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OF FINANCE

Finnish Productivity Board

Skilled people create productivity

Skills shortage threatens to slow down the effectiveness of R&D investments and productivity growth

Board

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Finnish Productivity Board

Ministry of Finance Helsinki 2023

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Abstract

Productivity is an absolute requirement for material welfare in the long term. The productivity growth was very rapid in Finland from the 1990s until 2007, while it has been slow since 2008.

The slow development of Finland's productivity can be attributed to a number of factors. These include the negative technology shock in the electronics industry's value chain, the low level of productivity in the service sector and its very slow growth, the poor allocation of resources and its further decrease, the relatively small number of high-productivity companies, and the small number of machinery, equipment and, above all, intangible investments. Furthermore, the shortage of skilled employees in companies and the lack of human capital continue to reduce the capabilities for productivity growth. Finland requires more radical innovation to help companies significantly improve their productivity.

Training and R&D investments increase the ability of companies to innovate and also to imitate innovations made by others with a delay. Attracting international professionals actively would help to eliminate the shortage of competence and increase human capital in Finland. Cooperation between companies and higher education fosters the spillover of competence and new knowledge. Features of the regulatory and tax systems may form obstacles in the way of productivity growth.

Keywords	economic policy, productivity, economic growth, technological development, competitiveness, boards, companies, national economy, competence, training		
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Osaavat ihmiset tekevät tuottavuuden
Osaajapula uhkaa hidastaa t&k-investointien tehoa ja tuottavuuden kasvua

Valtiovarainministeriön julkaisuja 2023:88		**Teema**	Lautakunnat
Julkaisija	Valtiovarainministeriö		
Yhteisötekijä	Tuottavuuslautakunta		
Kieli	englanti	**Sivumäärä**	74

Tiivistelmä

Pitkällä aikavälillä tuottavuus on aineellisen hyvinvoinnin välttämätön ehto. Tuottavuuden kehitys oli Suomessa hyvin nopeaa 1990-luvulla aina vuoteen 2007 saakka ja on ollut hyvin heikkoa vuoden 2008 jälkeen.

Syyt Suomen hitaaseen tuottavuuskehitykseen ovat negatiivinen teknologiashokki elektroniikkateollisuuden arvoketjuun, palvelualojen alhainen tuottavuuden taso ja hyvin hidas kasvu, voimavarojen heikko kohdentuminen ja kohdentumisen edelleen heikkeneminen, korkean tuottavuuden yritysten suhteellisen vähäinen määrä sekä vähäiset kone-, laite- ja ennen kaikkea aineettomat investoinnit. Myös osaajapula yrityksissä ja sekä osaamisen ja henkisen pääoman puute myös tulevaisuudessa osaltaan heikentävät tuottavuuskasvun edellytyksiä. Suomessa tarvitaan enemmän radikaaleja innovaatioita, joiden avulla yritykset voisivat kohentaa tuottavuutta merkittävästi.

Koulutus ja T&K-investoinnit kohentavat sekä yritysten kykyä innovoida että imitoida muiden tekemiä innovaatioita viiveellä. Kansainvälisten osaajien aktiivinen houkuttelu poistaisi osaajapulaa lisäisi henkistä pääomaa Suomessa. Yritysten ja korkeakoulujen välinen yhteistyö edistää osaamisen ja uuden tiedon läikkymistä. Sääntelyn ja verotuksen yksityiskohdat voivat muodostaa pullonkauloja tuottavuuden kasvulle.

Asiasanat	talouspolitiikka, tuottavuus, talouskasvu, teknologinen kehitys, kilpailukyky, lautakunnat, yritykset, kansantalous, osaaminen, koulutus, tuottavuuslautakunta		
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Kompetenta människor skapar produktivitet: Kompetensbrist kan hämma FoU-investeringarnas effekt och bromsa produktivitetstillväxten

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Referat

På lång sikt är produktivitet ett nödvändigt villkor för materiellt välbefinnande. Produktivitetsutvecklingen i Finland var mycket snabb under 1990-talet fram till år 2007 och har varit mycket svag sedan år 2008.

Orsakerna till den långsamma produktivitetsutvecklingen i Finland är den negativa teknikchocken i elektronikindustrins värdekedja, den låga produktivitetsnivån och den mycket långsamma tillväxten inom servicebranscherna, den svaga allokeringen av resurser och den fortsatta försämringen av allokeringen, det relativt låga antalet företag med hög produktivitet samt den låga investeringsnivån vad gäller maskiner, utrustning och framför allt immateriella investeringar. Bristen på kompetent personal inom företag och bristen på kompetens och humankapital kommer att bidra till att minska förutsättningarna för produktivitetstillväxt även i framtiden. I Finland behövs mer radikala innovationer som skulle göra det möjligt för företag att avsevärt förbättra produktiviteten.

Utbildning och FoU-investeringar förbättrar både företagens förmåga att innovera och imitera andras innovationer med en fördröjning. Att aktivt attrahera internationella experter skulle eliminera bristen på experter och öka humankapitalet i Finland. Samarbete mellan företag och högskolor främjar spridandet av kompetens och ny kunskap. Detaljer inom lagstiftning och beskattning kan leda till flaskhalsar i produktivitetstillväxten.

Nyckelord	finanspolitik, produktivitet, ekonomisk tillväxt, teknisk utveckling, konkurrenskraft, nämnder, företag, samhällsekonomi, kompetens, utbildning		
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1 Why has Finland experienced poor productivity development?

1.1 Introduction

Labour productivity is calculated as the ratio of value added or gross domestic product to hours worked. It describes the value we create through work. The development of economic welfare depends, above all, on productivity growth. Over the long term, productivity growth is essential for the development of material welfare.

In this report, we focus on assessing productivity development in the market segment that lends itself to relatively reliable measurement of productivity. This topic is discussed in detail in a report published by the Finnish Productivity Board in 2019, and a specific problem involved in measuring productivity is examined in Box 1 in Section 1.2.

Value added is created as the combination of labour, capital, technology and competence used in production. Consequently, labour productivity is determined as the ratio of capital to hours worked, human capital to hours worked, and the so-called total factor productivity. Productivity can be boosted by increased or improved factors of production and improved skills of the worker. Total factor productivity, on the other hand, describes technology in a very broad sense: it is the part of productivity not explained by capital deepening (increase in capital per hours worked) and improved skills of the workforce.

In the long term, productivity growth can only be based on innovations that increase the quantity or quality of the output gained from the inputs. An innovation is a challenging commodity (Arrow, 1962). It is not affected by wear and tear, and it tends to spread – also unintentionally from its creator’s perspective. Due to these characteristics, the widest possible adoption and spread of innovations is desirable from society’s point of view. On the other hand, private revenue depends on others not being able to use an innovation. The conflict between private incentives and use that is desirable from society’s viewpoint means that without specific policy measures, sufficient innovations and new information will not be produced. This market failure should consequently be addressed by policy. Policy covers many things: supporting education and basic research with public funding; granting temporary monopolies in form of intellectual property rights for ideas; and encouraging private innovators to make additional investments through direct public subsidies, loans and tax breaks.

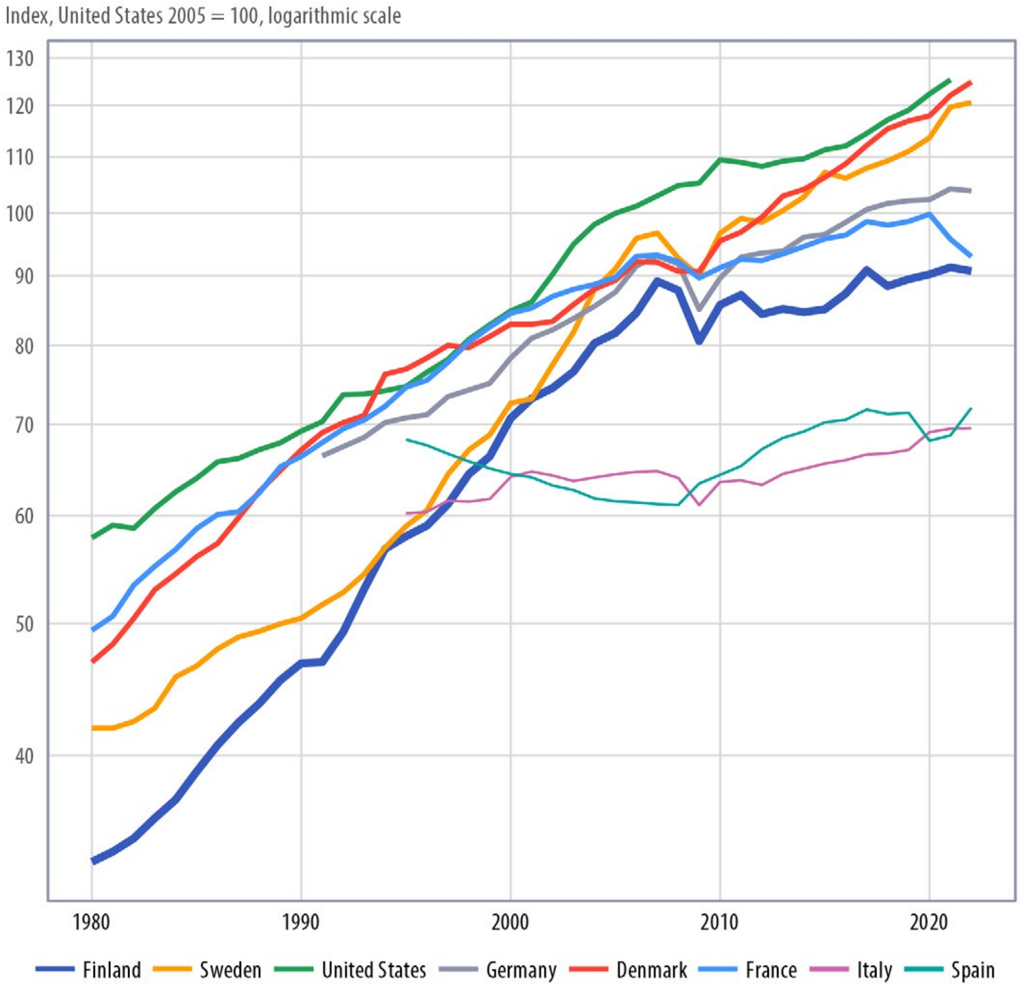
Industrial history has favoured technologies that burden the environment. Due to path dependences, the emphasis of current innovation activities is misplaced. The reason for this often is that market prices do not adequately reflect all costs and externalities of the production and use of products and services. More accurate pricing of the climate and environment, for example through emissions trading, corrects this problem from a static perspective. However, targeted technological development is also needed to correct the dynamics of the economy; this means promoting research, development and innovation focusing on clean production, distribution and consumption, for example through targeted programmes (see also Blanchard et al., 2023). In future reports, we will discuss this environmental perspective of productivity in detail (see also Deschryvere et al., 2023).

Productivity developed very rapidly in Finland in the 1990s until 2007 and has been very sluggish since 2008 (Figure 1). Growth in countries at the forefront of productivity has again been faster than in Finland, also since the upturn that started in this country in 2015, and the gap to the global forefront has widened.

Productivity growth has simultaneously slowed down across a broad front in industrialised countries. Goldin et al. (2023) examine the reasons for this in France, Germany, Japan, the United Kingdom and the United States. While their study is mainly based on macro-level statistics, it also relies on company-specific register data, which the authors use to examine such aspects as resource allocation between companies. There is no single explanation for the slower productivity growth, and there are also some differences regarding its reasons between countries. The underlying reason, however, is a combination of factors that together appear to explain a large part of the observed slowdown. The key reasons are sluggish total factor productivity growth and smaller impact of capital deepening, measurement errors, decrease in the share of capital per employee, smaller impacts of growth in intellectual capital, slowing of world trade, and reduced efficiency of allocation. Market dynamics had also declined in these countries. In the countries included in the study, the most significant sector-specific impact was the slowing of productivity growth in the manufacturing industry.

The decline in productivity development was exceptionally strong in Finland. The reasons for Finland's poor productivity levels and sluggish development have already been discussed in previous reports of the Finnish Productivity Board, and their observations differ to some extent from the above-mentioned conclusions by Goldin et al. (2023).

Figure 1. Level of labour productivity in the business sector, United States 2005 = 100, logarithmic scale



In a nutshell, the diagnosis of Finland's productivity problem is as follows: 1) a negative technology shock in the electronics industry value chain, 2) low level of productivity and very slow growth in the service sectors, 3) poor resource allocation (low-productivity companies receive an excessively high share, while high-productivity companies get an excessively low share) and further deterioration in the allocation, apparently until as late as 2018, 4) relatively low number of high-productivity companies, and 5) low level of investment in machinery and equipment and, above all, intangible investments. On the other hand, market functioning or dynamics do not appear to be a problem in Finland. As new observations, we can mention 6) shortage of skilled workers in companies currently and as a future threat; 7) shortage of competence and intellectual capital also in the future; we will discuss these themes in detail in future reports. We also considered the relevance of the 8) ‘convergence club theory’ as an explanation for the productivity gap.

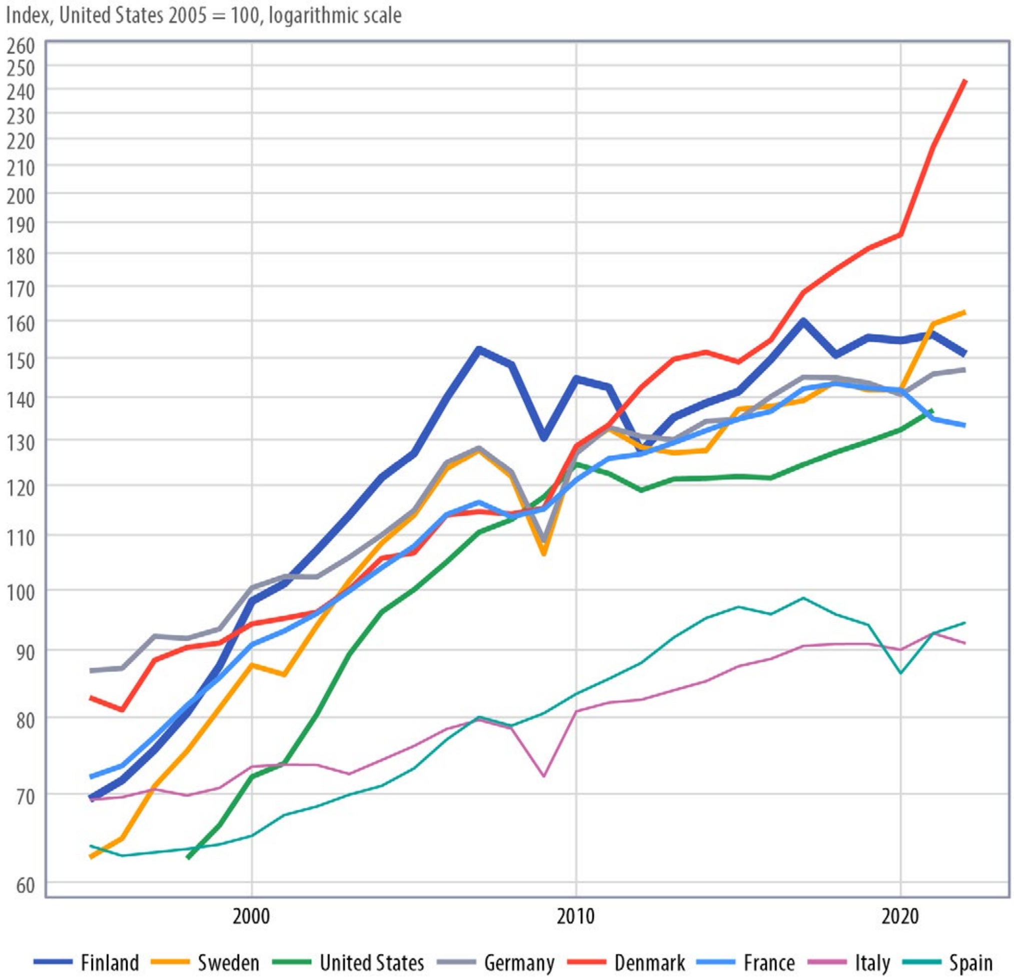
These issues are discussed in the following section. Four background memoranda take a closer look at the impacts of intellectual capital (Kangaspunta, 2023) and intangible capital (Huovari, 2023), resource allocation (Kuosmanen, 2023) and artificial intelligence (Etelävuori, 2023). The background memoranda will be published on the Finnish Productivity Board’s website[1].

1.2 Negative technology shock

While the level of labour productivity in the industrial sector was clearly higher in Finland than in the reference countries in 2008, due to a negative technology shock in the electronics industry value chain, a great deal of high productivity manufacturing and jobs were lost in many industrial sectors. As a result, many countries caught up with Finland (Figure 2). A shock affecting one company or industry may also spill over to other sectors through production chains, and these networks reinforce the impact of the original shock, be it positive or negative (Acemoglu et al., 2016). According to Calligaris et al. (2023), the negative shock accounted for at least one third of the decrease in aggregate productivity experienced in 2009–2013. For a detailed description of the impacts of the technology shock, see the 2022 report of the Finnish Productivity Board (Chapter 5, pp. 73–80).

[1] https://vm.fi/tuottavuuslautakunta

Figure 2. Level of labour productivity in the manufacturing industry, United States 2005 = 100, logarithmic scale NB. See Box 1 about a problem in measuring productivity in Denmark.



BOX 1. PROBLEMS ASSOCIATED WITH DANISH PRODUCTIVITY STATISTICS

The development of labour productivity in Danish industry appears implausibly rapid. And it is, at least since 2020. It is likely that productivity growth in the Danish industry has actually been faster than in the reference countries in the 2010s. The Danish pharmaceutical industry has been successful, in particular, and its productivity has grown rapidly.

The rapid growth rate of labour productivity in industry in 2021 and 2022 is not plausible, however, and a more detailed examination of Danish statistics shows that this is, at least partly, about a statistical problem due to a rapid rise in prices.

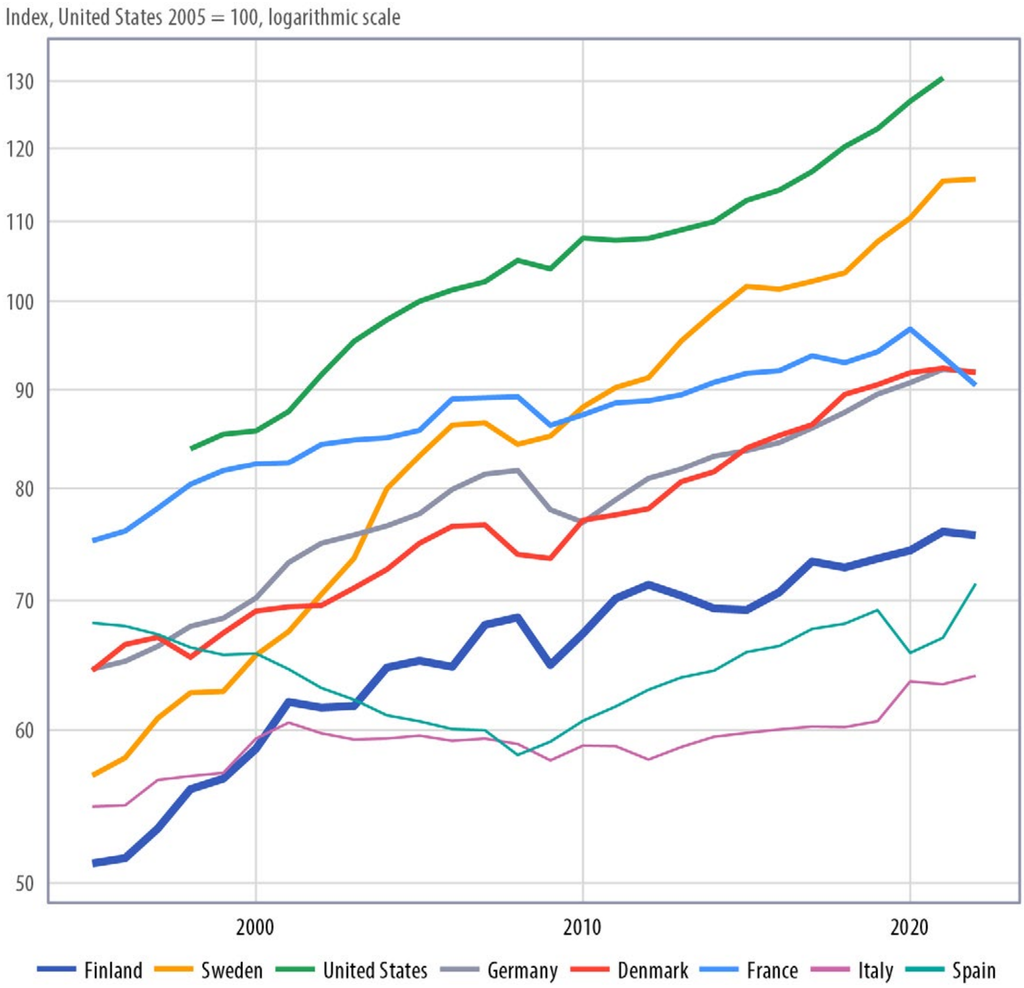
In Figure 2, labour productivity has been calculated as a ratio of the volume of value added in industry to hours worked. Value added is the difference between output and intermediate consumption in production. While value added is straightforward to measure, its volume is not, as there is no market price for value added. The volume of value added is calculated through output and the volume of intermediate consumption. Using the same price index, the price of output, for deflating both the output and intermediate consumption is a simple way of doing this. In principle, using ‘double deflation’, in which the output and intermediate consumption are deflated with their specific price indices is a better but, in practice, more challenging method. Any problems in measuring prices may have a rather strong impact on the volume of value added when using double deflation.

Prices have risen rapidly in recent years, bringing problems with measuring prices to the fore. If we look at values, the value of intermediate consumption in the Danish industry has increased faster than the value of output, whereas the value of value added has only increased marginally. Based on the price indices, however, the prices of intermediate consumption have gone up considerably faster than output prices. When deflated, this means that the volume of intermediate consumption has clearly increased more slowly than the output volume, whereas the opposite is true when measured by their values. For its part, the price index calculated on the basis of the volume and value of value added has decreased clearly. This is hardly the case while other prices and wages have gone up. Consequently, this is partly a question of price measurement problems, which are likely to also affect the measurement of productivity in other countries. This effect is rarely quite so large and obvious, however.

1.3 Low productivity of private services

In private services, Finland's productivity level has been very low by international comparison (Figure 3). Productivity growth in this sector has also been very slow, especially considering how far behind the United States, Sweden and other reference countries Finland is in the services sector. The reasons for the poor level of productivity and extremely sluggish growth are shrouded in mystery. Further studies in these matters would be needed to understand their causes and to accelerate productivity growth.

Figure 3. Level of labour productivity in private services, United States 2005 = 100, logarithmic scale



1.4 Resource allocation

The aggregate productivity of a sector or national economy is influenced by not only firm productivity (or its development) but also the allocation of resources across firms. If a larger share of resources is allocated to firms showing high productivity (or rapid productivity growth), the level of productivity (or rate of growth) in the national economy is higher than in a situation where a larger part of the resources is allocated to firms with low productivity (or slow productivity growth).

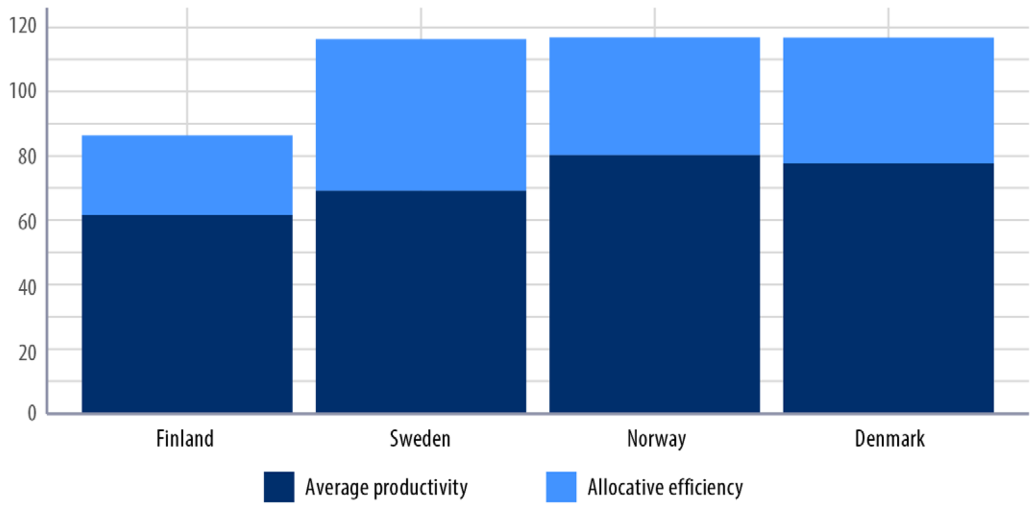
In order to examine the allocation of resources, firm- or establishment-level data is needed. Structural change productivity decompositions are tools for analysing the link between individual companies' operations and the productivity of an industry, or the entire business sector. Some decompositions can distinguish the contributions of entry and exit (Baily et al., 1992; Griliches & Regev, 1995; Foster et al., 2001), while others focus on the contribution of resource allocation (Olley & Pakes, 1996). More recent decompositions account for both resource allocation and the contribution of entry and exit (Melitz & Polanec, 2015; Maliranta & Määttänen, 2015), as well as the contribution of firms industry switching (Kuosmanen & Kuosmanen, 2021, 2023).

Olley and Pakes (1996) propose a static productivity decomposition, in which labour productivity in the examined industry, or the entire business sector, is broken down into average productivity and a covariance component. This component is large and positive when the largest companies are the most productive and companies showing the lowest productivity are small. Because the workforce can in this case be regarded as being efficiently allocated between companies with various productivity levels, the covariance component can be interpreted as an indicator of efficient allocation.

For instance, Goldin et al. (2023) observe, above all by using the Baqaee & Farhi's (2020) method, that a decline in allocation efficiency explains approximately 42% of the slower development of total factor productivity in the United States between 2007 and 2014. They also consider this a good estimate for other countries.

The OECD's Multiprod project, using register data, compared variations in labour productivity among companies across different countries and assessed the impact of resource allocation efficiency on aggregate productivity (Berlingieri et al., 2017). In OECD Economic Survey Report: Finland 2020 (OECD, 2020), the project's results are used to compare allocation efficiency in manufacturing industries in Finland and the other Nordic countries. The findings indicate that lower productivity of the Finnish manufacturing industry compared to Sweden, Norway and Denmark is explained by inefficient allocation (Figure 4).

Figure 4. Labour productivity in manufacturing by component, 2011 (USD thousand purchasing power adjusted, 2005 prices).

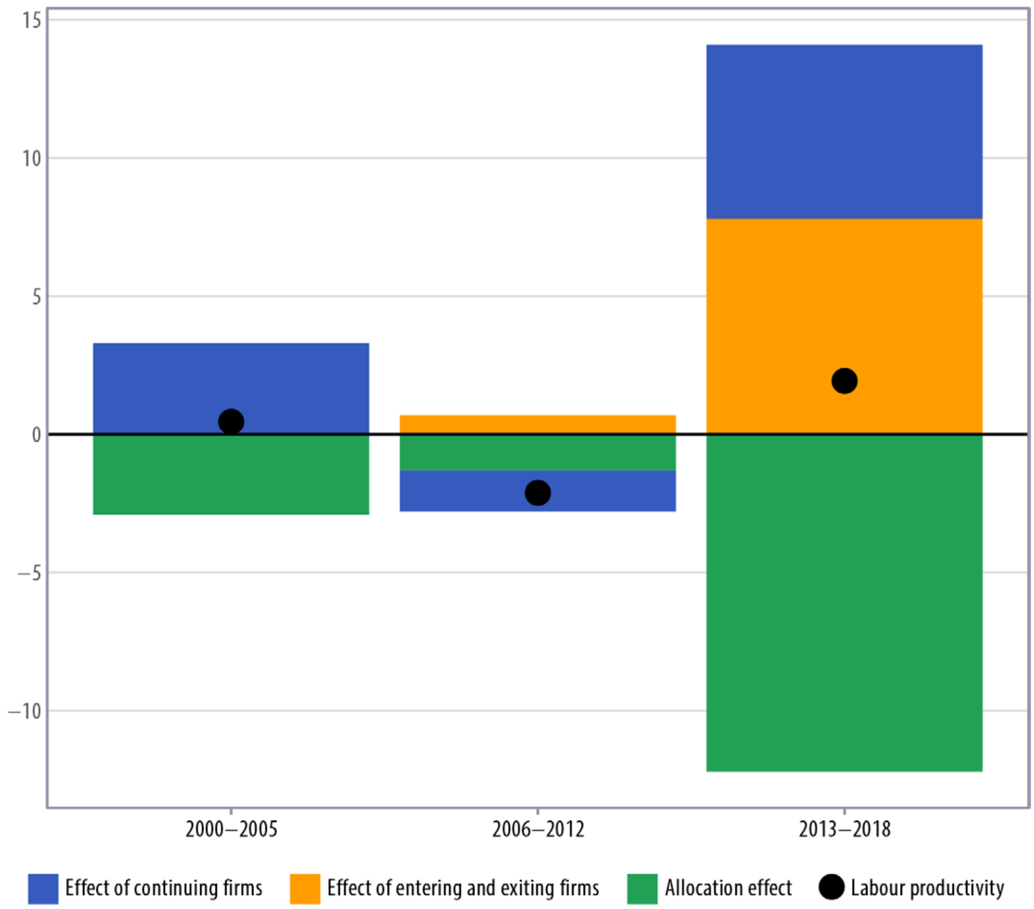


The Finnish Productivity Board’s report (2021) found that labour productivity in the Finnish manufacturing industry was only 74% of the corresponding figure in Sweden in 2011, whereas the average productivity of companies in the manufacturing industry was 90% of this average in Sweden. This indicates that the lower labor productivity in Finland's manufacturing industry is mainly attributable to a diminished value of the covariance term, a measure of allocation efficiency, which was only around 51% of Sweden's corresponding value. It is likely that this phenomenon is partly due to the negative technology shock described above, resulting in an excess of labour and capital in the electronics industry and related sectors in relation to strongly declined productivity.

Based on a study by Kuosmanen and Kuosmanen (2022), the Finnish Productivity Board’s report (2022) noted that the deterioration in resource allocation continued and contributed to cancelling out the positive labour productivity development that took place within companies and due to market entry and exit even after 2012 (Figure 5). Based on Kuosmanen et al. (2022) and Dai et al. (2022), the same report found that the allocation of both labour and capital resources was distorted in many industries. Many companies appear to be employing less labour and more capital than would be optimal for profit maximization. This phenomenon indicates challenges in the availability of skilled labour and the regulation of the labour market on the one hand and, on the other, distortions in capital taxation. At the national economy level, better allocation of resources, while maintaining the available technologies and resources, could increase productivity significantly.

The reallocation of labour force is ultimately about finding a new employee suitable for a newly created job, whereas an employee who has lost their job must find a new job in which they can put their capabilities into productive use. This requires investments in intangible and tangible capital in companies, workers' investments in new human capital, and mobility of workers between jobs. While Eurostat statistics show that the mobility of workers between jobs in Finland is at a high level by European comparison and almost on par with Sweden and Denmark, matching workers to new productive jobs inevitably takes time. This may explain why labour allocation can be ineffective for a long time after a negative technology shock.

Figure 5. Productivity growth in the business sector declined due to the deteriorated labour allocation, percent



Fornaron et al. (2021) systematically compare five different types of productivity decompositions and their results produced with Finnish data. One of them is a version of the Olley-Pakes decomposition suitable for examining the development of productivity over time; the others decompositions are from Foster et al. (2001), Griliches & Regev (1995), Holm (2014), and Böckerman and Maliranta (2007). In these decompositions, productivity development is thought of as being divided into internal productivity development in companies on the market, change in average productivity resulting from changes in relative sizes of companies (‘between component') as well as changes in productivity caused by the emergence of new companies and exit of old ones. Decompositions may also include correction terms that add specificity to the approximation used in the decomposition and are often referred to as cross-terms.

Fornaro et al. (2021) compare the results of these decompositions at the levels of companies and establishments in the same time intervals, or 2000–2005, 2006–2012 and 2013–2018, as shown in Figure 5. Similar to Figure 5, in the period 2006–2012 which includes the financial crisis and the shock that hit the electronics industry value chain, an exceptional drop in labour productivity is observed in nearly all decompositions, whereas in the period before and after it, productivity growth in the business sector is positive. On the other hand, in all decompositions of Fornaron et al.'s study, the most significant factor affecting the change in productivity in each period is the internal productivity growth of companies. In Böckerman and Maliranta's decomposition (2007), the shifting of labour input between companies has a minor negative impact on productivity development, whereas in other decompositions, the impact of labour reallocation is usually slightly positive. The combined productivity impact of firm entry and exit is positive in terms of economic development during the more usual periods of 2000–2005 and 2013–2018 in other decompositions besides that of Böckerman and Maliranta (2007), which probably can primarily be explained by the loss of low productivity companies.

While numerous decompositions have been proposed in research literature, most of them have significant methodological shortcomings (Kuosmanen & Kuosmanen, 2021). Firstly, the productivity figures aggregated at company level may differ significantly from the productivity figures calculated at aggregated level in most decompositions; in other words, they include an aggregation bias. Of the decompositions referred to above, only those proposed by Böckerman and Maliranta (2007) and Kuosmanen and Kuosmanen (2021) are able to aggregate establishment or company level productivity figures to the level of the sector or the entire national economy without bias. On the other hand, companies whose value added is temporarily zero or negative must be excluded from the productivity calculations based on productivity figure logarithms. As the objective is to examine the productivity impacts of structural change, in particular, the decision to exclude loss-making companies from the scrutiny as a basic premise appears questionable. More efficient allocation of the resources of companies producing negative value added ('zombie companies') would have the greatest marginal impact on aggregate productivity. These factors explain why the findings of Kuosmanen and Kuosmanen (2022) differ to some extent from the results of Fornaron et al. (2021).

Finally, a background report for this report (Kuosmanen, 2023) examines separately the relationship between misallocation of labour and capital, and labour productivity. The analysis reveals a significant negative correlation between labour allocation and labour productivity, emphasising the importance of efficient workforce allocation. In other words, a higher level of distorted labour allocation between companies is related to lower labour productivity. While the magnitude of the regression coefficients is very small, statistical significance indicates a systematic negative correlation of poor allocation with labour productivity.

The available evidence indicates that resource allocation is a key factor in the development of productivity at the level of both companies and the national economy. Well-allocated resources promote productivity growth and economic wellbeing, while inefficient or even distorted resource allocation leads to productivity losses. In Finland, attention should be paid to effective market functioning to ensure that the workforce would be effectively reallocated from low-productivity jobs to companies of higher productivity. This would improve the competitiveness of the national economy and create sustainable economic growth.

1.5 Shortage of high productivity companies

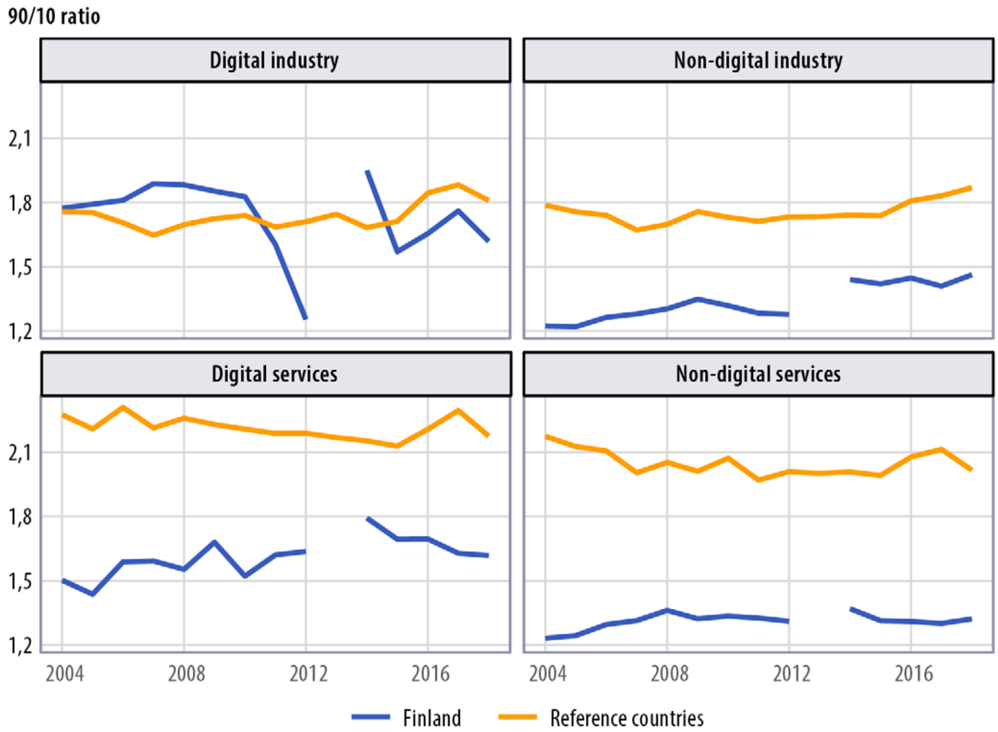
As we have seen, the covariance component can be used to describe allocation efficiency in the Olley-Pakes decomposition. The efficiency of resource allocation can additionally be measured using several other indicators. The 90-10 log ratio of productivity is a commonly used indicator of dispersion of companies' productivity. It refers to the ratio of companies at the top 10% and companies at the bottom 10% of the productivity dispersion. If the value of this indicator is two, for example, this means that the total factor productivity of a high-productivity company is twice that of a low-productivity company.

According to Berlingier et al. (2017, p. 26), the dispersion of both labour productivity and total factor productivity is exceptionally low in Finland, both in the manufacturing industry and in market services. Figure 6 shows that the dispersion of total factor productivity between companies is lower in Finland than among the reference countries. Digital industry, in which the dispersion of productivity was higher than in the reference group at the beginning of the period under scrutiny but decreased after the collapse of a high-productivity company (Nokia), is again the exception. In other sectors, the dispersion of productivity has also remained relatively unchanged over time.

A low dispersion of productivity may be explained by competition being too tough for low-productivity companies to survive on the market. On the other hand, a high dispersion of productivity may also be a sign of intensive innovation, which has allowed companies at the forefront of technology to get away from others. This is why a low dispersion of productivity may also indicate a lack of high-productivity companies or their insufficient share of inputs and production.

In Finland, companies' profit margins are lower than in the reference country group on average; dynamic indicators also point at continuous renewal of production activities at the company level (Finnish Productivity Board, 2022, Sections 6.5 and 6.6). Consequently, it could be said that the low productivity ratio indicates a lack of high productivity companies in Finland.

Figure 6. The 90-10 ratio of productivity by industry.



Source: OECD MultiProd project, http://oe.cd/multiprod, December 2021

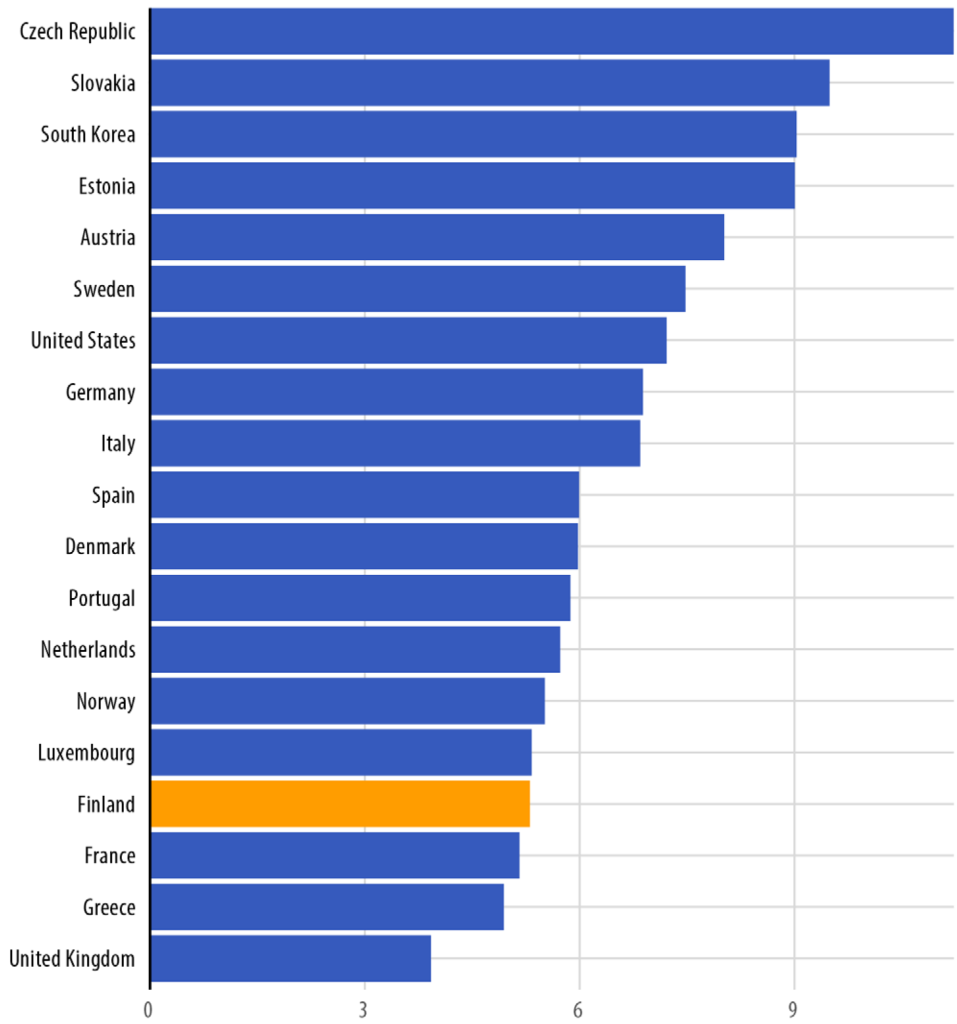
In 2006–2010, industry experienced a negative productivity shock. This was entirely due to the highly negative productivity growth of old high-productivity companies in practice. In addition, these high-productivity companies were losing their labour share, whereas new companies increased their productivity rapidly. On the one hand, an industry-specific analysis shows that new and young companies had simultaneously started to boost the productivity development of industrial sectors. On the other hand, the fact that the productivity growth rate in cohorts after 2006–2010 has been slower than in other groups of companies is a cause for mild concern, and the same microdynamics has not been seen in them as in the cohort of 2006–2010. (Koski et al., 2023).

The renewal of business structures is taking place faster in private services than in industry. Typically, the labour shares of new and young companies grow and those of old companies, in particular, decrease. There are also signs of accelerating renewal in private services.

1.6 Investment

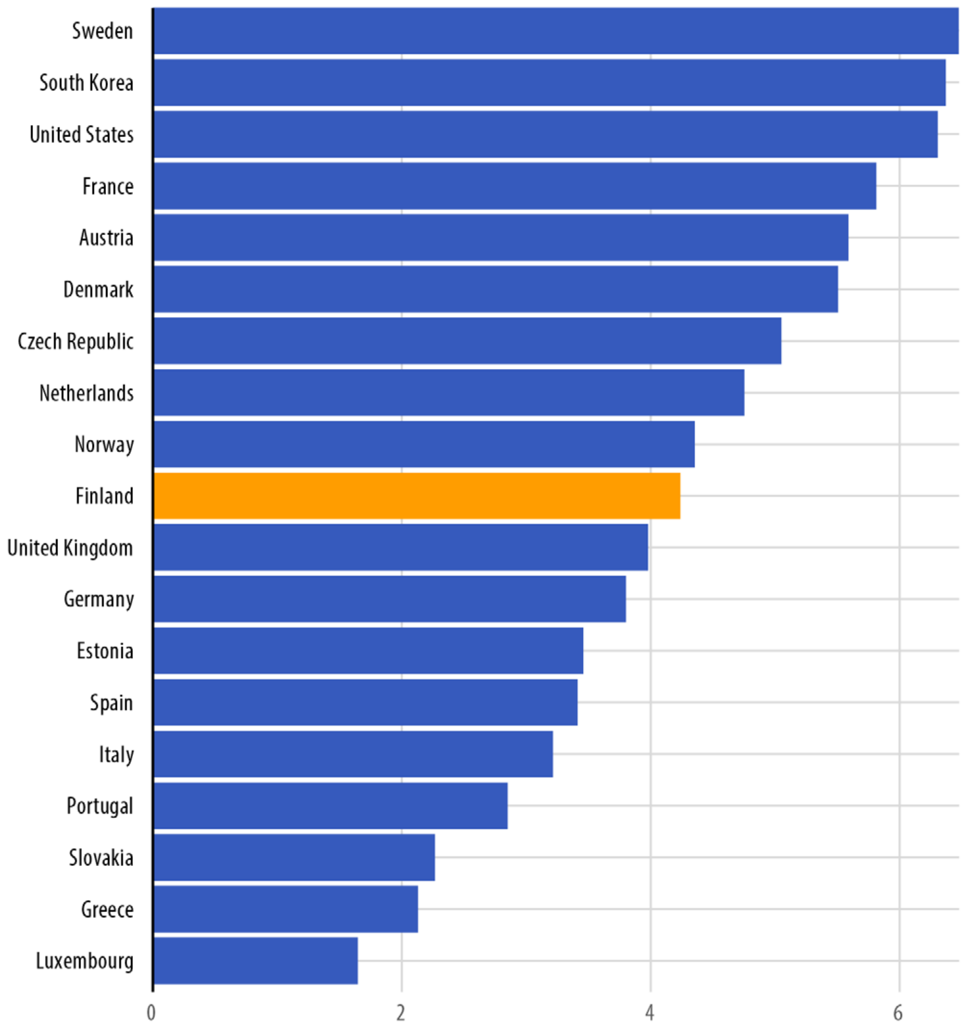
While business sector investments are relatively high as such in Finland, Finnish companies invest more in buildings and less in machinery and equipment as well as intangible capital than companies in the reference countries. See Figures 7 and 8 for investments in machinery and equipment as well as intangible investments in Finland and the reference countries based on national accounts data. The situation regarding investments has not improved significantly even after the upturn that started in 2015.

Figure 7. Investment in machinery and equipment to GDP ratio, median 2015 Q1 – 2023 Q2%.



Source: OECD

Figure 8. Intangible investment to GDP ratio, median 2015 Q1 – 2023 Q2%.



Source: OECD

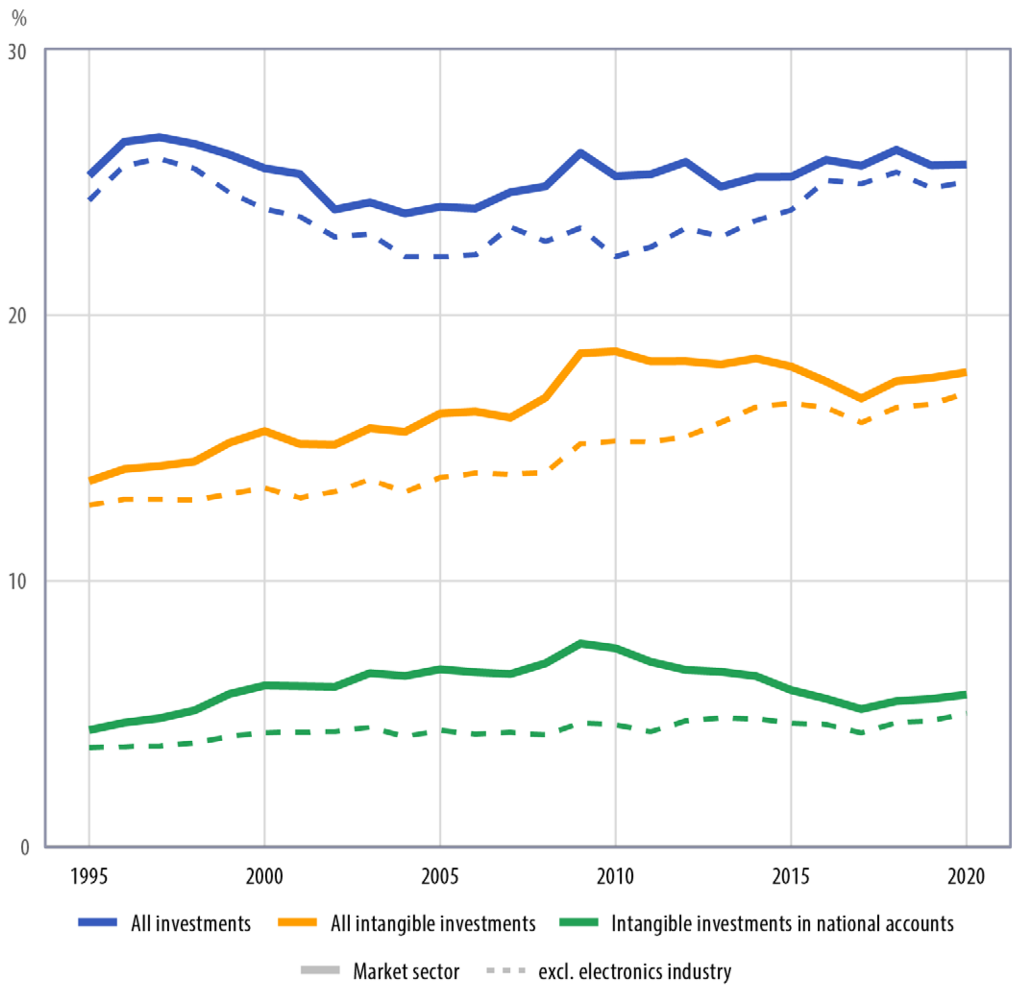
On the other hand, national accounts only recognise some of the actions aimed at improving the company's future income flow as investments. Most of the real market sector investments are made in intangible capital (Figure 9). While digitalised information as well as research and development are considered investments in the national accounts, companies' inputs in financial capability are not. These inputs have a major impact on companies' future growth, however, and companies' investments in them outweigh the intangible investments included in the national accounts.

There is a difference between the accumulation of tangible and intangible capitals. Unlike tangible capital, intangible capital can often be duplicated with small or non-existent costs. Intangible capital may also unintentionally spread between companies, among other things through employee mobility (Stoyanov & Zubanov, 2012). In particular, employee mobility associated with research and development appears to be linked to the rate of productivity growth in companies (Maliranta, Mohnen, & Rouvinen, 2009).

Intangible investments and intellectual capital are very difficult to measure. Evidence of this includes the fact that the market values of the world's largest companies are typically many times higher than the balance sheet values presented in their financial statements (Corrado et al., 2022). The system of national accounts has been developed for years to identify and measure intangible investments more accurately.

Despite these development efforts, many intangible investments (and intellectual capital) remain excluded from official national accounting systems. Due to the importance of this matter, researchers in economic growth have produced complementary calculations alongside official accounting data, which complement the data on intangible investment and capital. Necessary corrections to the production data in the national accounts have also been made in this context (Corrado et al., 2022).

Figure 9. The ratio of all investments, all intangible investments, and intangible investments included in the national accounts to value added corrected with intangible investments in the market sector (solid line) and in the market sector excluding the electronics industry (Industrial Classification TOL 26) (dashed line).

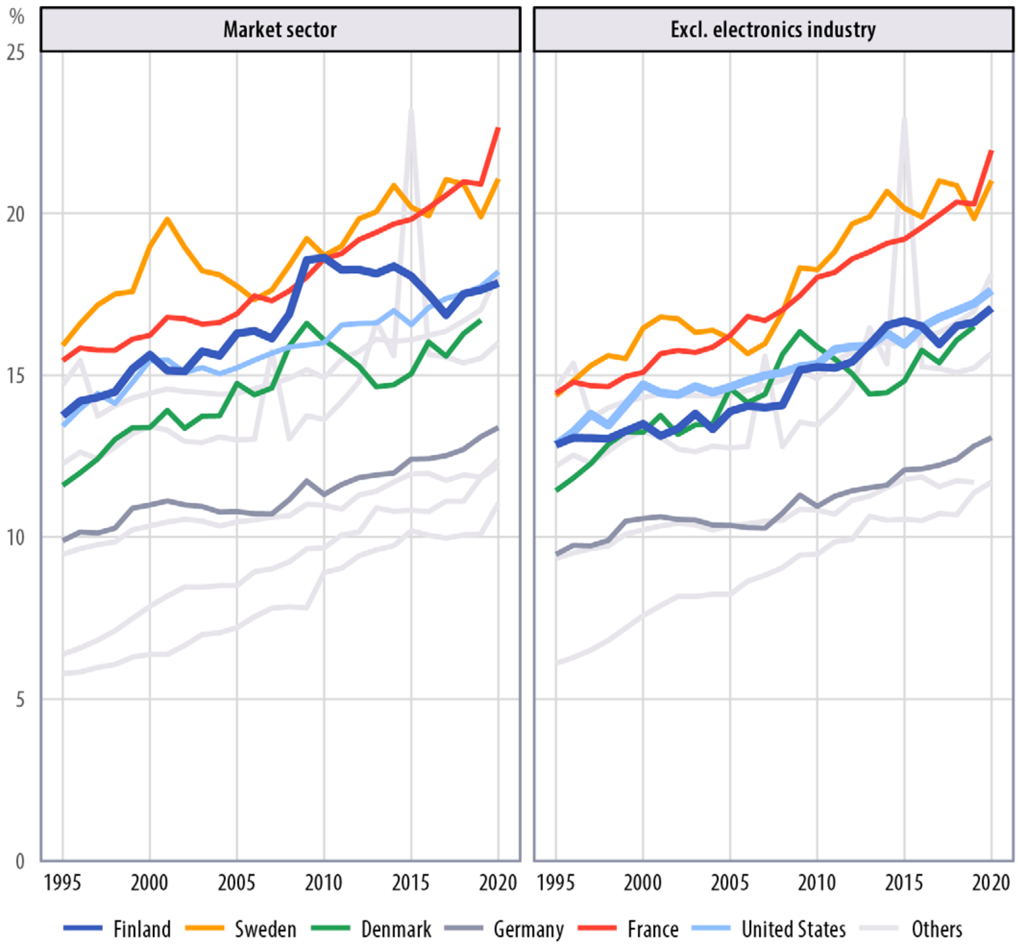


Source: Calculations from Bontadini et al., (2023).

The Finnish market sector had made relatively large investments in intangible capital, and the ratio of intangible investments to value added in Finland has been among the highest in the world (Figure 10). Unfortunately, the relatively high rate of intangible investments does not tell the whole story. Intangible investments have been particularly large in the electronics industry, and in some cases their yields were poor after Nokia's collapse in 2008.

The investment ratio of the entire market sector was increased and kept high by the collapse of value added in the financial crisis and weak growth since then. On real terms, intangible investments have hardly increased in Finland since the financial crisis, whereas most countries have seen a growth of as much as 50% by 2020.

Figure 10. Ratio of intangible investment to value added in the market sector in Finland and reference countries. The other countries are Belgium, Spain, Italy, the Netherlands, Austria, Britain and Norway.



Source: Calculations from Bontadini et al. (2023)

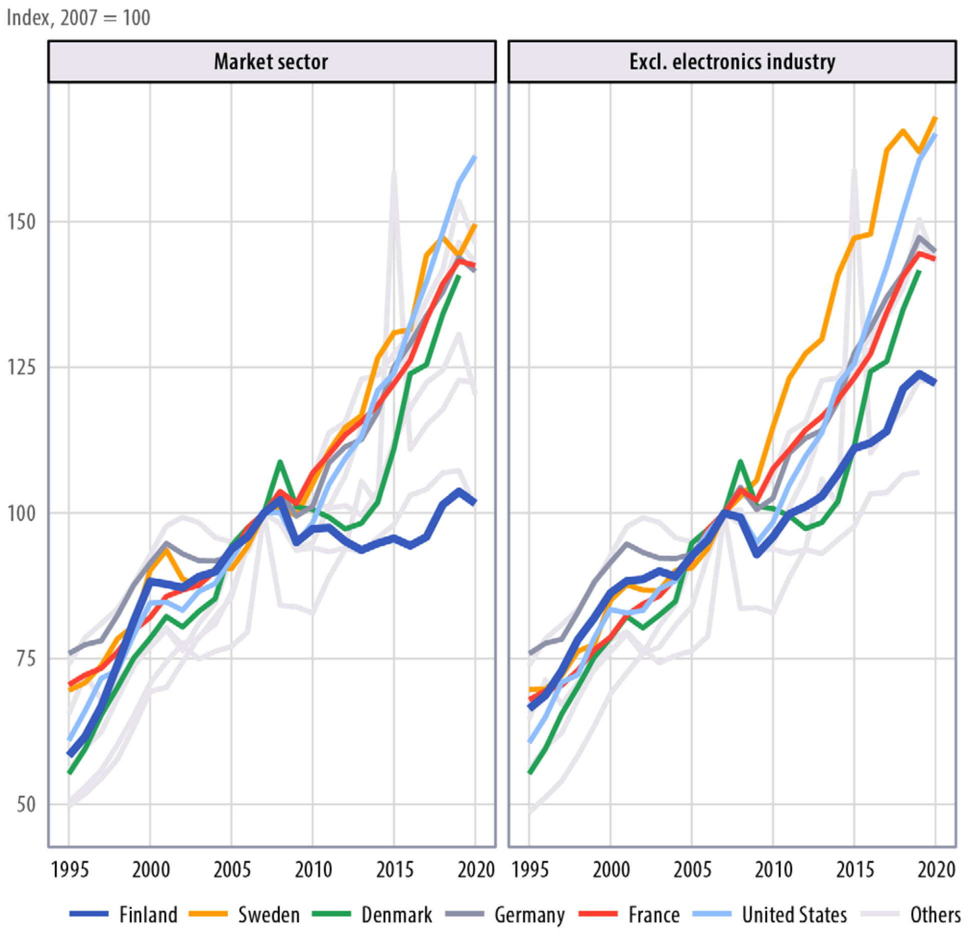
If the electronics industry is excluded, the picture is more hopeful. While Finland has not been at the forefront of intangible investments, their level has been reasonable. Excluding the electronics industry, intangible investments have also been growing. This growth has been somewhat slower than in the reference countries, however.

In addition to investments, the ratio of intangible investments to value added also depends on changes in value added and prices. Intangible investment volume development aims to describe the trend in investments at constant prices. This naturally involves a great deal of uncertainty, as measuring the prices of intangible investments is challenging (see Box 1).

However, the trend in the volume of intangible investments paints a similar picture as the investment ratio, however with the difference to reference countries being emphasised in volume series (Figure 11). The investment ratio compared to the reference countries is decreased by growth in value added, which has also been slower in Finland than in the reference countries.

The importance of the electronics industry in Finland's intellectual capital investments is underlined by the fact that after 2007, the volume of intangible investments in the Finnish market sector has not increased at all in practical terms, whereas in most reference countries it has gone up by about 50%. The volume of intangible investments has also increased in Finland in the market sector excluding the electronics industry, however clearly more slowly than in the reference countries.

Figure 11. Development of intangible investment volumes in Finland and the reference countries in the market sector and the market sector excluding the electronics industry, index 2007 = 100.

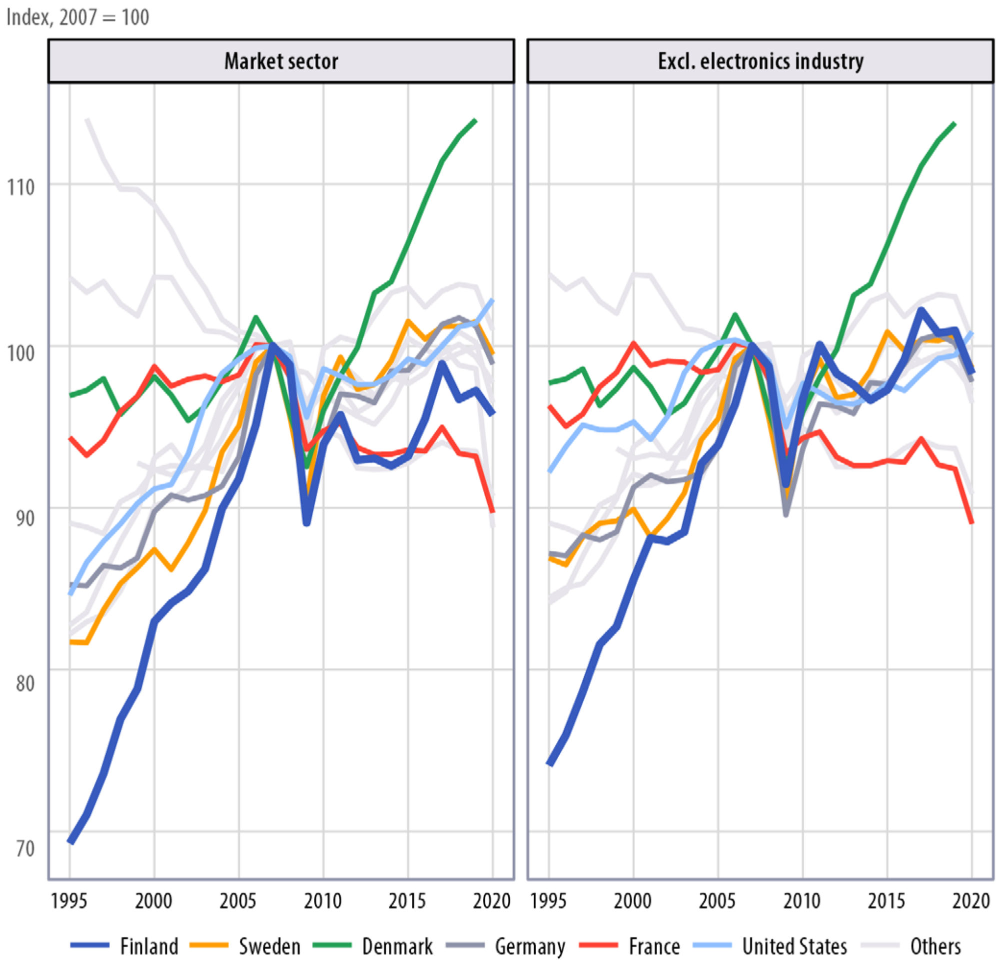


The share of increase in production that cannot be explained by a change in production inputs, capital, labour, energy, material inputs, outsourced services, quantity or quality is called total factor productivity growth. While total factor productivity is often interpreted as technology, the concept of technology needs to be interpreted in a very broad sense here. This means that anything that improves productivity with the given inputs is regarded as technology, including better management and resource allocation.

Technological development and innovation are the ultimate drivers of economic growth. Theoretically, technological development in fact explains companies' investments in tangible and intellectual capital. The development of AI technology, for example, is also reflected in companies' investments in new processors (tangible capital) and applications (intellectual capital). Consequently, we could say that total factor productivity is the most interesting factor in the so-called growth calculation. As it is the residual term of the calculation, all possible measurement errors of output and inputs affect it directly. For example, if the change in the volume or quality of intangible investments has a downward bias, the development of total factor productivity has an upward bias and vice versa.

In 1995–2008, the Finnish market sector experienced strong growth in total factor productivity (Figure 12). The annual growth in total factor productivity in Finland was 2.3%, while this figure was 0.9% in Sweden and 0.7% in the United States.

Figure 12. Development of total factor productivity in the market sector, 2007=100



Source: Bontadini et al. (2023). NB: ‘bottom-up’ approach.

The total factor productivity of the market sector collapsed in Finland in 2008–2009, however. Since then, growth has been very slow. In 2009–2020, the annual growth in total factor productivity in Finland was 0.3% on average. In Sweden, for example, this figure was 0.8%, while it was 0.4% in the United States. The slower growth than in the reference countries in total factor productivity is, however, mainly explained by the decline of the electronics industry in Finland. In the market sector excluding the electronics industry, the growth in total factor productivity has been quite similar to that in key reference countries. The decline in total factor productivity in most countries in 2020 was affected by the COVID-19 crisis.

The slowest increase in total factor productivity was recorded in France in 1995–2020. It should be noted that, as we saw in the above analysis, intangible investments in France were exceptionally high compared to other countries. This observation indicates that when interpreting the measurement results of intangible (and other) investments, the development of total factor productivity should be taken into account. France's results can be interpreted to mean that inefficient investments were made at the expense of total factor productivity.

No significant turnaround is foreseen in productivity growth, which has remained sluggish globally, in the future. Box 2 examines the recent potential of new AI technologies to influence the development of productivity growth.

BOX 2. PRODUCTIVITY IMPACTS OF AI[2]

Modern AI technologies, especially such *large language models* (LLM) as ChatGPT (*generative pre-trained transformer*, GPT), have evolved in leaps and bounds in recent years. This technological advancement has attracted numerous companies to invest in AI (Babina et al., 2023) and driven the demand for AI experts (Alekseeva et al., 2021). Artificial intelligence has potential to increase productivity by improving existing production methods and, according to optimistic views, it may bring about a similar impact on productivity as previous major general-purpose technological innovations, including the steam engine, electricity or the internal combustion engine.

Recent studies indicate that generative artificial intelligence can increase labour productivity, for example in word processing (Noy & Zhang, 2023) and customer service tasks (Brynjolfsson et al., 2023). Companies that invest in AI technology (Babina et al., 2023) and participate in developing it (Alderucci et al., 2020) additionally appear to grow faster and employ more people. In general, however, it is still difficult to fully assess the broader impacts of artificial intelligence on productivity. Even the most optimistic views accept that, rather than new technologies having an immediate impact on productivity, productivity gains may be seen with a significant delay.

[2] The impact of AI on productivity development is examined in detail in a literature review by Elsi Etelävuori, a Ministry of Finance trainee (2023).

While AI has been developed since the 1950s, modern forms of artificial intelligence are seen as a significant step forward in the revolution of information and communication technology (ICT). The ICT revolution has continued for the past thirty years. In United States, a country at the forefront of this technology, productivity growth accelerated in 1995–2005, only to later return to the pace seen before the mid-1990s (Fernald et al. 2017). Growth of earnings has also slowed down. This contradiction between technological development and productivity growth is commonly known as the Solow paradox, named after Robert Solow, winner of Nobel Prize in Economic Sciences. Some of the views concerning the impact of AI on productivity are pessimistic, while others are optimistic. The pessimistic view is underpinned by the idea that AI has limited potential to influence productivity, and the impacts may be short-term at best. Such authors as Gordon (2017) argue that the current digital technologies will not have the same impact as earlier technological transformations, as they only focus on specific areas of activity. He also points out that most of the productivity benefits of automation that ensued from digitalisation have already been achieved since the 1990s. According to Acemoglu and Johnson (2023), on the other hand, a precondition for achieving the wider positive impacts of AI is that it complements workers' competence in their current tasks and creates new, more productive tasks.

From the optimistic viewpoint, there are several possible explanations for the productivity paradox, including unrealistic expectations, errors in measuring human capital, income redistribution and delays in implementation. Brynjolfsson et al. (2021) pinpoint as the most important explanation for the productivity paradox the fact that the impacts of AI have not spread widely enough yet, and in order for AI to reach its full potential as a general-purpose technology, combined effects with other innovations are required. For example, the effects of technology on companies and productivity may only be fully reflected in productivity statistics with a long delay (David, 1991) and may require complementary organisational changes (Brynjolfsson & Hitt, 2000). According to Brynjolfsson et al. (2021), total factor productivity growth follows a ‘J curve’ after the introduction of a new general-purpose technology. In the beginning, productivity will decrease as intangible investments that complement the technology but are not productive grow in relation to other investments. Once the benefits of intangible investments are realised, productivity growth will later be overestimated.

Brynjolfsson et al. (2021) believe that the main economic impacts of new technologies are due to their general-purpose characteristics. Examples of such general-purpose technologies include the steam engine, electricity and the internal combustion engine mentioned above, which have directly increased productivity and inspired important complementary innovations. Artificial intelligence clearly has potential to become widespread, develop over time and give rise to complementary innovations, which means that it may become a general-purpose technology. Pratt (2015) argues that combining ICT with other new technologies, especially robotics, will lead to a significant improvement in the standard of living.

The potential of AI to act as a general-purpose technology can be assessed by examining the typical features in the development of previous general-purpose technologies. The introduction of a general-purpose technology will, according to Jovanovic and Rousseau (2005), stimulate business dynamics and increase the number of patents, young companies will enter the market, and investments by young companies will grow. In connection with previous technological waves, wage premiums associated with skills have additionally increased, total factor productivity growth has slowed down at the beginning of the wave, and more new companies have been established. According to Goldin et al. (2023), however, several factors in the United States appear not to be consistent with previous technological waves, including pay development and business dynamics.

It has also been claimed that, with the help of information and communication technology, AI could accelerate new scientific discoveries (King et al. 2009; Sparkes et al. 2010) and technological innovations (Cockburn et al., 2019). Automation would reduce innovation costs and could accelerate productivity growth. Improved productivity in scientific research would also balance out the recent slowdown in the pace of innovation (Bloom et al. 2020). An extreme scenario refers to a ‘technological singularity’, in which accelerating technological development would challenge the position of humanity as a whole (Sandberg, 2013). However, Nordhaus (2021) does not find convincing evidence to indicate that economic growth would accelerate significantly once the increase in knowledge, technology and artificial intelligence has exceeded a certain limit.

As in the case of previous major technological advances, AI deployment may also lead to transformations in the labour market, and productivity growth may only benefit a small part of the population. AI deployment may make occupations and part of the workforce obsolete as automation progresses (Korinek, 2022). Unless AI simultaneously improves worker productivity, its deployment may increase unemployment and slow down the growth of real wages (Acemoglu & Johnson, 2023) or reduce the income share of labour (Hémous & Olsen, 2022).

Artificial intelligence can also create other societal challenges, such as increasing cybercrime (Guembe et al., 2022) and discrimination based on algorithms (Lee et al., 2019). In addition, collection of the big data needed to develop artificial intelligence raises questions of protection of privacy and copyrights (Jin, 2018). The potential negative effects of AI have increased the need to regulate its development. For example, the EU is about to introduce new legislation to regulate AI (European Parliament, 2023). The challenge lies in finding a balance between protecting the rights of individuals and businesses on the one hand, and excessive regulation and interference with technological development on the other (Kerry, 2020). In addition to regulation, education, taxation and subsidisation can provide means for ensuring that as many people as possible will benefit from technological development (Acemoglu & Johnson, 2023).

To sum up, while the current AI technologies can be expected to have positive impacts on business productivity, their wider impacts on productivity remain uncertain. In addition, long delays may occur between the deployment of AI technology and productivity impacts. While clear indications of AI’s potential for being a general-purpose technology are not yet visible, digital technologies, similarly to general-purpose technology, nevertheless have potential to influence many aspects of the economy.

1.7 Lack of skilled workers

Technology and innovations are not created from nothing, nor do they come down as manna from heaven. They take research and development, and experts are needed to carry them out. In order for a new technology developed elsewhere to increase a company's productivity, the company often has to carry out in-house research and development to adopt the new technology and use it in a productive manner (Cohen & Levinthal, 1989; Griffith et al.,2003). Studies also indicate that the demand for experts in a company is typically high at the beginning of its life cycle as it deploys new technology (Bartel & Lichtenberg, 1987). In other words, improvement in productivity has often been preceded by significant inputs from experts over a long period of time. Studies relying on Finnish data indicate that it takes several years for an increase in the number of experts employed by a company to be reflected as an improvement in its productivity.

Against this background it is worrying that, according to a corporate survey conducted by the European Central Bank, the availability of skilled managers and workers is one of the most important barriers to growth faced by Finnish SMEs. The shortage of experts plays an important role in the development and deployment of technology (Koski et al., 2023). A recent wage study based on individual data also shows that the salaries of highly educated workers are increasing faster than those of other groups (Fornaro & Maliranta, 2023). Workers who have a higher tertiary degree in science, technology, engineering and mathematics and who have changed employers have seen a particularly rapid increase in their pay. This observation suggests that companies are increasingly competing for those workers who are often needed for developing and deploying new technologies.

The scarcity of experts needed to develop new technologies may lead to a situation where attempts to increase Finland's R&D expenditure to 4% of GDP may boost actual R&D activities less, and productivity impacts may remain clearly more modest, than has been hoped. The shortage of experts may also increase the costs of R&D.

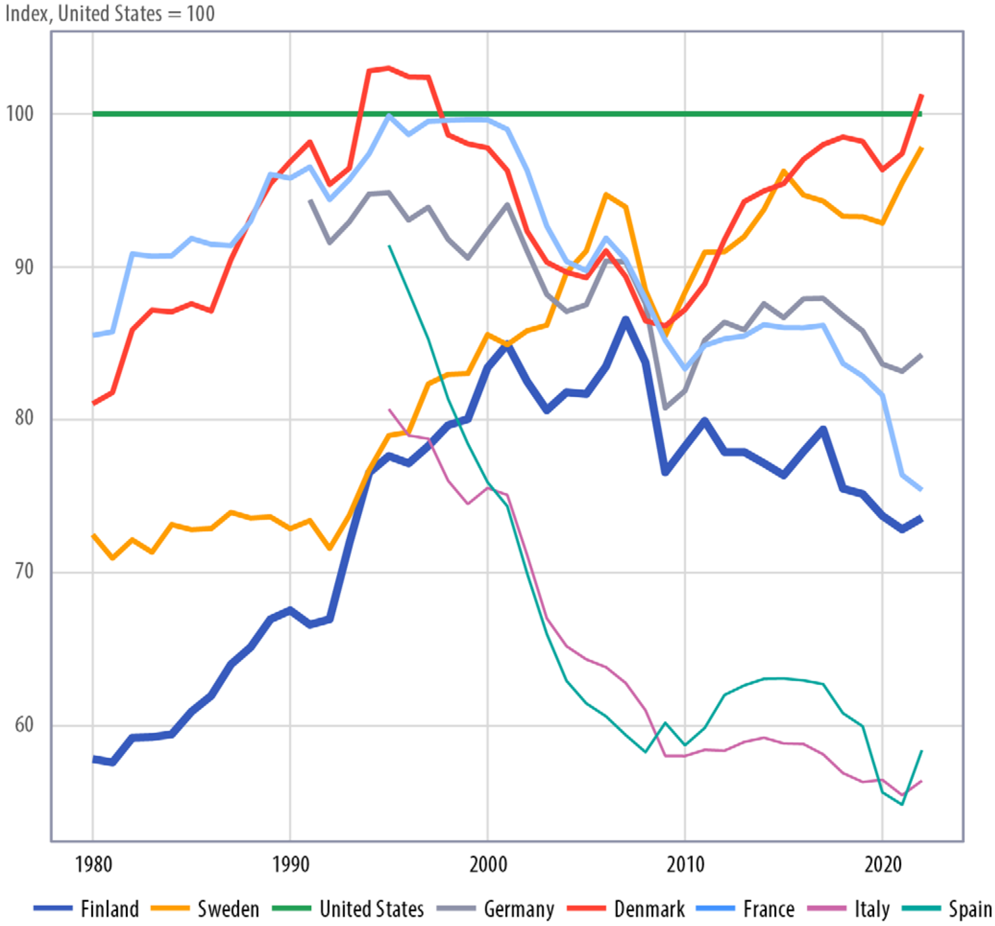
1.8 Convergence club

Research in growth and development has found that economies with lower income and productivity levels are not necessarily catching up with the global leaders. You could expect these economies to have an advantage as they could deploy technologies and practices tried and tested in more developed economies, in which case rapid growth and catching up with the leaders would be common. However, this is often not the case. As a conclusion, researchers have come up with the idea of convergence clubs (Baumol, 1986; Quah, 1996a, b; Rassekh, 1998). In short, this means that economic institutions and other permanent characteristics determine an economy’s capability to close the gap to the global leaders. These factors determine how close to the global leaders a member of each club can get. The idea has been applied in a wider context than GDP development alone, including in Akram et al. (2023), Islam (2003) and Tomal (2023).

Goldin et al. (2023) noticed that narrowing the gap did not affect productivity growth in the countries under review (France, Germany, Japan, UK) in 1995–2005. Consequently, catching up more slowly cannot explain the more sluggish productivity growth in the next period.

See Figure 13 for business sector productivity in the reference countries in relation to development in the USA. The Figure shows how Finland approached the global frontrunners, thanks to rapid productivity growth in such sectors as the electronics industry, until 2007. Since then, the gap between Finland and the frontrunners has widened again. Figure 13 also shows how Sweden and Denmark have in recent years been able to close the productivity gap in relation to global leaders, whereas in some countries, including Finland, the gap has grown wider rather than narrower. The convergence club is not a law of nature, and by reforming economic structures, the gap can be narrowed or even closed. We should establish if Finland's institutions or other relatively permanent structures contain some feature that prevents us from closing the productivity gap.

Figure 13. Labour productivity in the business sector in relation to the United States. Productivity in the United States in 2022 was estimated based on labour productivity in the economy as a whole. Source: Eurostat, OECD, GGDC and the Finnish Productivity Board.



2 Intellectual capital

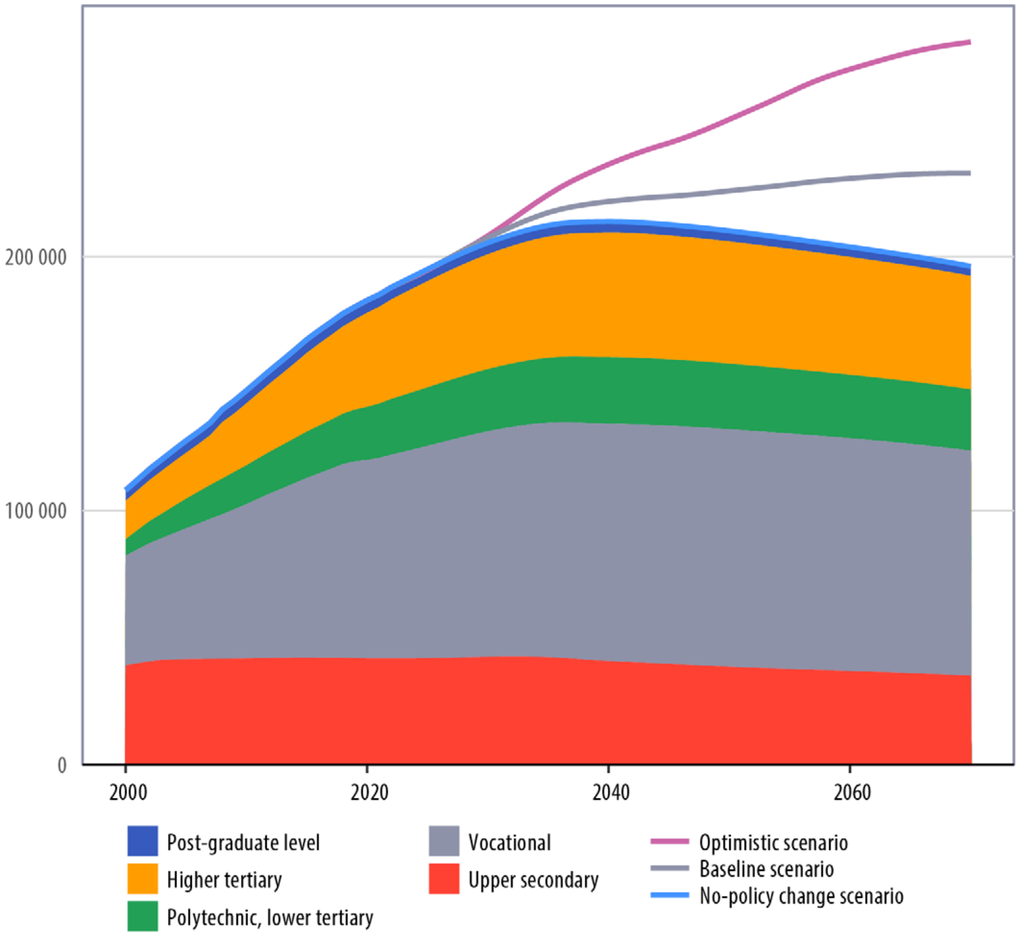
Intellectual or human capital refers to the knowledge, skills, competences and other characteristics of individuals or groups acquired during their lifetime and used to produce goods, services or ideas under market conditions (Criscuolo et al., 2021; Égert et al., 2022). For a more detailed and extensive discussion of the significance of human capital at the company level, see two background memoranda (Jurvanen, 2023; Kangaspunta, 2023).

In Bank of Finland’s new long-term macro model, productivity development is explained by growth in the intellectual and tangible capital stock of the economy; the latter is also influenced by technological development of capital products (Mäki-Fränti et al., 2021a, 2021b, 2023). In this model, intellectual capital is interpreted as the knowledge and skills of the working-age population accumulated through education and completion of qualifications and degrees. Other acquisition of competence is not regarded as an investment in intellectual capital in this model.

The volume of human capital in Finland has increased since the late 19th century. Its development has been supported particularly by a continuous improvement in the working-age population’s average level of education. However, there is a risk of the improvement in the level of education stalling in the next few decades. On average, new cohorts entering the labour market are still better educated than retiring ones, but the average education level of the youngest cohorts has already started to decline. In the meantime, the number of completed higher education degrees has decreased, while the number of vocational qualifications has increased.

See Figure 14 for the development of human capital in a situation where the decline in the working-age population continues according to the population projection, and the education level of young cohorts does not improve while their size dwindles. In this scenario, intellectual capital continues to grow in the 2030s but will eventually start declining as we reach the 2050s, and this decline will continue until the end of the projection period at an average annual rate of 0.2% to 0.3%.

Figure 14. Development of human capital based on the population projection. EUR million at 2010 prices.

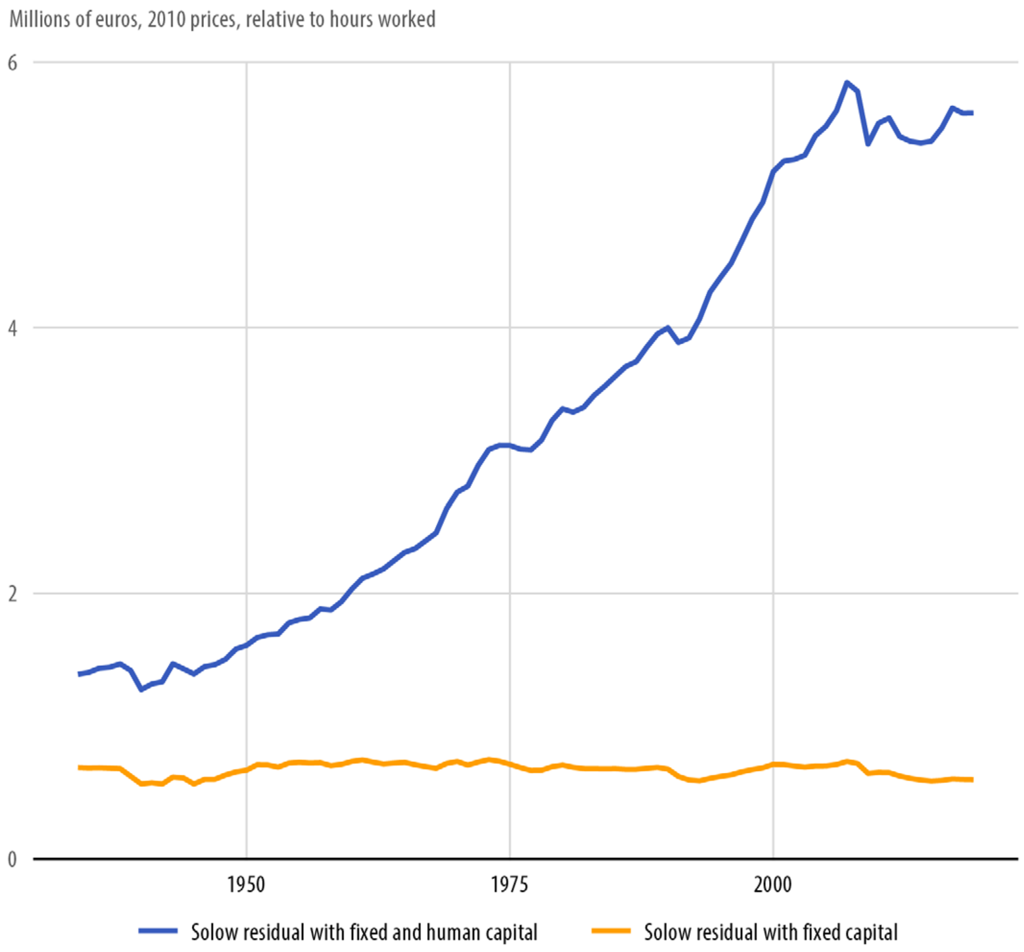


Source: Bank of Finland.

The projection discussed above assumes that no effort is made to actively curb the decline in human capital. In addition to the unchanged policy scenario, the Bank of Finland has looked at two more optimistic scenarios, in which attempts are made to prevent the reduction in human capital. In the basic scenario, the amount of education expenditure per student is increased in the 2050s and 2060s to equal its levels in the late 1980s and early 1990s. In this scenario, the growth in the human capital volume would slow down significantly in the 2040s and stop in the 2050s. In the third, more optimistic scenario, work-based immigration is additionally increased gradually, amounting to 6,000 people more than today in 2050–2070. With these more optimistic assumptions, intellectual capital would grow until the end of the projection period, even if the growth slowed down significantly in the 2040s.

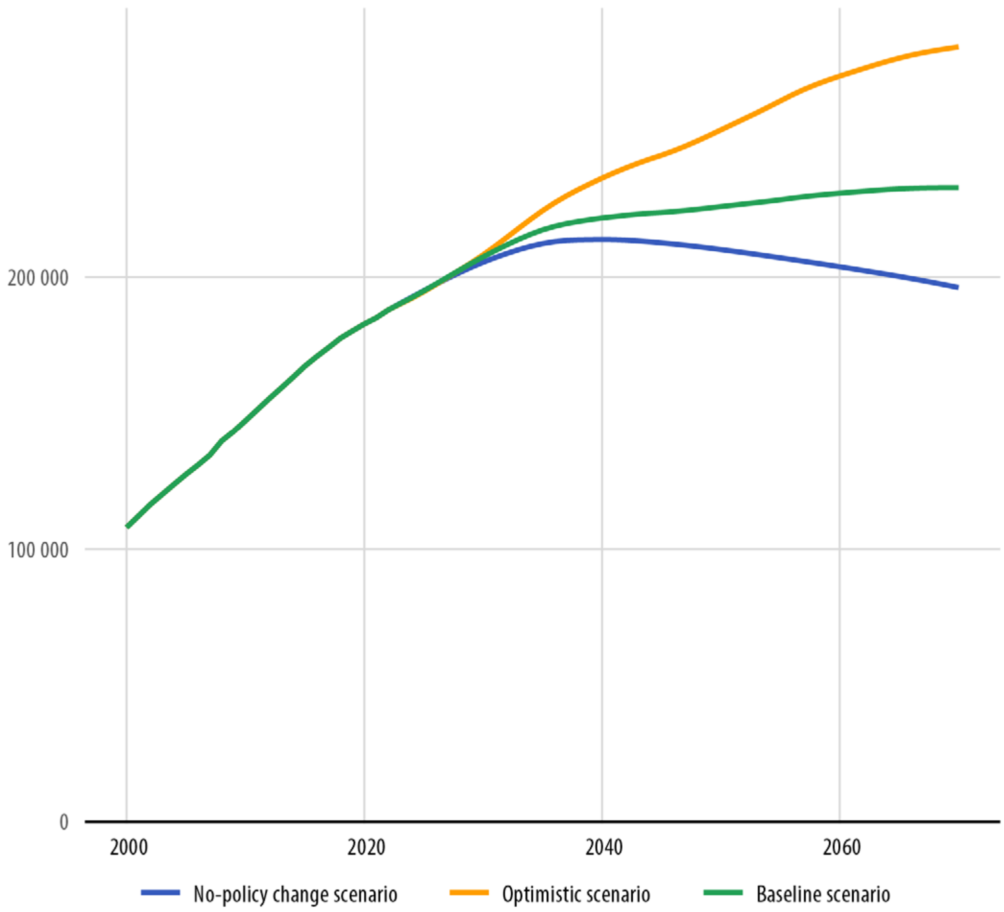
Intellectual or human capital is a key factor in a worker's productivity. Skills, abilities and competences correlate strongly with productivity, not only at the individual level but also at the levels of companies, countries and even urban areas (Becker 1962; Mincer, 1974; OECD, 2016b; Haltiwanger et al., 1999; Mankiw et al.,1992; Rauch, 1993; Combes et al., 2012). The population's education level appears to explain well historical productivity development in Finland (Figure 15).

Figure 15. Solow's residual term in models explaining Finland's economic growth, depending on if the independent variable in the model is the ratio of fixed capital to working hours only, or also the ratio of human capital to working hours.



Source: Bank of Finland.

Figure 16. GDP development in different scenarios. EUR million, at 2010 prices.



Source: Bank of Finland.

The decline in education levels and dwindling share of young people threaten to permanently slow down the accumulation of human capital or even turn the development in a negative direction. A decline in human capital would slow down productivity growth and could result in negative growth (Mäki-Fränti et al., 2021a, 2021b, 2023) (Figure 16).

2.1 Education and skills

Improvement in workers' average level of education has played a key role in productivity growth in the OECD countries over the last fifty years. However, the dynamics of human capital and labour productivity have declined dramatically as the increase in the working-age population's average number of years spent in education has slowed down. The slowing growth in human capital and its link to slower productivity growth concern OECD countries across a broad front (Bruneau & Girard, 2020; Bruneau & Girard, 2022).

The OECD's standardised PISA and PIAAC tests have revealed significant differences between countries in pupils' and working adults' literacy, numerical and non-cognitive skills that are vital for productivity. The combined results of the PISA studies in 2000 and 2021 suggest that there is a strong link between students' skills at the age of 15 and later working life skills (Albæk, 2017). Differences between countries observed between individuals in the same occupations have been found to decrease according to the level of the qualification: the higher the qualification, the more it 'guarantees' a high competence level.

The tests have also identified inconsistencies between workers' education level, observed competence and job skills requirements. In an international comparison, 9% to 11% of workers in different countries had skills that were inconsistent (poorer or better) with the skills required in their occupations. Those whose skills were disproportionate to both the skills and education required in the occupation accounted for 17% to 19% of workers. Incompatibility of skills with job requirements can be both a source of employee dissatisfaction and a barrier to productivity growth (Brun-Schammé & Rey, 2021). In order to avoid it, the importance of an integrated and shared strategic vision for higher, continuing and in-service education alike is stressed (NCPC, 2022). A complicated and fragmented education system may hamper the provision of competence and, on the other hand, employers may not be able to make use of the skills that are available, which may indicate a conflict between the offer of skills, career guidance and the labour market (UK Productivity Commission, 2022).

2.2 Concentration of intellectual capital

In recent decades, human capital has increasingly concentrated in the largest urban areas (OECD, 2016a), which has contributed to workforce polarisation and geographical disparities in productivity. A strong positive correlation has been observed between employee productivity and population density. A large and dense supply of workers benefits tasks requiring learning and intensive interaction the most (Gaspar & Glaeser, 1998). The productivity benefits of population density can be measured, and they grow with the cognitive intensity of the sector (Combes et al., 2012).

Labour polarisation, or an increase in highly paid and low-pay jobs at the expense of jobs with a medium pay level, is a phenomenon observed over the past 30 years (Autor et al., 2006; Jolly, 2015; Albertini et al., 2017). It applies to all countries and all development phases (CNP, 2021; Manning, 2019). This phenomenon is explained by the fact that ICTs replace or automate routine tasks performed by medium-paid workers, or that companies replace the goods and services they produce with imports, known as off-shoring (Malgouyres, 2017; ILO, 2016). Companies with more ICT intensive employees are growing faster than companies with fewer ICT intensive employees.

Over the past two decades, the concentration of the most skilled employees in the most productive companies has increased. The difference between highly educated employees in high-productivity and median productivity companies increased by an average of 0.3% a year in the examined countries. Sweden (0.5%) and Denmark (0.4%) were among the countries where this difference grew faster than in others (Criscuolo et al., 2021).

In Finland, companies half-way up the productivity distribution have also increased their shares of highly skilled workers. The average of annual change between median companies and companies at the forefront of productivity in the share of highly skilled workers is -0.1 percentage points. Unlike in most OECD countries, companies with median productivity in Finland have consequently caught up with the most productive companies when it comes to hiring highly skilled workers. For this reason, it does not appear that the highest productivity companies in Finland would be getting away from others regarding employee skills. Managers in the Finnish market sector are highly skilled. This means that better managers would not improve productivity growth (Jurvanen, 2023).

The concentration of the most qualified employees in the most productive companies may reflect an increasing differentiation in the skills structures of companies, where the more sophisticated technologies of the leading companies complement the expertise of highly skilled workers, in particular. However, the ways in which employees' skills are combined in companies to achieve high performance vary by sector and country. For example, the most productive German companies rely more than their counterparts in other countries on workers with medium-level education, which may reflect the effectiveness of the country's education system in producing a good quality workforce with a medium level of education (CNP, 2022b).

2.3 Intellectual capital and productivity of companies

In high-productivity companies, the share of employees with a high level of education is clearly larger than in others, and they have special high cognitive level skills (e.g. ICT related skills) as well as soft skills, including in management and communication.

This is particularly clear in knowledge-intensive sectors. Almost one third (31%) of the difference in labour productivity between leading companies and companies of average productivity is explained by the human characteristics of their employees. (Criscuolo et al., 2021) Increasing its human capital may thus provide a significant opportunity for an average company to catch up with leading ones in terms of productivity (CNP, 2022b).

Managers' skills have a crucial impact on the company's productivity (Criscuolo et al., 2021; Bloom et al., 2019; Siepel et al., 2021) and explain not only the deployment processes of new technologies but also the significant differences in productivity within and between countries. (Hsieh & Klenow, 2009; Hsieh & Klenow, 2014; Syverson, 2011; Restuccia & Rogerson, 2017; Schivardi & Schmitz, 2020). The use of good management practices correlates strongly with the productivity of companies (Bloom, 2007). There are considerable variations in these practices, not only from one company to another but also between a company's different branches (OECD, 2019). Their importance appears to increase in the most productive companies, as they have a greater impact on the most productive employees (Bender et al., 2018). The management practices of the Finnish manufacturing industry are only slightly less effective than those in the United States and on par with Germany (Ohlsbom, 2023). According to findings of Jurvanen (2023), almost all managers in Finland are of high quality based on the criteria of Criscuolo et al. (2021). Consequently, the standard of management is high in Finland by international comparisons, and poor management does not explain the slow productivity growth.

Evidence of the quality of management includes the fact that high-productivity companies invest heavily in intangible assets, such as organisational capital, education, training, research and development, patents and similar, enabling them to increase their productivity through genuine 'forefront innovations'. Good management practices in companies can also have a positive impact on their productivity by making better use of employees' skills in the workplace and by influencing ICT use, as in order to exploit the full potential of their ICT capital, companies must make additional adjustments to organisational structures and culture (Brynjolfsson & Hitt, 2000). Profitable and well-managed companies also appear to have positive spillover effects on companies in the same sector and region, which may be based on employees' and managers' mobility (Bloom et al., 2019). Successful ICT deployment also leads to an increase in wages, which in turn attracts highly educated people from abroad.

Even a management training course of one year has a significant impact on the company's overall productivity (Bruhn et al., 2018). These are long-term and permanent impacts. Management training programmes have been shown to increase the productivity of companies by 30% to 50% over a ten-year period (Giorcelli, 2021). Suitable market conditions and a well-functioning competition system have a positive impact on average management skills in countries. The quality of management and number of competitors correlate positively with each other, as does the prevalence of imports at sectoral level. Companies improve their management practices in response to increased competition (Bloom & Van Reenen, 2007).

Leading companies in terms of productivity have a larger share of employees working in management than other companies. They also differ from other companies regarding the following three factors associated with human capital: 1) They are closer to achieving gender balance, 2) they have a more heterogeneous cultural background, as demonstrated by the diversity of employees' countries of origin and nationalities, and 3) the age distribution of workers is more diverse than in other companies. Average productivity companies could narrow the productivity gap significantly by increasing the number of managers, developing their skills and paying more attention to the complementarity of managers' and employees' skills and diversity in the organisation. However, this is not only about measures taken by companies but also about policy impacts (Criscuolo et al., 2021).

2.4 Intellectual capital, innovation and productivity

The growth in developed economies stems from knowledge, its sharing and its dissemination, in particular. This knowledge is directly associated with people (intellectual capital), specialisation of research, and institutions that promote the sharing of knowledge between an increasing number of people and enable its use in the economy. Ultimately, the success of an economy depends on the extent to which innovation enables the creation and productive deployment of new technologies. Innovation-based growth theory strives to explain technological change through a general increase in knowledge ensuing from R&D and through particular human capital, whose role the theory emphasises. Technological development depends on this investment and makes sustainable technological development possible (Romer, 1986; Lucas, 1988).

Innovation is the result of interaction between individuals, groups and the context in which they work at different levels of the organisation, in which the cross-cutting skills of the groups responsible for innovation and organisational change, or 'soft skills', together with cognitive skills are keys to the success of innovation. Unlike technical skills, soft skills are often difficult to define as well as measure and evaluate in cognitive tests, which is why their visibility in public policy is low and why they do not come up in surveys. Key soft skills for innovation include communication, cooperation, rational thinking, extroversion, perseverance, openness and cognitive empathy (du Roscoat et al., 2022).

It is likely that the skills in demand in the labour market of the future will increasingly be highly cognitive, such as skills related to working independently and leadership and communication skills that are essential for productivity growth, at the cost of routine skills requiring non-cognitive competence (Grundke et al., 2018). This is why it would be important to educate and support individuals to become aware, draw on and legalise the soft skills they have acquired in previous education, projects or projects not related to their occupations. Company managers and work organisations should, on the other hand, be encouraged to integrate a wide range of competence profiles and to recognise cross-cutting, interrelated competences. It is also important to support organisations in developing a cross-cutting work context and their organisation environments (du Roscoat et al., 2022).

2.5 Development of intellectual capital

The slowing growth of human capital and labour productivity since the 1990s is a natural phenomenon and something most developed countries share. In a situation where an increasing proportion of cohorts complete a matriculation examination and the share of the cohort that pursues higher education is already significant, more attention should be paid to the quality of education and competence (CNP, 2021).

Finland is lagging behind in this development. In Finland, the share of persons who have completed a tertiary degree among those aged between 25 and 64 (over 42%) is only around the OECD average, and far from the average in such countries as Canada (approx. 62%). When comparing those with a tertiary education degree among the population aged 25 to 34, Finland is one of the lowest-ranking ones of the OECD countries with a share of 41%. The difference to the leading countries, or Korea, Canada, Japan, Luxembourg and Ireland in which this share is between 62% and 69%, is considerable. Finland runs the risk of improvement in the working-age population's educational level stalling in the next few decades, which together with the dwindling size of the working-age population may lead to a reduction in human capital and slow down productivity growth, or even turn it in a negative direction (Figure 16).

Globalisation and digitalisation have led to an increase in market size and the specialisation of companies. A precondition for the development of emerging sectors associated with the green transition and digital transformation is the availability of a workforce with new skills. This development has increased the importance of human capital for companies. (CNP, 2021) Problems relating to skilled labour may become an increasingly significant obstacle to the development of companies and new sectors, productivity development and solving major societal challenges (NCPC, 2022).

The slowing down of population growth will lead to an ageing population, which may have adverse impacts on productivity. While individual productivity increases until the age of 50, after which it does not decrease significantly (SBGE, 2011), companies with older workers are slower to adopt new technologies (Meyer, 2011). In addition, companies whose workers are older than average appear to have lower productivity (SBGE, 2011). Older workers' human capital may not have adapted to new technologies, and it may be more difficult for them to learn new working methods (Weinberg, 2004). Slower population growth and the ageing of the population may also have a negative impact on the starting of new companies and the reallocation of the economy's resources and, consequently, on productivity (Karahan et al., 2019; Engbom, 2019).

Increasing competition for skilled labour in the face of technological change, rapidly changing competence needs and demographic change has led to intensified competition between countries for skilled labour, which underlines the importance of lifelong learning and, in this context, high-quality continuing education and retraining, apprenticeship training and on-the-job learning. (NCPC, 2022; CNP, 2021; CNP, 2022a; CNP, 2022b; SBGE, 2019; NPB, 2021; UK Productivity Commission, 2022; Criscuolo et al., 2021)

The structural factors of competence should also be developed. Among other things, this means improving the basic skills of a whole generation, reducing educational inequalities, developing pedagogy, improving early childhood education and care, increasing student mobility between different educational pathways, and investing in the IT infrastructure of education, personal tutoring and teacher education. (CNP, 2021; SBGE, 2019; NPB, 2021) Improving the capacity to learn and reducing inequalities from an early age are particularly important as they help leverage better educational outcomes at all later stages of life (Criscuolo et al., 2021). In such countries as Ireland, efforts are being made to improve the coherence of the education system by targeting the elements of continuing education, higher education, and research and innovation more accurately at meeting the diverse needs of all students (NCPC, 2022).

Immigration can also serve as a means of improving the competence and productivity of the workforce. The new knowledge and ideas brought along by foreign labour can lead to new and more efficient ways of organising workflow processes, which may increase productivity in the economy. An increase in foreign labour may also help Finnish workers to use their skills more efficiently if Finnish and foreign competences complement each other, for example due to differences in education and skills. In addition, an increase in foreign labour may lead to a situation where Finnish workers who have an equal competence level with immigrants transfer to higher-paid jobs with more complex requirements. In Denmark, it has been found that recruiting a highly specialised foreign expert has led to an increase in the salaries of other highly qualified workers at company level in the following years. (De Økonomiske Råd, 2022)

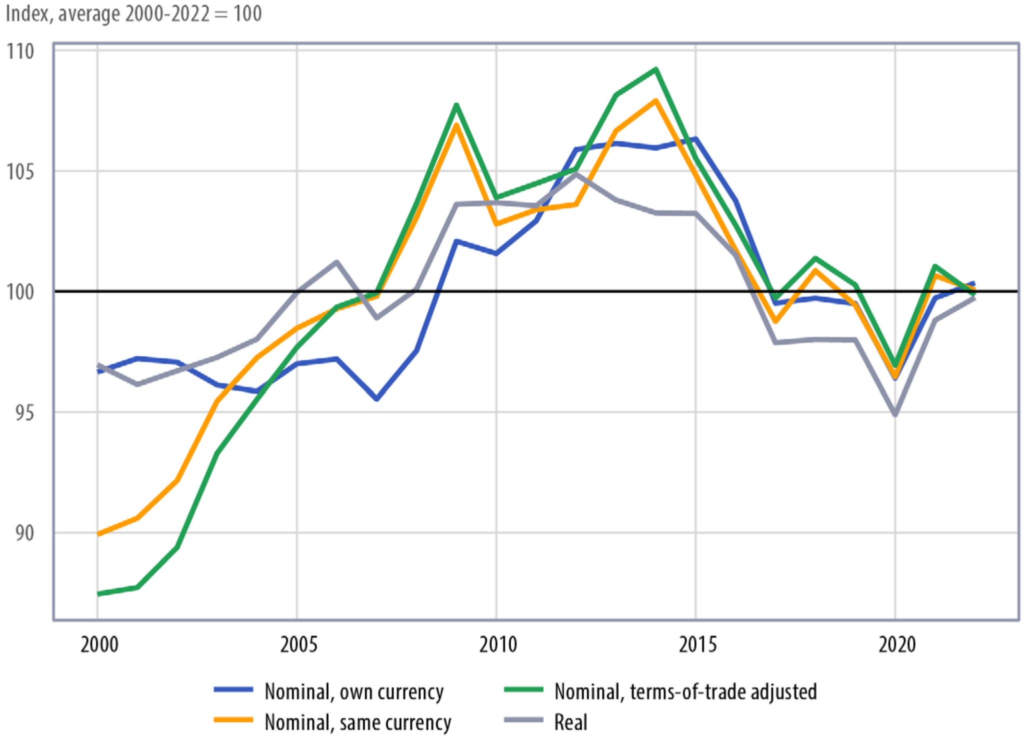
3 Cost competitiveness and earnings

3.1 Development of cost competitiveness

In 2022, Finland's cost competitiveness remained at its long-term average (Figure 17). The picture of Finland's cost competitiveness given by different unit labour cost indexes, which are used as its indicators, is very similar. Cost competitiveness has changed little since last year, in which it clearly deteriorated as Finland's unit labour costs increased more than in the reference countries. However, 2020 was an exceptional year due to the COVID-19 pandemic.

Excluding 2020, the increase in nominal unit labour costs in Finland has been rather similar to that in the reference countries since 2017, and cost competitiveness has remained stable at the average level. In 2017–2021 real unit labour costs, which account for not only the price of the labour input but also change in production prices, were somewhat lower in Finland in relation to the reference countries than they were last year. This means that while real cost competitiveness has deteriorated slightly, it remains at an average level.

Figure 17. Development of relative unit labour cost indices of the Finnish economy as a whole in 2000–2022. In relation to 16 key reference countries.

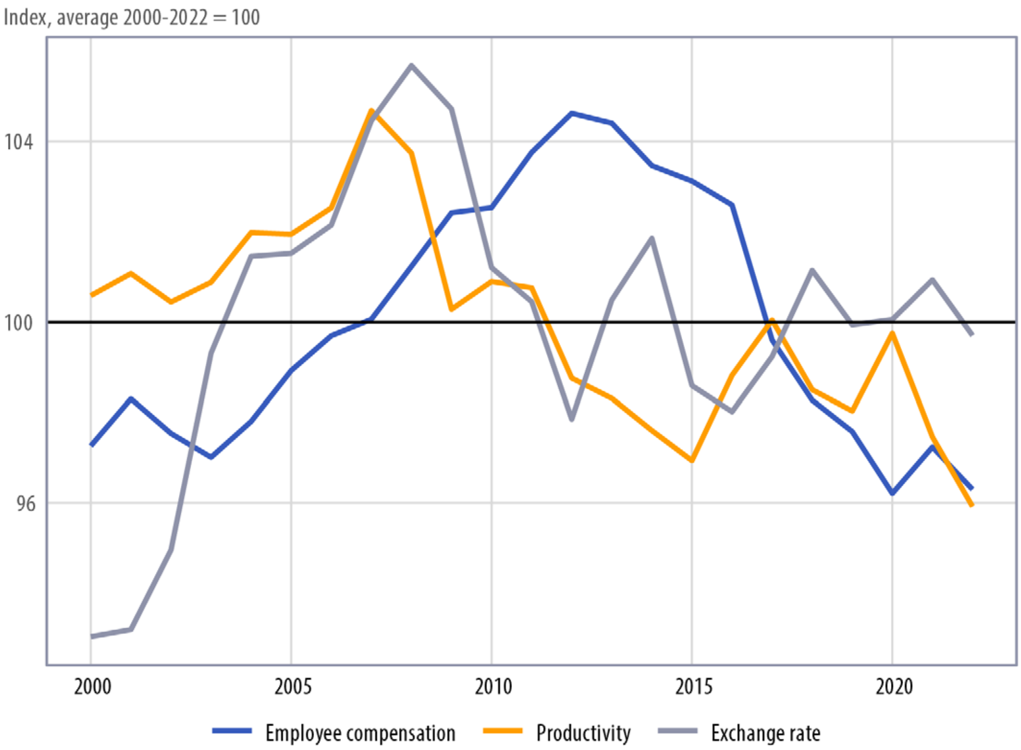


Source: Eurostat, AMECO, IMF, Finnish Productivity Board.

The reasonable cost competitiveness masks poor productivity and wage development, however (Figure 18). As a rule, labour productivity development in Finland has been weaker than in the reference countries since 2007. Labour productivity in Finland grew slightly faster after 2015 but has in recent years been slower than in the reference countries. In 2022, labour productivity in the economy at large was poorer compared to the reference countries than at any other time in the 2000s.

The weak growth in labour productivity has been counterbalanced by poor wage development. With the exception of 2021, the development of wage and salary earners' pay per hour has been weaker than in the reference countries each year since 2013. While this has maintained a fairly good cost competitiveness in Finland, maintaining good competitiveness boosted by rapid productivity growth rather than slow wage growth would have been preferable. Exchange rate changes have had little impact on cost competitiveness in recent years.

Figure 18. Components of the relative nominal unit labour cost index for the Finnish economy as a whole calculated in the same currency 2000–2022. In relation to 16 key reference countries.



Source: Eurostat, AMECO, IMF, Finnish Productivity Board.

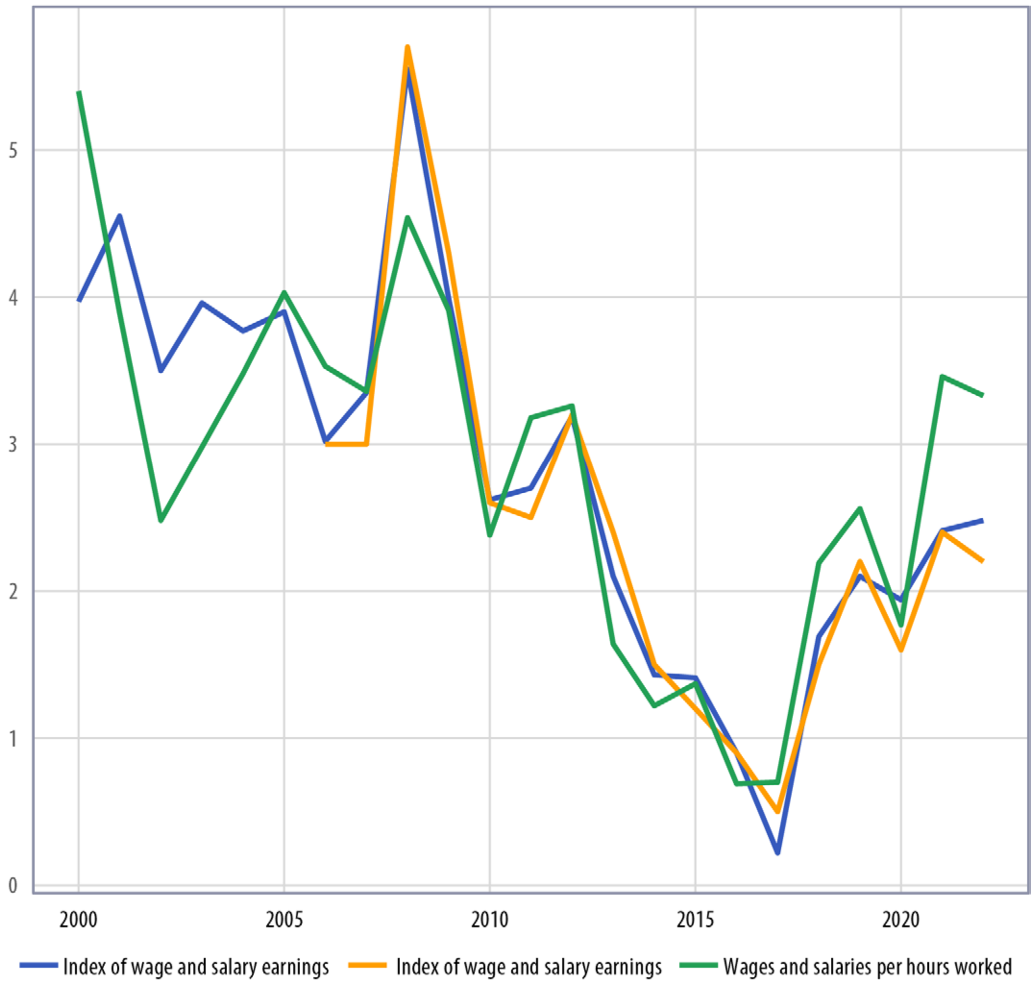
3.2 Earnings level development in Finland

The purpose of the Index of wage and salary earnings is to illustrate the development of the average earnings of full-time wage and salary earners with regular working hours. See Figure 19 for the development of the Index of wage and salary earnings and two other indicators for the level of earnings – the Index of regular earnings, and wages and salaries per hour worked. Unlike the Index of wage and salary earnings, the Index of regular earnings does not include performance bonuses or one-off instalments included in the collective agreement, which is why it describes the more permanent wage development of full-time employees better than the Index of wage and salary earnings.

As shown in Figure 18, the change in relative nominal unit labour costs consists of relative change in compensation of employees per hour worked, relative changes in labour productivity, and exchange rate changes. Compensation of employees includes wages and salaries and employers' social insurance contributions. The third one of the pay level indicators in Figure 19, wage and salary earners’ wages and salaries per hour worked, is consequently the most relevant one for the earnings level from the perspective of competitiveness indicators.

Among other things, the Figure shows that after the Competitiveness Pact was concluded, the growth in earnings slowed down in 2016–2017 and that growth has accelerated since 2018. In the Figure, wages and salaries per hour worked differ from the Index of wage and salary earnings in 2021–2022 to an exceptional degree. The data on wages and salaries per hour worked are based on the national accounts and, as the data in the national accounts for 2022 are currently merely preliminary, the difference in 2022 may decrease as the data are updated.

Figure 19. Annual change in the Index of wage and salary earnings, Index of regular earnings, and wage and salary earners' wages and salaries per hour worked in 2000–2022.[3]



Source: Statistics Finland.

The current year's strong inflation has also increased pay demands and the expected earnings development in 2023. The Ministry of Finance's economic forecast published in June estimates that the level of earnings measured by the Index of wages and salaries would increase by 4.8% this year, 3.6% in 2024 and 3.3% in 2025.

[3] Statistics Finland has only published the Index of regular earnings from 2005 onwards, and information on changes in this index for years preceding 2006 are missing.

Statistics Finland previously calculated estimates of the trends in Indexes of wages and salaries and negotiated wages and salaries in the near future for the use of the Information Committee on Cost and Income Developments (Tukuseto), which finished operating in 2020. The forecasts published in each Tukuseto report concerned development in wages and salaries in the year in which the report was prepared. The forecasts concerning the development of negotiated wages and salaries were based on the contents of collective agreements that were known as the forecast was prepared.

See Tables 1 and 2 for the results of the corresponding calculations made by Statistics Finland in June 2023. According to them, the earnings level measured by the Index of wages and salaries would increase by 4.4% this year. If realised, this forecast would mean a moderate decrease in wage and salary earners' earnings, as the current year's inflation measured by the consumer price index is likely to be close to 6%, whereas the forecast published by the Ministry of Finance in June puts it at 5.9%.

According to this calculation, the Index of negotiated wages and salaries related to the Index of wages and salaries, which includes one-off items of collective agreements, would increase by 3.9% this year. The increase in negotiated wages and salaries in local government, which includes counties and municipalities, is exceptionally rapid compared to other sectors, as the Index of negotiated wages and salaries related to the Index of wages and salaries is expected to increase by 5.4% this year.

Table 1. Development of the Index of wages and salaries for all employees and by employer sector and industry.

	On average from previous year, %			From Q4 of previous year, %	
	2021	2022*	2023	Q4/2022	Q4/2023
All wage and salary earners					
Index of wage and salary earnings	2.4	2.4	4.4	2.7	5.1
Index of negotiated wages and salaries	1.8	1.8	3.9	2.0	4.6
Other factors	0.6	0.6	0.5	0.7	0.5
Private sector					
Index of wage and salary earnings	2.4	2.7	4.0	2.9	4.7
Index of negotiated wages and salaries	1.7	1.8	3.4	1.9	4.2
Other factors	0.7	0.9	0.6	1.0	0.5
Industry					
Index of wage and salary earnings	2.6	3.2	4.1	3.3.	4.7
Index of negotiated wages and salaries	2.0	1.8	3.5	1.9	4.1
Other factors	0.6	1.4	0.6	1.4	0.6
Central government					
Index of wage and salary earnings	2.1	2.0	4.4	2.0	4.9
Index of negotiated wages and salaries	1.9	1.9	4.3	2.0	4.6
Other factors	0.2	0.1	0.1	0.0	0.3
Local government					

	On average from previous year, %			From Q4 of previous year, %	
Index of wage and salary earnings	2.3	2.0	5.7	2.8	6.5
Index of negotiated wages and salaries	2.0	1.7	5.4	2.5	6.2
Other factors	0.3	0.3	0.3	0.3	0.3

Source: Statistics Finland

Table 2. Development of regular earnings for all employees and by employer sector and industry.

	On average from previous year, %			From Q4 of previous year, %	
	2021	2022*	2023	Q4/2022	Q4/2023
All wage and salary earners					
Index of regular earnings	2.4	2.2	3.5	2.4	4.2
Index of negotiated wages and salaries	1.8	1.8	3.0	2.0	3.7
Other factors	0.6	0.4	0.5	0.4	0.5
Private sector					
Index of regular earnings	2.3	2.4	3.3.	2.5	4.0
Index of negotiated wages and salaries	1.7	1.8	2.7	1.9	3.4
Other factors	0.6	0.6	0.6	0.6	0.6
Industry					
Index of regular earnings	2.3	2.2	3.1	2.4	3.7
Index of negotiated wages and salaries	1.9	1.8	2.5	1.9	3.1
Other factors	0.4	0.4	0.6	0.5	0.6
Central government					
Index of regular earnings	2.2	2.0	3.3.	2.0	3.8
Index of negotiated wages and salaries	1.9	1.9	3.2	2.0	3.5
Other factors	0.3	0.1	0.1	0.0	0.3
Local government					
Index of regular earnings	2.4	2.0	4.3	2.8	5.1

	On average from previous year, %			From Q4 of previous year, %	
Index of negotiated wages and salaries	2.0	1.7	4.0	2.5	4.8
Other factors	0.4	0.3	0.3	0.3	0.3

Source: Statistics Finland

4 Policy recommendations

Productivity is the most important factor in the material standard of living. Wages and salaries as well as cost competitiveness are also underpinned by productivity. Additionally, productivity development appears to be linked to general government finances and employment development (Figures 20 and 21). Productivity is linked to employment at least through competitiveness: productivity has a positive impact on (real) unit labour costs and consequently gives companies additional incentives to increase hours worked and take on more employees. Through employment, there may also be a link to public debt. Increased productivity means a larger tax base and higher tax revenue as well as less budgetary pressure, which reduces general government deficit, the need for borrowing and the general government debt-to-GDP ratio.

Figure 20. Change in labour productivity in the business sector and change in general government debt-to-GDP ratio (EDP debt), five-year rolling average

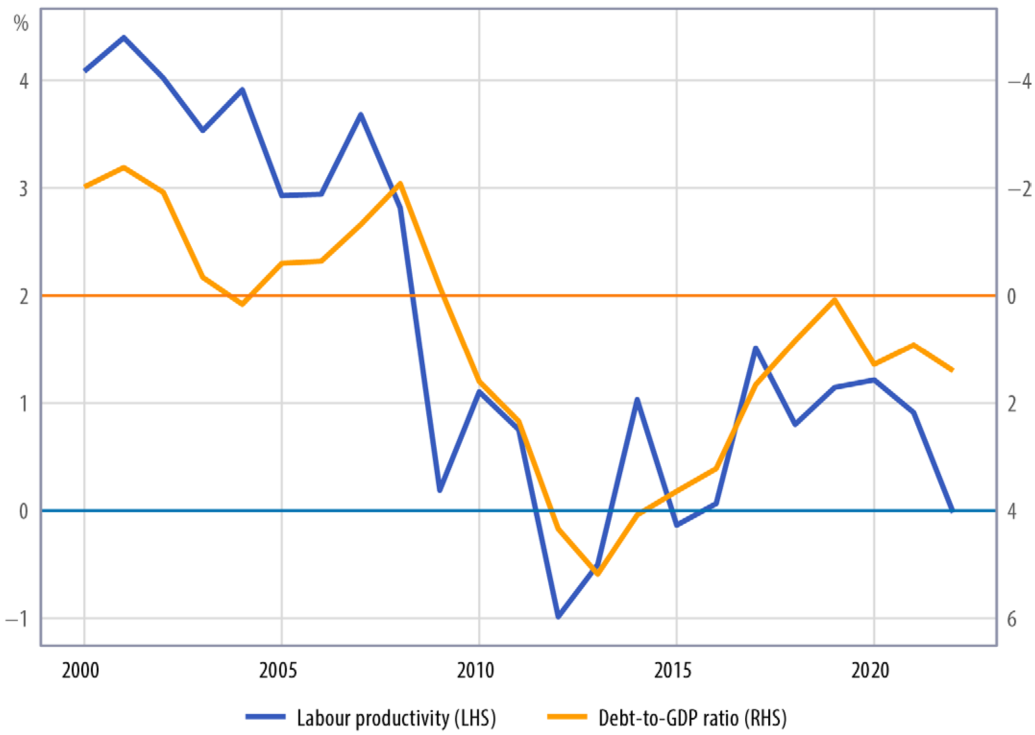
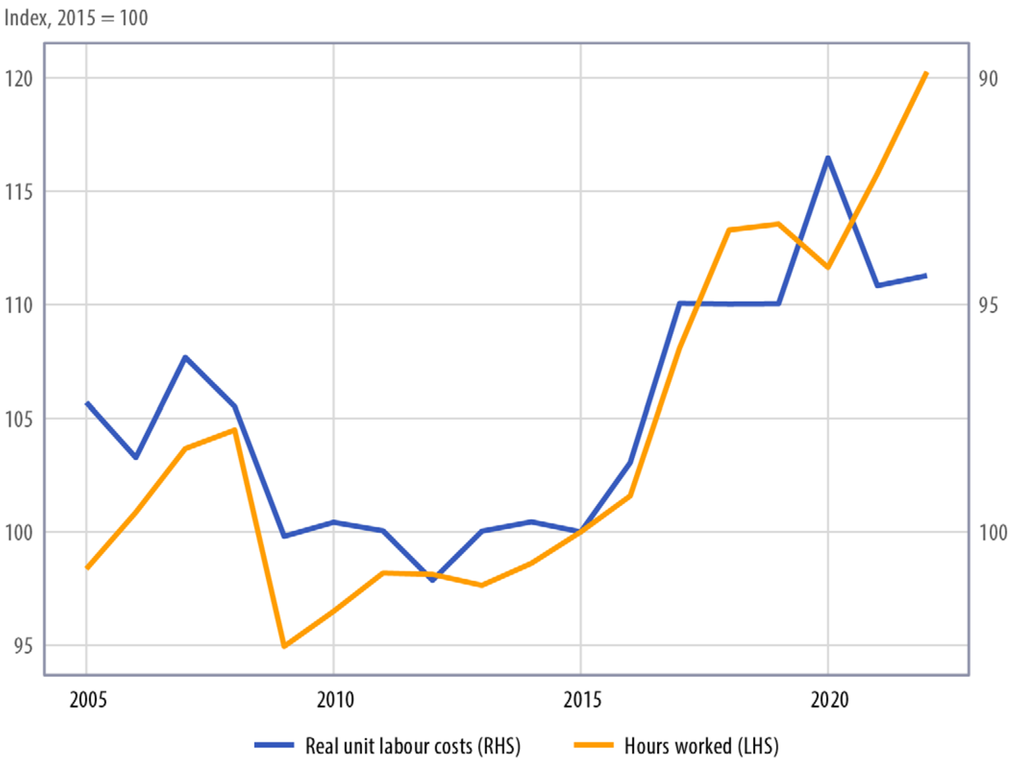


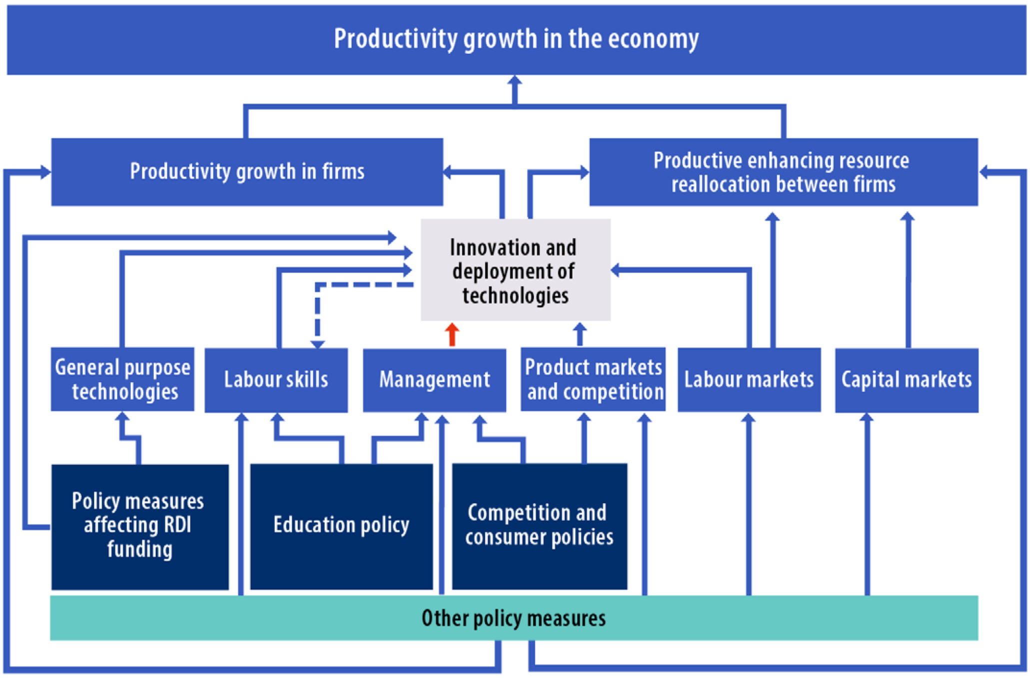
Figure 21. Ratio of real unit labour costs in the business sector to the EU-15 (inverted scale) and hours worked in the private sector to population aged 20-64.



Ratio of hours worked in the private sector to population aged 20-64 (estimated from wage bill)

When planning policy measures, their impacts on productivity should consequently always be considered. Productivity can also be influenced by many other measures in addition to R&D funding. Unfortunately, the impact of policy measures on productivity usually materialises slowly and with a delay, and this link is also complex and uncertain. See Figure 22 for an attempt to systematise the link between policy-making and productivity (see also Fornaro et al., 2023).

Figure 22. Factors and policy measures affecting productivity growth in the business sector



Productivity growth is ultimately based on innovations: new and better technologies, new modes of working and ways of managing work, better organisation. Innovations are largely based on the results of research and development. Research and development create new knowledge and competence through spending money. Innovation draws on new knowledge and competence to make money (or produce other outcomes that promote welfare).

The Parliamentary Working Group on RDI (2023) has decided to increase Finland's R&D funding to 4% of GDP if the private sector does its part. This will strengthen Finland's ability to improve productivity in the future. The journey from new research to productivity impacts is long and uncertain, however.

Using QUEST III R&D model (Roeger et al., 2022), the Ministry of Finance (2023) has simulated the impacts of direct R&D funding (4% of GDP) and tax subsidies for R&D (1.3% of GDP). The impact of policy measures on total output is moderate, and cumulative GDP correspondingly only increases by about 1.5 and 2% compared to the baseline. Wages and salaries are very flexible in this model, which contributes to curbing the acceleration in the growth of volume in the examined scenarios. On the other hand, the result confirms the need to maintain a high level of intellectual capital and a large number of experts to ensure that R&D funding would also increase volume, consequently supporting innovation and productivity growth, rather than trickling excessively into wages and prices.

Another way to improve productivity at the company level is to imitate innovations made by others. The Finnish business sector accounts for about 0.5% of companies' R&D investments in the OECD countries. Imitation would consequently be an affordable way to improve productivity. Imitation, too, requires sufficient understanding of and competence in R&D that underlies the innovation in question. To tap spreading technological knowledge productively, 'reception capacity' is required of the receiving companies, the preconditions for which are skilled labour and often in-house R&D. Investments in R&D and higher education may also improve productivity through this channel.

The third way to increase companies' potential for productivity growth faster is to attract international experts. The shortage of experts is a significant bottleneck in companies' innovation activities, development and growth and may contribute to increasing the costs of RDI.

As radical innovations at the forefront of productivity are most likely to succeed in companies with the most efficient innovation capabilities, it would be useful for the national economy to focus on them when granting R&D support (Acemoglu et al., 2018, Einiö et al., 2022a). Selective R&D support focusing on innovation capacity would be more efficient than broadly targeted support. Identifying innovation capabilities is obviously problematic. Einiö et al. (2022b) discuss practical tools that decision-makers could use to single out high innovation capacity companies among applicants for R&D support and to target support more effectively. The assessment could draw on information on the company's past successes (e.g. number of new products, innovations that improve quality) and look at recent actions taken by the company to strengthen innovation capacity (e.g. recruitment of R&D staff). In the case of young companies, their future innovation potential should be assessed.

The level and development of productivity in the service sector and, unexpectedly, especially in the digital service sector in Finland are very low. More research would be needed to understand this phenomenon better. As productivity in the service sector is far from the global forefront, it may not have the capabilities for radical innovations. R&D policy targeted at the service sector, in which service-intensive companies in the service and industrial sectors would cooperate with higher education institutions, could open up some possibilities. Examining the details of regulation and taxation in order to identify and eliminate bottlenecks in productivity development could be another possibility.

At the level of an industry or the national economy, productivity is also influenced by the allocation of resources. 'Creative destruction', in which a company offering better products or services replaces older ones that have proven worse, also promotes better allocation. Creative destruction and productivity are promoted by protecting workers with safety nets, whereas they are prevented by protecting jobs and business subsidies that maintain old ways. Policy measures that contribute to a well-functioning market are also likely to contribute to the preconditions for productivity growth.

While the dynamics in the capital, commodity and labour markets in Finland appear to be effective, research results indicate that resources have not been allocated correctly in this country. Firstly, the most productive companies are not getting large enough a share of the resources, whereas low-productivity companies receive an excessive share. Secondly, companies do not employ as large a workforce as pursuit of profit would require. This may indicate that the acquisition of labour involves costs and risks that are not factored in in the equation that describes the pursuit of profit. By eliminating such risks, productivity could be improved.

The third problem in resource allocation from society’s point of view seems to be that companies have too much capital, while the volume of intangible investments apparently is too low. This may be partly due to details of regulation and corporate taxation. According to Määttänen and Ropponen (2016) and Harju et al. (2017), tax relief for the dividends of unlisted companies is driving decision-making in companies in the wrong direction from society's viewpoint. In addition, high taxation of innovators, companies and often high-income individuals significantly reduces incentives to invest in innovation (Akcigit and Stantcheva, 2020; Akcigit et al., 2021).

Productivity is ultimately created by skilled people and technology. Investment in human capital will boost productivity growth over the longer term. In addition to increasing the number of higher education intake places, the entire education chain should be strengthened.

Cooperation between companies and higher education institutions may be the most effective policy measure for promoting the spillover effects of new knowledge and competence. Actively attracting foreign experts to the country is a faster way of increasing the intellectual capital. Holding on to international students better would also help to increase the availability of experts. Without skilled workers, the planned increase in R&D funding may not lead to the desired increase in productivity.

The details of regulation, taxation and business subsidies should be examined from the perspective of investments and, in particular, intangible investments. A closer examination of the link between taxation and innovation would be necessary.

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MINISTRY OF FINANCE
Snellmaninkatu 1 A
PO BOX 28, 00023 GOVERNMENT
Tel. +358 295 160 01
financeministry.fi

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