition between networks: A study of the market for yellow pages." *The Review of Economic Studies* 71, no. 2 (2004): 483-512.

10. The competition analysis of vertical restraints in multi-sided markets

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1. Introduction

The competition assessment of vertical restraints in multi-sided markets is an area of remaining controversy and confusion across Europe. Failure to properly internalise the economic insights of the past 30 years on the role of contractual restrictions between vertically-related firms in traditional "one-sided" markets has carried over – amplified – to multi-sided environments. The European Commission's Vertical Guidelines of 2010 have been a missed opportunity to set out clear principles for enforcement, and presumptions in favour of vertical restraints in traditional environments. These shortcomings are coming back to haunt us in multi-sided platforms, online and e-commerce – right at a time when firms are facing uncertainty and are rethinking their distribution models, experimenting with multiple channels.[1]

The current enforcement record is a heterogeneous patchwork of activity across Member States. Various types of vertical restraints have been probed between online platforms (providing various functionalities typically "for free" to consumers), and brands/sellers using the platform as a distribution channel – including "best price clauses"/"MFNs", and platform exclusions of various kinds. The approach does not reflect a careful, systematic application of economic principles but more often the persistence of idiosyncratic views on the anticompetitive effects of vertical contracting (e.g. that manufacturers want to shut down cheaper distribution channels "to keep prices high", or that "best price clauses" are inherently anticompetitive). On the one hand, agencies tend to regard platforms trying to bring about uniform prices with other channels through MFNs as anticompetitive; while at the same time, price discrimination resulting from platform exclusion decisions is also regarded as anticompetitive. There is also limited effort to understand the efficiency properties of such contracts and the motivation of firms using them to solve certain problems (e.g. on a view that "free riding" does not exist).

The implication is that firms are scared to articulate their true motives for fear of being misunderstood, and seeking alternative solutions to deal with their issues without being caught in investigations. Some are structuring their online distribution much more "in-house" as an integrated function; while platforms are redesigning certain functionalities to "work around" perceived antitrust risks. This involves foregoing the experimentation around new independent distribution formats which is needed to trial and test new ideas. It also implies that investment are incurred in redesign and "workarounds" that may be

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redundant and displace more productive ones. As a result, online distribution of goods and services in Europe is being held back and in danger of ending up a lot less varied and efficient than it should be.

After a brief introduction to multi-sidedness and the questions we set out to consider (Section 2), in Section 3 we explain how the key insight that vertical restraints are motivated by contractual incompleteness carries over directly to multi-sided markets. Similarly in Section 4 we argue that while multi-sidedness may appear to complicate greatly the analysis of competitive effects, the assessment can be simplified to an approach close to the approach to vertical restraints in more standard environments. Where a new approach is truly needed is in developing and taking seriously the evidence for the efficiency properties of these restraints, which tend to be systematically overlooked or dismissed (Section 5). Compounding the current problem is the structure of the law, which involves a sequential assessment of anticompetitive effects and efficiencies and is particularly ill-suited to vertical restraints; and possibly the reality that Industrial Organisation research continues to put too much emphasis on the details of specific models and is not encouraging enforcers to look beyond analyses of short-term price effects, at dynamic issues of investment and experimentation (Section 6). Building on these considerations, in Section 7 we make a number of suggestions for a roadmap to the analysis of these practices. Section 8 concludes.

2. Multi-sidedness and vertical contracting

Markets are described as "multi-sided" when they are organised around an intermediary (a "platform") with interdependencies in demand between agents performing and obtaining services on various sides of the platform. While there are multiple classic examples (TV and newspapers, payment cards), for purposes of this paper we focus on digital platforms that connect different constituencies of users: consumers searching for information and a product/service to "match" their requirements; sellers looking to realise a sale; advertisers serving up adverts to match and anticipate users' interests; and the platform itself, looking to monetise its services (information, matching) through advertising and various other sales commissions.

Multi-sided markets involve a number of characteristics: (a) there are typically network externalities across the sides of the platform; (2) the platform has incentives to invest to develop a user base as wide as possible on one side, so that it can monetise its investment on the other side (e.g. through advertising revenues on the other side, and as well as through commission on sales/bookings); (3) this typically involves offering an attractive service "for free" (or at a low price) to build up customer base on one side quickly; and (4) investments in functionalities which are provided to users for "free" are susceptible to free riding if they are available to all, but there is a separate channel through which purchases/bookings can be made.

The question we discuss in this paper is whether we need to make changes to the competition analysis of vertical contracts in these settings. For instance, contracts that introduce restrictions on the prices that can be charged by sellers across channels (e.g. "best price clauses"); on the distribution channels that may be used (e.g. brands allowing distributors to use certain online marketplaces but not others); and on branding and features that may be displayed (e.g. prohibition to use a logo on a platform). Do we need new insights and new tools to deal appropriately with these cases?

3. Contract incompleteness motivates vertical restraints also in multi-sided markets

A broad insight provided by economic analysis over the past 30-40 years on the motivation for vertical restraints is that these give rise to anticompetitive effects only in limited, very specific circumstances.[2] Vertical co-ordination does not typically lower the competitive pressure faced by a firm, but allows it to organise sales in a more effective way. If a firm "restricts" its own downstream distribution, it does not affect directly its competitors but restricts access to market of its own goods. As brand owners have an interest in the distribution of their products being as competitive as possible, the question is *why would they limit the channels of distribution they use*, or leave "money on the table" in the form of a greater margin to the retailer? The most natural explanation in most cases is that they can only be interested in doing so if this creates incentives for beneficial activities that cannot be otherwise directly mandated and controlled. While there is a literature on the anticompetitive effects of certain vertical restraints (e.g. the classic case of RPM being used in order to solve a commitment problem between manufacturer and retailer which arises with asymmetric information), theory does not support a general presumptions against such restraints from a competition point of view. Much of the empirical evidence from cross-sectional studies also supports the notion that vertical restraints are benign and pro-competitive[3] (though again with exceptions[4]).

Contractual incompleteness from the endogenous price structure in multi-sided platforms

The insight from economic analysis on the motivation for vertical restraints in traditional ("offline") distribution formats is that these typically reflect the presence of some externality, and an *incomplete contracting problem* which means the externality cannot be resolved directly by writing a contract. For instance, a manufacturer cannot sign a complete contract with a retailer/distributor mandating a given optimal level of "sales effort/services". This is because the manufacturer has asymmetric information on the amount and effectiveness of the retailer's "sales effort", and therefore cannot specify the optimal level of effort in a contract in a way that can be enforced. As a result, there is no explicit compensation for "services" and the incentive needs to take the form of a commission on sales achieved.

This same motivation holds *a fortiori* in an online environment: indeed it is arguably even more difficult to write complete contracts for online distribution as it is difficult to anticipate all of the ways in which an online retailer may do things the brand does not like, and police this. But in a multi-sided setting there is an *additional motivation for contractual incompleteness, stemming from the pricing structure*. Because a platform tends to find it optimal to charge less to the more elastic side, and indeed charges nothing in most cases, the "service level" offered by the platform cannot be priced and contracted for separately to users. A sales/booking platform that does not charge users on the consumer side may offer a rich functionality, including well-designed user interfaces and real-time information on product availability, as well as proprietary algorithms to ensure the best possible match between consumers' heterogeneous preferences and the products available – all services that benefit sellers too. Could the platform not charge the seller directly for the search services it benefits from? The problem is there is no objective measure of "quality of search" that can be explicitly contracted for: the only measurement of the effectiveness of a platform for the seller is the extent to which it originates sales. We thus have the same problem of contract incompleteness that arises with asymmetric information in traditional environments; and in both situations an efficient way to reward

effort is to reward the outcome – i.e. link remuneration of the platform to a metric that proxies for success: in practice, a commission on achieved sales.

The "catch" also in this case is that if people search on the platform but "convert" on a channel with lower commission, there is no remuneration for the "sales effort" and no reward for the platform's investment in quality. If consumers use the search facility but do not "convert" the search into a booking, other channels will be free riding on the platform. Incompleteness of contracting *combined* with the structure of prices which is optimal for the platform generate clear efficiency reasons for vertical restraints in these environments.

Externalities, incomplete contracts and platform exclusion decisions

Restrictions on the use of platforms and marketplaces imposed by a manufacturer on online distributors and retailers can also reflect specific externalities which cannot be internalised because it is not possible to write complete contracts to that effect. "Selective distribution" on the part of brands (i.e. the decision to selectively licence certain channels for distribution but not others) has been traditionally associated with "luxury" goods and brand owners wanting to "deselect" outlets that do not meet a certain standard of presentation. In an online multi-sided environment there are *additional reasons* for selective distribution. For instance, a platform/site may have different interests for how consumers are *searching and comparing*, relative to the brand. Think of price comparison websites which tend to steer comparisons towards prices alone, as they rank products only in terms of price. Conversely, the brand may want the consumer to focus *both* on price and quality, and comparisons to be made more in terms of price/quality trade-off (because it may have product lines and may want consumers to consider products that may cost more but are better). If these price/quality comparisons are suppressed and the only comparisons are price-based, with cheapest products ranking first on the list, there may be a vertical externality in terms of diverging incentives of platforms and sellers: the mix of what is being shown and compared on the site based on price alone may be distorted relative to what the brand wants to achieve.

These concerns may then lead brand owners to want to ensure their distributors do not contract with certain marketplaces ("platform exclusion decisions") because they do not provide the type of service they want. The brand would like to be present on the marketplace and provide incentives for it to develop in a certain direction (for instance, include quality considerations when ranking the various offerings); but if that is not possible because the platform/marketplace has a uniform policy towards resellers, then the brand *may prefer not to be on the marketplace at all*. For instance, a brand which also offers "upper end" products will want consumer to have visibility of these offerings, because it might not look so competitive at lower price points but would sell if comparisons were properly done to take account of quality. Yet if the comparisons do not allow for this, it may prefer not to be on the marketplace at all. Other examples are *order fulfilment* standards, and *security of payment* standards applied by marketplaces, which may not satisfy the brand's requirements. The brand may well be legitimately concerned that the platform allows resellers which are frequently *out of stock* (e.g. advertise availability of a product to make a sale but only later inform the customer they are out of stock, and meantime benefit from the cash flow); or who do not meet certain standards of *shipment time,* or do not refund customers promptly. It is reputationally damaging for the brand to be associated with a marketplace where a number of resellers may not meet its standards, even if it benefits from free search and comparison services.

These are considerations specific to an online multi-sided environment that can create new conflicts between platforms, consumers and brand owners. If control over standards remains with the marketplace, and the brand owner as "customer" of the platform has no control over standards but must take them as given, it may legitimately decide to retain some control over its distribution by being selective about the sites its resellers are allowed to use. This may well take the form of an outright restriction on resellers' use of certain marketplaces, or restrictions on the type of functionalities that resellers may allowed to use on marketplaces. For instance, if a platform commits to a particular way of doing comparisons between products, order fulfilment, payment etc., by setting standardised terms that cannot be individually negotiated, the brand owner may not want to be seen to be trading in that particular way and engage in the selective use of marketplaces, and "platform exclusion" decisions.

Yet we have seen that agencies tend to regard these decisions as a form of anticompetitive "discrimination" by brand owners across outlets, intended to prevent price competition and "keep prices high" for their products – and as such, they tend to be seen as "per se" anticompetitive and "by object" restrictions. An example is the ASICS case in Germany, where it was deemed anticompetitive for ASICS to restrict resellers' use of price comparison websites, and the use of logo/brand on third party platforms. It is always hard to understand in coherent economic terms why a manufacturer would want to restrict competition *in the distribution* of its product – as in traditional environments, the brand benefits from the distribution of its product being as competitive as possible. The notion that the motive must be anticompetitive does not seem justified in light of what we know, and of the efficiency reasons for restricting a channel of distribution.

Uncertainty on the online format and residual control rights

The incentives for introducing a variety of restrictions in an online, multi-sided environment are amplified by the presence of *uncertainties on the online business model*,[5] in which case it is natural for the brand to want to preserve more residual control rights over decisions about how to retail the product – as well as the authority to deal ex post with any issues that might arise. The ability to make platform selection decisions provides greater residual control rights as brands try to anticipate the best way of dealing with multiple channels. This is a typical efficiency-enhancing response to the presence of uncertainty, when it is not easy to settle on the "right" approach, and unanticipated contingencies will arise which are hard to write into a contract. The alternative is for the brand to take distribution "in house" and vertically integrate, and that is indeed a step we are increasingly seeing brands to be taking. But only a few brands can generate the economies required to be able to do this, and if they cannot, vertical integration of distribution is not an efficient model (relative to the economies of scale and scope of being sold on a platform with other products).

The key point for our purposes is that contractual restrictions between brands, resellers and platforms naturally arise in multi-sided environments as firms seek to overcome incomplete contracting problems in the presence of externalities and free riding concerns. The *nature of the externalities* and the *source of the contractual incompleteness* may well be specific to the multi-sided environment, and there may well be multiple externalities between various sides of the platform. But the issue remains that aligning incentives between the different sides directly through a contract may not be possible, and this requires either incentives to be provided in a different way, or restrictions to be imposed on prices or product features or availability to deal with externalities.

4. The competition assessment of vertical restraints in a multi-sided environment appears more complex, but it is not fundamentally different

The assessment of the competition implications of vertical restraints in multi-sided environments seems inherently more complex: multiple sides, network externalities and vertical relationships between platform and users potentially imply multiple foreclosure effects and performing trade-offs seems harder. But again, it is not a fundamentally new analysis which requires new approaches and new tools relative to more traditional environments, and it can be considerably simplified – if we focus at least in the first instance on direct customers on the "pay-side" of the platform, think of the investment in developing the platform and getting a user base as an investment in "quality" of service provided on the pay side, and assess the incentives of the platform and its pay customers in terms of competition between standard vertically integrated and disintegrated players. Then we can work with the tools we have.

Consider a platform which allows users to search and purchase, while sellers simultaneously make available their product also on other platforms, their own online channel as well as brick and mortar outlets (to fix ideas, this is the classic set-up of hotel booking platforms which have been the focus of extensive antitrust investigation over the past few years across Europe, but they apply more broadly). There are separate effects arising from the interaction of platforms with sellers using multiple distribution channels for their product:

- The seller may pay a commission to the platform on which a sale is achieved, and this commission is equivalent in practice to an *input price* that is charged by the platform to the seller. The higher the commission, the higher the final price of the product.
- A platform invests in developing efficient algorithms to assist consumer search, in software to exchange information with sellers, in sales management assistance and in acquiring and displaying information which might be useful to buyers. These investments increase the likelihood of successful matching of sellers with buyers, but are also subject to a free riding problem as consumers might find the right match on a full-service site but complete the purchase on a no-frills site where the price is lower. There is thus an incentive for the platform to try to reduce this free-riding inefficiency by adopting contractual clauses that restrict sellers from charging lower rates on other platforms ("broad MFNs").[6]
- Platforms also face a vertical inefficiency in the form of free riding by sellers themselves, making the product available at lower prices through their own direct sales channels (online and offline). The contractual solution that platforms may then seek to adopt is a restriction on sellers charging a lower price through these channels than that quoted on the platform ("narrow MFNs").
- The contractual "solutions" for the various vertical inefficiencies can also affect competition between platforms as MFN clauses could potentially dull the platforms' incentives to compete by offering lower commissions.

Netting out these effects appears analytically complicated – and multiple modelling efforts were put forward e.g. in the hotel booking case (with results depending finely on assumptions about effects such as "cannibalisation" – the extent to which if a hotel charged a lower price on a platform charging lower commission it would eat into its own sales where it pays no commission, the ability of hotels to "delist" from sites that charge higher commission, etc.). But the fundamental reason for the complexity is that there are

multiple parties interacting "upstream" and "downstream", not that there is something inherently different arising from multi-sidedness. Indeed it is not clear that multi-sidedness makes any essential difference to the analysis. What multi-sidedness implies (again) is that there are search services offered for free on one side of the platform, on which others can free ride; and these free-riding opportunities mean the platform cannot get a return from direct search customers and may well seek to introduce restrictions on prices for the same product sold on other channels. However, we would have essentially the same issues also with an agency model with in which an "upstream firm" was selling a product on a platform and setting the final price, while at the same time selling the product as an input to the platform at a price either negotiated or set by the platform. In practice there is a set of "vertically dis-integrated" offers (the platform which provides the "downstream" booking service only) competing with "vertically integrated" offers (the seller which provides the "upstream" product and competes for sales with the dis-integrated seller through multiple channels), and this creates additional trade-offs, but the analysis of competitive effects does not require a change in our analytical tools: it still requires us to gauge the extent to which simultaneously selling a product through multiple independent platforms, and through the seller's own integrated channels, may give rise to foreclosure incentives upstream and downstream between the platform and its pay customers.

5. Systematic dismissal of efficiencies is the major outstanding issue

The area where most progress needs to be made – and where tools need to be sharpened – is the testing of the efficiency motivations for the contractual restrictions that we see. Competition authorities and the courts have rarely if ever accepted contractual incompleteness as a motivation for vertical restraints in more traditional environment, and have not engaged with the task of properly understanding organisational structures and business models: theories that explain organisational structures and their efficiency properties are typically dismissed, and this problem has carried over entirely to the multi-sided environment.

Thus the case against hotel booking platforms has been strongly motivated by a prior that MFNs/Best Price Clauses imposed by platforms on their suppliers (hotels) to ensure they were not selling rooms at a discount on other platforms and their own sites were no more than a form of RPM, intended to increase prices and deter the entry of cheaper platforms. A number of analyses have been more subtle,[7] but the prevailing view was that booking platforms somehow "squeeze themselves" between the customer and the hotel, and there is nothing wrong with customers searching on booking sites and then booking with the hotels separately ("information on the internet is by its nature free"). The argument that these restraints are efficient because by increasing the "conversion" of search on the platform into sales they increase the incentives to invest in search (only search that leads to booking is rewarded) has been fundamentally set aside. The efficiency motivation have been systematically "disbelieved" by agencies ("I understand the argument for efficiencies, I just don't believe it"). In the more elaborate version of the argument, the answer has been that there can be no concern about the effect of free riding on incentives to invest because the investment of the platform are not "specific" to a particular hotel – thus if there is free riding on the part of a particular hotel, this does not undermine the incentive of the platform to invest overall.

But it is simply incorrect to dismiss efficiency motivations on these grounds: a website which involved a material investment to design and launch is not protected from free

riding concerns just because the investment in the technology was not "seller specific". Of course it is the case that for free riding to undermine the incentive to invest it must be the case that the investment is "relationship specific"; but to conflate this with "seller specific" is a mischaracterisation of the economic insight. What platforms are doing here is creating a public good for everyone who searches the website, and the investment is still *specific* in that sense. When pursuing arguments sourced from the economic literature we need to be careful to capture their true meaning and substance. What happens on the platform *is* a specific investment, because it is all about creating a public good for the other side of the market.

Similarly, for selective distribution the key is that given the uncertainties of online selling, brand owners want more residual control rights over decisions about how to retail their products, and want authority ex post to deal with issues that might arise in an uncertain environment. It is simply not possible for a competition agency to assess whether the parties can write a complete a contract or not. A typical reaction is "we don't accept your efficiency arguments, because the incentive problem can be solved through a two part tariff". But this is incorrect: two-part tariffs can only resolve some types of vertical inefficiencies, and by no means all.[8]

In practice very little progress has been made in developing an understanding of how to assess the credibility and significance of efficiency motivations for contractual restrictions of the type considered here. In the hotel booking case the economists advising the platforms sought to run various experiments to substantiate the claim that in the absence of the clauses, conversion through the booking platform would decline – which was at least the first "building block" in an analysis of the potential for free riding concerns undermining the incentive to invest in the platform in the first place. One "natural experiment" was made possible by the fact that in Germany the HRS platform had been banned from using MFNs altogether, and this provided an opportunity for studying whether this had a material effect in terms of inducing lower conversion rates on the HRS platform (i.e. fewer bookings relative to searches) once the ban came into force. Evidence was also collected from platform search and booking data in other countries to assess whether conversion rates varied with the degree of "price dispersion" – i.e. the extent to which consumers were more likely to make a booking ("convert" their search) on the platform when prices for hotel rooms were more uniform, and less likely to do so when they were faced with greater dispersion of room rates. The experiment was not "clean" in the sense that MFNs were in place, and therefore the degree of price dispersion which was observed was only reflecting "lack of adherence" to MFNs. However an interesting claim was the finding that where price dispersion was higher (i.e. MFN were not being adhered to), there was a *material decline in the probability that customers would book through the platform, even though they continued to use the search functionality.* This type of evidence gained little traction and was given little weight in the case.

6. Focus on short term price effects vs dynamic effects has long term costs

The failure to provide a coherent assessment of the competitive effects of these restrictions in practice has two further causes.

One is the well-known problem of the unhelpful structure of the law, which has separate steps for (a) finding a restriction of competition under 101.1 and *then* (b) considering whether there are offsetting efficiencies under 101.3. This dichotomy completely misses the economic point that a "restriction" is precisely the *means through which* the

efficiency benefits are achieved. Separating the analysis into stages, placing the burden of proof on the parties to prove efficiencies and somehow show they offset the restriction, is not how we should proceed. Weighing anticompetitive effects against efficiency benefits is not how our economic theories work. Different is the case of mergers, where we evaluate the change in incentives while leaving the cost structure unchanged. But contractual vertical restraints *change the incentives to compete in price vs. the quality dimension,* and it is just not possible to separate a price increase motive from an efficiency motive. The burden of proof on efficiencies is simply impossible to meet.

And indeed, because it is seen as all too difficult to make this "balancing" assessment of restrictions and efficiencies, there has been a major lurch back towards the use of the hardcore "object box", so we do not have to worry about efficiencies at all.[9] In an online environment all forms of internet retailing are labelled "passive sales", so that every restriction one might want to adopt for efficiency reasons can be labelled a violation of object.

A second factor may be the bias of Industrial Organisation for looking too much at the details of specific models, and less at the bigger qualitative questions that matter for policy. Related to this, much of our competition policy advice is that we should get prices as close as possible to marginal cost at all times. We worry about restrictions increasing prices in the short term, though we know that higher prices can be good because they signal profitable market niches and high consumer demand, and direct investments and entry to where the highest marginal values are. We hamper this market process of eliciting information about demand with too much focus on static short-run price competition and too little on market dynamics, yet we have not been particularly helpful in suggesting evidentiary standards that are implementable in practice. We live by the legacy of "example economics": "there is a paper that shows that this practice *can* be problematic, we have an intuition things may go this way, so it is better to be prudent".

If we downplay efficiency arguments, and require companies to show "objective justification" for a business practice, we are adopting the opposite of a model in which innovation is driven by experimentation. In traditional industries in which business format did not change as much with the product, that might not have been that much of a problem, but with internet retailing and platform markets the freedom to experiment in sales strategy and business format is much more central. A direct implication is we are seeing business format change under significant strain in Europe, and a return to vertical integration into distribution: brands selling increasingly through flagship stores or by renting shop-in-shop modules in department stores. The purpose is to regain control over the vertical chain, in an environment in which there is perceived great uncertainty about what is allowed and what is not in terms of online distribution. Would we have seen so much vertical integration if firms could control their vertical sales channels via contracts? Probably not. Firms self-provide distribution services to regain control over their product, but this development is induced as a reaction to concerns about enforcement in this area, and may lead to foregoing or restricting forms of innovation that could take place online. We are in danger of undermining the rate of innovation in this area by yielding to firms that would like to see competition authorities shift rents to them,

7. Practical analytical map for antitrust Analysis

There is no unique test that can be implemented to assess the potential anticompetitive effects of vertical contractual restraints in multi-sided environments. And because the formal analysis can be complicated by effects going in different directions, it will be

important to remain focused on "first-order" economic effects. The first priority in our view is to establish a framework for conducting the analysis that makes economic sense and reflects the insights we have from the economics of vertical restraints, multi-sidedness, online and network effects. We sketch below a possible roadmap.

Interpreting multi-sided markets in a standard vertical framework

While multi-sidedness involves network effects across different sides of the market, this does not mean that the first-order effects of vertical restraints in such an environment cannot be analysed with a standard set of analytical tools. With multi-sidedness, the price on one side of the market typically drops to zero (or generally below marginal cost) in order to boost demand on the other side (where strictly positive margins are obtained). Harm to consumers from vertical restraints does not arise (directly) on the "zero-price" side, and only customers on the other side of the market could be directly harmed (though this does not exclude the possibility that customers on the zero-price side could be *indirectly* harmed, if the platform is a pure intermediary and they purchase from platform customers on the other side).

But as a first-order approach, we believe the antitrust analysis should focus on customers who could be *directly* harmed. This allows a first-cut assessment of the impact of vertical restraints based on the standard economics of vertical contracting. In this approach, *the size of the customer pool on the "zero price" side of the market can be seen as a "quality parameter" in the demand function on the other side of the market.* Price setting, advertising, and investments in quality of platform experience for customers on the "zero-price" side of the market can then be seen simply *as aspects of "investments in quality" in standard vertical models* in which retailers set both prices and quality level. The fact that no margin is made on the zero-price side of the market can be interpreted as an investment in quality for the other side.

With this framework, the antitrust analysis of vertical contracts in multi-sided markets can be reduced to a model in which *the platform is in effect an upstream firm offering "contacts" at some prices and quality level, and potential vertical restraints. These can be accepted or rejected by the customer (the seller) who in turn sets a downstream price to its own customers (who could be the zero-price customers of the platform itself).* The impact of network effects on the zero-price side of the markets is taken into account in this approach.

This framework allows for an analysis of vertical restraints in multi-sided environments which does not fundamentally deviate from the approach we should follow to assess vertical restraints in more conventional environments. The advantage is to break down the complexity of multi-sided cases into pieces that are more manageable, and for which an analytical framework is available and should be familiar to antitrust authorities. The specificities of multi-sided markets are more likely to be taken into account if we follow a simplified approach, than if we suggest that everything has to be looked at the same time.

Getting market definition right: multi-homing and substitutability between levels of the service "stack"

With a standard framework for the analysis of vertical contracting, market definition should also in principle follow standard rules. However, certain features of digital markets tend to perpetuate mistakes that are routinely made in defining markets in vertical structures. This holds especially true for competition "in the vertical stack" and for multi-homing of customers across supply channels, where the failure to acknowledge

competitive constraints properly leads to market boundaries being too narrow and market power being overstated for purposes of assessing vertical contracting practices.

First, almost all positive-price customers in multi-sided markets *multi-home*. They tend to be sellers to end-customers and will use all distribution channels that can add to their margins. The key is that with multihoming *all distribution channels tend to be substitutes to some extent*. That multiple distribution channels tend to be used in equilibrium is *not* a sign that they are complements or independent (which tends to be the standard view). Selling through more channels is pro-competitive in itself because it reduces the marginal contribution of each distribution channel to a firm. But since no supply channel can extract more than its *marginal* contribution to downstream profits, with more distribution channels the prices paid by firms for each particular channel will be lower. This effect is more pronounced, the greater the degree of multi-homing and the greater the transparency of different offers to the end customers.

Second, and closely related, digitalisation has made it much easier to offer services through a variety of business formats, *both vertically integrated and dis-integrated*. The fundamental innovation of platform markets is precisely that complementary components to services can "plug-in" to already existing services, facilitating intermediation on any type of service. Online retailing integrates multiple functions such as product information, product search and matching/choice, financial transacting, and physical transportation. These activities involve different costs, and customers typically demand different mixtures of these activities which are offered in all kinds of combinations, with different degrees of vertical integration, and often with a mixture of digital and traditional markets. Thus a firm can make a sale as a result of consumers searching on a price comparison site, and then clicking through to the firm's website, or through search and purchasing on a booking/sale platform; these are substitutes in the economic sense, even though in the first case the seller pays the price comparison site for the click through, in the second it pays the platform for click through and fulfilment. Similarly, a brand can reach customers through a click advertisement on Google Products but also as a result of the customer searching for the product on Amazon and buying there. In the case of a direct purchase from the manufacturer the order may be fulfilled through an external contract with UPS, in the Amazon case through Amazon fulfilment, but in principle these are substitutable packages.

The analysis ought to start from a description of all channels through which an end-consumer can be reached, and the departing presumption should be these are potentially in the same market. However this is not what happens. The analysis often starts with a description of the "experience" of different distribution channels, to conclude on that qualitative basis that a number of them can be excluded from "the market". The simple argument that the "online experience" is different from the "offline experience" may well establish product differentiation, but it is not enough to exclude substitution a priori. We also often find that a distinction is drawn by pointing to the fact that different firms, e.g. price comparison sites and sites that allow search and booking, do not offer the same services. But this is incorrect, because what matters is the substitution between the "full stack" including the price comparison site together with whatever financial transaction and physical fulfilment solution they offer, and a site which provides an integrated facility for product search, selection and financial transaction.

Several practical steps should be followed for a proper analysis:

- First, all channels have to be identified through which end-consumers can be reached by the positive-price customer of the multi-sided platform. All such

channels should be treated as potential substitutes unless there was strong countervailing evidence.

- Since end-customers drive the incentives for substitution across channels, we need information on end-consumer behaviour. We should study:
  - The degree of multi-homing among end-customers as a first-cut for substitutability between channels;
  - The degree of search among different distribution channels before a purchase. Do consumers search on Google + specific retailers, Google + brand manufacturer, Amazon, and physical shopping before they make a final purchase decision?
  - Evidence on (possibly hypothetical) responses to prices or (better) to a channel no longer being available.

There are multiple survey methods for eliciting quantitative evidence for these drivers of substitution in an antitrust investigation, where less tight deadlines mean that surveys can be designed in principle much more carefully than in mergers. End consumers can be asked about their multi-homing behaviour, their search behaviour the last time they made a purchase, as well as hypothetical responses to a certain channel not being available, but clearer standards for such surveys must be developed in particular to capture the possibility of multi-homing.

Thinking of theories of harm as analytical tools

What is often under-appreciated is that a "theory of harm" in the economic sense is not just an assertion of expected effects (as the term is often used in law). Instead it is an analytical tool for case analysis. For instance, a statement that a particular practice "will deter entry" does not amount to a useful theory of harm that helps the analysis. Developing an economic theory of harm means specifying a theory that makes clear which assumptions are necessary to generate the anticompetitive effects. Whether these assumptions can be validated in the market under investigation will then determine whether the theory of harm must be dropped, or can be credibly pursued. Often theories of harm also involve predictions about market behaviour: for example, how pricing changes as a result of the predicted behaviour. If these predictions are not borne out by market behaviour, again the theory of harm must be rejected.

A "theory of harm" in the economic sense is therefore a tool to generate the right questions and identify the relevant evidence. We use it to spell out the precise assumptions under which there could be anticompetitive effects according to economic theory, and these assumptions then become what we need to test with data. For example, in the hotel platform booking cases the conjecture was that MFNs deterred the entry of cheaper, low-frill platforms that would charge lower commission to hotels. Yet what was observed in at least one case was that attempts entering new platforms (who complained against MFNs) set royalty rates exceeding those of existing hotel booking platforms. Higher royalty rates would have created incentives to raise the end-customer price, but then the MFNs could not have been binding with respect to the entrants. Entry therefore could not have failed because of the inability of the hotels to pass on savings from entry pricing to final customers.

Any analysis should therefore fully spell out a testable theory of harm that clearly identifies the mechanism through which foreclosure or higher prices would be achieved – having identified the vertical structure of the market appropriately, and having followed the correct approach to verifying substitution at the market definition stage. The

framework must be specified before starting the evidence gathering, so that it can discipline the interpretation of evidence and avoid the conjectural approaches that are currently most common in complex cases.

Assessing entry conditions

Because markets in the digital economy tend to be fast moving, entry and exit with new business models at different points in the vertical supply chain are frequent. Failure of a significant number of entry attempts is normal under entry and exit dynamics, so that observed exit can neither be an argument for high entry barriers or foreclosure. Neither is the existence of network effects, which is inherent in multi-sided markets, sufficient to presume entry is difficult. We have seen a number of services, for example ride sharing, in which the initial entry by Uber has been imitated multiple times – including with app based services from incumbent taxi companies.

Furthermore, network effects on the customer side can be easily overcome in multi-sided markets in which firms adopt platform models. Essentially it becomes easy to enter when a company already has a large customer base in related activities. There are countless examples of this: think of the shift of Tripadvisor from a travel advice and comment provider into a hotel price comparison site (later also with its own hotel bookings offering). Thinks of a service like "dinner boxes" (recipe choice online, plus ordering on the internet, and home delivery); we have seen entry in this market in the form of de novo entry, supermarkets branching out to cover such offerings, as well as a recipe provider like the magazine "Bon Apetit" teaming up with independent food providers to develop similar services in a vertically dis-integrated model, but based on its network of existing customers.

Thus while de novo entry may be possible, there can be many entry channels – vertically integrated or dis-integrated. This means that entry analysis to assess the likelihood of vertical foreclosure must systematically assess the *capabilities of firms in related markets to expand their activities and use their customer base to introduce a competing offer*. We cannot just look at vertically integrated entry, but need to assess entry also in parts of the vertical chain that can eliminate bottlenecks of individual access. Sometimes individual firms cannot effectively use services due to economies of scale – but in these cases intermediaries often enter that provide these economies by aggregating many small firms.

Entry analysis should therefore have four elements:

- Avoid a narrow focus only on *de novo* entry;
- Track the entry experience in the market so far, with emphasis on different paths of entry;
- Identify firms with an existing consumer base and assets in adjoining activities that could expand through imitative entry;
- Analyse entry failures with a view to whether they can be explained by a lack of innovative differentiation from existing offerings.

Evaluation of efficiencies, and consideration of the counterfactual

The most important issue in the analysis of efficiency claims is that a shift in attitude is required on the part of competition authorities. Firms in the main adopt vertical restraint to deal with problems they face in implementing business strategies when dealing with retailers – not because of anticompetitive objectives. As explained the reason lies – as in virtually all organisational forms (including outright ownership) – in the difficulties of

writing complete contracts on all aspects of the actions of the contract partners. These business reasons need to be seriously engaged with by competition agencies, but currently they are not. Efficiency claims are routinely dismissed with reference to some contract that the firm could theoretically write that would eliminate the problem: for instance, that a contract could in fact be written that conditioned on the very variable with respect to which the contract is incomplete; or that all contracting problems could be solved with two-part tariffs.

These claims are not economically justified (just as the claim that "free riding problems do not exist"). There is ample evidence from everyday life and from the economic literature that (a) free riding is particularly pervasive in digital environments because its costs have declined, (b) the predictions of incomplete contracts theory explain shifts in ownership and contract structure in a multitude of markets. Furthermore, the theoretical literature makes clear that two-part tariffs solve incentive problems only in a non-generic set of cases, and they fail whenever firms in a contracting environment are not risk neutral. A first step in the analysis of efficiencies of vertical restraints should be for these simple principles to be acknowledged by competition authorities.

Second, we should not be asking firms to prove a negative: that there is never any other possible contract that could possibly have the same effect on resolving the contracting problem, but may not have potentially some anti-competitive effect. It is obvious that this will not be possible. Firms are required by precedent to show "objective justification" for a practice, but if what is "objective" is an entirely subjective assessment by case teams with strong priors, there is risk for firms whose vertical restraints have in practice no anticompetitive effects.

The basic issue is that the standards for proving efficiencies have been made impossibly high, while the standards for proving infringements are much lower. Of course it is entirely reasonable that to prove an infringement one does not have to show actual effects in many cases. This would be an impossible standard and would end effective enforcement. Quite reasonably the standard has been set to "likely effects", which can then be proven by a coherent theoretical framework and evidence that it applies (or even evidence that quite regularly in similar circumstances there have been anticompetitive effects). As there is little evidence for strong and widespread anticompetitive effects of vertical restraints, this is in practice a very low standard of proof – even if it is a reasonable one. However, it is then fundamentally wrong to set an impossibly high standard of proof for efficiency defences.

We therefore propose that efficiencies should be treated to the same standard as anticompetitive effects:

- There should be a clear theory for why the vertical restraints have been adopted ;
- The assumptions of the theory should hold in the particular market; and
- The predictions of the theory should be more consistent with the facts of the case than the anticompetitive theory the competition authority pursues.

In practice this would mean that **the burden of proof for the efficiency defence should depend on the strength of evidence for the theory harm.** For example, if a theory of entry-deterring effects is found to be inconsistent with the pricing behaviour of entrants, the efficiency explanation for the behaviour should gain greater weight.

Overall, the priority for the foundation of a more effective assessment of efficiency defences does not lie in new techniques of analysis, but in **creating standards of proof for efficiencies that can actually be met, and that are nothing more than the**

equivalent to the low standards which are routinely applied to "prove" likely anticompetitive effect.

8. Conclusions

Economic analysis has failed to inform a rational policy towards vertical restraints in Europe, and this basic failure is carrying over to multi-sided environments. We have argued in this paper that the appropriate response is not to call for a separate toolkit for the analysis of vertical restraints in multi-sided markets. On the contrary, **most multi-sided markets can be reinterpreted for the purposes of analysis in antitrust cases as a standard contracting problem in vertically related markets.**

Most progress can therefore be made if we are able to adopt a simple structure of analysis that should be in principle familiar, but is not rigorously applied even in standard vertical cases. Our recommendations for the analytical framework is therefore not to focus on adapting techniques, but on the **approach to the analysis**. Just some improvements in approach to market definition and a systematic use of the assumptions and implications of theories of harm would lead to a much more reliable analysis of vertical restraints cases.

The call for new techniques may in part be a symptom of Industrial Organisation looking too much at the details of specific models and less at the bigger qualitative questions, which features of markets are important when considering policy intervention. It is not enough to tease out and try to trade off every conceivable effect of best price clauses, for instance, if these insights are not embedded in an investigative procedure that allows relevant and irrelevant theories to be distinguished from each other. It is unimportant that "there are models" showing anticompetitive effects, the key is whether such models need assumptions that tightly map into the market circumstances of the case. This is something we do not have enough clarity about (and discipline) in practice. The priority is to make sure that investigations put a process into place that makes the applicability of a specific theory directly testable, and makes this a stringent requirement – rather than relying on general "findings" and theoretical result in the literature to justify a prior.

Notes

1 See also Kühn, K.U., "Economic Deficits in the Competition Policy Analysis of e-commerce: is the Current Enforcement Practice Justified from An Economic Perspective?", in Competition Law and Policy Debate, Volume 2, Issue 2, June 2016.

2 For a broad overview see among others the classic Rey, P. and T. Vergé, 2008, "Economics of Vertical Restraints", in P. Buccirossi, Ed, Handbook of Antitrust Economics, MIT Press, pp. 354 – 390.

3 See, Lafontaine, F. and M. Slade, 2008, "Exclusive Contracts and Vertical Restraints: Empirical Evidence and Public Policy", in P. Buccirossi, Ed, Handbook of Antitrust Economics, MIT Press, pp. 391 – 414.

4 MacKay, A., and Smith, D.A., 2016 "The Empirical Effects of Minimum Resale Price Maintenance", Kilts Center for Marketing at Chicago Booth – Nielsen Dataset Paper Series 2-006, at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2513533.

5 For an analysis of the importance of choosing the right "business model, see Rochet, J.C. and J. Tirole, 2003, "Platform Competition in Two-Sided Markets", Journal of the European Economic Association, 9:4, pp. 990 – 1029.

6   See inter alia Johnson, Justin P., The Agency Model and MFN Clauses (January 25, 2017). Available at SSRN: https://ssrn.com/abstract=2217849 or http://dx.doi.org/10.2139/ssrn.2217849 and Boik, A.K. and K.S. Corts, 2013, "The Effects of Platform MFNs on Competition and Entry, Research Paper, available at https://www.researchgate.net/profile/Andre_Boik/publication/305220937_The_Effects_of_P latform_MFNs_on_Competition_and_Entry/links/5785173408ae3949cf5384ee.pdf

7   See inter alia Fletcher, A., and Hviid, M., Retail Price MFNs: Are they RPM 'at its Worst'?, ESRC Centre for Competition Policy, University of East Anglia, April 2014.

8   See for example Rey-Vergé (2008). Ibid.

9   See e.g. Pierre Fabre judgment ECJ 2011, which deems selective distribution an object restriction in the absence of "objective justification'.

Rethinking Antitrust Tools for Multi-Sided Platforms 2018

This report investigates how competition agencies can respond to the challenges posed by the multi-sided nature of platform markets, which are particularly common in the digital economy. It asks whether the antitrust tools that are traditionally used to define markets, to assess market power and efficiencies, and to assess the effects of exclusionary conduct and vertical restraints, remain sufficient to address those questions in the context of multi-sided platform markets. It then proposes how these tools might be redesigned or re-interpreted in order to equip competition agencies with the tools they require when analysing these markets.

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