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The Wider Economic Benefits of Transport:

Macro-, Meso and Micro Transport Planning and Investment Tools

SUMMARY AND CONCLUSIONS

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ABSTRACT

This paper summarizes and organizes presentations and discussions of the Round Table on Macro-, meso and micro infrastructure planning and assessment tools, that took place at Boston University, on 25 and 26 October 2007. The goal of the meeting was to investigate how recent research on direct and wider economic impacts of investment in transport infrastructure can be used to improve the practice of transport project appraisal. While the potential importance of "wider benefits" is clear, it is less obvious that attempts to quantify them should be part of all project appraisals. Timely availability of results of simpler approaches might improve the quality of decision-making just as much. And when wider impacts are part of the appraisal, their quantification should follow consistent procedures. Policy-oriented research should focus on these procedures, not on producing general results, as the latter are thought to be irrelevant to policy, to the extent they exist.

EXECUTIVE SUMMARY

This Round Table evaluated the relevance of research on the wider economic impacts of investments in transport infrastructure for the practice of project appraisal. Wider impacts are those not captured in standard cost-benefit analysis, including effects relating to returns to scale, agglomeration, thickening of labor markets, and market power, as well as firms' and households' behavioral adaptations to changes in transport costs.

Macroeconomic analysis of the effects of investment in transport infrastructure, in the Aschauer tradition, suggests that there are modest wider economic benefits from such investments. Recent, more disaggregated work that focuses on the impact of infrastructure investments on markets at the local level, and particularly labour markets, confirms that there are wider economic impacts. It also confirms that the sign and size of these wider effects differs strongly across projects. Results for one project therefore cannot simply be transferred to other projects. There is thus little prospect of developing simple rules of thumb to factor wider impacts into routine project appraisal. Undertaking more sophisticated analysis on a routine basis is hampered both by shortcomings in the availability of the data needed and in the analytical frameworks that might be used.

Accepting that wider impacts are potentially important, what recommendations can be made for improvements in the appraisal of transport infrastructure? Manuals for transport project appraisal can include guidelines for extensions of standard cost-benefit analysis with valuations of wider effects in a methodologically consistent fashion. Research should focus

on the development of sound and practical frameworks, not on a search for widely applicable results.

In constructing such frameworks, it is useful to relate the range of the analysis to the size of the project. For smaller projects, an ambitious analysis that includes wider impacts would be too costly and probably yield results too late to affect decisions. The most practical approach for small projects is therefore to work on the assumption that there are no wider economic benefits. The risk of excluding real wider benefits or costs exists, but there was considerable agreement that this is outweighed by avoiding the risk of introducing double-counting of benefits and avoiding delays in project evaluation. For large projects and for the evaluation of investment programs, more sophisticated analyses may well be justified. But also in these cases it useful to keep in mind that the provision of information early in the decision-making process has a larger impact than information that becomes available only further down the line – even if that information is based on a more comprehensive analysis.

Another way to increase the policy impact of economic appraisal is to improve the analysis of direct impacts. Standard cost-benefit analysis does cover these impacts but the results are not always presented in a form that is easily understood by policy-makers. Economic modeling, for example along the lines of the applied general equilibrium tradition, can help outline how direct benefits are transmitted through markets and transferred between economic agents like households and firms. It might be possible to supplement the economic indicators typically presented in project appraisal summaries with a description of the expected economic effects of an investment on the basis of such modeling.

1. INTRODUCTION

This paper summarizes the Round Table's presentations and discussions, draws conclusions where possible, and points out where opinions differ. It is divided in three main sections. First, the presentations and discussions provided an overview of the advances, promises, and pitfalls of current research on the economic impacts of investments in transport infrastructure. A first recurring theme was that advances in the analysis of "wider impacts" were acknowledged, but their transferability across projects was questioned, so there are "no simple rules" for generalizing results. Moreover, routine analysis is difficult because of shortcomings both in data availability and in the analytical framework. This theme is developed in some detail in section two. A second recurring issue was the major differences in the approach to transport project appraisal between countries. The impact of economic appraisal on policy decisions varies greatly from one region to another and this has consequences for the way wider economic impacts might be taken into account. These issues are addressed in section three. Building on the insights from sections two and three, section four tackles the key question of the Round Table: given the current state of research and the practice of transport project appraisal, what recommendations – if any – can be made for improvements in the appraisal of transport infrastructure? A broadly accepted position was that simple rules of thumb, for example taking the form of multipliers to capture wider economic benefits, are to be avoided. Instead, recommendations might be integrated in manuals for transport project appraisal, allowing extensions of standard cost-benefit

analysis with valuations of wider effects in a methodologically consistent fashion. The focus for researchers ought to be on the development of sound and practical frameworks, not on a search for widely applicable results.

2. RECENT RESEARCH ON WIDER ECONOMIC EFFECTS

This section covers the main topics addressed in the presentations and discussions. It follows the program of the Round Table, as shown in Box 1.

Box 1 Programme of the Round Table

Setting the stage (Section 2.1)

Opening statement: T.R. Lakshmanan
Presentation: Roger Vickerman
Discussant: Peter Mackie

Empirical work on wider benefits (Section 2.2)

Presentation: Jeffrey Cohen
Discussant: Yossi Berechman
Presentation: Dan Graham
Discussant: Andrew Haughwout

Comprehensive modeling frameworks (Section 2.3)

Presentation: Börje Johansson
Discussant: Ulrich Blum
Presentation: Ian Sue Wing
Discussant: Bruno De Borger

Progress with and challenges for applied economic project appraisal (Section 2.4)

Presentation: Glen Weisbrod

2.1. Setting the stage

The core purpose of the Round Table was to investigate how emerging insights from research on the direct and wider benefits of investments in transport infrastructure may inform the practice of the appraisal of transport project infrastructure. In his opening

statement, T.R. Lakshmanan's sketched the challenges for the research community. Macroscopic approaches to estimating the effects on productivity of public capital in general, and of transport infrastructure in particular, produce a wide range of results. In order to understand this diversity of results, the mechanisms that generate the economic impacts need to be uncovered. An explicit framework that captures the linkages between (changes in) the provision of infrastructure and economic impacts is also a required if the analysis of wider impacts is to be relevant to the practice of project appraisal. This is because macroscopic approaches do not directly relate to the policy levers that are of central concern in economic analysis to support decision-making on transport projects.

Various strands of research contribute to a more microeconomic understanding of the effects of transport infrastructure investments, but progress is uneven: much has been done on the analysis of increasing returns to scale and on agglomeration effects, but less attention given to improving knowledge of the dynamic effects of innovation and technical diffusion.

Roger Vickerman developed these themes, by providing a classification of research on the (wider) economic benefits of transport infrastructure investments, and an assessment of their usefulness to the question at hand: how does this research help us make better decisions on infrastructure investments? The main insights are as follows:

- Macro-studies, in the Aschauer tradition, focus on overall impacts. The literature is prone to methodological problems, especially in pinning down the direction of causality, and it is based on insufficiently detailed representations of transport infrastructure to be of direct use in project appraisal.[1] Furthermore, as emphasized by Peter Mackie, there is potential confusion over whether measurements of the economic benefits of infrastructure concern **wider** benefits (i.e. those not captured in standard cost-benefit analysis, which considers effects in transport markets alone), or whether they refer to the ultimate **incidence of direct effects** (that is: the equilibrium allocation that would result from a project without considering wider effects).[2]

- Substantial work has been done at the meso-level, here defined as work that makes transport and other market interactions explicit.[3] Some contributions, like the general equilibrium framework proposed by Sue Wing et al., mainly serve to clarify how changes in transport costs as perceived by network users translate into costs and benefits, and the distribution thereof, for various economic agents (like households and firms). But, with standard applied general equilibrium assumptions of constant returns to scale and perfect competition, the approach sheds no light on wider benefits associated with returns to scale, agglomeration, thickening of labor markets, or the weakening of market power, or the limiting effect of market power on benefits from better infrastructure. Such wider benefits are addressed in narrower market-studies, of which Dan Graham's is an example.

- Microscopic approaches, that aim to capture the effects of changes in transport conditions on the internal reorganization of firms and households, are scarce. This is not surprising, given that these types of responses are difficult to integrate in microeconomic frameworks that focus on market interactions, but it is unfortunate, as there is evidence that households and firms do re-organize in response to changes like, for example, the congestion charge in London, or the opening of high-speed rail links in Western Europe.

- Also scarce are ex post studies. The results of those that have been done do not provide strong support for the existence of wider economic benefits from transport infrastructure investments.

In summary, recent research suggest that if project appraisal is to go beyond standard cost benefit analysis and wishes to include wider economic effects, it should distinguish between direct user benefits and effects on productivity, agglomeration, competition, and on the labor market. In addition, when spatial spillovers are large (irrespective of whether they include wider benefits or only direct benefits), one should expect different levels of jurisdiction to arrive at different evaluations. Understanding spatial spillovers hence is of clear relevance to policy.

2.2. Empirical work on wider benefits

The presentations by Jeffrey Cohen and by Dan Graham illustrate the current state of econometric work on spatial spillovers and agglomeration effects. A common feature of the econometric work is that empirical specifications are explicitly motivated by a microeconomic framework. This is desirable, as it makes clear which interactions are included in the analysis and which ones are not, allowing a consistent and transparent discussion of the results. Of course, making behavioral assumptions implies the possibility that the assumptions are wrong, leading to misspecification. Two examples of this problem were discussed:

- The estimation of spatial spillovers rests on assumptions of cost minization and the treatment of transport as a costly input. The validity of these assumptions was challenged.

- The assumed direction of causation is critical. Most studies assume growth is caused by infrastructure. But as wealthier economies may choose to spend more on infrastructure, infrastructure may follow growth as well.

While these limitations need to keep in mind when interpreting results, it is clear that empirical analysis requires an explicit framework in order to make sense of data, and that such a framework will always contain restrictive assumptions. Refinements of the specification, on the basis of improved theoretical understanding, will lead to more robust results. And more flexible statistical techniques to deal with error terms, e.g. non-monotonic forms of spatial autocorrelation, will increase the practical relevance of such econometric work.

Despite the methodological limitations, the empirical work generates several relevant insights. First, **spatial spillovers** of investment in public capital are real in the sense that firms' variable costs in one jurisdiction depend on infrastructure provision in other jurisdictions. These effects can be large, and they differ strongly between transport modes, as well as being dependent on local conditions ("the starting point"). This was illustrated in a review of some applications. A study for the US (Cohen and Morrison Paul, 2004) finds that higher highway capital in one State slightly reduces variable costs in neighboring States, while a Spanish study (Moreno et al., 2004) finds evidence of cost increases. A study of port infrastructure at the level of US States (Cohen and Monaco, 2007) finds that higher port capital stocks in one State increase variable costs in neighboring States. For US airports,

however, States with many flights to States with a lot of airport capital have lower variable costs.

While information on spatial spillovers is of obvious interest to policy-makers, questions were raised regarding the extent to which the framework used is relevant to the appraisal of individual projects. Some arguments to support this skepticism are as follows:

- Although plausible hypotheses were formulated, there is no explicit explanation for the large diversity in results. This makes it impossible to separate out the impact of local conditions, and this strongly limits the transferability of results from one case to another.

- The presence of substantial spatial autocorrelation in many studies can be seen as an indicator of the extent of our ignorance, as imposing a structure of spatial autocorrelation on the errors essentially is a statistical technique that helps us deal with incomplete understanding of, or data on, relevant economic interactions.

- Public capital is measured as (the value of) the stock, while project appraisal is about changes in (the physical level of) the stock of infrastructure.[4]

Second, the empirical work on **agglomeration economies** shows that they exist and they can reasonably be measured (although there are obviously caveats here as well, some of which are discussed below). The concept of agglomeration is made operational by constructing an index of the amount of economic activity that is accessible to a firm at its location ("economic or effective density"). Effective density is treated as an input in a (translog) production function, so allowing estimation of agglomeration economies. Agglomeration economies vary strongly among industries; an application for the UK finds they are rather small for manufacturing industries (e.g. the elasticity of productivity with respect to effective density is 0.08 for manufacturing) and large for service-oriented activities (e.g. an elasticity around 0.22 for business services, and around 0.24 for banking, finance and insurance).

Accessibility clearly depends on available transport infrastructure, amongst other factors, so an empirical link between infrastructure and agglomeration can be established. Such an exercise was carried out for the CrossRail project in London, suggesting that this project's (local) benefits increase by about 20% when agglomeration economies are accounted for. The same exercise for a bus subsidy in South Yorkshire (also in the UK) increases direct benefits by some 3%.[5]

Questions were raised regarding the interaction between agglomeration effects and traffic congestion. Agglomeration economies may become exhausted and can be outweighed by congestion effects; the analysis for a Dutch project indeed found "negative agglomeration effects" (Oosterhaven and Broersma, 2007). Empirically separating agglomeration from congestion is difficult but useful (and some work on the issue is available, e.g. Graham, 2006). Analyses of the interaction between agglomeration, location decisions, and transport costs in polycentric contexts shows that lower transport costs may induce firms to move out of the center, as cheaper transport reduces returns to density. Location decisions are, however, ignored in much of the empirical work. It was also noted that congestion pricing can stimulate agglomeration economies if it succeeds in allocating roadspace to activities that benefit most from agglomerations; this is an element of the debate on road pricing in New York city. A related point is that technological developments

affect the trade-off between congestion and agglomeration economies. For example, improved information technology may reduce firms' need to locate close to other firms or two workers (Blum and Dudley, 1999 and 2002).

As with the discussion on spatial spillovers, there were concerns that the modeling of agglomeration effects is too much of a "black box" to be truly useful to project appraisal. A better "microscopic" understanding of the mechanisms that generate the benefits of agglomeration would be very valuable. Such mechanisms include production effects, ease of deliveries, and access to diverse inputs. But there are dispersion economies too. For example, a good highway system allows just-in-time deliveries. Manufacturers exploit this opportunity by dispersing the production of automobiles over several locations so as to avoid upward wage pressure associated with producing in a single location. Opening up the black box is challenging. Many sources of agglomeration effects are empirically equivalent, at least with the sort of data currently available, meaning that econometric identification of the various sources presents a major challenge.

Lastly, it was agreed that the work on spatial spillovers suggests that care should be taken with local estimates of agglomeration effects. For example, the work on the Crossrail link in London found agglomeration benefits that increase the benefits identified in standard cost-benefit analysis by some 20%. But it is not clear to what extent these additional benefits are offset by losses in other jurisdictions.

2.3. Comprehensive modeling frameworks

Börje Johansson and Ian Sue Wing presented analytical frameworks that aim to embed the analysis of economic effects of changes in transport infrastructure in a context that is broader than the narrow transport focus of standard cost-benefit analysis. Johansson's approach is rooted in spatial economics combined with a standard discrete choice travel model. Although the conceptual framework is somewhat different from the static neo-classical microeconomic framework that underlies cost-benefit analysis and its extensions, it leads to empirical strategies that aim to integrate wider economic effects that are similar to the ones identified above (agglomeration effects, in particular). The work of Sue Wing et al. is firmly rooted in neo-classical economics, as it integrates a network representation of space with a standard computable general equilibrium framework. In its present form, the general equilibrium model focuses on making interactions between markets explicit. Agglomeration effects are not included as such, but it appears that such extensions pose no particular conceptual problems.

The Johansson approach emphasizes that transport networks generate a spatial structure, and the particular spatial structure may entail agglomeration economies. The central concept to describe spatial structure is that of a functional urban region, which corresponds to the distance that can be travelled within an hour or so (implying that times and distance matter). The framework is operationalized by constructing measures of how (improvements in) transport networks lead to (improvements of) accessibility. Households desire access to jobs, services, and to the wage sum (as a measure of economic opportunities). Firms demand access to labor and to specific skills, and they are better off when labor and production factors are more abundant (more accessible). Empirical results suggest that central cities respond primarily to internal accessibility, and all urban areas benefit from intra-regional accessibility. It is emphasized in the empirical work that

infrastructure should be measured in physical characteristics, not capital values, and that studies based on panel data produce more robust results than those relying on only cross-sectional or time series data. Although not stressed in Johansson's contribution, it may be added that an accessibility measure based on a discrete choice model allows calculating log-sum welfare measures of changes in transport networks.

The discussion centered on whether focusing on accessibility as an objective or as a measure of network performance is valid. There was wide agreement that performance measures refer to intermediate variables and that they should not be seen as policy goals in themselves. A comprehensive welfare measure provides better policy guidance than narrow performance indicators. For example, accessibility is large when households live in skyscrapers, but welfare may be low. Similarly, road congestion is avoided by banning cars, but welfare may decline. Nevertheless, careful analysis of the likely impacts of changes in infrastructure is a prerequisite for good cost-benefit analysis.

The general equilibrium model introduced by Ian Sue Wing represents a meso-level approach, in that it makes explicit the interactions among the many markets that are affected by changes in transport infrastructure. It does not tackle the issue of how better infrastructure relates to long run economic development, nor to other "non-linearities" like agglomeration effects. A sizeable, though not huge, literature on general equilibrium effects of a variety of transport policies exists. Most of this work has an analytical emphasis, and the numerical results that are available are on too high a level of aggregation to be directly relevant to project appraisal. The model proposed by Sue Wing improves on the available "maquette models" of the interaction between transport conditions and input and output markets, by integrating a detailed representation of transport networks with the economic model.

The approach is useful for at least three reasons. First, it shows how benefits from better infrastructure are transmitted between markets; the final equilibrium allocation shows how costs and benefits are distributed across economic agents, and this information is useful to policy-makers. Second, compared to existing spatial general equilibrium tools, the particular network representation allows investigating the effects of localized network improvements on the overall economy, which is useful as it fits well with the nature of many transport infrastructure projects. Third, on a methodological level, the framework can be used to analyze the impact of spatial aggregation on modeling results, an issue which is known to matter – in the sense that model results depend on the level of aggregation – but which is poorly understood. Whether operational implementation of such a framework is sufficiently easy and reliable to provide routine policy support remains to be seen. In other words, it is not clear whether general equilibrium modeling will be able to make the transition from a research tool to a standard policy support tool for transport.

2.4. Progress with and challenges for applied economic project appraisal

Glen Weisbrod extracted common themes and policy messages from the papers and from the discussions. His focus was on the application of economic analysis for transport decision making. One key message is that the match between research on wider economic benefits and policy makers' needs is far from perfect. The level at which effects are measured and the tools that are used, with the associated lack of replicability and transferability, reflect a preoccupation with pure research interests; there is no strong correspondence between research and the policy levers available to decision makers. This

mismatch carries some risks. First, research may be misused when it is taken out of context. Second, interest groups, in particular from the business community, become increasingly dissatisfied with economic appraisal because it ignores wider issues of core interest to them.

A prime example of such issues is the impact of infrastructure on productivity and competitiveness, measured through conditions of market access, connectivity, and reliability. The state of research on these and other issues, as exemplified by the various presentations, suggests strongly that standard cost-benefit analysis does not capture many of the effects of central concern to interest groups and policy-makers. But the research does not provide a set of operational tools for including them in project appraisal. In particular there is a lack of attention from research for microscopic, intra-agent processes, and their connection to transport infrastructure. In contrast, business-led studies have adopted a case study approach where the wider issues take center stage. The impacts addressed in these case studies concern the effects of infrastructure on market access, connectivity and reliability. And the focus in dealing with these effects is on the recognition of non-linear and threshold effects related to market size.

The dissatisfaction of at least some users with the state of transport project appraisal poses a challenge, but at the same time, should not come as a surprise. The research community is aware of many shortcomings: standard cost-benefit work misses wider effects, which are known to be real and potentially large. The understanding of some, but not all, of those wider effects can be integrated in the static framework underlying cost-benefit analysis. But there are no general, hard and fast rules for project appraisal. In addressing the challenge, participants cautioned against the generalization from ad hoc case study work. A central characteristic of economic project appraisal is that it consistently applies a consistent methodology. Research can provide such a framework, and include any direct or indirect impact to the extent that tools and data for quantifying them are available. This means that project appraisal cannot be tailored to politicians' or interest groups' concerns, nor should it be. Instead, it is just one imperfect input into an equally imperfect decision-making process. Section 4 develops ideas on approaches to project appraisal in more detail.

3. THE PRACTICE OF TRANSPORT PROJECT APPRAISAL

The previous section reviewed research on the economic impacts of transport infrastructure, and clarified how such impacts are or are not captured in standard cost-benefit analysis. Several participants emphasized that we ought also to look for improvements in the actual practice of project appraisal, where it needs to be recognized that the current practice often falls short of ideal cost-benefit analysis.

In the United States, cost-benefit analysis – in the sense of a formal comprehensive welfare economic valuation – is not systematically applied to transport infrastructure investment projects. Most cost benefit appraisals undertaken are for road projects in rural areas. [6] In these cases, safety benefits are frequently larger than the time savings benefits. Because funding is generally apportioned or allocated by type of project (e.g., resurfacing, capacity expansion, safety, etc.), the analysis focuses on cost effectiveness. Similarly,

although documentation of environmental consideration is a legal requirement for federally funded transport investments economic analysis is sometimes done within this context. Cost-benefit analysis is occasionally incorporated in this documentation process. It was noted that because this documentation process occurs prior to the completion of project design, costs sometimes change and the cost-benefit analyses are rarely revised when new cost information about a project becomes available (although new information on environmental impact would occasion a supplement to the documentation process).

One further reason (in addition to the use of cost effectiveness noted above) suggested for this relative paucity of cost-benefit analysis is that overall net benefits are not of prime interest in the decision-making process. Instead, decision-makers are, for example, strongly interested in a project's distributional impacts. Spatial distribution gets particular attention, given the spatial structure of politicians' constituencies. The question as to whether inclusion of distributional impacts in project appraisal – which poses no conceptual problems and for which analysis tools are increasingly available – would lead to wider implementations, was left open. A second possible reason is that the policy practice in the US is to allocate funding geographically even within States as well as allocating funding to different goals, such as pavement maintenance, congestion and safety. There is therefore less reason for a systemic "all projects" benefit-cost analysis. The question was asked whether an imperfect cost-benefit analysis is necessarily useful. But it was also pointed out that fragmentation of the analysis increases the risk of double-counting of benefits.

Cost-benefit analysis is applied more systematically in Northern European countries, although there too it is only one input in the decision-making process. In the United Kingdom, which employs CBA systematically, the results are presented to decision makers in a summary appraisal form, side by side with the results of EIA and multicriteria analysis to reflect the relevance of factors that cannot easily be monetized. Financial and environmental indicators are presented together with a description of how they and the project relate to the governments equity and other policy goals, on a single page. The strength of this system is transparency, but it tends to leave the political decision makers out of the discussions involved in the economic appraisal. It was noted that the US tradition, structured around EIA, appears to be much more successful in engaging political decision makers in discussions of the economic as well as environmental aspects of projects from an early stage.

For other European countries, there was an impression that cost-benefit analysis is often carried out simply because it is a legal requirement, and it takes place late in the decision-making process, casting doubt on whether it has a strong impact on decision-making.

A potential explanation for the mixed success of cost-benefit analysis in affecting decisions is that there is a disconnection between policy-makers' objectives and the objectives implicit in cost-benefit analysis (e.g. maximizing surplus).[7] Policy-makers may wish to increase densities in cities, or they may aim to boost employment, or they may focus on accessibility or similar performance measures. Although such intermediate objectives don't necessarily clash with surplus-maximization, the connection between them is not always clear. Several suggestions were made to improve the match between what policy-makers are interested in and what cost-benefit analysis provides. First, researchers can increase efforts to arrive at an accurate analysis of a project's impacts. Second, going beyond impact assessments, cost-benefit analysis should be used to avoid serious mistakes, i.e. it should guard against projects that constitute a major waste of resources. Arguably, it has been relatively successful in doing so. Third, researchers could gear their analysis more carefully towards policy-makers concerns, rather than to their own research agenda. On this

point, however, it was emphasized that this should not lead to the abandonment of the basic principles of cost-benefit analysis, which are those of welfare economics, as information on a project's impact on efficiency and on economic surplus is a valuable input into the decision-making process. Otherwise said, project appraisal can inform decision-makers on intermediate objectives, but should go further and provide an overall assessment.

4. WHAT KIND OF APPRAISAL FOR TRANSPORT INFRASTRUCTURE IS BEST?

The macroscopic analysis of the economic effects of investment in transport infrastructure suggests that there are modest wider economic benefits from such investments. But different projects show different scales of wider effects, and sometimes negative effects. Care also needs to be taken to avoid double-counting. While the macroscopic literature helps debunk the crowding out argument, it is not of direct relevance to project appraisal. Meso- and microscopic methods seem promising, as they provide ways to extend and improve cost-benefit analysis. But which specific improvements can we suggest? Round Table participants arrived at some common ground, along the following lines.

Standard cost-benefit analysis focuses on a project's direct effects, i.e. it restricts attention to changes in transport users' economic surplus. A first question of interest to policy-makers is how these direct transport benefits translate into (regional) economic benefits, or more bluntly, do time savings really translate into tangible gains. Using terminology introduced by Peter Mackie, in his comments on Roger Vickerman's paper, this is the "**alchemy** question". If there are no wider economic benefits, cost-benefit analysis provides a complete answer, but it does not come in a form that is easily understood by policy-makers. Economic modeling, for example along the lines of applied general equilibrium tradition, can help outline how direct benefits are transmitted through markets and transferred between economic agents like households and firms.

The second question on policy-makers' minds is the "**additionality** question": are there any wider, additional economic effects (benefits or costs) attached to a project? It is useful to distinguish between static wider impacts and dynamic wider impacts. By static effects we mean productivity impacts, external economies (e.g. increasing returns to scale, agglomeration, thicker markets) and diseconomies (e.g. congestion). On a conceptual level, static effects are easily captured in the framework of standard cost-benefit analysis. On an operational level this is more difficult, but there is progress. By dynamic effects we mean adaptations to changes in transport conditions that take place at the microscopic level, e.g. within households or firms. One example is the ability of spouses to take jobs at greater distances from home, with the housing location determined by school choice rather than employment opportunities. Such dynamic effects clearly matter, because they affect economic welfare, but they are difficult to capture in the static framework of cost-benefit analysis, and little progress has been made to date.

On the advice that could be given to policy makers on the existence or otherwise of wider economic benefits additional to those captured by standard cost-benefit analysis, the

position emerging from the discussion was one of caution. While the economic profession's understanding of wider economic benefits is improving, it is insufficient to provide a strong basis for *routine* project assessment. There are several explanations for this situation: limited availability and low quality of data, incomplete theoretical understanding of directions of causality, and econometric issues of identification.

Given this state of the research on additional effects, it seems impractical to recommend the inclusion of wider economic impacts in routine project assessment. The risk of excluding real wider benefits or costs exists, but there was considerable agreement that this is outweighed by avoiding the risk of introducing double-counting benefits. For large projects, and especially for the assessment of investment programs, a more ambitious analysis that addresses wider impacts may very well be justified. The recognition of wider effects in the evaluation of entire programs is particularly important, as the interactions between various parts of the program are likely to be underemphasized (or ignored entirely) in a typical cost-benefit analysis.

It is clear that wider benefits are important for some projects, and that an operational understanding of these effects improves decisions on transport infrastructure investments. There is thus a strong case for continued research and development of empirical and analytical frameworks, including operational general equilibrium models.

A particularly strong warning was made against the adoption of "hard and fast rules", like average multiplier effects, to account for additional benefits. Examples were given of projects where the additional benefits are negative, because of congestion effects that outweigh agglomeration effects (Elhorst *et al.*, 2004). Furthermore, discussions of the econometric work on agglomeration effects and on spatial spillovers made it clear that results are strongly context-dependent, and no transferability should be expected. While complexity should not be sought for its own sake, researchers should resist policy-makers calls for comprehensive, simple, and transparent decision making rules to capture wider economic benefits; such rules are inappropriate and may produce highly undesirable outcomes.

A constructive way forward would be for the research community to agree on a practical framework for applied project appraisal. Such a framework may contain guidelines on which effects to include and how to measure them, and can be accompanied by a typology of projects that indicates how broad-ranging the analysis should be for each type.[8] So, while there should be a single framework, the complexity of the method can be adapted to the size of the project: for small projects, the main issue is to get results quickly, so that a less sophisticated approach is preferable; for large projects, more sophisticated analyses may be justified. Even for such big projects, however, it useful to keep in mind that the provision of information early in the decision-making process has a larger impact than information that becomes available further down the line – even if that information is based on a more comprehensive analysis.

Focusing on timely availability of appraisals has its downsides: new information may emerge, and this obviously can affect results. One way of dealing with this is to see appraisal as an ongoing process, where the analysis is updated as relevant information becomes available. Alternatively, the ex ante analysis may contain a quantification of risk, e.g. by specifying several scenarios and attaching probabilities to them.

NOTES

1. It is worth pointing out that Aschauer's work was not originally intended to inform the practice of project appraisal, but rather addressed the issue of whether public investment crowds out private initiative.

2. This problem arises with macro-studies, but also with meso- and micro- studies, and its importance will be highlighted throughout much of this paper.

3. The definition of meso-approaches in these conclusions differs from that used in Vickerman's paper, in that we put general equilibrium work under the meso-approach and not the macro-approach. We do so because general equilibrium models make market interactions explicit, even while they possibly focus on aggregate outcomes. Also, our classification fits better with the meso-scope of the paper by Sue Wing et al. This classification, however, has no bearing on the substance of any of the arguments made.

4. On a technical note, it was pointed out that using the size stock instead of changes may help address endogeneity problems.

5. The costs-benefit analysis for South East airport developments in the UK does not include any measure of wider benefits. The reason is that there is no empirical basis for quantifying then (presentation and comments by David Thompson, UK Department for Transport, at the Workshop on Competition in Transport Markets, ZEW, Mannheim, Germany, 25 November 2007).

6. It was mentioned that many ex post analyses are available for such projects. Cf. http://www.fhwa.dot.gov/planning/econdev/ and http://www.fhwa.dot.gov/hep10/corbor/border/laredo/fhwastatement.htm .

7. We abstract here from the problem mentioned earlier, that economic analysis is often carried out at too high a level of aggregation, so does not speak directly to the policy instruments available to policy makers.

8. Not all participants were convinced that such a single framework is desirable. Some advocated the use of different partial models at different stages of the planning process, or suggested limiting the analyst's role to implementing standard cost-benefit analysis while leaving all other dimensions of the decision to politician's discretion.

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