Chapter 1

Boosting productivity in Switzerland

Swiss GDP per capita stands amongst the top OECD performers. However, to face medium-term challenges productivity developments will be key to allow the country to maintain its enviable position. Recent trends have not been favourable, with productivity growth underperforming peer countries. Based on macroeconomic analysis and supported by firm-level data, results point to a significant role for competition, innovation, education, firm characteristics and entrepreneurship. The regulatory environment is a crucial element driving productivity and could explain some of the differences across cantons. It is also an important factor for productivity differences across sectors. Other issues weighing on Switzerland's future performance include risks from ageing, which can have major consequences on productivity via its influence on economic sectors and also via the age structure and the evolution of productivity through working life. Fully utilising the potential of underrepresented population segments would also be beneficial, notably encouraging full-time participation of women and better integrating immigrants. More enterprise creation could be achieved with increased entrepreneurship education, expanded non-bank financing and a reduced regulatory burden. R&D, while an obvious success in Switzerland, has apparently not produced commensurate returns in output. Diversification, more knowledge sharing, a stronger role for higher education institutions and promotion of start-ups would help reinforce the links from R&D to productivity.

The Swiss economy is performing relatively well in a variety of dimensions. Average GDP per capita is one of the highest amongst OECD countries; survey- and indicator-based measures of well-being also put Switzerland among the top countries; and income inequalities are quite modest. Yet, medium-term challenges will arise as ageing and digitalisation along with other macroeconomic risks – including protectionism in many parts of the world – bring about structural changes that endanger its relatively good performance. In this context putting in place the conditions to boost productivity is crucial. Without productivity improvements, economic problems such as those related to ageing and inclusiveness will be harder to solve. Indeed, faster productivity growth will naturally expand fiscal revenues needed to finance social transfers and ageing-related direct government spending. To achieve faster productivity growth, it is also crucial to underpin the competitiveness of Swiss firms and the attractiveness of the economy for foreign investors.

There has been a generalised productivity slowdown across OECD countries in recent years, pointing to a likely failure to translate technological change into commensurate innovations (OECD, 2016a). But, over the last several decades labour productivity has grown on average more slowly in Switzerland than in its main counterparts. Accordingly, it is important to identify any Swiss-specific structural weaknesses in order to avoid any persistence of such underperformance. This could in principle involve: slow adoption of new technologies; insufficient development of higher value added activities; skills shortages or mismatches; limited labour mobility; credit misallocation; weak aggregate demand (limiting the incentives and scope for innovations); and a lack of competition associated with heavy regulatory burdens. At the same time, its advanced ITC sector and developed infrastructure makes Switzerland well placed to take advantage of digitalisation and the next production revolution. However, this depends on the diffusion of innovation and the responsiveness of the education and training system to changing skill needs (OECD, 2017a and 2017b).

In most cases promoting productivity and fighting inequality involves no trade-off (Ostry et al., 2014). Therefore, economic policies should be carefully designed to encourage both higher and more inclusive growth. Switzerland has long favoured inclusiveness through its maintenance of very high employment rates, even though its unemployment rate has trended slightly upwards over time. However, forces such as digitalisation raise the risk that future growth is less equally shared if it translates into higher demand for highly skilled workers and a marginalisation of others.

This chapter examines Swiss productivity growth as the main driver of future improvements in standards of living. First, it discusses the macroeconomic environment and recent productivity developments. That covers a comparison of Switzerland with international peers, the decomposition of productivity growth into changes in capital intensity and total factor productivity, the role of ageing and regional aspects. The following section goes into more detail about what has potentially driven the productivity slowdown, drawing on firm-level data when possible. Scrutiny of sector characteristics complements analysis of capital and labour allocation, followed by firm entry and exit

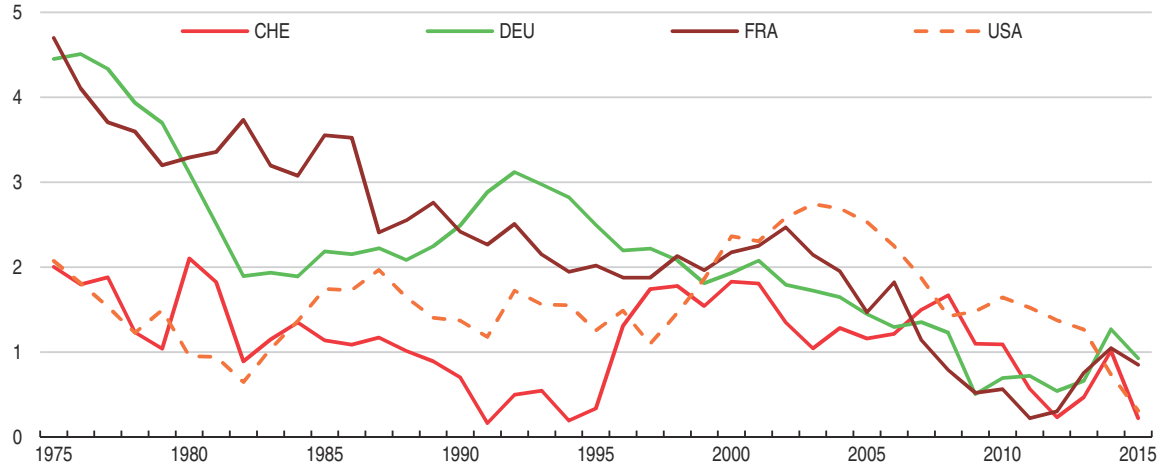
specificities for Switzerland. The section also highlights the importance of international trade and existing restrictions on its development as well as on competition. Additionally, the role of Swiss R&D is discussed. The chapter concludes by making policy recommendations aimed at designing a productivity growth framework that does not neglect distributional outcomes.

Productivity growth has under performed recently, but its level remains elevated

Hourly labour productivity growth in Switzerland has been lower than in most OECD countries in a context of a global productivity slowdown, which increases risks as to maintaining its relatively high living standards in the future (Figure 1.1). When removing the influence of the cycle, trend labour productivity growth (per employee) in Switzerland has fallen by more than half over the past two decades, from about 1.1% per annum over 1996-2006 to less than 0.4% over 2006-16. In comparison, OECD-wide trend labour productivity has grown 1.0% annually over the latter decade (1.6% over 1996-2006).

Figure 1.1. **Growth of output per hour worked**

5-year moving average growth rate, in per cent



Source: OECD, *Productivity database*.

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The level of productivity remains high when compared with international peers

Measurement issues can affect conclusions, even though they do not seem to be large enough to drive the recent decline (Box 1.1). Additionally, other elements not systematically incorporated in output matter for sustainability and are important to bear in mind (Box 1.2).

Productivity growth is essential, but Switzerland's relative underperformance could also be related to a higher starting level to which other countries hope to catch up. However, though Switzerland's GDP per capita ranking is enviable (third-best amongst OECD countries), its productivity level, while still good, is not as high (tenth rank; Figure 1.3). It is essentially the employment-to-population ratio (second best) that explains its good per capita GDP performance (OECD, 2015a). This happened in a context of a rising share of cross-border workers in the labour force (gaining 1 percentage point over 2010-15 to reach 6%). Continued labour force growth is also attributable to high levels of immigration (see below).

Box 1.1. **Role of measurement issues**

Mismeasurement of output can bias the analysis of productivity developments. Some issues are well known: for example, uncertainty and extensiveness of imputation methods for health, education and finance outputs. Over recent years there has been a surge in activities that barely existed previously or were drastically transformed. The process of digitalisation is clearly disruptive for producers and consumers. Indeed, increasing use of big data, peer-to-peer platforms, online and targeted advertising, crowd sourcing, free internet services, new forms of financial intermediation and activities of growing numbers of self-employed workers using new forms of transactions could potentially be difficult to measure in GDP. In addition, the new economy is characterised by the rising importance of intangible assets (e.g. intellectual property). Their prices can be volatile and depend on characteristics quite different from those for tangibles. Therefore, they are not broadly accepted to secure business loans, for example.

Those changes seem to affect consumer welfare more than market-sector production, as many new services are free and then partly uncounted in GDP. Ahmad and Schreyer (2016) argue that the accounting framework for GDP is broadly adequate to face the digitalisation era. There remains some scope though for improving statistics and measures of output and deflators. That includes better accounting for certain cross-border flows (like e-commerce) and the continued effort to differentiate quality and price changes, especially when dealing with new products or services. But measurement issues so far have been marginal in comparison with the actual productivity decline. And even the well-being gains do not seem to compensate for the observed slowdown (Syverson, 2016; Byrne et al., 2016). Conversely, Aghion et al. (2017) argue in the case of the United States that measurement issues were substantial (about 0.5 percentage point per year) over 1983-2013, but they fail to show a significant error increase that could explain the recent productivity slowdown.

Metrics that are related solely to GDP performance fail to catch all dimensions of improved well-being that matter most. Inclusiveness, well-being and environmental sustainability are all ultimate objectives, and higher productivity should be considered as a means to achieve higher levels of each of them. In particular, a specific measure of environmental productivity shows that Switzerland should pay more attention to the CO_2 content of its imports.

The availability of jobs for the entire population helps to moderate Switzerland's level of income inequality. However, it also reins in productivity, as the inclusion of a large set of workers including the less skilled drags down its average. In contrast, countries like

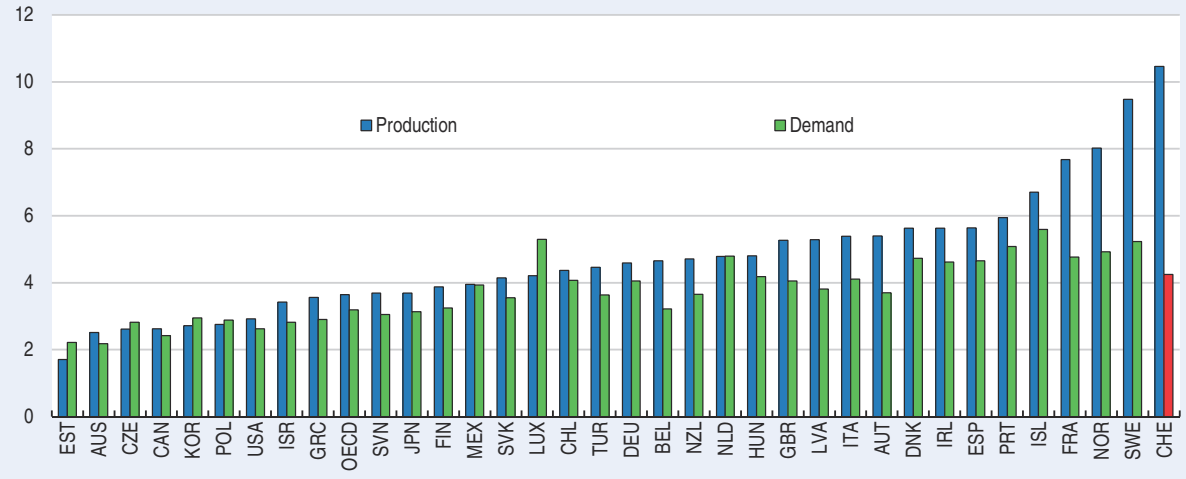
Box 1.2. **Environmental productivity**

A central element of green growth is the efficiency of production and consumption in terms of environmental inputs and resource usage. The OECD has developed indicators to monitor the transition to green growth. They are derived from a comparison between the use of environmental services (including natural resources, energy and pollutants) as inputs and the generated output.

As CO_2 is a major contributor to greenhouse gases, its productivity measures to what extent ongoing climate change mitigation can affect economies. Switzerland is particularly efficient in that dimension from the perspective of production-based productivity; however, it is the OECD country which has the highest difference with the demand-based approach (Figure 1.2). Domestic production is highly efficient in terms of environmental inputs, notably because of Swiss specialisation in low-carbon industries. Nevertheless, Switzerland is responsible for a larger amount of CO_2 emissions that are embedded in national demand: between half and three-quarters of the environmental impact is estimated to be embodied in imports (OECD, 2017c).

Box 1.2. **Environmental productivity** *(cont.)*

Figure 1.2. **CO_2 productivity**
2010 PPP US dollars per kilogram, 2011



Note: Production-based productivity corresponds to real GDP generated per unit of CO_2 emitted in production. Demand-based productivity is real national income per unit of CO_2 emitted.
Source: OECD, *Green Growth Indicators database*.

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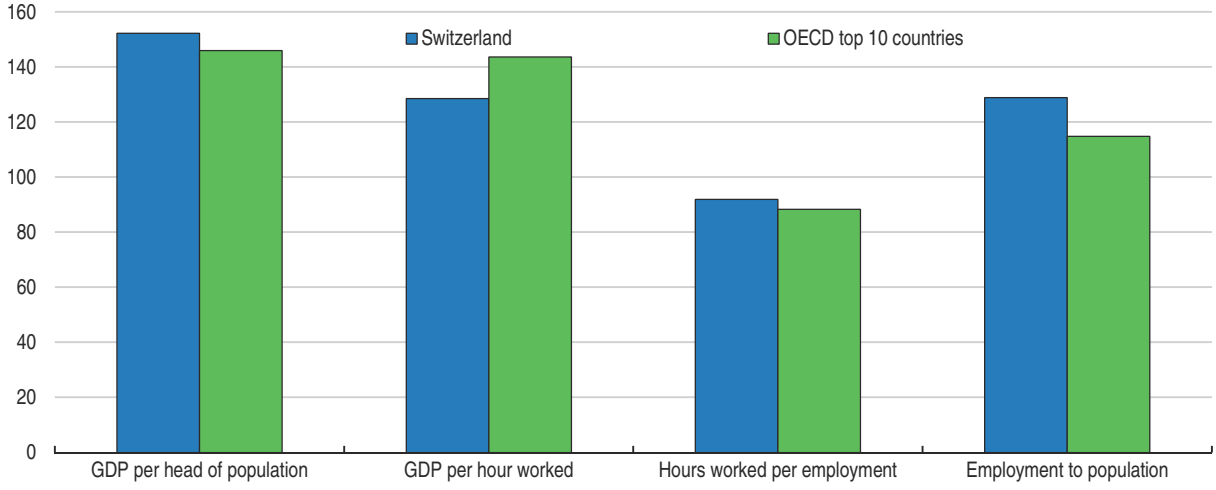
Figure 1.3. **Decomposition of GDP per capita amongst OECD countries**
2015, relative to OECD average (=100), in 2010 PPP USD



Note: OECD top 10 countries are selected according to their performance in GDP per capita.
Source: OECD, *Productivity database*.

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Belgium, France and Ireland have higher average productivity but employ a much lower share of their populations. In addition, it appears that countries with higher productivity levels tend to have lower average hours worked (correlation of -0.8), in large part because of an income-elastic demand for leisure.

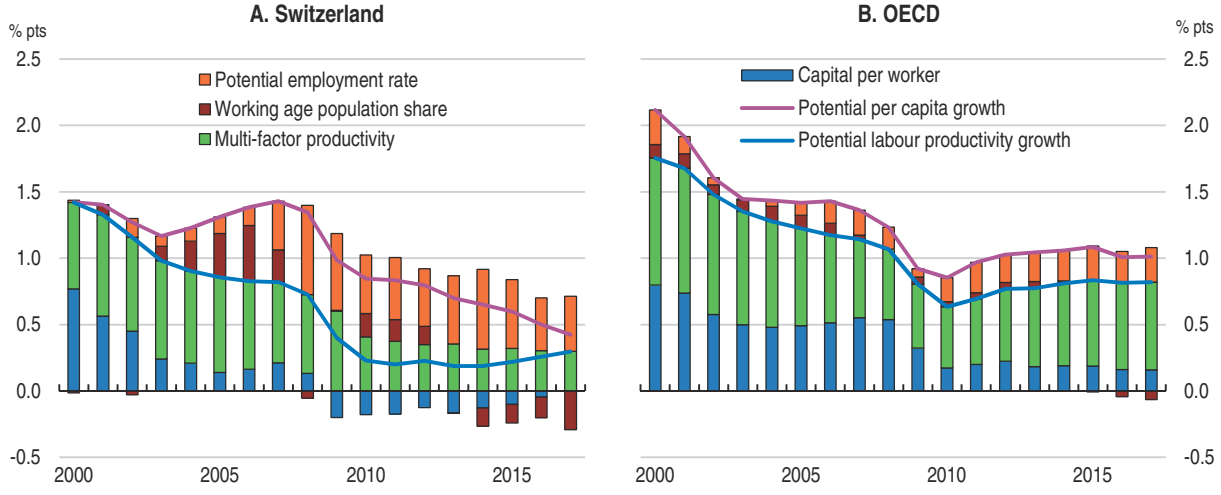
Low multi-factor productivity growth along with weak capital deepening are hampering the economy

Recent productivity outcomes and ageing have weighed on GDP per capita. In particular, population ageing has already started to dampen economic growth significantly (Figure 1.3). Switzerland had been counting on persistent rises in the employment rate to limit the divergence with OECD average growth in GDP per capita. This has favoured inclusiveness to some extent, as inequality increases with unemployment. The employment rate has, however, limited scope to rise any further, as it is already one of the OECD's highest. By 2018, OECD estimates imply that, without the contribution from a higher employment rate, GDP per capita would fall, which points to the crucial role of productivity developments.

Productivity growth has been trending down since 2000 for both Switzerland and the OECD average (Figure 1.4). While the gap in GDP per capita growth has been contained, the difference in productivity growth has become more pronounced. The contributions from both multi-factor productivity (MFP, a measure of technical change) and from capital deepening are shrinking, with no sign of recovery at the end of the projection period. This means that technological progress is modest and that investment has been too weak to compensate for the rise in labour input. This is consistent with findings for other OECD countries (Ollivaud et al., 2016). Further improving the business environment would boost investment and generate both an increase in the capital-labour ratio and a rebound in MFP.

Figure 1.4. **Decomposition of growth of potential output per capita**

Contribution to potential output per capita growth



Source: OECD (2017), *OECD Economic Outlook 102 database, preliminary version.*

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Boosting productivity will prop up the competitiveness of the economy, which has been eroded by currency appreciation and a relative increase in labour costs when expressed in foreign currency. Indeed, the increase in real wages since the crisis, together with the end of the currency ceiling in January 2015, have curbed Swiss firms' margins in the context of a very open economy (exports are almost two-thirds of GDP). This probably lies behind some of the weakness in business investment as a share of GDP – even though its five-year moving average has edged up in recent years. Nevertheless, the current

account surplus remains large and export performance strong, demonstrating continuing competitiveness at least for some industries and an ability to further increase investment financed by domestic saving.

Swiss public investment has been relatively weak in recent years, and it could be a factor dampening productivity. As a share of GDP, public investment has averaged around 3% since 2000, compared to 4% over the 1980s and 1990s. Raising public investment and increasing public capital stock can directly increase labour productivity and long-term growth even though gains suffer from decreasing returns (Fournier, 2016); it can also potentially generate spill-overs to private investment. Together with more spending on early childhood education and care (as recommended in the previous *Survey*), those additional expenditures are able to spur productivity in the long run and also enhance inclusiveness (Fournier and Johansson, 2016).

Ageing also impacts on productivity

As mentioned above, ageing represents a major challenge. On top of other impacts on the economy (OECD, 2015a), Switzerland's demographic structure also influences its productivity outcomes. Not only will the old-age dependency ratio increase (almost a third of the population will be over 60 by 2030), but also the average worker's age will rise. Productivity differs across age groups because of changing educational attainment, accumulation of experience, depreciation of knowledge and varying age-related capabilities. Employees' knowledge could also become gradually outdated as they age, which could penalise a typical worker's ability to adapt to technological changes and to job requirements. The impact depends on the occupation and the sector but has been estimated to have reduced labour productivity growth by about 0.1 percentage point each year over the past two decades in the euro area and could reach an annual loss of nearly 0.2 percentage point in the next 20 years (Aiyar et al., 2016). The large effect suggests strengthening policies to limit productivity decline through one's working life, including by improving and promoting preventative health programmes and lifelong training for older workers (Chapter 2). In addition, health care has a direct positive impact on productivity, as people in ill-health are less able to take part in productive activities (OECD, 2016a). Removing unnecessary barriers to labour mobility is also crucial, as older workers tend to be less willing to move between firms and regions.

Demographics are also affecting the structure of the economy, but the overall effect of ageing on productivity is difficult to observe. Consumption will be increasingly driven by the needs of the elderly. It will therefore accentuate the recent shift towards more services (such as health and personal care) to the detriment of manufacturing, which is normally more productive (Siliverstovs et al., 2011). However, it appears difficult to find any negative relationship in recent decades between countries experiencing rapid ageing and their GDP per capita growth rate. Demographic changes seem to force countries to adopt automation technologies more quickly because of lower labour supply (Acemoglu and Restrepo, 2017). In the Swiss case, there appears to be no shortage of labour, but adoption of robots could become more systematic, for example in the case of specific skills scarcity possibly due to lower net immigration flows. However, so far, digitalisation seems to have had a rather limited effect on employment in Switzerland (Arvanitis et al., 2017a).

Immigration has been one temporary solution to ageing problems and can potentially boost productivity. The share of immigrants in Switzerland's population increased from about

21.9% in 2000 to 29% in 2015 (the highest share amongst OECD countries, after Luxembourg), which has slowed the rise in the dependency ratio. As pointed out in the last *Survey* (OECD, 2015a), most immigrants have originated from the European Union (especially Italy and Germany) and have actually filled skills gaps (see Chapter 2). Evidence based on a panel of countries shows that they have generally boosted overall productivity (Box 1.3). In recent years immigration has decelerated, especially that from Europe, partly because of an economic upturn in some origin countries and possibly also uncertainty generated by the 2014 referendum that called for the application of limits. The amendment voted in December 2016 and the draft ordinance presented in June 2017 look likely to be less severe; the draft proposed forcing firms wishing to hire in professional categories with unemployment above 5% to go through a local job centre for a short period before the advertisement can be widely disseminated. The final ordinance will be decided in early 2018. Nevertheless, in order to achieve the benefits of immigration on productivity, Switzerland should pursue policies that encourage integration of migrants in society and facilitate inflows, and especially try to attract high-skilled immigration from outside the European Union.

Box 1.3. **The effects of immigration on productivity outcomes**

Immigration impacts economies via different channels including by changing wages, income, competitiveness, the fiscal balance, employment, financial flows and productivity. Jaumotte et al. (2016) find that immigration increases GDP per capita for host countries, mostly by raising labour productivity: a one percentage point increase in the share of migrants in the adult population can raise GDP per capita by up to 2 per cent in the long run. The effect on productivity comes via several channels. While it depends largely on migrants' profile, the positive demographic shock usually increases the share of the most productive workers in the total population, in part because they are younger on average. Migrants arrive with skills and abilities that supplement the stock of human capital in the host country. Some immigrants also import innovation in processes and in products, and more broadly they bring with them their knowledge. Highly educated people (who arrived between 2010 and 2015) represented about 30% and 45% of total migrants for European OECD countries and the United States, respectively (OECD, 2016b). In addition, immigrants are more likely to study science and engineering and subsequently tend to produce more innovations (Hanson, 2012). Even low-skilled workers that arrive can improve the efficiency of an economy: they fill in occupations that are important but neglected by natives; they tend to be more mobile; and high-skilled workers can concentrate more on their jobs when non-work chores are done by less skilled migrants. Productivity is then positively correlated with immigration even in countries that have non-selective migration policies (Boubtane et al., 2016). In the context of the free movement of persons in Europe, mobility also helps provide each labour market with appropriate skills and limits mismatches that in turn harm productivity. Admittedly, the effect can become negative if migrants, for example, work largely in labour-intensive sectors, such as construction or tourism where productivity is below average (Nicodemo, 2013). The recent large inflow of refugees in several European countries, including Switzerland, may also temporarily lower average productivity, because such immigrants tend to have more problems integrating in society as employers have difficulties in evaluating their employment experience and qualifications are not always recognised, among other obstacles. The language barrier also creates additional challenges.

Regional differences are diminishing, but some barriers may still hinder economic developments

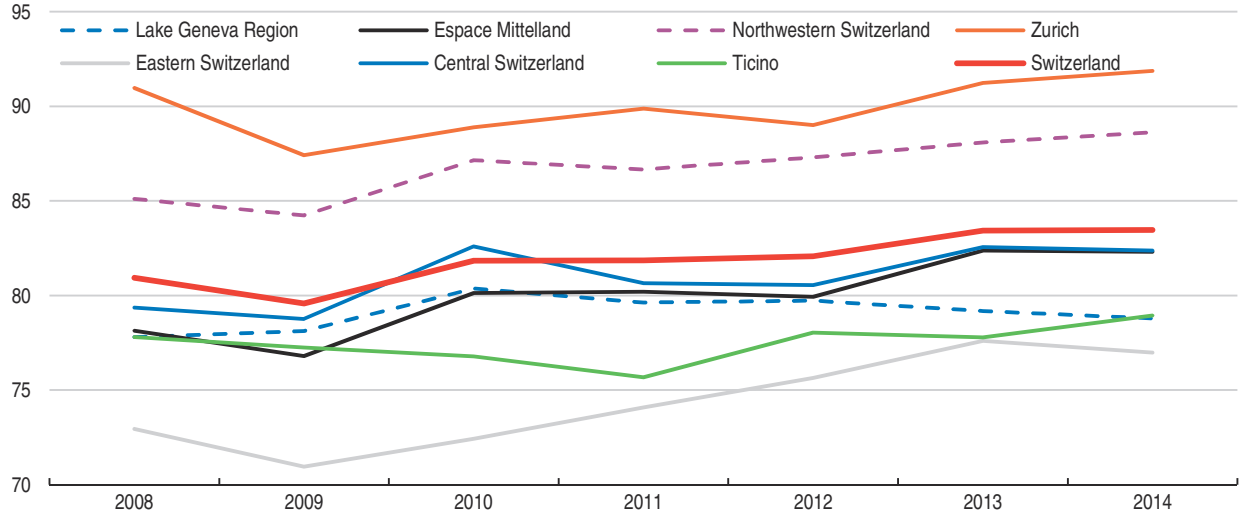
Switzerland is a highly decentralised confederation with four linguistic regions (German, French, Italian and Romansh). The 26 cantons (first level of administrative subdivision) have their own governments, laws, courts and constitutions. In particular, they raise taxes and are

responsible for most education and health care. In that context, productivity variations can derive from cultural and legislative differences as well as geographical and historical legacies.

At the onset of the global crisis in 2008 the difference in productivity levels between the most and least productive Swiss regions stood at about CHF 18 per hour worked (Figure 1.5). The crisis affected the regional leader, Zurich, to a greater extent than others, probably due to its specialisation in finance, and thus reduced the gap, but that could be only temporary as Zurich's productivity growth has outperformed the national rate in the last two years. However, productivity differences continued to decrease after the crisis, as the lagging Eastern part, along with the Swiss Plateau continued to outperform, with average productivity growth of about 0.9% per annum over 2009-14, substantially above the national average of 0.5%. Conversely, Ticino and the Lake Geneva region have underperformed: they started with lower productivity levels but failed to catch up, except with Zurich. This diversity justifies more analysis to better understand the drivers in order to both spread good practices and remove hindrances in the business environment in lagging regions.

Figure 1.5. **Labour productivity trends by major regions**

In Swiss francs per hour worked, current prices



Source: Federal Statistical Office.

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The New Regional Policy, which entered into force in 2008 and was renewed in 2016, aims at boosting lagging areas. It focuses on rural, mountainous and border regions, even though others could be eligible. The project's objective is to facilitate innovation, value added creation and competitiveness under the European Territorial Co-operation (Interreg) programme. However, there is no explicit requirement to assess regulatory and policy differences across sub-national governments, which could also contribute to some productivity deficit. For example, the persistence of below-average early-stage entrepreneurial activity in Ticino (Baldegger et al., 2015) could be further studied, including if the late-2015 cantonal law on innovation (which focused on shrinking deadweight losses) helps to reduce the gap. In addition, policy makers should provide all regions with the means to unlock their growth potential, not only the laggards. The significant extent of administrative fragmentation (OECD, 2016c) also intensifies the need for co-ordination and harmonisation.

Some cantonal regulations may explain part of the differences. In February 2017 COMCO (the competition authority) reported that several cantons (Bern, Vaud, Ticino) have excessive restrictions on cross-cantonal market access for many occupations, including private security, childcare, architects and engineers (COMCO, 2017a). It is crucial that coherence is maintained between cantons and that federal laws are applied equally across regions to ensure a correct territorial allocation of labour and capital according to inherent advantages.

It is equally important not to erect barriers to internal migration. Indeed, there should be enough mobility to avoid having locations with falling employment co-existing with other areas experiencing excess demand other than in a transition period. This flexibility would bring more inclusiveness in the confederation and also stimulate productivity. In that regard domestic language barriers hinder labour mobility to some extent.

Understanding the drivers and determinants of productivity

Sector characteristics

The structure of the economy, manufacturing's share in particular, has a large impact on productivity growth but can also explain differences between countries. Indeed, specialisation on more or less productive activities translates directly into higher or lower overall productivity growth and could shed light on overall macroeconomic developments. There is a general trend amongst OECD countries that activity is shifting away from manufacturing towards services, with a negative impact on productivity. Switzerland, however, still has a sizeable manufacturing sector.

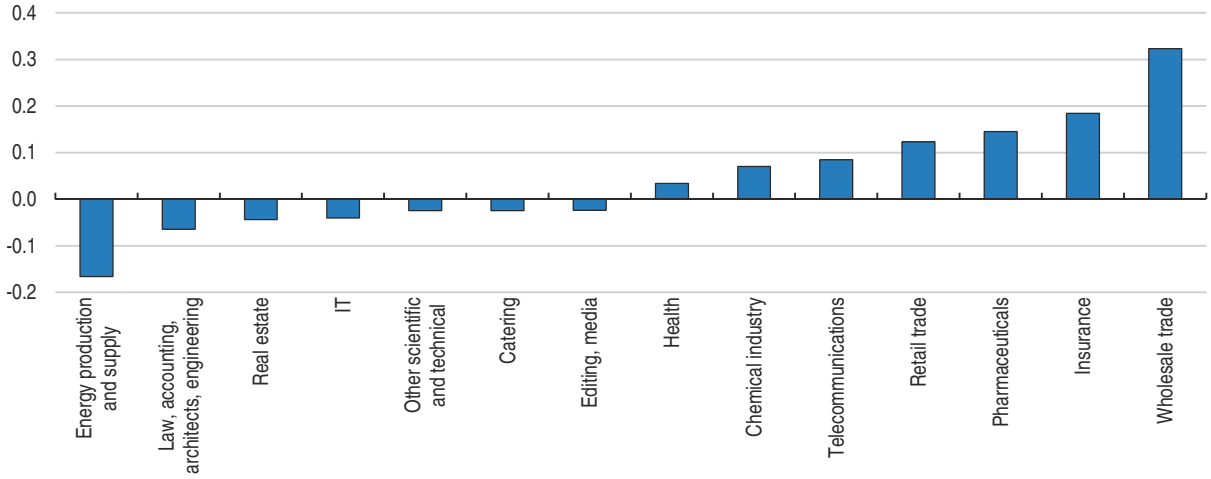
In Switzerland, over the period 1998-2015, energy, media and professional, scientific and technical services (including law, accounting, engineering and architecture) accounted for most of the drag on productivity growth (Figure 1.6). Surprisingly, IT also figures among the poorest performing sectors. This might be related to measurement problems (Kaiser and Siengenthaler, 2015), but could also be related to trade restrictions in computer services (see below). Conversely, chemicals and pharmaceuticals, insurance services and trade all experienced above-average gains over that period.

Labour reallocation has not always favoured productivity outcomes as employment gains in some sectors limited productivity growth. Indeed, the employment shares of some low performing sectors in terms of productivity growth have risen over 1998-2015, notably IT and the professional services sector (Figure 1.7). Conversely, trade, finance, insurance and chemicals have lost some ground, despite good productivity growth performance.

Over 1998-2013 Swiss productivity ranks more highly relative to other European countries when only the market sector is compared than when non-market activities are included (Eberli et al., 2015). In addition, the authors split overall productivity growth into structural change, a growth impact and an interaction term. They find that overall, structural change has been a steady positive contributor to productivity in Switzerland, unlike in Belgium, Germany and the Netherlands. This would suggest that the effect through specialisation by successfully moving the economy from traditional to highly innovative industries (like life sciences) has been stronger than the effect from strong employment growth in health or government services. However, they conclude that Switzerland is highly dependent on a few activities, while other countries' drivers of productivity are much more diversified.

Figure 1.6. **Contribution to productivity growth by sector**

Within-sector contribution to average growth per annum[1], percentage points, 1998-2015



1. Direct contribution within the sector only, corresponding to average labour productivity growth times the employment weight in 1997. Shows the 7 top and 7 bottom 2-digit industries (amongst 47) ranked by contributions.

Source: Federal Statistical Office; OECD calculations.

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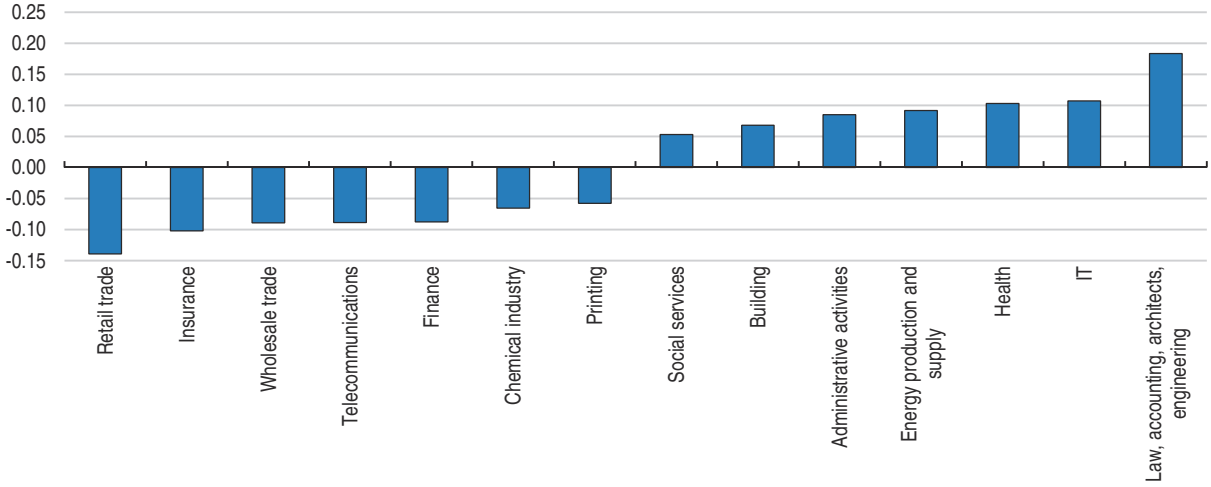
Figure 1.7. **Labour reallocation**

Contribution from relative change in employment shares to average labour productivity growth[1], percentage points, 1998-2015



1. Shows the 7-top and 7-bottom 2-digit industries (amongst 47) ranked by contribution.

Source: Federal Statistical Office; OECD calculations.

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Optimising capital and labour allocation

Recent changes in the allocation of labour inputs

Through time it is expected that the most efficient firms gain market shares and command a relatively larger share of industry inputs. The process may in turn boost overall productivity, but it also depends on the distribution of firms. Starting from the approach developed in Olley and Pakes (1996), sector and firm information is used to analyse labour productivity and employment developments. When the weighted average of firms' labour

productivity increases compared to a non-weighted average, it means that more resources are devoted to the most productive firms, and that a better allocation of inputs is leading to higher overall productivity.

Using the Swiss Innovation Survey (SIS) database (Box 1.4), the allocation of inputs is found to follow an upward trend – 2013 being an exception (Figure 1.8). That shows that more productive firms have tended to increase their employment shares, but this includes as well structural change across industries. Applying the same approach at the 2-digit industry level shows that within-industry reallocation is much more stable over time. It suggests that input allocation did not change efficiently during a period characterised by a global crisis (with higher exit rates) but improved in 2015 following the large appreciation. While the KOF database is useful in shedding light on firm-level productivity developments that are otherwise unattainable, it has some caveats. For example, it lacks information on hours worked and excludes information on young firms. Nonetheless while omitting hours worked can bias estimates of the productivity level, the impact on the growth rate is more limited as average hours worked over the period considered at the aggregate level moved much less than employment growth.

Box 1.4. **Availability of Swiss firm-level data**

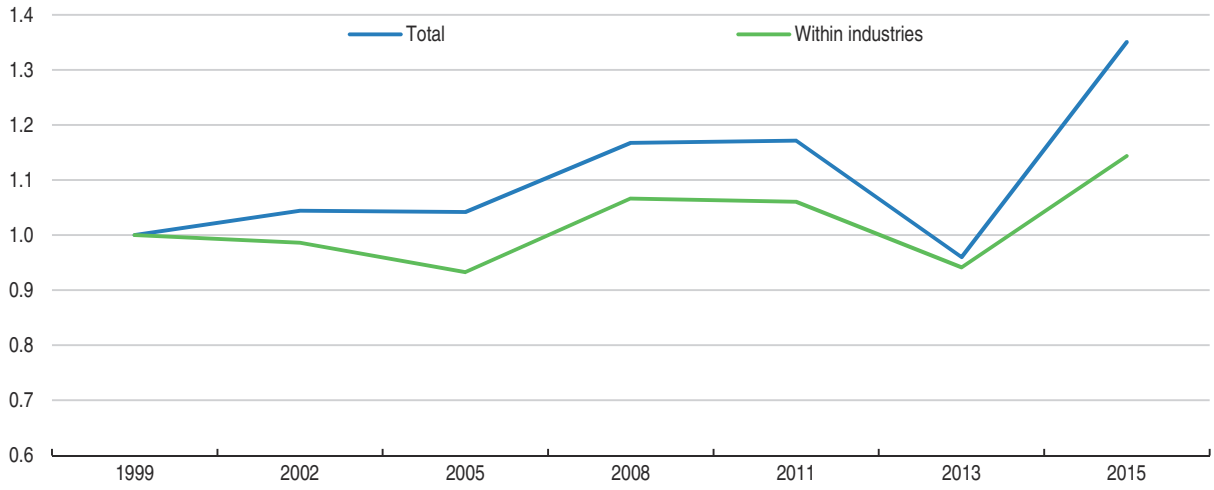
Determining the causes of productivity developments through a firm-level approach has gained importance in recent years. The OECD has developed several statistical projects in that respect to offer more inputs in understanding how different policy frameworks impact on firms, in particular using the *MicroBeRD, Multiprod* and *DynEmp* databases. However, Switzerland is unfortunately absent from these databases: see, for example, Criscuolo et al. (2014). Switzerland is also one of the rare OECD countries that is not fully represented in *Entrepreneurship at a Glance* (OECD, 2016d), preventing a comprehensive comparison with other countries in that dimension. Ecoplan (2016) – a study on creation of new businesses and high-growth firms in Switzerland with some limited comparison with other OECD countries – was welcome in that regard. However, this *ad hoc* exercise could be more easily repeated and expanded if Swiss firm-level data were more available and accessible. The KOF institute in that regard also contributes to fill in some of the gap.

To allow some comparison of Swiss productive growth with cross-country findings from OECD work, this chapter makes use of firm-level data from the Swiss Innovation Survey (SIS), while other OECD studies use the Orbis database (where Switzerland coverage is not satisfactory for many variables) or national statistical agencies' registry. The SIS is maintained by the KOF Economic Institute, which conducts economic research notably through surveys. The SIS is based on a stratified random sample of firms with at least five employees, covering all relevant industries in the Swiss business sector. The analysis uses data for 1999, 2002, 2005, 2008, 2011, 2013 and 2015. Annex 1.A1 further describes the dataset and some caveats that should be borne in mind when using it.

Using a sample of 21 countries, Andrews and Cingano (2014) compute an index of allocative efficiency for 2005 (based again on the difference between a weighted and an unweighted measure of labour productivity) and similarly find that Switzerland, with a value close to zero, is the fifth-worst performer and was not allocating resources to its most productive firms. More broadly, the authors highlight a negative relationship between that index and the amount of policy-induced frictions, in particular regarding employment

Figure 1.8. **Allocation of labour input across firms and labour productivity**

Ratio of weighted to unweighted labour productivity[1], 1999 = 1



1. Unweighted labour productivity is the simple average of labour productivity across firms. Weighted labour productivity is the sum across firms of value added divided by the respective sum of total employment, not adjusted for hours worked. Total refers to the comparison by year between the simple average of all firms' productivity with the weighted measure. Within-industries is the same approach but computed at 2-digit industry level; the difference is then weighted by employment in that sector to have an aggregate measure by year.

Source: KOF, *Swiss Innovation Survey database*; OECD calculations.

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protection legislation, product market regulations and constraints on foreign direct investment. This work highlights the need for Switzerland to pay attention to remaining barriers in the economy (see below) that prevent better resource allocation, which would boost productivity.

Further improving labour utilisation

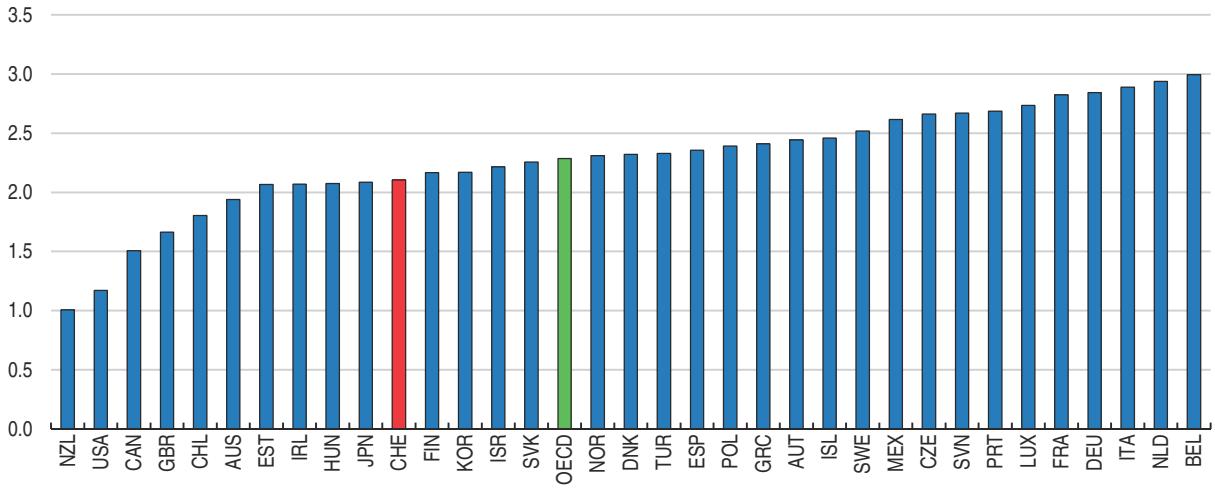
Labour market and skills. The Swiss labour market is quite flexible in comparison with the OECD average, but layoff restrictions remain significantly above those in New Zealand, United States, Canada and the United Kingdom (Figure 1.9). In addition, there has been a recent tendency to add more constraints (like minimum wages in some cases and the obligation to advertise jobs first in local employment centres when unemployment is considered too high). They should be carefully monitored to avoid imposing unnecessary economic costs and weighing on the labour market.

More labour market deregulation is not always followed by an improvement in productivity (Égert, 2016), because there are other factors at play. For example, people may not invest in job-specific skills but rather in general skills to make themselves attractive to future employers. Deregulation may also boost turnover, thereby reducing productivity, because new workers take time to adapt to their new company. Finally, employers may devote less time to screening and training if they can fire more easily. Conversely, more flexibility gives employers more leeway to adjust to changes in market conditions and so would avoid the costs of having labour stuck in poorly performing firms. More flexibility also provides incentives for workers to optimise their efficiency.

Skills mismatch is a common concern in many OECD countries and has been linked with lower productivity performance. Public policies play a large role (Adalet McGowan and Andrews, 2015). The well-functioning Swiss education system succeeds in producing the

Figure 1.9. **Employment protection legislation strictness**

Protection of permanent workers against individual and collective dismissals[1], 2013



1. Indicators of employment protection legislation measure the procedures and costs involved in dismissing individuals or groups of workers and the procedures involved in hiring workers on fixed-term or temporary work agency contracts. Index values range from 0 (least restrictive) to 6 (most restrictive).

Source: OECD, *Employment Protection Legislation database*.

StatLink http://dx.doi.org/10.1787/888933621253

right skills relatively efficiently thanks to strong collaboration with the business sector (see Chapter 2). The country has also resorted to immigration in the past to fill in missing competencies (Swiss Confederation, 2017). However, the recent decline in the number of migrants could potentially increase mismatches, hampering productivity. Those restrictions could also put greater pressure on the Swiss education system to respond to labour market needs. In parallel, there should be constant focus on lifelong learning, skills upgrading and the necessity to avoid leaving any part of the population behind.

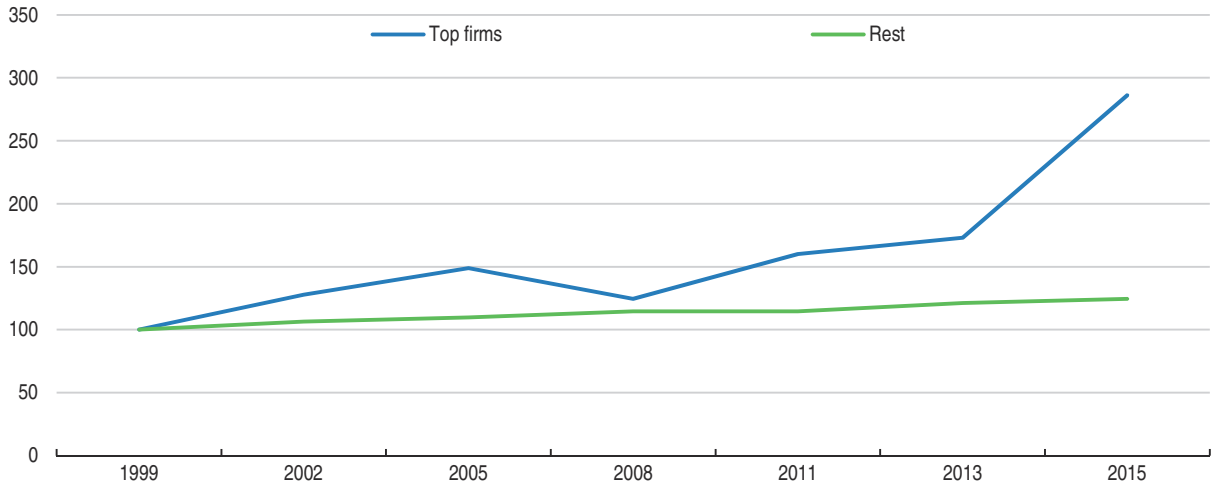
The role of education and skills in boosting both productivity and inclusiveness is widely acknowledged and has been key to understanding both the convergence of certain countries to higher economic standards and the continued growth in productivity in leading economies. In that regard Switzerland is outstanding in many metrics (see Chapter 2), notably thanks to a very effective vocational education and training system. It also has some of the best universities in the world, which places it at the forefront of R&D and innovations. At the firm level higher educational attainment of staff is positively correlated with productivity growth (Annex 1.A1), underlining the importance of a well-functioning education system. This also contributes, together with a very high employment rate, to making Swiss growth go hand in hand with a high degree of inclusiveness.

More inclusiveness and equality can spur productivity. Having several globally top-performing firms means that Switzerland has a favourable position in certain industries where competition is global. However, it may have drawbacks domestically, especially in terms of inclusiveness, because of a lack of spill-overs from the most productive firms to the rest of the economy. Inequality and poverty are relatively low, although there remains scope for improvement (see previous *Survey*). Evidence from OECD countries shows inequality and poverty can also hurt economic growth, notably via their indirect impact on human capital and hence productivity (OECD, 2016a).

Analysis using firm-level data shows that average wages offered by frontier firms have tended to increase more than in the other 95% (Figure 1.10). That is particularly the case for 2015, but the trend would need to be confirmed with the next SIS update. Even between 1999 and 2013, the pace of average annual wage growth of the top 5% of firms was twice that of the others. It suggests that the increasing gap in productivity has also been translated into a commensurate between-firm expansion in the wage gap; in other words, the benefits have been shared with workers. Indeed, as wages in top firms follow global trends in a few industries rather than evolving in line with domestically determined wages, inequality tends to increase. This may harm productivity in the long-term, notably through less widespread human capital investment. A similar trend is observed in other OECD countries showing divergence in wages between firms in the same sector (Berlingieri et al., 2017). The evolution is associated with growing differences between high- and low-productivity firms, which are also confirmed for Switzerland (more below). Travail.Suisse (2017) also points to a growing divergence of wages of top executives from those of other employees over 2011-16 (with growth of 11% and 3.4%, respectively).

Figure 1.10. **Wage differences between leading and other firms**[1]

1999 = 100



1. Wages are proxied by labour costs per employee at the firm level (see Annex 1.A1). Top firms are those 5% with the highest level of labour productivity at the 2-digit industry level for each survey year and may not be similar across surveys. The difference in wages is around 13% in 1999.

Source: KOF, *Swiss Innovation Survey database*; OECD calculations.

StatLink http://dx.doi.org/10.1787/888933621272

Barriers to some groups fully participating in the economy can also weigh on productivity as their potential is not fully utilised. Improving the integration of these groups would better exploit the competences of all, and increase motivation and diversity in the workplace. In Switzerland, two groups particularly need policy attention – women and migrants – even though they both have high employment rates relative to other countries.

As highlighted in OECD (2013), increasing the role of women in the economy could boost Swiss productivity. Switzerland is leading the OECD in women's employment rate but has one of the highest incidences of female part-time work. This is due to the high cost of childcare, low supply of early childhood education, the organisation of the school day, and to disincentives to return to full-time work (a high marginal income tax rate due to

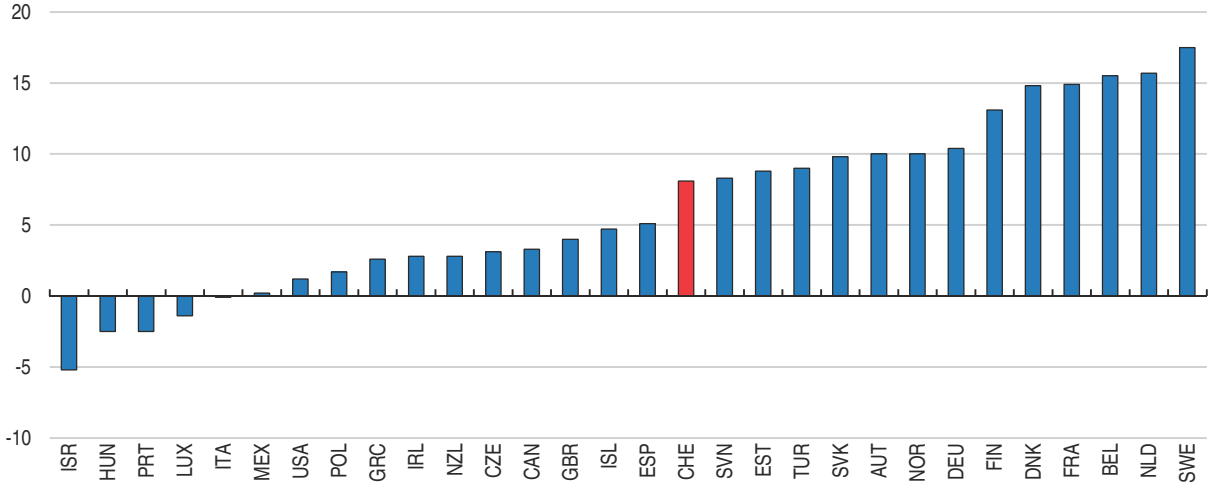
taxation at the family, rather than individual, level and deterrent effects of social benefits for second earners), as well as personal preferences. They are accordingly significantly underrepresented in top positions compared to other OECD countries (Deloitte, 2015).

Establishing a federal statutory parental-leave system (to be divided between parents), as in most European countries, would facilitate mothers' post-maternity reintegration into the labour force (OECD, 2013). It would bring paid-leave entitlements available to mothers closer to the OECD average and may have important positive economic and social spill-overs even if returns to productivity take longer to materialise (Adema et al., 2015). The availability of affordable childcare should also be expanded to help women work extra hours, if desired (OECD, 2015a). An evaluation of childcare is currently underway. The recent implementation of a dedicated five-year fund to expand childcare is welcome. It needs to better match parents' working hours and be concentrated in places of larger tensions between supply and demand. A proposal to increase tax credits for childcare costs is being discussed and could reduce work disincentives for women, especially in high-income households. The government is also planning to eliminate circumstances in which married couples pay more federal income tax than unmarried ones (discouraging work for second earners).

A second under-represented group of workers is immigrants. Switzerland's performance in migrants' integration is good (OECD, 2012a), but greater integration would increase their employment rate and could boost productivity. The Migrant Integration Policy Index ranked Switzerland 21st out of 38 countries in 2014 (Huddleston et al., 2015), especially due to relatively weak anti-discrimination laws. Indeed, migrants suffer longer unemployment periods partly due to discrimination against them (Auer et al., 2016). The employment rate is lower than for natives (Figure 1.11), even though it is one of the highest within the OECD. As proposed in the previous *Survey*, providing more support for immigrants, especially in early childhood education, would prevent them from lagging behind during their whole career (OECD, 2015a). Expanding the supply and uptake of high-quality language training at all ages, adult education, bridging courses, work placements and improved recognition of foreign diplomas (for non-EU/EFTA citizens) would also help them to maximise the use of their skills.

Figure 1.11. **Employment rate differences between native- and foreign-born population**

2015, population aged 25-64, in percentage points



Source: OECD, *Migration Statistics database*.

StatLink http://dx.doi.org/10.1787/888933621291

The 2016 joint pledge by the State Secretariats for Migration and for Education, Research and Innovation, and the Conference of Cantonal Ministers for Education, to have the same objective of 95% of both Swiss and non-Swiss recently arrived youths with at least a secondary diploma is welcome. Offering pre-apprenticeship integration training from 2018 will also provide additional qualifications for migrants in need. The expansion of compulsory early childhood education to two years (starting from the age of 4) in almost all cantons by 2017 is also welcome.

In addition, given that migrants were mainly employed in sectors with insufficient local labour supply (Swiss Confederation, 2017), the recent slowdown in the number of EU migrants could accentuate labour shortages in some sectors (Chapter 2). Recourse to non-EU immigration would be beneficial if it meets labour market needs and should be facilitated. More broadly, policies aiming at reducing inequality and poverty, notably through effective education spending and active labour market measures, will sustain long-term inclusive economic growth as they spur skills development for a whole range of the population (OECD, 2016e).

Facilitating firm entry

Starting a business

Starting a business in Switzerland is not particularly easy: the World Bank's *Doing Business* ranks the country 71st in 2017, down from 66th in 2016 (World Bank, 2017), notably because of the number of procedures and the time required to register a firm. Nevertheless, according to Ecoplan (2016), new firm creation was stable in Switzerland over 2007-13 and was close to the OECD average, thanks to the services sector, while the number of new industrial corporations has remained weak since the crisis. The five-year survival rate is quite high – only Austria, Belgium and Sweden do better – but the exit rate after one year tends to be high. However, there is a question of international comparability, highlighting the benefits of the Federal Statistical Office participating more in OECD data collection on firm characteristics (Box 1.4).

Public infrastructure makes it possible for firms to tap into available skills, technology and capital. It also represents a major element for attracting firms and putting in place conditions for new entry. New public spending tends to boost productivity (even though it can take some time) when the new facility responds to needs and is appropriately financed. Switzerland is rather well endowed with infrastructure according to the World Economic Forum (WEF, 2016) and is even the leader in quality terms.

Firm size and age

While there are no comparable international data on entry rates, the share of small firms in Switzerland also points to difficulties in starting up businesses, given the size of the country. In comparison with other OECD countries, Switzerland has one of the lowest shares of small enterprises (fewer than 20 employees) in manufacturing, services and construction and ranks 6th, 1st and 5th in terms of the share of large enterprises (above 250 employees) in those same sectors, respectively (Figure 1.12).

Firms' size can impact on productivity, but its role is difficult to capture. Small enterprises that are unable to grow coexist with those with high potential to conquer a larger market. Success depends on many characteristics, including the capacity to develop disruptive innovations, entrepreneurship and managerial capabilities, and agility to respond to customers' needs. The process, also dependent on effective competition, is

Figure 1.12. **Share of small enterprises by main sector**

In percentage of total number of firms, 2014 or latest available year[1]

1. Small firms are those with 20 employees or fewer. Definitions vary slightly across countries. For Canada, Switzerland, the United States and Russia, data do not include non-employers. UK data exclude about 2.6 million unregistered small businesses.

Source: OECD, *Structural and Demographic Business Statistics database*.

StatLink http://dx.doi.org/10.1787/888933621310

highly valuable for the economy in order to avoid a rigid structure and be productive. Conversely, large firms can reap economies of scale, attract the best talent and afford to invest in a wide variety of innovations. Overall, firm-level evidence suggests that small enterprises tend to have lower productivity growth than medium-sized companies, suggesting that non-high-growth small firms outnumber more dynamic ones (Annex 1.A1). Finally, large firms have higher productivity growth notably because they are more innovative (see below). Furthermore, they usually have management practices that involve a better allocation of workforce to required tasks, boosting their productivity (OECD, 2016f).

Small firms usually receive a lot of policy attention across OECD countries, as they are responsible for a large share of new and existing jobs. But more than their size, firms' age matters more for job creation, because young (usually small) businesses can have huge productivity increases and should then receive more public policy attention (Criscuolo et al., 2014). Baldegger et al. (2015) reports that more than 50% of all Swiss firms that exit report bureaucracy as the main cause, far more than for other similar countries, even though the exit rate is the lowest across 16 OECD innovation-driven economies. Compliance with regulations has a fixed-cost element, which affects small firms disproportionately. The stock of regulations should be reviewed, focusing on those that are most costly for young firms. Enhancing transparency and developing e-government could lower the cost of accessing information and complying with regulations, and enable the government to adapt more quickly to ongoing disruptions.

Streamlining direct support to firms across the different levels of government is important. Depending on the canton, there exist up to 87 different programmes of public financing for firms (Federal Council, 2017). On top of inherent difficulties to create a start-up, there is a potential need for one-stop shops at the cantonal level to concentrate efforts towards start-ups, notably in terms of financing. SERI (2016) also listed 126 services providers that encourage innovation (93 at cantonal, 14 at regional and 19 at national levels), which often fail to co-ordinate. The envisaged implementation of a virtual one-stop shop at the federal level is also crucial for all activities that are not dependent on cantons (like registration) and for agreed common procedures across them.

The number of high-growth small firms in Switzerland is above average according to a recent government report (Federal Council, 2017). There are about seven recent start-up firms per 100 000 inhabitants, more than in Israel (six) and the United States (five), which are usually top-ranked in that domain. This top position results mostly from a high survival rate, rather than from a larger number of creations. Indeed, the low unemployment rate, together with cultural preferences, reduces incentives for entrepreneurship and puts the number of new firms below the international average. Only 40% of Swiss inhabitants view entrepreneurship as a good career choice, compared to about 56% on average in 16 OECD innovation-driven economies (Baldegger et al., 2015). Developing competency in leadership, creativity and innovation at school could have a leverage effect (Lackéus, 2015). That would help spur entrepreneurship, notably for the 18-24 age category, for which Switzerland stands 18th out of 22 countries (measured by the number of entrepreneurs as a share of the population in the age group).

An important complement to boosting start-up rates is to ensure relatively small firms are able to scale up. As mentioned earlier, e-government should be enhanced to reduce administrative burden and information costs, and some government regulations (economy-wide or sector-specific) could prevent firms' growth and should be reviewed.

When start-ups benefited from government support, there could be also some follow-up programmes that would monitor those firms in order to measure their success. In the end, the government should continue its support to those firms that will be able to scale up as they vastly contribute to overall employment growth (Criscuolo et al., 2014). A report for the United Kingdom states that only 6% of high-growth firms have contributed to half of employment growth over 2002-08 (NESTA, 2009). More broadly, successful companies could be used more as role models.

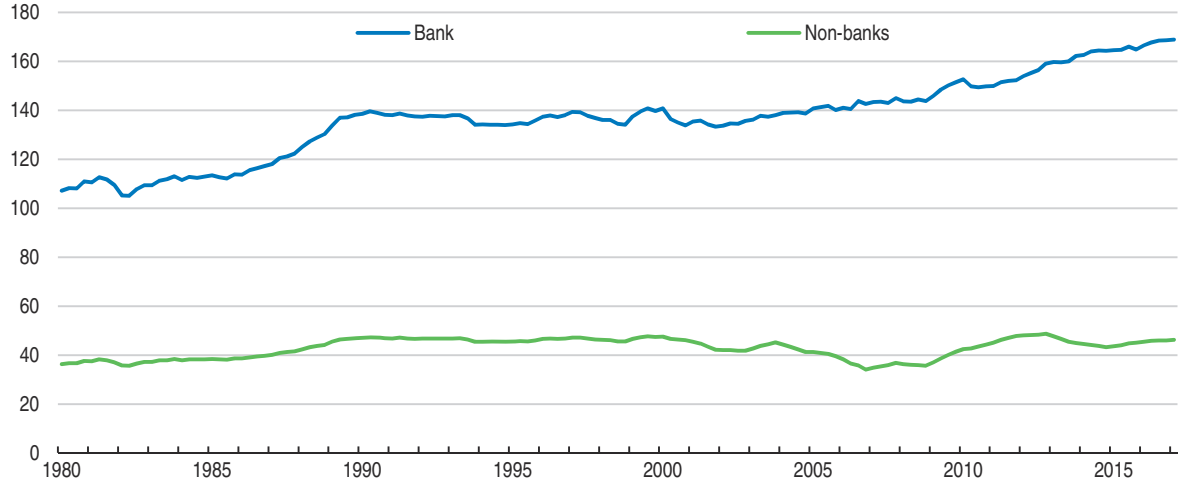
Finance

Switzerland has a unique and well-developed finance industry. This should be an advantage in adequately funding the right projects and accompanying the disappearance of unviable enterprises. It is also important to fund innovation. That depends notably on solid bank capital and appropriate regulations. On top of the direct contribution of the financial sector to the economy (which has decreased in the wake of the global recession), the positive link between finance and productivity is fairly widely agreed, at least up to a certain limit (Heil, 2017). But financial frictions can limit the positive relationship and impede access to capital for investors: they can be market-wide, peculiar to a particular provider of funds or originate with the borrowing firm. In addition, the financial sector can ease the process of digitalisation, though Swiss firms point to a lack of financial means as an important hampering factor, especially for small firms (Arvanitis et al., 2017a).

In Switzerland credit from non-banks to the private sector has lost ground to other forms since the turn of the century (Figure 1.13). It should be developed more, along with private equity markets, as it offers more options for firms to get adequate project funding, because it circumvents some potential financial frictions and increases competition. In particular, smaller and younger firms tend to be confronted with higher interest rates, as well as credit rationing. Offering them new opportunities is crucial to stimulate innovative entrepreneurship and is particularly relevant for young and innovative companies with no track records and untested business models. The deeper are markets for seed and early-stage venture capital the greater the productivity and size of frontier firms (Andrews

Figure 1.13. **Importance of bank and non-bank financing**

Private non-financial sector, total credit, in percentage of GDP



Source: BIS, *Credit to Non-Financial Sector database*.

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et al., 2015). The extent of policy support for such markets is also positively associated with more technological diffusion and a reduction in the productivity gap. While venture capital is rather developed in Switzerland compared to the rest of Europe (but not by Israeli and US standards), alternative online finance is not (Zhang et al., 2016). That suggests reviewing associated regulations including regarding peer-to-peer lending and equity-based crowdfunding. Recent developments in fintech industries and crowdfunding (OECD, 2017d) and a proposed law to supervise them are all positive steps.

Overall, evidence from a sample of 20 European countries (unfortunately excluding Switzerland) shows that strong credit expansions tend to slow economic growth, while more reliance on stock markets seems to boost productivity (Cournède and Denk, 2015). Moreover, both are correlated with a less equal distribution of household disposable income (Denk and Cournède, 2015). The financial sector also tends to offer substantial wage premiums, estimated to be 25% of average earnings and up to 40% for top-paid workers (Denk, 2015a) and is overrepresented among the top 1% of all earners (Denk, 2015b). Those rents are likely to reduce overall measured productivity (if their wages exceed their productivity) and increase inequality. Ongoing reforms to too-big-to-fail guarantees and monitoring should help.

Removing barriers to exit and to firm restructuring

Having an efficient process for exit of the weakest firms is desirable, as it will free resources for more productive companies. Using cross-country analysis Adalet McGowan et al. (2017a) demonstrate that the share of "zombie" enterprises (firms that survive despite financial weaknesses and would typically exit or be forced to restructure in a competitive market) rose since the mid-2000s in nine OECD countries and that their existence constrains the growth of other firms, thereby limiting optimal capital reallocation. The recent low level of interest rates could have helped to sustain the weakest firms by cutting their debt repayments. Banks can also help those weak firms to survive to avoid facing the immediate cost of dismantling them and simultaneously fail to provide funds for new ones: see, for instance, Caballero et al. (2008) for a discussion of Japan's situation in the 1990s. It also creates additional barriers for newcomers in those affected industries.

Framework conditions for the insolvency regime are slightly better than the OECD average (Table 1.1). Regulations were upgraded in 2014 to offer firms easier access to insolvency proceedings and tools to redress financial difficulties. But the changes seem to have been partly ineffective, possibly due to delays in adopting the new system and to a tendency to wait before a recourse to an insolvency proceeding. Lowering the cost of failure can also boost start-up rates (Peng et al., 2010). In Switzerland the lack of an effective discharge proceeding from personal bankruptcy considerably limits the ability of individual and personally liable entrepreneurs to obtain a "second chance". The regime would be improved by introducing an effective discharge proceeding for personal bankruptcy that reduces the period during which individuals are required to repay past debt from future earnings to three years, in line with international trends, and increasing the use of early warning mechanisms for all firms (Adalet McGowan et al., 2017b). Indeed, Switzerland is poorly ranked (30th amongst OECD countries) on the efficiency of its insolvency regime according to the Doing Business indicator (World Bank, 2017) due to the low recovery rate, and the time and cost of resolving insolvency. Creditors continue to face significant upfront costs in initiating proceedings, adding to delays. A welcome amendment is currently being discussed in parliament: it would propose additional options for restructuring distressed companies, including creating incentives to take actions at an early stage and avoid insolvency.

Table 1.1. **Comparison of the regime for resolving insolvency**

	Recovery rate (cents in the dollar)	Time (years)	Cost (% of estate)	OECD indicator of insolvency regimes[1]	Of which:	
					Time to discharge	Early warning mechanisms
Switzerland	46.6	3.0	4.5	0.32	1.0	1.0
OECD high-income countries	73.0	1.7	9.1	0.41	0.6	0.6

1. Composite indicator based on a survey with 13 indicators and takes values between 0 and 1. A lower value means a more efficient regime.

Source: World Bank, *Doing Business 2017 database;* M. Adalet McGowan, D. Andrews and V. Millot (2017), "Insolvency Regimes, Zombie Firms and Capital Reallocation", *OECD Economics Department Working Papers*, No. 1399, OECD Publishing, Paris.

Easing the exit process of the weakest firms facilitates creative destruction and capital reallocation. However, the cost to workers can be significant due to insufficient skills adaptation, geographical displacement and earnings losses. And the impact is greater for low-income workers. Under certain conditions, higher spending on active labour market policies can help mitigate those negative effects (Andrews and Saia, 2017). In addition, reducing the number of near-insolvent enterprises overall increases employment growth (Adalet McGowan et al., 2017a) and could limit skills mismatch (Adalet McGowan and Andrews, 2015).

Continuing to seek the benefits from international trade openness

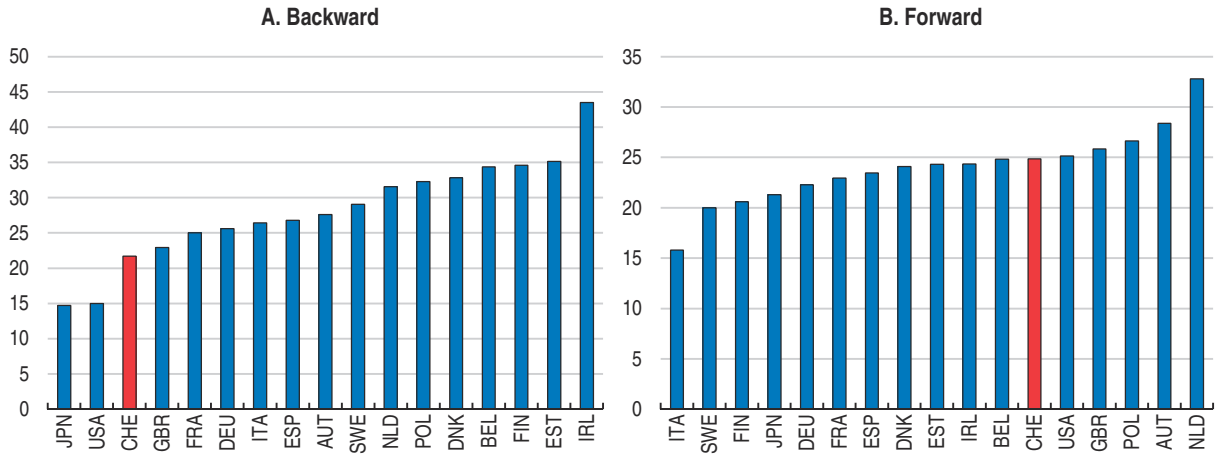
International trade has long been viewed as beneficial to global productivity (Hufbauer and Lu, 2016), as countries specialise in production for which they have a comparative advantage and thus exploit available economies of scale. In addition, flows of goods and services are accompanied by exchanges of technologies and knowledge spill-overs. Finally, trade raises productivity because of increased competition, which favours creative destruction at a global level. That points to the advantages of continuing to liberalise trade world wide. For example, Ahn et al. (2016) estimate that for advanced economies the implied productivity gains from eliminating remaining tariffs are about 1%, excluding additional benefits from removing non-tariff barriers.

Compared to other OECD countries, Switzerland is relatively well positioned in terms of forward participation in global value chains (GVCs) but is not as highly ranked regarding backward participation, indicating potential net value-added gains from linking more extensively into GVCs (Figure 1.14). Forward linkages (local inputs into foreign exports) have improved over the last decade, but that may be related to the increasing importance of pharmaceuticals (an industry that uses GVCs quite extensively), which surged from 5% of total goods exports in 1990 to more than 20% in 2016. Backward linkages (foreign inputs into local exports) could be promoted, especially given Switzerland's location next to the largest members of the European Union. Together with the associated foreign direct investment, this would facilitate knowledge diffusion and accelerate the reallocation of domestic resources towards the most productive firms. Greater GVC linkages, on top of direct trade channels, would encourage the diffusion of productivity improvements to the rest of the economy, because impacted firms operate in the domestic economy too. More generally, countries that have increased their participation in GVCs the most have also experienced the largest increases in productivity (OECD, 2017e).

Given likely spill-overs to productivity, Switzerland should pursue ongoing trade liberalisation negotiations through the European Free Trade Association, notably with Asia

Figure 1.14. **Backward and forward participation in global value chains**[1]

In per cent, 2011



1. The backward participation index is defined as the percentage share of foreign value added in a country's gross exports. Forward participation is defined as the share of domestic value added embodied in foreign countries' exports. For comparability and readability reasons, the comparison is restricted to selected OECD members.

Source: OECD-WTO, *Trade in Value Added database*.

StatLink http://dx.doi.org/10.1787/888933621348

(India, Indonesia, Malaysia and Vietnam in particular) and MERCOSUR. That will boost GVCs whose development can suffer heavily from even low rates of duty.

The role of multinational enterprises is usually associated with productivity improvements through within-firm optimisation. Alfaro and Chen (2012) compared such gains with those from increased inter-firm competition and implied factor reallocation, as multinationals can crowd out the weakest domestic companies. The authors conclude that the second mechanism accounts for the majority of aggregate productivity gains. That suggests that in Switzerland opening more markets to international competition and corporations would be especially beneficial.

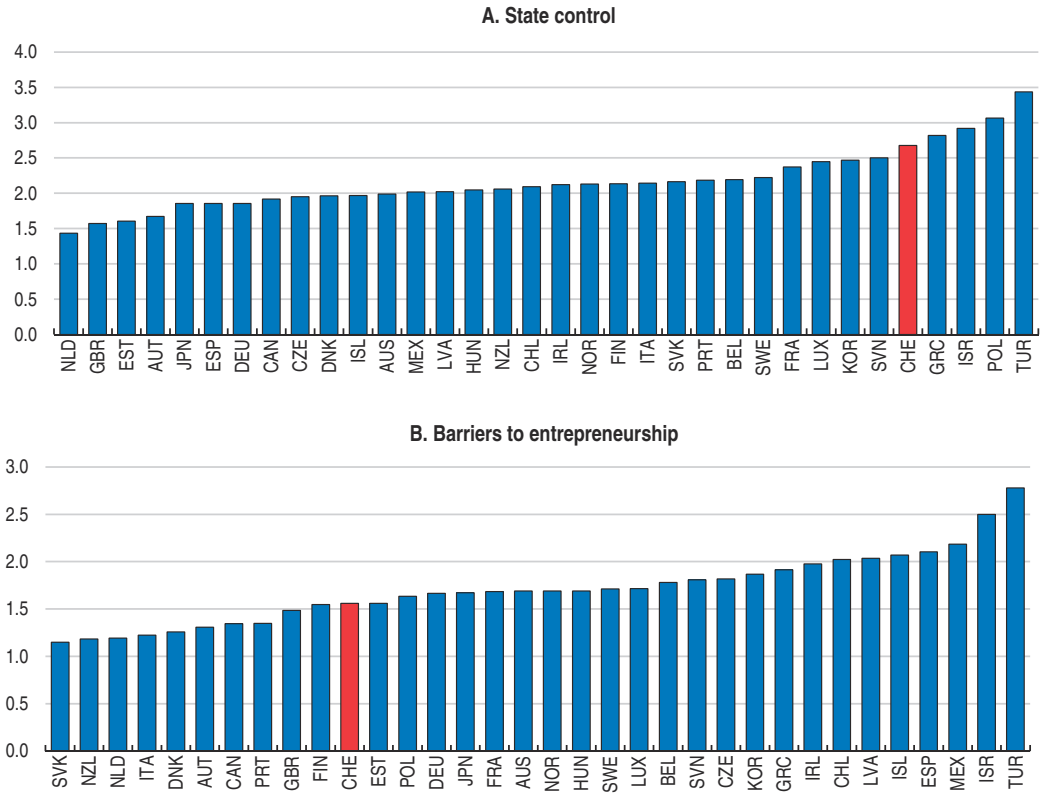
Improving the framework conditions for business development

Competition

The regulatory environment has a substantial role in driving productivity gains, as it can grease or seize up the mechanisms at play. In particular, less stringent product market regulations (PMRs) tend to raise aggregate productivity (Bouis and Duval, 2011; Égert, 2016), which makes it crucial to reduce their burden. And they do not consistently alter income equality (Causa et al., 2016). While barriers to entrepreneurship in Switzerland are slightly lower than the OECD average, the grip of the state on business enterprises is quite firm (Figure 1.15). There seem to be many restrictions in the energy sector (Figure 1.16) – related mostly to electricity but also to gas. Telecommunications regulations are also stringent. In addition, the governance of regulators in network industries (gas, electricity, telecom, rail transport and airports), in terms of independence, accountability and scope of action, is slightly worse than the OECD average (Koske et al., 2016).

Firm-level information provides more details on the impact of competition on productivity. Two indicators were used to measure the influence of competitive pressures (Annex 1.A1). First, price versus non-price competition was assessed against productivity using the SIS database. While this should be interpreted cautiously given endogeneity

Figure 1.15. **PMRs in international comparison, 2013**[1]

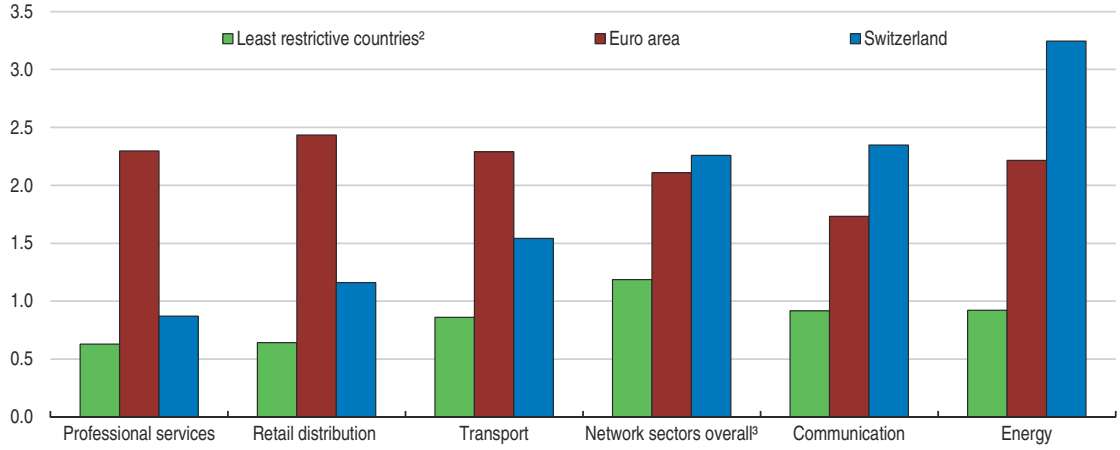


1. The Product Market Regulation (PMR) indicator is a composite index that encompasses a set of indicators that measure the degree to which policies promote or inhibit competition in areas of the product market where competition is viable. Scores range from 0 to 6 and increase with restrictiveness.

Source: OECD, *Product Market Regulation database*.

StatLink http://dx.doi.org/10.1787/888933621367

Figure 1.16. **International comparison of PMRs by sector, 2013**[1]



1. The Product Market Regulation (PMR) indicator is a composite index that encompasses a set of indicators that measure the degree to which policies promote or inhibit competition in areas of the product market where competition is viable. Scores range from 0 to 6 and increase with restrictiveness.
2. Least restrictive countries are the 3-top countries' average by sector.
3. Network sectors overall is the unweighted average of communication, transport and energy.

Source: OECD, *Product Market Regulation database*.

StatLink http://dx.doi.org/10.1787/888933620892

issues, the results point to a significant relationship with both types of competition but with a different sign. Price competition seems to weigh on productivity, probably through lower profitability and room for investment; however, the effect may differ with more lags; to some extent, the least productive firms can also be discouraged from catching up when competition is fierce.

This is consistent with some findings linking negatively firm productivity with local competition (Bellone et al., 2016). A robustness check also points at some sectoral difference: for instance when excluding water and energy production together with some part of manufacturing industries, the negative impact is not significant anymore (Annex 1.A1). The indicator of non-price competition, however, affects productivity positively, likely because of incentives to innovate so as to differentiate the product.

A second indicator of competition was also tested, suggesting a negative relationship between the number of competitors and productivity growth. Interpretation is complicated because, as for the price competition indicator, firm-level price reactions are not known and new entrants that gain market share are not included in the database.

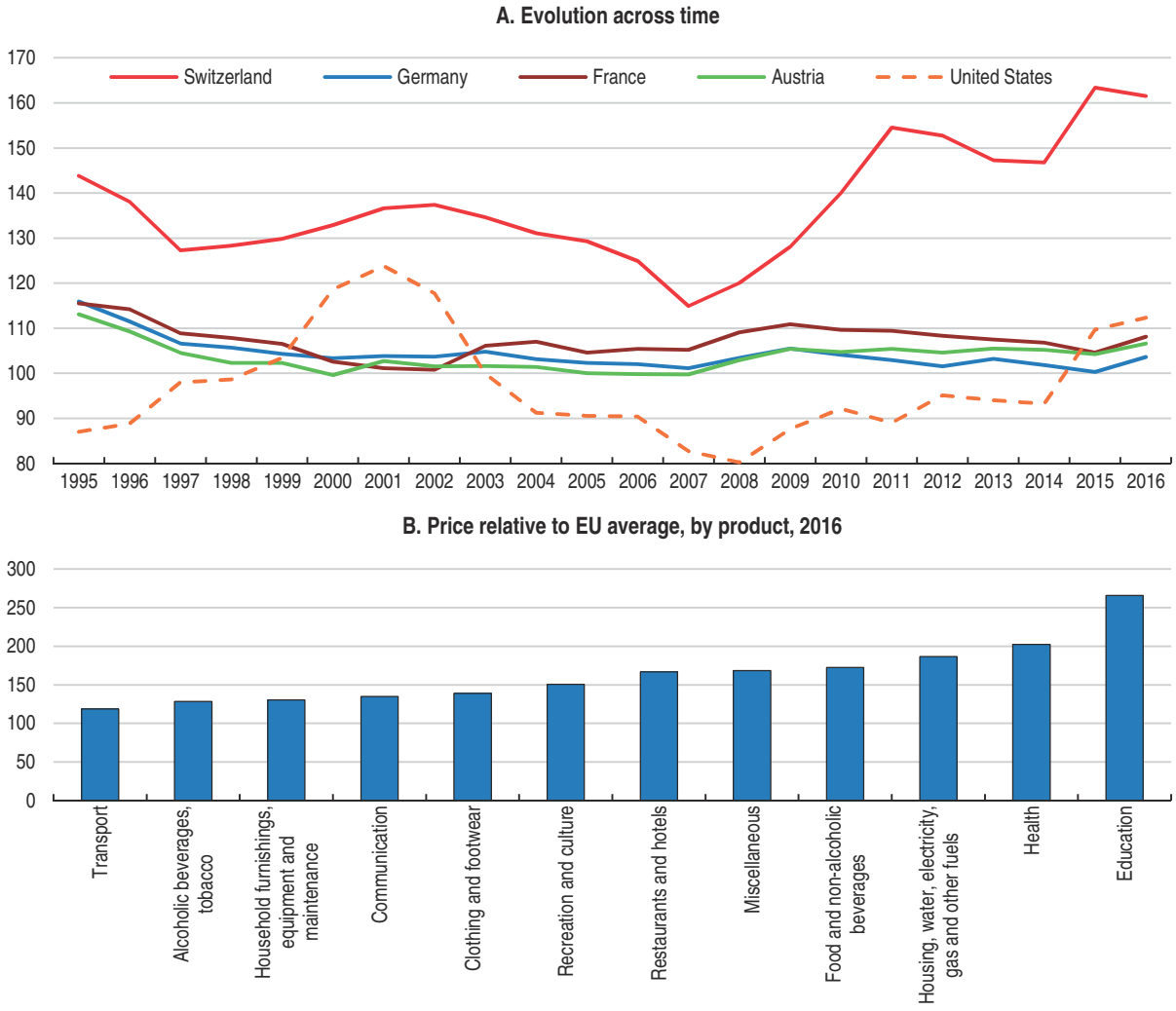
The Swiss price level is above that in other similar countries. Part of the premium may be driven by weak competition. Not only is the premium not fully explained by higher GDP per capita (OECD, 2006), but the differences in household expenditure have also increased dramatically in recent years (Figure 1.17, Panel A). The 2015 currency appreciation has apparently not been transmitted into lower consumer prices. Food and communication, highlighted for being less competitive, have some of the largest differences (Panel B). In addition, over 2007-16, communication prices have outpaced those in the EU by more than 60%. Regarding gross fixed capital formation, prices are relatively close to the EU average for machinery and equipment, and especially software, suggesting robust competition is at play.

Overall, the government should pursue more liberalisation, especially in certain sectors where competition is weak, notably in network industries. Strengthening competition will boost productivity and have positive spill-overs to consumers. Indeed, some of those network industries have been clearly dragging down productivity over the recent past (see above).

Other factors serve to intensify competition like promoting and facilitating COMCO's work. Its co-operation with EU institutions should be further developed, notably to ease dealing with the many multinationals operating in both the European Union and Switzerland. Mergers and acquisitions need close scrutiny because of their competition-inhibiting effects, but the Swiss regime is considered more permissive (OECD, 2006). Indeed, in 2015-16 only 3 of 51 merger notifications were investigated after preliminary examination (COMCO, 2017b). All in all, greater market power potentially leads to larger economic rents, helping those firms to block new entry through their credible threat to resort to their deep pockets. To that end, on 22 June 2016 the Federal Council decided to revise merger control before the end of 2017. In particular, harmonisation with the European Union's merger control system would be beneficial, including adopting the SIEC test ("significant impediment of effective competition"), which focuses on the subsequent changes to competition in a market following a merger rather than on acquiring an excessive level of market power (Röller and De La Mano, 2006). Additionally, characteristics such as a part-time board and a large proportion of whom representing special interests raise some controversy regarding the weakness of COMCO's governance and pose concerns regarding their independence (OECD, 2006).

Figure 1.17. **Price level comparison for household final consumption expenditure**

EU28 level = 100



Source: Eurostat, *Purchasing Power Parities*.

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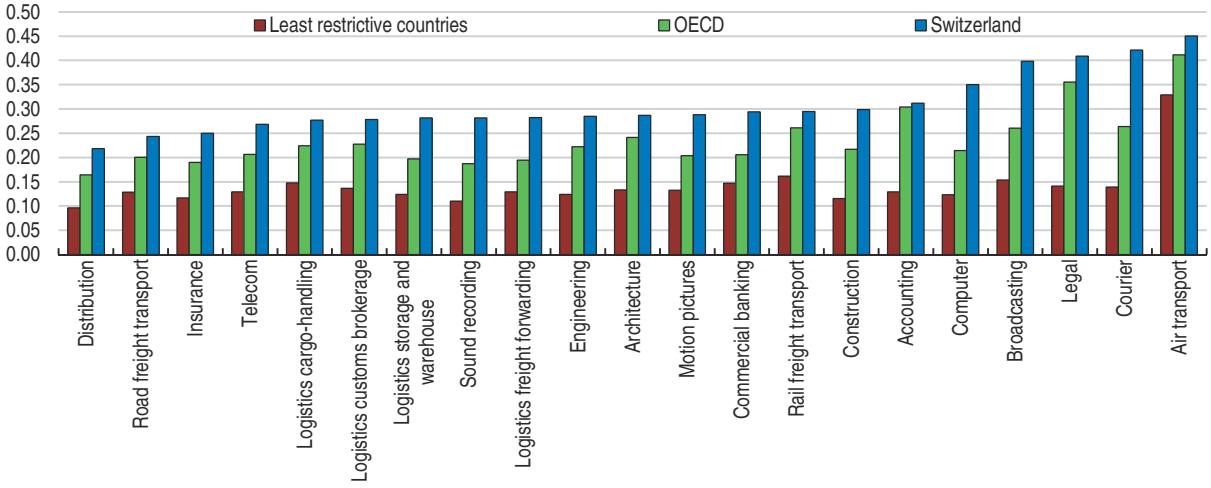
Competitive neutrality is crucial especially given the extent of public ownership in Switzerland (both at the federal and sub-national levels). A level playing field with respect to regulation should be ensured to avoid different treatment of state-owned and private companies (OECD, 2012b). For example, Swiss Post is able to use night truck drivers while this is forbidden for other companies. Likewise, stores operating in facilities owned by Swiss federal railways are advantaged by having longer opening hours than other stores. Commercial activities operated by a public entity should be incorporated to avoid conflicts of interest, abuse of dominant position and more generally policies harming competition. As recommended in the last *Survey*, public ownership should decrease, notably in the telecommunications and energy sectors, including via the privatisation of Swisscom. Indeed because of a 51% stake in the company, Swisscom benefits from an implicit State guarantee lowering its costs: for example, Moody's ratings agency treats Swisscom as a government-related issuer resulting in two-notch uplift in rating (Moody's, 2016). A recent proposal to set the framework for future privatisation of Swisscom was, however, recently rejected by the Parliament.

Foreign trade and investment

Having an efficient services sector is crucial, because services are such a dominant sector in all OECD countries for both households and business users. Services are important as direct exports and also as intermediate inputs for goods exporters. In each and every component of the OECD Services Trade Restrictiveness Index (STRI), which summarises related regulatory constraints, Switzerland runs behind the OECD average (Figure 1.18). The STRI contains factual information on laws and regulations in five areas: restrictions on foreign entry; restrictions on the movement of people; other discriminatory measures; barriers to competition; and regulatory transparency. This indicator has been found to be negatively and significantly correlated with exports and imports of services and also weighs on trade in manufactured goods (Nordås & Rouzet, 2015). GVC involvement is particularly sensitive to the quality and efficiency of services (OECD, WTO and World Bank, 2014). Policies should concentrate on liberalising computer services (focusing on restrictions on movement of people such as limitations on duration of stay for services suppliers), broadcasting and courier services (limitations on foreign entry such as equity restrictions), which are the sectors for which the difference from the OECD average is greatest. Telecommunications also suffer from relatively important barriers to competition.

Figure 1.18. **Services trade restrictiveness index[1], 2016**



1. Higher values mean heavier restrictions. Least restrictive countries are the five countries with the lowest score in each sector.
Source: OECD, *Services Trade Restrictiveness Index database.*

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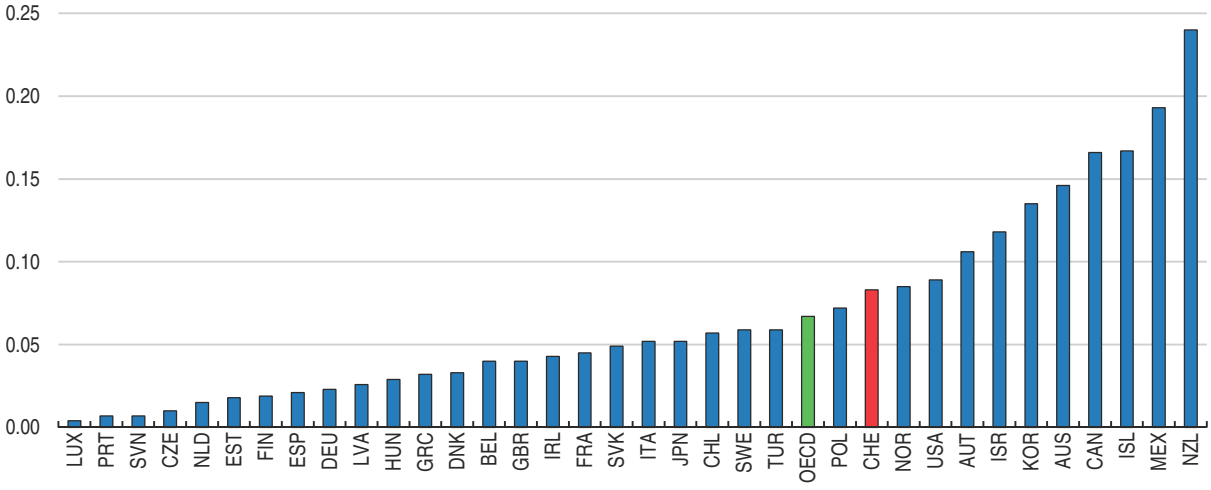
More broadly, there is evidence that services trade restrictiveness is associated with weak competition in Switzerland. Rouzet and Spinelli (2016) found that heavier restrictions enable firms to charge higher mark-ups in a majority of services sectors. The authors suggest that there is scope for improving competition from trade liberalisation, especially in broadcasting (where Swiss regulation is particularly restrictive), construction, storage, and air and maritime transport.

Restrictions in goods trade also remain significant in some areas, both in terms of tariffs and non-tariff barriers. In particular parallel imports can be hindered by custom formalities (including difficulties in delivering the requisite certificates of origin), technical barriers to trade, and exceptions (notably to the "Cassis de Dijon" rule which allows a product to be

traded in Switzerland as long as it complies with rules of the EU or the EEA) which limit domestic competition and contribute to Switzerland's comparatively high prices (Federal Council, 2016a). The *Doing Business* indicators emphasise that the cost of exporting and importing is systematically much higher than for other OECD high-income countries (World Bank, 2017). Some sectors are particularly affected by tariffs, notably food, where the weighted average effective tariff rate was 27% in 2015. The overall weighted average on all products is much smaller (1.3%); however, even small duties can affect trade volume as they imply formalities and administrative costs. Export and import subsidies also distort trade (Jarrett and Moeser, 2013).

Similarly, but to a lesser extent, Switzerland imposes constraints on inward foreign direct investments (FDI) (Figure 1.19), especially regarding electricity and the media, more so than on average in the OECD and much more than best practice. Constraints are mainly through equity restrictions, whereas other aspects are fairly unrestricted. Reducing the burden of regulation where possible, particularly in energy and telecommunications, would have a large payoff in terms of productivity developments.

Figure 1.19. **FDI Regulatory Restrictiveness Index[1], 2016**



1. The FDI Regulatory Restrictiveness Index measures statutory restrictions on foreign direct investment by looking at the four main types of restrictions on FDI: 1) Foreign equity limitations; 2) Discriminatory screening or approval mechanisms; 3) Restrictions on the employment of foreigners as key personnel; and 4) Other operational restrictions, e.g. on branching and on capital repatriation or on land ownership by foreign-owned enterprises.

Source: OECD, *FDI Regulatory Restrictiveness Index database*.

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The importance of the performance of highly-productive Swiss firms for driving aggregate productivity

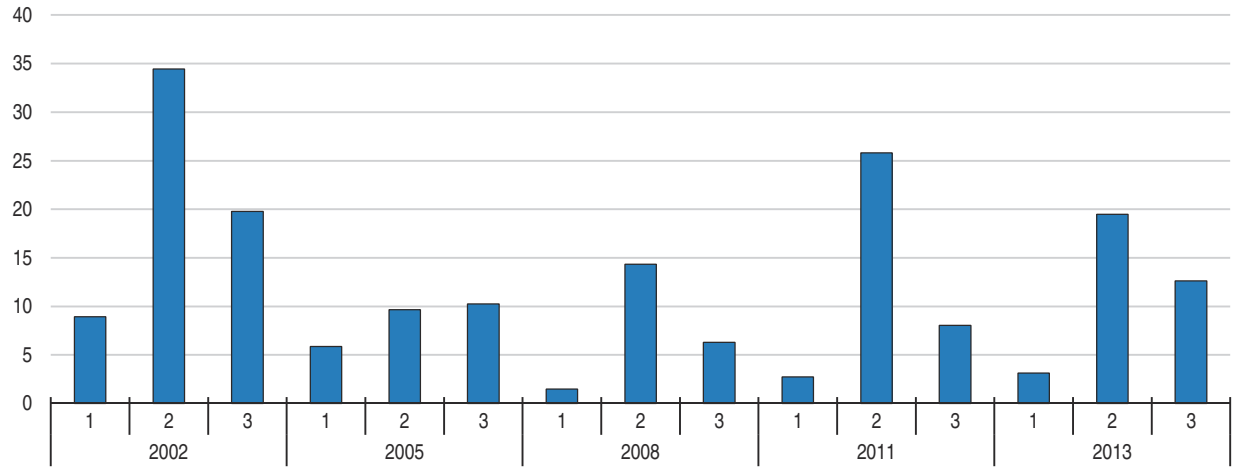
International comparison

Recent research has noted that over the last decade, across many OECD countries, a productivity divergence has opened up between frontier firms (the most productive) and others (Andrews et al., 2016). The global slowdown in productivity growth is then associated with a divergence of those leaders from others that may have been incapable of reaping the benefits of ongoing innovation waves. Switzerland is absent from this comparison due to missing micro-data in the Orbis database.

Resorting to a specific Swiss database from the KOF research institute allowed a comparison with the global productivity frontier – in terms of labour productivity levels – as determined by Andrews et al. (2016) using the top 5% of firms within each industry and year (Annex 1.A1). There seems to have been a trend decline in the number of Swiss firms among the global leaders before the global crisis and a rebound after (Figure 1.20). While productivity levels are highest in the manufacturing industry, only 3% of Swiss manufacturers belonged to the global frontier group in 2013. In construction and services, however, well over 10% of Swiss firms are among the top 5% of global firms.

Figure 1.20. **Share of Swiss firms that are highly productive**[1]

In per cent of total number of firms by sector



1. Share of Swiss firms with labour productivity level above the global productivity frontier estimated in Andrews et al. (2016). Labour productivity is defined as value added per employee converted in PPPs (using sectoral PPPs) and is not adjusted for average hours worked per employee. 1 refers to manufacturing, 2 to construction and 3 to services. The comparison is made between the global labour productivity frontier (as in Andrews et al. 2016) and Swiss firms' real labour productivity (see Annex 1.A1 for details).

Source: D. Andrews, C. Criscuolo and P. Gal (2016) "The Best versus the Rest: The Global Productivity Slowdown, Divergence across Firms and the Role of Public Policy", *OECD Productivity Working Papers*, No. 5; KOF, *Swiss Innovation Survey database*; OECD calculations.

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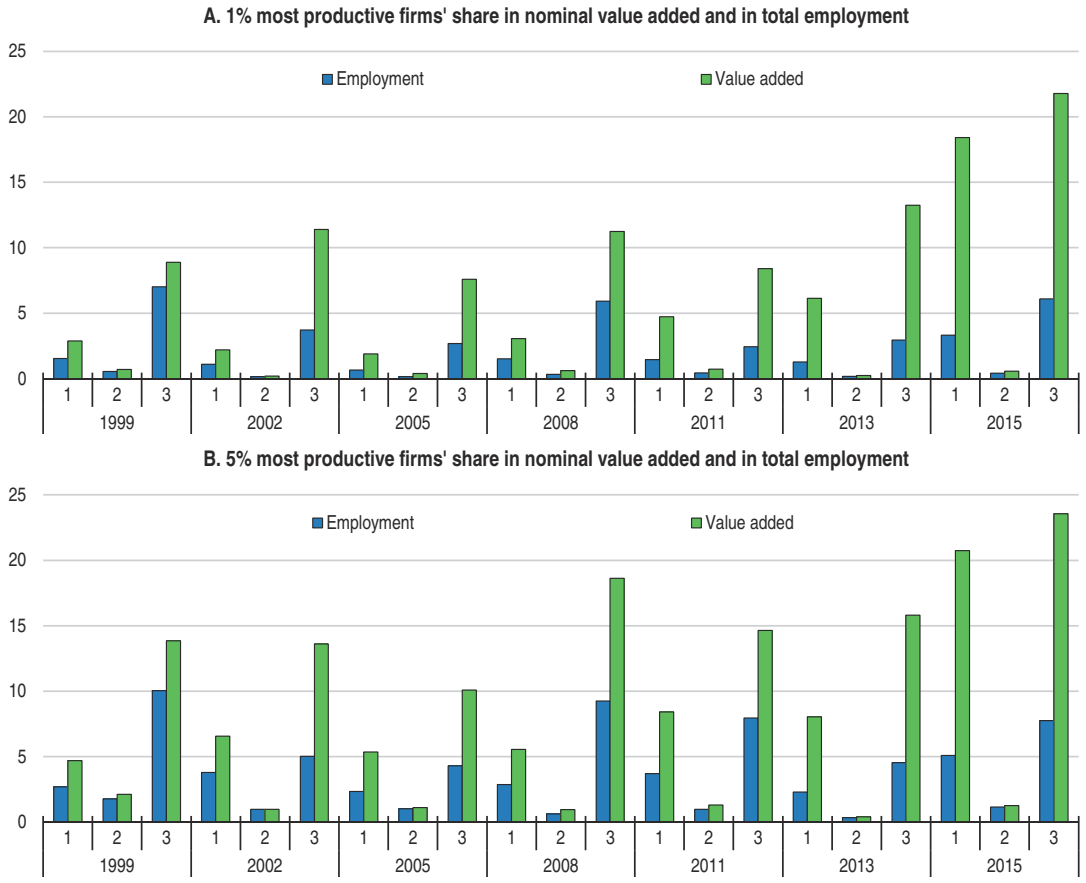
National perspective

Evaluating the performance of the Swiss frontier firms against the rest sheds light on the drivers of Swiss productivity developments. Over 1999-2015, their share in sectoral value added has been rising, especially in recent years (Figure 1.21). While the construction sector is not especially concentrated around a few prominent firms, the top firms in services account for a significant and growing share of value added. In manufacturing, frontier-firm concentration has also been rising in the most recent period.

As there has been no commensurate rise in employment in frontier firms, productivity in services and manufacturing has soared. Indeed, even though the most productive firms were more impacted by the crisis, the pre-existing gap with the rest of the economy has widened in recent years (Figure 1.22). The firm-level data reveal that a majority of the top performers are large, export-oriented and innovative, which is consistent with their good performance.

The increasing gap between leading and lagging firms can result from: i) a decline in diffusion of technology and knowledge away from frontier firms; ii) poorly performing firms hanging on rather than exiting, thereby trapping resources in unproductive activities;

Figure 1.21. **Importance of the most productive firms**[1]



1. 1 refers to manufacturing, 2 to construction and 3 to services.

Source: KOF, *Swiss Innovation Survey database*; OECD calculations.

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Figure 1.22. **Labour productivity of the most productive firms versus the rest**[1]

Labour productivity per employee, 2002 = 100

1. Labour productivity is defined as value added per employee, not adjusted for average hours worked. Top firms are the best firms in terms of the level of labour productivity at the 2-digit industry level. Rest is the 95% remaining firms. In 2002 top 1% firms were nearly 3 times more productive than the rest. The sample of the 1% and 5% most productive firms is recalculated each survey year at the 2-digit industry level.

Source: KOF, *Swiss Innovation Survey database*; OECD calculations.

StatLink http://dx.doi.org/10.1787/888933621481

iii) increasing concentration of high-skilled workers in frontier firms; and iv) growing market power of, and rent-seeking by, frontier firms (OECD, 2015b). Recent evidence from other OECD countries highlights the role of competitive pressures in containing the divergence in productivity, which would suggest the importance of the fourth driver of the divergence (Andrews et al., 2016).

Before the crisis there was apparently a convergence process, with non-frontier firms' productivity catching up with the most productive firms. However, after the crisis, a divergence appeared. The two periods seem to point to two different drivers of the overall productivity slowdown in recent Swiss history. Pre-crisis, productivity growth of all firms was moderate but even more so for frontier firms, while post-crisis productivity growth of frontier firms accelerated compared to the rest of the economy, but not enough to pull up the aggregate outcome. Indeed, that period coincides with frontier firms becoming increasingly productive in international comparison. One reason for that success lies in the importance of R&D for productivity growth and the concentration of R&D in fewer firms (see below). But it remains unclear why R&D has been recently more concentrated. There are probably other factors at play, including a differential impact of the exchange rate appreciation (penalising exporters selling products with higher price elasticities), different market perspectives (some firms operating globally, while others are more dependent on European or Swiss markets, which have been lacklustre in recent years) and potential divergent credit conditions (as banks have been keener to lend to already profitable firms since the crisis).

Improving the link from R&D to output

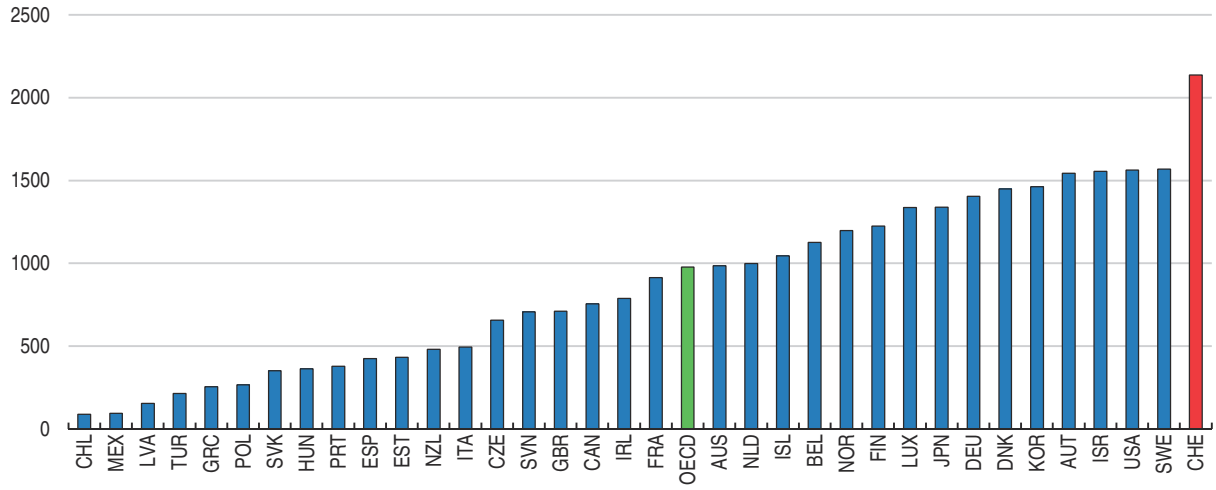
The role of technological advances in driving productivity and growth is clear, but a debate has emerged about the current global pace of innovation. On one side, authors such as Gordon (2012) argue that the actual rate of innovation is poor compared to previous industrial revolutions, contributing to the global productivity slowdown. Conversely, Brynjolfsson and McAfee (2011), for example, blame measurement issues and slow adoption of an ongoing wave of technological improvements. While other factors play a role, Switzerland is confronting a gap between its leading positions in innovation and R&D and relatively poor labour productivity growth, much like Israel (OECD, 2016g).

Increasing the returns to R&D

Switzerland is a leader in R&D spending per capita (Figure 1.23), production of high-quality research (Figure 1.24) and innovation performance (Figure 1.25). According to the Federal Statistical Office, in 2015 Switzerland devoted more than CHF 22 billion (EUR 20 billion) to R&D (over 3% of GDP), of which about two-thirds came from firms. However, in Switzerland and also world wide, the question of its economic returns is raising concerns. Over the last 50 years the number of researchers has increased substantially, while overall labour productivity growth has continued to decline. This apparent drop in yield could also be related to: the linkages from R&D and innovation to output; the capacity of workers to adopt and optimise innovations; and the usefulness of new technologies. Understanding its drivers is crucial, especially if some could be mitigated though policy changes. In particular, there are potential needs for complementary investments, e.g. in skills and organisational change, and for significant business dynamism. Promotion of diffusion of knowledge and technology can also reduce the productivity gap between firms and realise the potential of technological change (OECD, 2017a and 2017b).

Figure 1.23. **Gross domestic expenditure on R&D**

Current PPP $, per capita, 2015[1]



1. 2013 for Australia and 2014 for Ireland.

Source: OECD, *Main Science and Technology Indicators database*.

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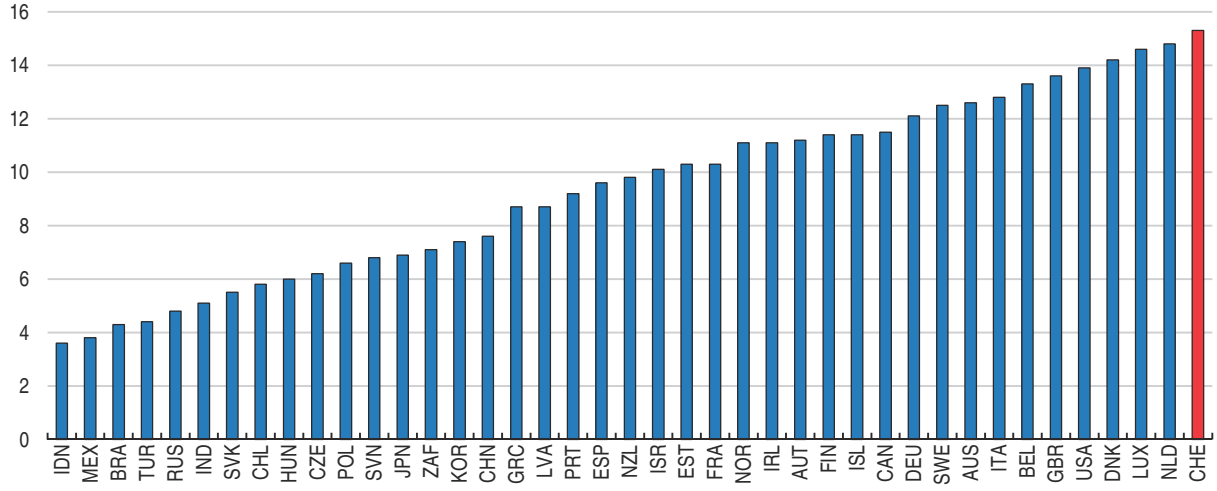
Figure 1.24. **Quality of academic publications**

Share in world top-cited publications,[1] 2003-12



1. Top-cited publications are the 10% most-cited papers in each scientific field.

Source: OECD (forthcoming), *OECD Science, Technology and Industry Scoreboard 2017*.

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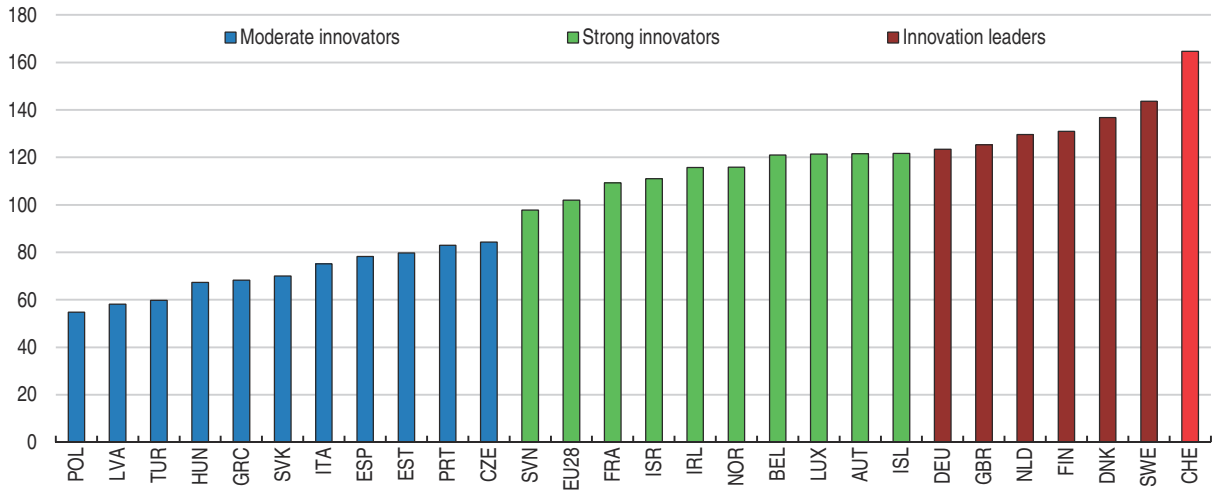
Using the KOF firm database, the private returns to R&D expenditures for Swiss firms conducting such spending is estimated at only 1.4% per year over the period 1999-2015 (Annex 1.A1). This is relatively low compared to the range of estimates in the literature (Hall et al., 2010), which in general are of the order of 10-20%. That would need some further investigation but could be related to the fact that the R&D benefits in terms of output are not mainly going to Switzerland, as an important share of R&D is made by multinationals which operate globally. This estimate excludes spill-overs to the rest of the economy. For example, innovations can affect the performance of other firms (in all

Figure 1.25. **Innovation performance remains high**[1]

Performance relative to the 2010 EU28 level, 2016



1. Average performance is measured using a composite indicator building on data for 27 indicators (only 25 for Switzerland).
Source: European Commission (2107), *2017 European Innovation Scoreboard*.

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industries) and can also trigger new avenues of research and find new applications elsewhere. The existence of a social return on top of the private measure helps to underscore the importance of R&D for an economy, supporting the arguments for well-designed government support.

Likely associated with the high level of R&D expenditure, Switzerland is performing well above the European Union in innovation, especially regarding international scientific co-publications, non-R&D innovation expenditure and human resources. The worst performing areas are employment in fast-growing enterprises and venture capital expenditure. European Union (2017) also reports that the areas underperforming over 2010-16 in Switzerland were medium- and high-tech product exports, SMEs' product and process innovations and opportunity-driven entrepreneurship.

Andrews et al. (2014) relate the returns to innovative activity to the economic environment, including: well-functioning product, labour and capital markets; an efficient judicial system; and an appropriate bankruptcy regime. Weaknesses in the Swiss economic environment could drive low private returns to R&D. Another aspect that affects firms globally is the need to register patents in different jurisdictions to protect inventions and the necessity to monitor existing patents as regards possible infringements. That is clearly a larger obstacle for small firms and can both rein in innovations and delay their market exploitation.

Another analysis based on the SIS database shows that firms that have introduced innovations (in processes or products) have higher productivity growth (see Annex 1.A1). Just as there is a rising productivity gap between leading and lagging firms, Arvanitis et al. (2017a) find a falling share of firms in Switzerland performing R&D, but that those doing so are spending a higher percentage of turnover. Based on the divergence in productivity, there is a growing risk that digitalisation will entrench a two-speed economy, with successful firms adapting to technological changes and adopting new technologies and new knowledge, and others lagging behind (EY, 2017). As innovation is increasingly occurring in large enterprises, there should be renewed public policy attention to helping young firms to invest in R&D and

produce innovations (see below). In particular, digitalisation is a growing concern for firms: 60% of enterprises surveyed by EY in 2017 considered digital technologies to be important (compared to 45% the previous year), but 15% of them lack the requisite financial capacity, 9% the qualified personnel and 8% the know-how to exploit them. Given the necessary large investment for R&D, and possible scale economies, there should be more SME collaboration in innovation. Public-sector initiatives through research institutes and laboratories could help those firms to band together. Another innovation barrier is the lack of specialised workers for SMEs, which should be better tackled by using the flexibility of the VET system (Chapter 2; Arvanitis et al., 2017a). To some extent, larger firms exploit talents from abroad to fill their gaps.

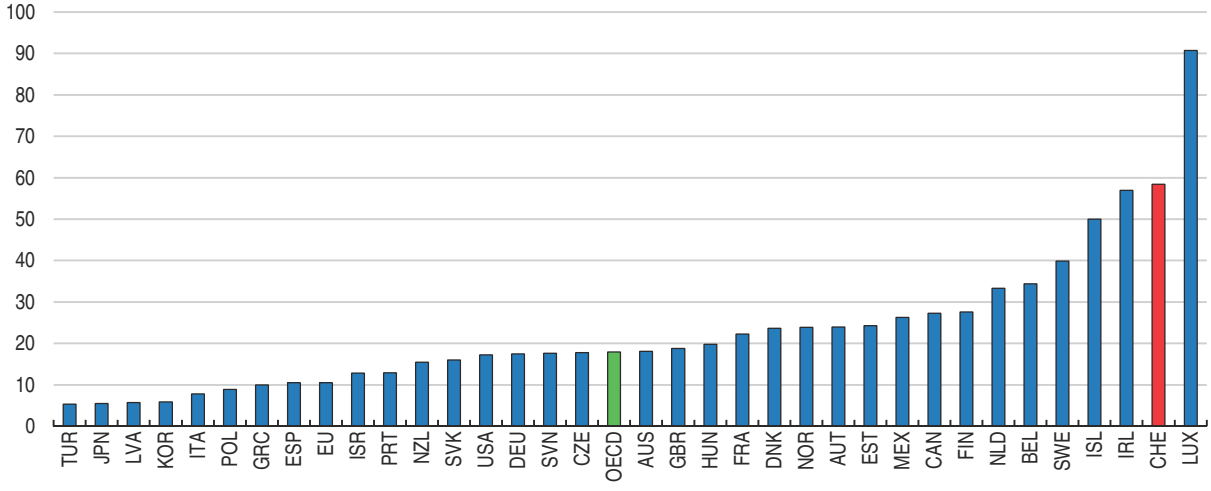
Boosting technology diffusion in Switzerland by reconsidering the role of multinationals

One explanation for the high level of R&D in Switzerland is the prominence of a limited number of multinational enterprises that perform a significant share of R&D (Federal Council, 2016b). Between 2006 and 2011, 63.4% of patents registered in Switzerland originated from just 20 firms and 25% from only two pharmaceuticals producers (SERI, 2016). Thanks to good framework conditions (including infrastructure and skilled labour), the economy has successfully attracted international companies that reinforce the Swiss position in R&D spending. Policies that would help to ensure Switzerland continues benefiting from the internationalisation of its economy include easing immigration from outside the European Union to compensate for the recent decline of flows from the European Union to Switzerland, which could accelerate due to ageing in Europe.

An important share of Swiss R&D involves international co-operation, but Switzerland should avoid just being a place to record innovations. Together with Luxembourg and Ireland, Switzerland has a high share of patents for which the research has been conducted in another country (Figure 1.26). Up to a certain point, participating in international collaboration is advantageous, as leading research can be disseminated all over the world. However, patent location can also be influenced by lower corporate income tax rates and preferential

Figure 1.26. **Patents covering inventions made abroad**

Percentage of total patents, 2013



Source: OECD, *International Co-operation in Patents database.*

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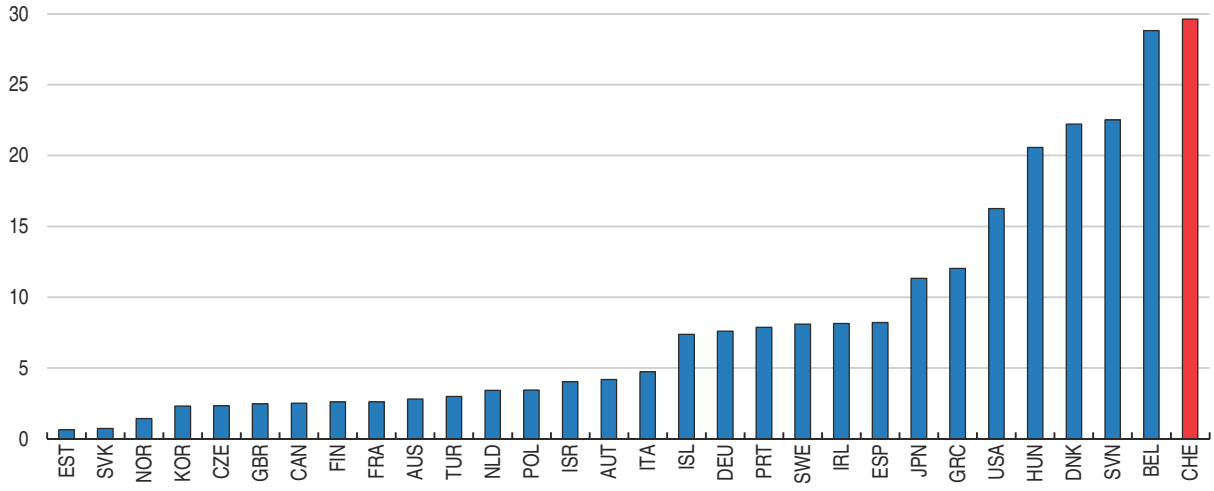
intellectual property regimes (Bieltvedt Skeie et al., 2017). In Switzerland, until the ongoing corporate tax reform is implemented (more below), multinationals benefit from preferential corporate income tax rates which may influence the location of patents. Patents that are derived from domestic R&D are important because they will raise social returns, while patents that are only recorded in the country or have limited Swiss inputs will have negligible positive spill-overs. The ongoing corporate tax reform is an opportunity to reinforce the Swiss position as an R&D hub with R&D tax incentives available for all firms including domestic ones. If this induces additional R&D, it may help reduce the gap between frontier firms and the rest.

The importance of pharmaceuticals is also a sign of the importance of multinationals for Switzerland. Almost 30% of business R&D spending is in the pharmaceuticals industry (Figure 1.27). To some extent, this fairly unusual share points to excessive dependency. While it can have potential positive externalities, it may generate crowding-out effects (financial and labour resources devoted to the sector are not available for the rest of the economy) and risks of a sudden stop (regarding a product or a firm), which can also negatively impact the rest of the economy. More diversification would be positive for Switzerland as the payoff from pharmaceuticals R&D is especially long and variable.

Figure 1.27. **Business R&D expenditure in the pharmaceuticals industry**

As a percentage of total R&D expenditure, 2013[1]



1. 2012 data for Switzerland, using ISIC Rev 4 industry classification.

Source: OECD, *Business enterprise R&D expenditure by industry*.

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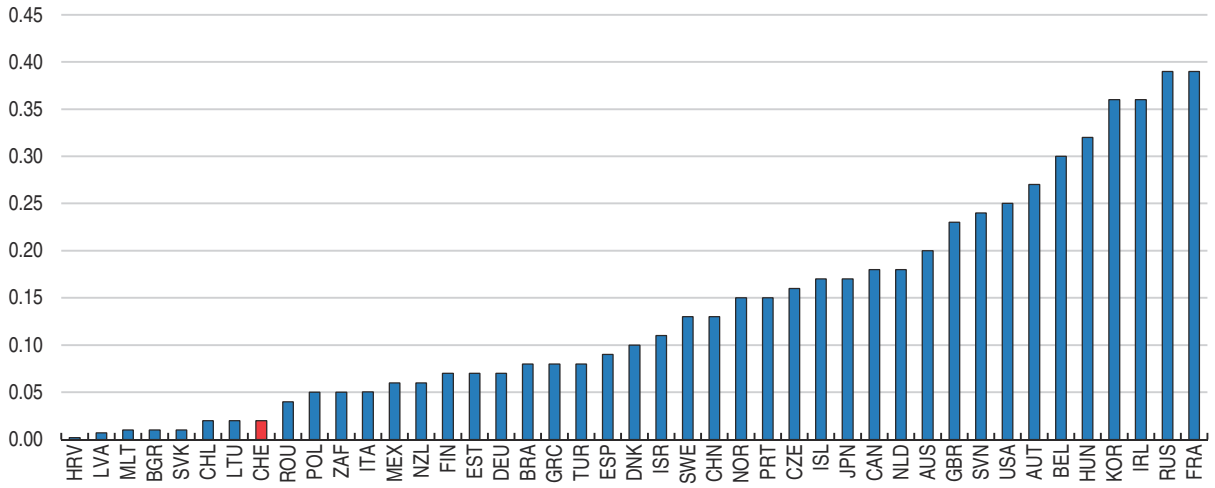
Government support for business R&D is low

Swiss government support (including direct support and tax incentives) for business R&D activities is modest compared to other OECD countries' (Figure 1.28). Even though there is no consensus on causality, the level of government support tends to be positively correlated across countries with R&D intensity in the business sector (OECD, 2015c). Some studies using firm-level data find a more direct impact of tax incentives on R&D spending (Guceri and Liu, 2017), but the literature is less clear-cut about finding an impact on productivity (OECD, 2015b; Westmore, 2013; Appelt et al., 2016). Neubig et al. (2016) highlights the need to have fiscal incentives tailored to favour the development, diffusion and use of new knowledge and innovations and avoid rent-seeking, arbitrage and

Figure 1.28. **Total government support to business R&D**

In per cent of GDP, 2014



Source: OECD, *R&D Tax Incentive Indicators*.

StatLink http://dx.doi.org/10.1787/888933621576

supporting less efficient activities and incumbents. That said, Switzerland currently offers no tax incentives (except the canton of Nidwalden), and business R&D is relatively high (as in Germany and Sweden), showing that government support is at least not a prerequisite, although it is relatively narrowly based (see Figure 1.26 above). While about 63.5% of R&D in 2015 was financed by the business sector, the government funded about 24% of R&D, mostly carried out by higher education institutions (representing 0.8% of GDP, above the OECD average of 0.6%). Government financing goes through the Swiss National Science Foundation (for basic research) and the Commission for Technology and Innovation (becoming Innosuisse, supporting applied research through entrepreneurship, start-ups and R&D projects). The involvement of the government is important as it provides funding for projects that have low internal returns but high externalities.

The Swiss government is planning a corporate tax reform and will likely offer a "patent box", which is a reduced tax rate on revenues from patents, and supplementary tax deductions for R&D expenditure. The patent box is to be in accordance with the international standard and mandatory for all cantons (due to the federal harmonisation law). It should be carefully designed to avoid providing windfall gains to incumbents without stimulating additional innovation. However, the tool is not considered very effective in promoting innovation, even though it is used in many OECD countries (Appelt et al., 2016). The proposed tax incentives for R&D expenditure provide incentives to domestic firms and multinational firms alike. However, these will provide windfall gains to firms already conducting R&D. The design and implementation should be evaluated to allow improvements to the instrument in generating additional R&D activity.

The share of firms receiving government support for R&D has risen in recent years (Arvanitis et al., 2017b). Direct government support should concentrate on early-stage financing for start-ups, which is lacking in Switzerland (OECD, 2015b). Support for R&D can negatively impact productivity if it benefits incumbents more than innovative start-ups (Bravo-Biosca et al., 2014). Howell (2017) shows that R&D subsidies, when provided in early-stage development, have positive impacts on revenues and patenting. Nevertheless, support

for young firms should remain temporary, as start-ups need to test the value of their business model. Indeed, incentives to remain small can hurt productivity (Benedek et al., 2017).

Public authorities should promote more the need for specialised workers in R&D, as both the share of researchers in the workforce and of women in the research labour force is low by international standards (SERI, 2016). The quality of Swiss education is particularly high, but the share of the population with a higher education qualification is not, most likely because of the importance of vocational training (Chapter 2). It is also related to a risk of Swiss students being crowded out of excellent institutions, given their reputation, by foreign candidates. As a result the lack of specialised workers constrains innovation for medium-sized firms (Arvanitis et al., 2017b).

Additionally, the Swiss consumer market is relatively small and thus does not suffice for many start-ups to be created or grow. As in Israel or the United States, Switzerland could make use of public procurement to spur the development of small firms, including start-ups, through targets for the maximum involvement of large firms. That can be facilitated by more public procurement being publicly available on the electronic platform *simap*. OECD (2017f) also makes several recommendations to utilise procurement for promoting innovation and highlights the absence of a strategic framework in Switzerland. This lack of a strategy also means that there is no assessment of such public procurement. For example, Finland has set an objective of 5% for innovative public procurement (OECD, 2016h). Sub-national governments can also play a role; in Finland municipalities incorporate innovation objectives, especially in construction, social and health care services, and energy and water supply.

The interaction between innovation and inclusiveness can also bring with it some productivity enhancement. Aghion et al. (2015) suggest that in the United States innovativeness could explain 17% of the total increase in the income share of the top 1% of earners between 1975 and 2010. The innovative process should be opened to the whole of society to allow for social mobility and avoid allowing incumbents to lock in rents. That suggests further lowering entry barriers for innovators and developing government mechanisms to accompany them, including help to find funding and provision of information on existing regulations and on possible public support (especially as some differences exist across cantons). That would contribute to diversifying R&D across industries and firm sizes. In addition, becoming an inventor is strongly related to one's education, which should also be utilised as a tool of innovation policy. Indeed, using German data, Frosch et al. (2015) find a positive link between the degree of education and inventor productivity. But schools should also help to develop creativity, leadership and innovation skills for a wider range of students to become inventors. In addition, providing training to (future and existing) entrepreneurs, notably in finance, is important.

Enhancing access to academic knowledge would facilitate the diffusion and use of technologies. In that regard the role of universities, already significant in Switzerland, is important to provide resources in terms of publications, scientists and machinery, but there are practical barriers to benefit from all those materials including the cost and the know-how. Andrews et al. (2015) find that R&D collaboration between business and universities matters for increasing technological diffusion. In Switzerland 17% of innovative firms co-operate with universities, which is similar to Germany but far short of outcomes for Finland, Austria and Denmark (SERI, 2016), revealing some room for improvement. One possibility would be to further promote incubators at higher education institutions as a bridge between academia and business (see Prencipe, 2016 for a study on Italy). The

recruitment and career development of academic staff could also take into consideration entrepreneurial experience or support activities. Collaboration with the business sector could be improved with more entrepreneurial education integrated into curricula.

Recommendations to boost Swiss productivity (Key recommendations in bold)

Better using the skills of older workers, women and immigrants

- Promote preventative health programmes, lifelong training and tailored job-search assistance to older workers to lengthen their healthy working lives.
- **Increase childcare affordability.**
- **Shift income taxation to individual rather than household incomes, or implement equivalent measures.**
- **Facilitate high-skilled immigration from non-EU countries to meet labour market needs.**

Improving framework conditions

- **Increase private ownership and remove barriers to entry, including restrictions on the number of competitors, in energy, telecommunications and transport.**
- Review existing regulations that could hinder young and small firms. Enhance transparency and use of information technology, and develop e-government.
- **Finalise the virtual one-stop shop for administrative affairs.**
- **Establish cantonal physical contact points to improve delivery of advisory services and public financing programmes.**
- **Complete the negotiations for free-trade agreements that are underway with Asian nations and MERCOSUR.**
- **Lower restrictions on trade in both goods and services, notably in highly protected agricultural products.**
- Facilitate foreign investment, notably by removing equity restrictions.
- **Remove representatives of economic associations from the board of the competition authority.** Improve the merger control system through adopting the EU approach.
- Improve the insolvency regime by introducing early-warning mechanisms and shortening the period during which individuals are required to repay past debt from future earnings to three years.
- Lower barriers to mobility and trade across cantonal borders.
- Develop internationally comparable firm-level data to expand analytical possibilities.
- Develop more non-bank financing, including expanding online alternative sources of funding through reviewing regulations regarding peer-to-peer lending and equity-based crowdfunding.

Innovation and R&D

- Promote incubators at higher education institutions, and recruit academic staff with entrepreneurial skills to boost start-ups' creation and success. Focus government support on early-stage development of start-ups.
- Facilitate more innovative small firms' participation in public procurement by extending the use of the electronic platform.
- Use universities and research laboratories to increase collaboration between start-ups.

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ANNEX 1.A1

Firm database

Firm-level data throughout the chapter are based on the Swiss Innovation Survey (SIS), maintained by the KOF economic institute which conducts economic research notably through surveys. The SIS is based on a stratified random sample of firms with at least five employees, covering all relevant industries in the Swiss business sector. Data exist for 1996, 1999, 2002, 2005, 2008, 2011, 2013 and 2015 but are less comprehensive for the first year. For the latter two years, the structure of the questionnaire has been brought into line with the Community Innovation Survey, a project carried out by Eurostat for EU Member states.

The 2015 survey contains 5 908 firms' responses, of which 3 099 are small, 2 320 medium-sized and 489 large. Because the average size varies across industries, thresholds used to define the size class are determined by the method of optimal stratification (Cochran, 1977). The database covers manufacturing, construction and services sectors. The rate of response is about a third, driven down by small firms (just above a quarter).

Firm labour productivity is the main variable of interest from this database. It is computed as value added divided by the total number of employees. Variables used in the chapter include:

- Value added
- Turnover
- Total number of employees
- Labour costs
- Gross investments
- Export (Yes/No)
- Intensity of price competition (from 1 to 5)
- Intensity of non-price competition (from 1 to 5)
- Annual R&D spending as a share of turnover
- R&D (Yes/No)
- Innovations in process and in products (Yes/No)
- Number of competitors (<= 5, 6-10, 11-15, 16-50, > 50)
- Share of employees with higher education (degree or further education)
- Size class (small, medium, large)

Limitations

The database is representative of the economy but is not a fully comprehensive picture of Switzerland's business sector. First, very small firms are not covered, as only those with at least five employees are questioned. That also means that young firms are underrepresented as they typically start very small. Second, the questionnaire is sent to firms that are part of the official registry of BFS (the federal statistical office), which is revised only every five years, thereby also excluding the youngest enterprises. Third, not all corporations answer the request and while large firms are well covered in all industries, the smallest ones tend to be underrepresented. Finally, amongst answers, some questions are left blank. To mitigate those issues, several exercises are performed at KOF:

- For every survey wave, a check analysis is done by calling 500 firms that have not sent back the questionnaire asking only three questions. The comparison of their answers with database results revealed no significant divergences between the two sets of information.
- Missing values are estimated following multiple imputation techniques developed in Rubin (1987), filling in with imputed variables on top of raw information.
- The SIS also contains firm-specific sample weights that correct for stratification and the different response probabilities of firms.

Data manipulation

Deflator

The SIS database has only nominal value added, which needs to be deflated to get a measure in constant terms. OECD national accounts data by industry have been used to complete the information with 2-digit industry deflators based on ISIC Rev 4. But this means that there is no information on price reaction at the firm level.

Purchasing power parities

To compare the SIS database with the global frontier productivity and remain as close as possible to Andrews et al. (2016) the data have to be converted to 2005 PPP. PPP conversion factors at the industry level have been derived from Inklaar and Timmer (2013). As Switzerland is missing from the authors' calculation, sector PPP information for Switzerland is based on EU27, while PPP conversion at the country level matches official OECD information.

Firms' size

The SIS database covers firms of at least five employees, but in the particular exercise of the comparison with the global productivity frontier in Andrews et al. (2016), companies of less than 20 employees are excluded.

Wages

The average wage in an enterprise is estimated as the ratio between total labour costs and the number of employees. This should provide a good proxy. As each firm is treated the same way, inter-firm comparisons are facilitated, but it does not allow within-firm analysis. To remove the influence of outliers, enterprises with estimated wages per employee above CHF 4 million are removed (3 in 2013 and again in 2015).

Rate of return to R&D activities

Investment in R&D and innovation is particularly expensive because of fixed costs and uncertainty, and accounting for its private return is key to understanding firm incentives. Inspired by Hall et al. (2010) and adapted to the SIS database, the equation below is estimated on all firms that spend on R&D in the SIS database, where *i* stands for the firm, *t* for time and *s* for the 2-digit sector:

$$\Delta y_{i,t} = \alpha_s + \gamma_t + \beta_1 \Delta l_{i,t} + \beta_2 \Delta c_{i,t} + \beta_3 \Delta k_{i,t} + \Delta u_{i,t} \quad \text{(A1)}$$

All variables are in logarithms, with *y* standing for firm productivity, *l* labour costs per employee, *c* physical capital stock per employee, *k* R&D capital stock per employee and *u* the residual term. The R&D capital stock intensity is approximated by R&D expenditure divided by turnover with the assumption that the growth rate and the depreciation rate of R&D at the firm level are broadly constant, following Hall et al. (2010). The same approach is used for the physical capital stock (proxied by gross investment per employee). Results are presented in Table 2. This does not take into account social returns or spill-overs to the rest of the economy.

Table A1.1. **R&D rate of return**

Dependent variable: labour productivity growth; unbalanced panel

	Coefficient	Standard error
Change in labour costs per employee	0.440***	(0.070)
Change in investment per employee	0.003	(0.010)
R&D expenditure as share of turnover	0.014**	(0.007)
Observations	1713	
R^2	0.18	

Note: Significance at 1%, 5% and 10% represented by ***, ** and *, respectively. Constant, time and sector effects are excluded from the table.
Source: Authors' calculation based on KOF, *Swiss Innovation Survey database*.

Determinants of productivity growth

In the SIS database, several variables can be exploited to look at correlations with labour productivity growth. A first set of regressions is performed on the type of competition using available firms' answers regarding the intensity of price versus non-price competition (Table A1.2, column 1). Contemporaneous effects are not significant, but there seems to be a correlation with a lag (which corresponds to the time between two surveys). When firms compete on prices, productivity is apparently dragged down, while non-price competition seems to boost subsequent value added per employee.[1] This could go through incentives to innovate in processes or in products, while fierce price competition may for instance negatively affect investment. However this seems to be driven by part of the manufacturing sector (at the 1-digit level, comprising: manufacture of transport equipment; other manufacturing and repair and installation of machinery and equipment; electricity, gas, steam and air-conditioning supply; water supply, sewerage, waste management and remediation) as the price competition coefficient loses significance when the sector is excluded (column 2).

Looking at competition from a different angle, Table A1.3 (column 1) suggests a negative correlation between the number of competitors (including outside Switzerland) and productivity growth. However, for example the absence of young firms in the SIS database could hide the benefits of competition in terms of productivity as their market share gains are

Table A1.2. **Type of competition**

Dependent variable: labour productivity growth; unbalanced panel

	(1)	(2)
Productivity level (one lag)	-0.500***	-0.516***
	(0.022)	(0.023)
Intensity of price competition (one lag)	-0.013**	-0.005
	(0.006)	(0.006)
Intensity of non-price competition (one lag)	0.016***	0.025***
	(0.006)	(0.006)
Observations	7025	6569
R^2	0.24	0.26

Note: Significance at 1%, 5% and 10% represented by ***, ** and *, respectively. Constant, time and sector effects are excluded from the table. Robust standard errors in parentheses.
Source: Authors' calculation based on KOF, *Swiss Innovation Survey database*.

Table A1.3. **Correlations with productivity growth**

Dependent variable: labour productivity growth; unbalanced panel

	(1)	(2)	(3)	(4)	(5)	(6)
Productivity level (one lag)	-0.484***	-0.484***	-0.486***	-0.487***	-0.488***	-0.496***
	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)
Number of competitors						
6-10	-0.03*	-0.03*	-0.03**	-0.03**	-0.03**	-0.03**
	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)
11-15	-0.06***	-0.06***	-0.06***	-0.06***	-0.06***	-0.06***
	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)
16-50	-0.06***	-0.06***	-0.06***	-0.06***	-0.06***	-0.06***
	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)
>50	-0.13***	-0.12***	-0.12***	-0.12***	-0.12***	-0.12***
	(0.018)	(0.018)	(0.018)	(0.018)	(0.019)	(0.019)
Firm size						
small		-0.043***	-0.04***	-0.04***	-0.03***	-0.04***
		(0.012)	(0.012)	(0.013)	(0.013)	(0.013)
large		0.025	0.025	0.02	0.02	0.01
		(0.018)	(0.018)	(0.018)	(0.018)	(0.017)
Export			0.028*	0.018	0.017	0.007
			(0.015)	(0.015)	(0.015)	(0.015)
R&D spending				0.042***	0.021*	0.009
				(0.014)	(0.017)	(0.017)
Innovations					0.034**	0.035**
					(0.016)	(0.016)
Higher education						0.002***
						(0.0004)
Observations	6486	6486	6449	6446	6446	6446
R^2	0.24	0.24	0.24	0.24	0.24	0.25

Note: Significance at 1%, 5% and 10% represented by ***, ** and *, respectively. Constant, time and sector effects are excluded from the table. Robust standard errors in parentheses. Number of competitors should be interpreted in reference to the category 'below 5 competitors'. Firm size coefficients are in reference to medium-sized firms.
Source: Authors' calculation based on KOF, *Swiss Innovation Survey database*.

not included. Another problem lies in the use of the aggregate deflator at the industry level instead of individual firms' price settings. Finally the coefficients, while significant, are not statistically different except for the last category.

When firm size is controlled for, competition effects remain, but there is a clear relative bias for large firms to have faster productive growth than small firms (Table A1.3,

column 2), presumably because of scale economies. This can be compensated somewhat by the effect of the lagged productivity level (assuming that large firms have higher productivity levels), which shows convergence in productivity level when sectors and years are controlled for: the higher the productivity level, the lower the growth rate. This could also indicate some level of technology diffusion across firms through the period.

Being an exporter seems to be associated with higher productivity growth, but it does not remain when R&D expenditure is included (columns 3 and 4). The large-firm dummy variable also becomes insignificant as larger companies probably tend to spend more on R&D. The R&D spending impact is blunted by the inclusion of the innovation dummy – some of the effect is probably picked up through increased probability of undertaking innovation – and disappears entirely with the use of the share of highly educated employees (columns 5 and 6).

Note

1. The regression results should be interpreted cautiously as endogeneity issues may bias the coefficients.