Wage Formation in Sweden 2019

Chapter 4 from
Lönebildningsrapporten 2019

Productivity growth in Sweden

Productivity growth in Sweden has been comparatively low since 2007, i.e. even before the financial crisis. Despite recent years' economic boom, when productivity growth would be expected to take off initially, it has remained lower than before the financial crisis. Many other countries have also seen historically weak productivity growth during the period. Slow adoption of new technology in the global economy is probably the main reason for the low productivity growth both in Sweden and elsewhere. Slower capital deepening has also contributed to the downshift in productivity growth in Sweden. Much of the decline in productivity growth has been in the information and communication technology (ICT) industry. The NIER estimates that annual productivity growth in the business sector will be 1.8 per cent in the long term. This is slightly below the average rate since 1980. The reason for this is that the structural transformation in the Swedish economy is hampering productivity growth. In the short term, however, productivity growth is expected to be lower still. This is partly because we expect the economy to be in a slowdown phase this year and next, when productivity growth is normally weak, but also because underlying productivity growth has been so weak in recent years.

This chapter aims to shed light on the past decade's weak productivity growth in Sweden and its possible causes, and consider the outlook for productivity. Due to difficulties measuring productivity growth in the public sector, we look mainly at productivity in the business sector. We use growth accounting to analyse which drivers may have caused the weak growth in business sector productivity. The focus is on 2011 to 2018, i.e. the period after the big swings in productivity in the wake of the financial crisis. Productivity growth is also discussed from an international perspective. Finally, we present the NIER's forecasts for productivity growth in the short and long term and a comparison with other commentators' projections.

What is productivity and why is it important?

The most common measure of productivity is labour productivity, which is defined as value added in constant prices per hour worked. Value added is defined as output (production) less the goods and services consumed as inputs, and thus consists solely of the value that has been created. Higher productivity means that more goods and services can be produced for the same number of hours worked.

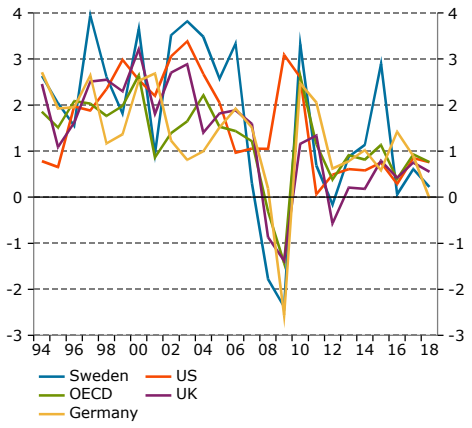
Productivity growth is an important component of GDP per capita growth in the longer term, and thus important for material prosperity in Sweden. Other factors that are important for a country's material prosperity include demographic developments, the employment rate and the terms of trade. In addition to what we produce in Sweden, returns and earnings paid to/from abroad form part of our material prosperity, which is captured in gross national income (GNI). The focus in this chapter, however, is on productivity.

Productivity growth in Sweden and abroad

One fundamental factor for wage formation in the long run is what happens to firms' labour productivity,[1] i.e. how much can be produced for a given number of hours worked. In Sweden as well as many other countries, productivity growth has been comparatively low for more than a decade (see Diagram 1).

Diagram 1 Productivity in the whole economy

Percentage change



Note. Refers to productivity per employee for the OECD, and per hour for other countries.
Sources: The Conference Board and Macrobond.

[1] Productivity is used throughout as a synonym for labour productivity in this chapter.

LOW PRODUCTIVITY GROWTH IN MANY COUNTRIES

The international productivity slowdown began even before the financial crisis erupted. For example, productivity growth has been falling gradually since 2003 in the US and since 2004 in the OECD countries as a whole. The decline accelerated in many countries during the financial crisis.

In the OECD countries, productivity fell in 2008-2009 and then bounced back before growing only slowly again. In the UK, the fall was of around the same size as in the OECD, but productivity growth there has since been very weak. Germany saw a sharp downturn in productivity growth in 2009, followed by high rates in 2010 and 2011, but there have been only moderate increases in productivity since, as in the other countries.

In the US, the economic boom before the financial crisis contributed to productivity growth beginning to slow as early as 2005 as hours worked increased rapidly (see Diagram 2). When the financial crisis erupted, productivity growth did not fall in the same way in the US as in the other countries in this comparison. The labour market adapted, and many firms cut their workforce rapidly as demand dropped off. This meant that hours worked fell sharply in 2009 (see Diagram 2). Hours worked fell more than GDP, which meant that productivity growth did not fall as it did in the other countries. Productivity growth in the US has nevertheless been subdued since 2011, as in the other countries in this comparison (see Diagram 1). The fact that so many different countries have seen low productivity growth simultaneously suggests that there are common casual factors.

LONG-TERM DECLINE IN SWEDISH PRODUCTIVITY GROWTH

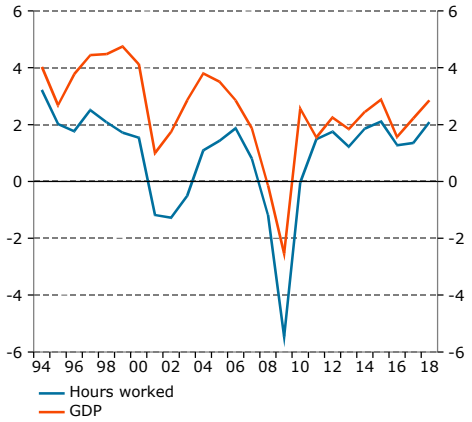
In Sweden, productivity was virtually flat in 2007 after a number of years of big increases (see Diagram 3). Hours worked rose rapidly in 2007, which put a damper on productivity growth (see Diagram 4). Sweden had then been operating above capacity for a few years, and productivity growth tends to decline towards the end of such periods as the workforce expands and the number of workers and hours worked increase quickly (see Diagram 4). The productivity slowdown was thus initially partly cyclical. In connection with the financial crisis in 2008 and 2009, productivity fell sharply, before recovering in 2010 to the same level as a year or so before the financial crisis (see Diagram 5).[2] These big swings around the financial crisis were largely a cyclical effect. Since then, however, productivity growth has been persistently low, with the exception of a spike in 2015.

The NIER believes that the strong productivity growth in 2015 was down to a combination of temporary and cyclical

[2] See also the chapter "Produktiviteten i Sverige" [Productivity in Sweden] in NIER (2017b) and the special analysis "Produktivitetsutvecklingen i Sverige" [Productivity growth in Sweden] in NIER (2015) for a discussion of how productivity moved in connection with the financial crisis.

Diagram 2 Hours worked and GDP in the US

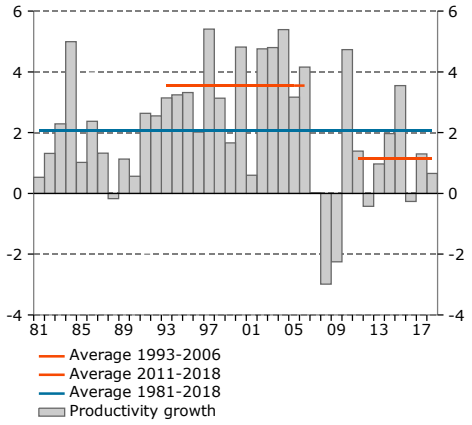
Percentage change



Source: the Conference Board.

Diagram 3 Productivity in the business sector

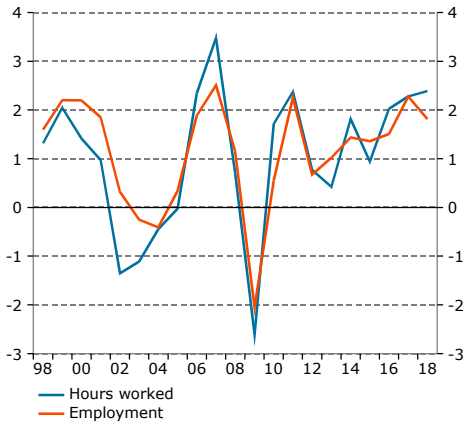
Percentage change



Sources: Statistics Sweden and NIER.

Diagram 4 Hours worked and employment

Percentage change, calendar-adjusted values



Source: Statistics Sweden.

factors. Exports of services grew unusually strongly that year, due partly to high royalties temporarily boosting production but not impacting similarly on hours worked.[3] Productivity growth was also high in parts of manufacturing, especially in the automotive industry, which the NIER considers to have been cyclical.

On average, business productivity grew 1.1 per cent per year from 2011 to 2018 (see Diagram 3). This is below the historical average for the period from 1981 to 2018 of just over 2 per cent. The unusually high immigration rate in recent years may, however, have caused measured productivity growth to have been underestimated slightly in some years.[4]

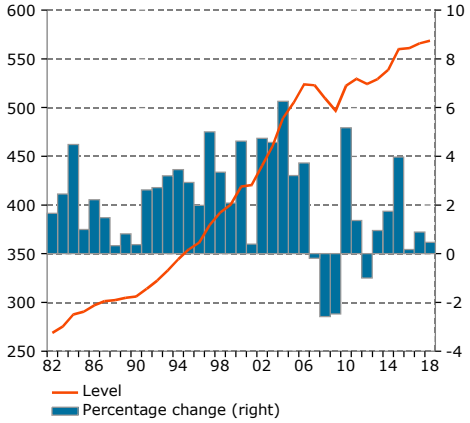
Strong growth in hours worked has propped up growth in production

Productivity growth is an important component of growth in production in the longer term (see the box "What is productivity and why is it important?"). Historically, in the period from 1981 to 2006, productivity growth was the greatest contributor to the increase in production in the business sector (see Diagram 6). From 2010 to 2018, however, an increasing number of hours worked contributed slightly more than productivity to growth in production. The pattern is particularly clear over the past three years, where hours account for almost all growth in business sector output (see Diagram 6).

The relatively rapid rise in hours worked since the financial crisis probably has multiple explanations. Recent years' brisk demand has led to a strong need for labour (see Diagram 4). A fast-growing population has also made it possible to rapidly increase the labour input in production. The bulk of the rise in hours worked has been in the service sector, while manufacturing has made negative or only slightly positive contributions to growth in hours worked in the business sector since 2010 (see Diagram 7). This is partly a result of the structural transformation in the Swedish economy, with less and less production occurring in the manufacturing industry and more and more in the service sector.

Diagram 5 Productivity in the business sector

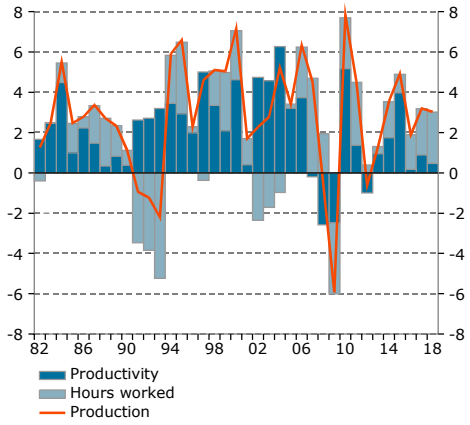
Value added per hour, constant prices, calender-adjusted values



Source: Statistics Sweden.

Diagram 6 Production, hours worked and productivity in the business sector

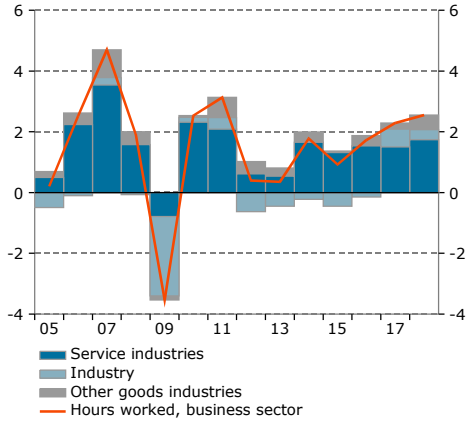
Annual percentage change, constant prices, calender-adjusted values



Source: Statistics Sweden.

Diagram 7 Contribution to the growth in the number of hours worked in the business sector

Percentage points, calendar-adjusted values



Source: Statistics Sweden.

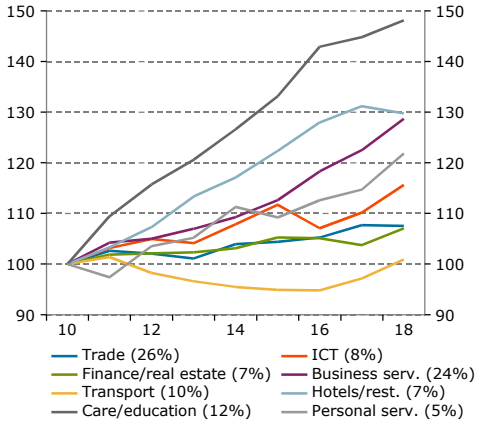
[3] These high royalties are probably partly a result of Swedish technology firm Ericsson reaching a settlement that year in a patent dispute with US technology firm Apple, which resulted in substantial royalties for Ericsson. See the press release "Ericsson and Apple sign global patent license agreement, settle litigation", 21 December 2015, available at www.ericsson.com.

[4] According to the NIER's calculations, employment growth in the economy as a whole and growth in hours worked may both have been overestimated by a few tenths of a percentage point per year in 2016 and 2017. In 2018 and 2019, on the other hand, employment growth may, if anything, have been underestimated. Going forward, this effect is expected to be only marginal. Similarly, productivity in the economy as a whole may have been underestimated. See also the box "Nyanlända i AKU" [Recent immigrants in the LFS] in NIER (2017a).

Growth in hours worked in the service sector since 2010 has largely been in health care, education and hotels and restaurants (see Diagram 9). The increases in recent years may be a result of a large number of people with lower education levels coming to Sweden, and some of these finding employment in these areas.[5] According to the Swedish Public Employment Service, four out of ten new jobs in the service sector in 2018 went to people born abroad, who accounted for the whole of the increase in employment in welfare services (education, health care and elderly care) in 2018.[6] However, hours worked have also increased relatively quickly in business services[7], leisure and hospitality, and information and communication services.

Diagram 9 Hours worked in the service industries

Index 2010=100, calendar-adjusted values

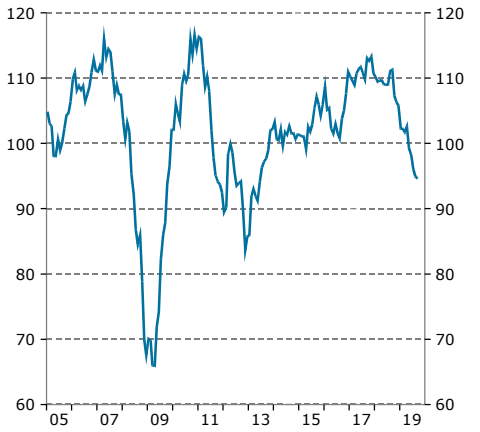


Note. Transport refers to transport and storage. The parentheses indicate the various service industries' share of hours worked in the entire service industry in 2018.

Source: Statistics Sweden.

Diagram 8 Economic tendency indicator

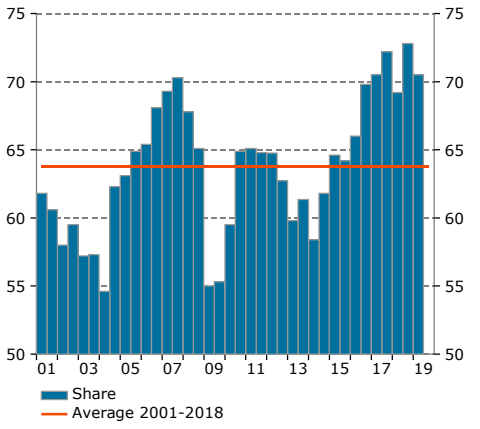
Index mean=100, monthly values



Source: NIER.

Diagram 10 Share of workplaces that can increase production by at most 10 percent without recruiting new employees

Per cent, half-year values



Source: Arbetsförmedlingen.

Weak productivity growth during the economic recovery

From 2011 to 2014, business productivity growth in Sweden was low (see Diagram 3). Resource utilisation at firms was then lower than normal. Since 2014, production in the business sector has increased at slightly above the historically normal rate (see Diagram 6). Demand in the business sector increased gradually from 2014 to 2017 (see Diagram 8). Resource utilisation at firms has also risen and been higher than normal since 2015. One indication of this is that the Swedish Public Employment Service's statistics for the percentage of employers able to increase production by no more than 10 per cent without recruiting new staff, has been above the historical average since 2015 (see Diagram 10). Manufacturing capacity utilisation has also been higher than normal since the end of 2016 (see Diagram 11).

When demand rises in an economic upswing, firms normally first step up production and make use of idle resources internally. Resource utilisation at firms therefore increases, boosting productivity growth. This cyclical effect on productivity growth was particularly clear in 2015. After that, as capacity utilisation became increasingly tight, firms tend to recruit new staff, and productivity growth drops back again. From 2016 to 2018, when capacity utilisation at firms was very high, both the number of workers and the number of hours worked grew quickly (see Diagram 4). As hours increased, productivity growth slowed. The comparatively low productivity growth in 2017 and 2018 was thus partly a predictable cyclical pattern.

[5] See the special analysis "Utrikes födda och integration på den svenska arbetsmarknaden" [The foreign-born population and its integration into the Swedish labour market] in NIER (2018).

[6] Swedish Public Employment Service (2019).

[7] Swedish Standard Industrial Classification (SNI) codes M and N, e.g. legal, accounting, scientific, leasing, property and travel services.

But potential productivity has also grown slowly

The NIER nevertheless believes that recent years' low productivity growth is to a great extent a result of structural factors. We estimate that potential productivity growth – productivity growth excluding cyclical effects – began to slow in the mid-2000s, i.e. before the financial crisis erupted. Potential productivity growth in the business sector was very low during the crisis and has since remained weak. We estimate that potential productivity growth has averaged around 1.0 per cent per year since 2010 (see Diagram 12). This is low by historical standards.

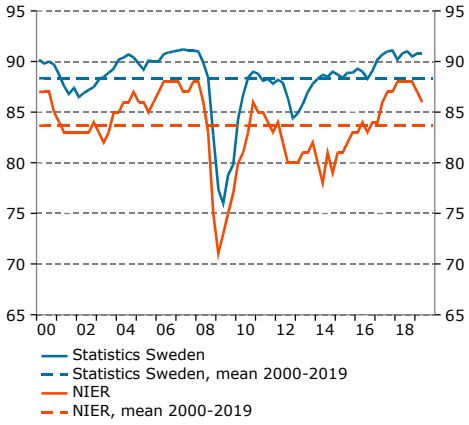
Actual and potential productivity growth

Productivity growth generally varies considerably from year to year due to cyclical variations in the economy and other temporary effects (see Diagram 12). These variations may be due in part to how production responds in the short term to changes in demand. When demand slackens, firms generally first cut back on production and then on the number of hours worked. This is because production can be adjusted more quickly than staffing. There may also be an element of labour hoarding, with firms retaining more staff than they need because redundancies and recruitment are expensive, and they do not know how long the downturn will last. Both of these factors normally mean that productivity decreases in an economic downturn. In an upswing, the reverse is normally the case.

To see how productivity growth moves in the longer term, these cyclical variations need to be excluded. The NIER estimates historical potential productivity growth from 1981 to 2012 using a Hodrick-Prescott filter to remove cyclical variations from the data. For the most recent period, currently 2013-2018, the NIER estimates potential productivity using indicators of resource utilisation at firms. Taken together, these indicators provide a picture of resource utilisation at firms which, in turn, gives us an idea of how actual productivity compares to potential productivity. Potential productivity is thus the productivity that would have been observed in the absence of cyclical variations (see Diagram 12).

Diagram 11 Industry capacity utilisation

Per cent, seasonally adjusted quarterly values

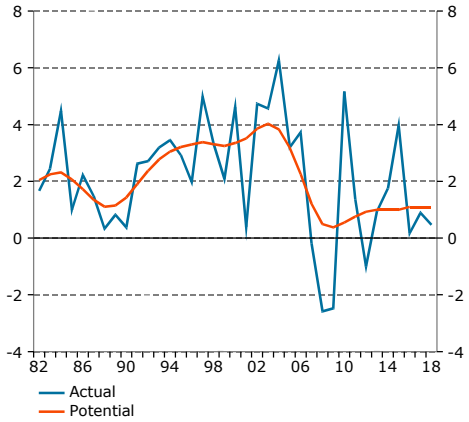


Note. NIER's capacity utilization refers to the manufacturing industry.

Sources: Statistics Sweden and NIER.

Diagram 12 Actual and potential productivity in the business sector

Percentage change, calendar-adjusted values



Sources: Statistics Sweden and NIER.

Possible explanations for the downshift in productivity growth

In this section, we discuss the structural factors that can explain the low productivity growth in Sweden since 2010. This is done partly by studying the role played by the production of information and communication technology (ICT) and structural

changes in the economy, and partly by using growth accounting to analyse what has driven productivity growth in recent years as compared to previously.

The review shows that a declining contribution to productivity from ICT is an important explanation for the slow increase in productivity. Composition effects as a result of structural changes, with a shrinking manufacturing industry and a burgeoning service sector, have also put a slight damper on productivity growth. Slow technological progress abroad is the single most important explanation for the low productivity growth in Sweden. One further contributing factor has been slow capital deepening.

DWINDLING CONTRIBUTION TO PRODUCTIVITY FROM THE ICT INDUSTRY

Decreasing productivity effects from ICT have played a major role in the decline in productivity growth in Sweden. The second half of the 1990s and the early 2000s stand out as the years when Sweden had especially high rates of productivity growth (see Diagram 1). Other countries too, such as the US, saw strong productivity growth in that period, which can be explained largely by high productivity growth in ICT.[8]

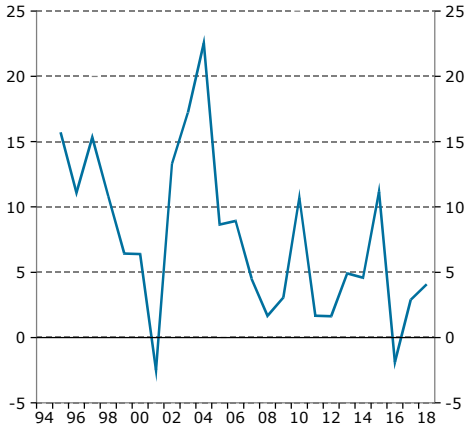
Productivity growth in Sweden's ICT industry was also particularly high at the beginning of the millennium but has gradually fallen back since (see Diagram 13 and Diagram 14).[9] In the period from 1994 to 2007, almost a third of productivity growth in the business sector can be put down to productivity growth in the ICT industry. This is despite ICT being a relatively small industry that accounts for just 10 per cent of business sector output –a share that has been fairly constant for a long period. Part of the reason for Sweden having had such strong productivity growth in the telecommunications industry was probably Ericsson's leading position.

The ICT industry's contribution to productivity has gradually dwindled, however, as its productivity growth has fallen. It still accounts for around a third of productivity growth in the business sector, but its contribution has declined in absolute terms. In the period from 2011 to 2018, the ICT industry's contribution to growth in business productivity was slightly less than 0.4 percentage points per year, as opposed to slightly more than 1 point per year in the period from 1994 to 2007.

One important reason for the productivity slowdown in the Swedish business sector since the turn of the millennium is thus lower productivity growth in ICT. Even excluding the contribution from the ICT industry, though, business productivity growth has been historically weak since 2010 (see Diagram 14).

Diagram 13 Productivity in the ICT industries

Percentage change

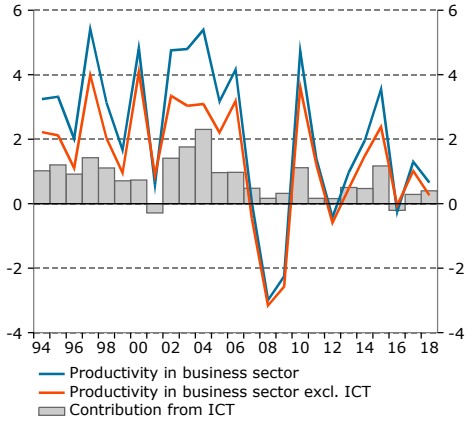


Note. The ICT industries refer to J58-J63 and C26 according to SNI2007.

Source: Statistics Sweden.

Diagram 14 Productivity in the business sector and contribution from ICT industries

Percentage change and percentage points



Note. The ICT industries refer to J58-J63 and C26 according to SNI2007.

Sources: Statistics Sweden and NIER.

[8] See OECD (2015) and SOU (2008:14).

[9] The diagram shows only the direct contribution to productivity from the ICT industry itself, and not the indirect effects that arise when ICT is applied in other industries.

The downshift in the ICT industry is thus only part of the explanation.

SHRINKING MANUFACTURING INDUSTRY PUTS DAMPER ON PRODUCTIVITY GROWTH

Productivity is also affected by composition effects that arise when industries with different trend productivity growth grow at different rates. The ongoing structural transformation in Sweden, with a shrinking manufacturing industry and a burgeoning service sector, has put a slight damper on productivity growth in the business sector as a whole (see Diagram 15 and Diagram 16). Manufacturing has historically been an important driver of Swedish productivity growth, while the service sector has historically seen slower productivity growth (see Diagram 17). All else equal, the service sector expanding to account for an ever larger share of the economy, while manufacturing moves the other way, will hold back productivity growth.

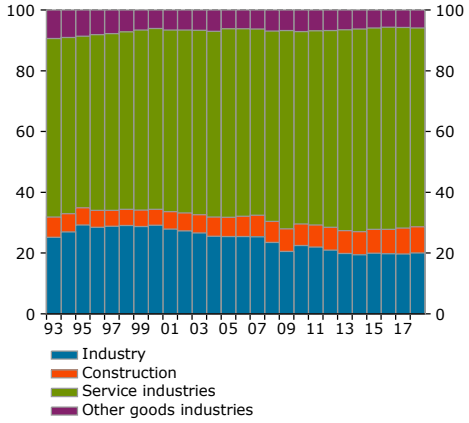
LOWER PRODUCTIVITY CONTRIBUTION FROM TECHNOLOGICAL PROGRESS

As discussed above, productivity growth has slowed not only in Sweden but also in other technologically advanced economies. Growth accounting can be used to divide productivity growth into three components: increased input of real capital per hour worked (capital deepening), changes in the labour force's knowledge and skills (labour quality), and a residual referred to as total factor productivity (TFP). TFP is often assumed to reflect long-term technological progress in the economy, understood as the adoption of new technology in production. In practice, however, TFP is a residual in the calculations and will therefore also capture both measurement errors and cyclical fluctuations in productivity (see the box "Growth accounting").

Growth accounting for Sweden reveals that productivity growth in the period from 1997 to 2007 was driven to a great extent by a rapid increase in TFP (see Table 1 and Diagram 18). After 2010, it shows that TFP is the main reason why productivity growth has been slow.

Diagram 15 Value-added shares in the business sector

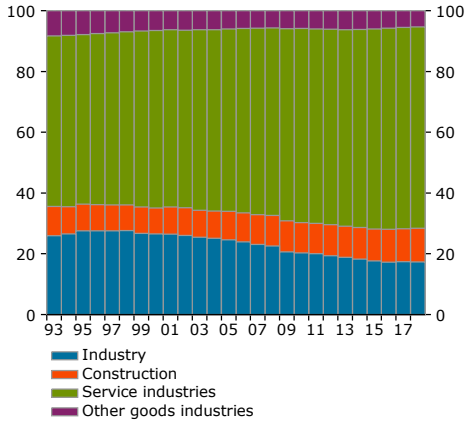
Percentage of value added in the business sector, current prices



Sources: Statistics Sweden and NIER.

Diagram 16 Share of hours worked in the business sector

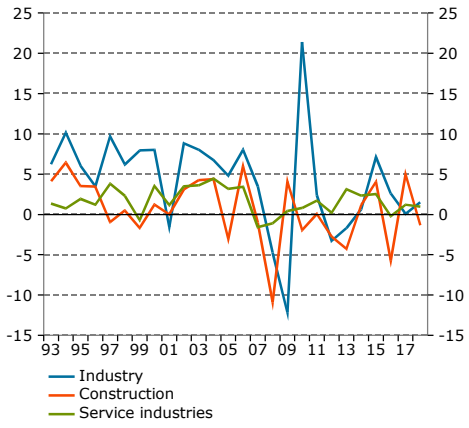
Percentage of hours worked in the business sector



Sources: Statistics Sweden and NIER.

Diagram 17 Productivity in the business sector

Percentage change



Source: Statistics Sweden.

Table 1 Contributions to productivity growth in the business sector

Approximate contribution in percentage units and approximate percentage change, calendar-adjusted values

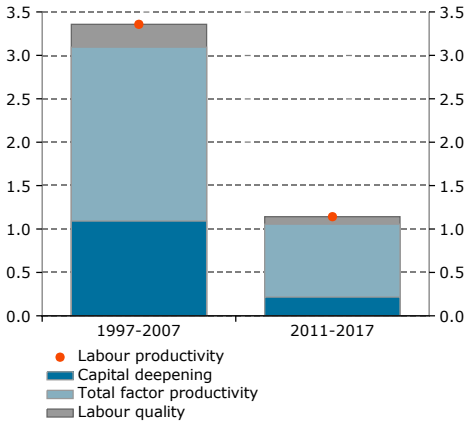
	1997–2007	2008–2010	2011–2017
Capital deepening	1,1	1,1	0,2
The education level of people in work	0,3	0,2	0,1
Total factor productivity	2,0	-1,3	0,8
Productivity growth	**3,4**	**0,0**	**1,1**

Note. Percentage and percent change are approximated by 100 times the change in logarithmic values, even for productivity growth. Calendar-adjusted values for hours worked and value added have been used in the calculation.

Source: NIER.

Diagram 18 Productivity in the business sector over different time periods

Approximate annual percentage change and contribution in percentage points, average over the period, calendar-adjusted values



Source: NIER.

These calculations do not say anything about why the adoption of new technology seems to have slowed. Movements in Swedish TFP depend largely on technological progress abroad, since technological advances normally spread relatively quickly. Since the slow growth in TFP is a global phenomenon, this can be assumed to reflect slower technological progress in the most technologically advanced economies.

Like productivity growth, TFP has slowed in many countries since the financial crisis (see Diagram 19). Many of the firms leading the way in R&D in various hi-tech areas are based in the US, and so the US is an important driver for global productivity growth. TFP growth has been especially subdued in the US since 2011 (see Diagram 19).

SLOW CAPITAL DEEPENING

The low productivity growth since 2011 is also a result of slow capital deepening for a period after the financial crisis, as there was less productivity-enhancing investment than before (see Table 1). More and better real capital – e.g. in the form of machinery, computers and buildings – in relation to labour input will tend to raise productivity. Similarly, increased R&D capital will boost productivity, at least in the slightly longer term. With the help of information on capital stocks, investments and hours worked, the importance of capital formation for productivity growth can be assessed.

Business investment fell sharply in the wake of the financial crisis and did not return to pre-crisis levels until 2014 (see Diagram 20). Since 2014, investment has risen more quickly again as the economy has strengthened. This has meant that the capital stock in the business sector has begun to expand more quickly again (see Diagram 21). Meanwhile, the number of hours worked has rocketed as a result of labour market measures, the buoyant economy and population growth. This means that the investment rate has struggled to keep up with the increase in hours. The amount of capital per hour worked has therefore risen slowly, and the contribution to productivity has been small.

Growth accounting

Productivity growth can be decomposed into different components using growth accounting. With this method, productivity growth can be divided into a component that depends on increased inputs of capital per hour worked, one that depends on increased knowledge and skills in the labour force (here we use workers' education level as a proxy for this variable), and a residual referred to as total factor productivity (TFP) which captures technological progress. In the long run, i.e. when we exclude cyclical factors, it is these three components that determine how productivity moves. The calculations can be performed in many different ways.

Capital deepening is defined as the change in the flow of capital services generated by the capital stock per hour worked. The flow of capital services can be approximated by the user cost of the total stock of physical real capital and capital generated by research and development (R&D capital). The user cost is calculated as the total cost of the capital and is determined by the risk-free interest rate, the risk premium, how quickly the real capital depreciates, and movements in the price of the real capital. Increased capital deepening will normally increase production for a given labour input and level of technical expertise, such that productivity increases.

The education level of people in work is used as a proxy for the labour force's knowledge and skills. A better educated labour force will normally also increase productivity.

TFP growth is the component of productivity growth that cannot be explained by changes in the other factors of production. Higher TFP means that the same quantity and quality of production factors (labour and capital) results in more production. An increase in TFP is normally assumed to be a result of technological progress, but can also be a result of improved co-ordination and planning of work. In practice, TFP is measured as a residual that captures any change in productivity that cannot be explained by capital deepening and increased labour quality. This means that TFP also captures cyclical fluctuations in productivity due to variations in resource utilisation, and also measurement errors, since it is hard to measure quality-adjusted capital, the labour force's knowledge and skills, and quality-adjusted production.

It is not, however, only the amount of capital that is important for capital deepening, but also the composition of the capital stock. Some types of capital are more productive than others. In the period from 1996 to 2002, the stock of intangible assets in the business sector expanded swiftly. Intangible assets – consisting mainly of investments made in R&D and computer software/databases – probably made a major contribution to the rapid capital deepening in the business sector during this period. Intangible investments in the business sector did not rise for many years as a share of production in the sector, but they did increase in 2017-2018, which should boost capital deepening in the near term (see Diagram 22).

Capital deepening is also related to TFP. When technological progress is rapid, a larger number of profitable investments can be made; when TFP rises slowly, there are fewer new technologies to invest in and so less of an incentive to invest more. The long period of weak TFP growth has thus probably contributed to the slower capital deepening.

The capital stock has been growing more quickly again for a couple of years now, and the labour force is expected to expand more slowly. Since real interest rates are currently very low, firms will probably want to increase the capital stock relative to the labour input. This would lead to increased capital deepening and stronger productivity growth in the years ahead.

LOWER PRODUCTIVITY CONTRIBUTION FROM WORKERS' EDUCATION LEVEL

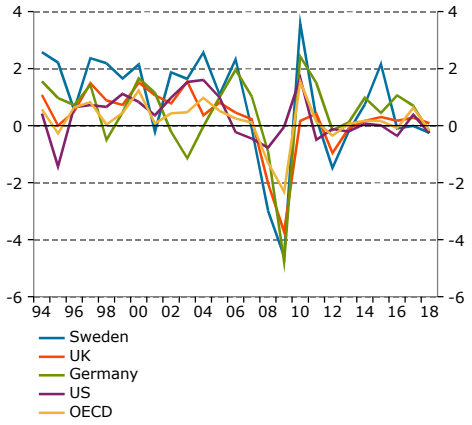
The composition of the workforce also plays a role in productivity growth. If the share of workers with a higher education increases, this will normally boost average productivity. To take account of this, the number of hours worked is quality-adjusted in our growth accounting. The NIER has estimated a quality component for hours worked which shows how workers' education level has contributed to productivity growth. Relative wage differences between education categories are used to approximate differences in productivity.[10]

The increase in the average education level in the period from 1997 to 2007 contributed an average of 0.3 percentage points per year to productivity growth (see Table 1). After the financial crisis, in the period from 2011 to 2017, this contribution was smaller, averaging only a tenth of a point per year. In other words, the rise in average education level has been slower since 2011 than before the financial crisis. This is partly because those born outside Sweden have accounted for an increasing share of the workforce in recent years. The foreign-born population has a

[10] The method used is a simplified version of that used for the growth accounting in SOU 2008:14, with the difference that neither age nor country of birth are included in our calculations. See Swedish Government (2008).

Diagram 19 TFP in the whole economy

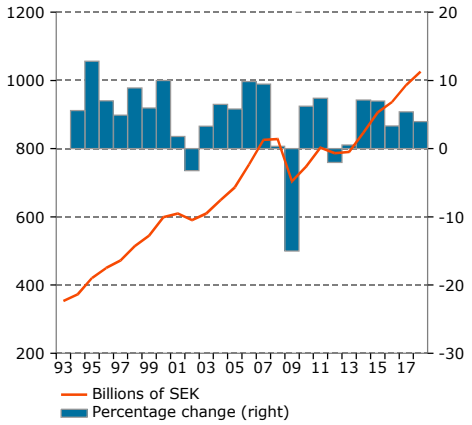
Percentage change



Sources: The Conference Board and Macrobond.

Diagram 20 Investments in the business sector

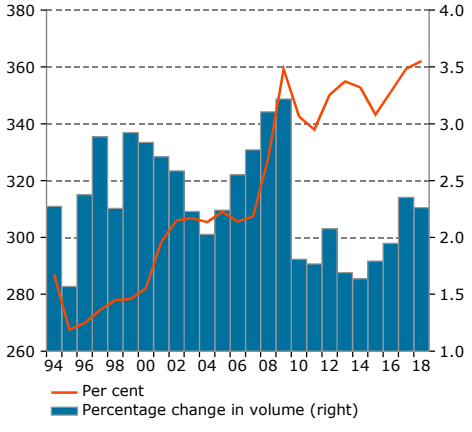
Billions of SEK, constant prices and percentage change



Sources: Statistics Sweden and NIER.

Diagram 21 Capital stock in the business sector

Percent of value added in the business sector, current prices and percentage change, constant prices, respectively



Sources: Statistics Sweden and NIER.

lower average education level than the Swedish-born population.[11]

The education level among those aged 25-34 in Sweden has increased since the turn of the millennium (see Diagram 23). The percentage with post-secondary education has moved almost identically to that in the US over the past decade, but is higher than in the OECD countries as a whole. South Korea and Japan have much higher percentages with post-secondary education than Sweden, which indicates that there is scope to raise the education level further in Sweden and so increase productivity growth. There have previously been signs of weaknesses in the Swedish education system. In the 2012 PISA study, Swedish pupils performed below the average for the OECD countries in all three fields (reading, mathematics and science) measured in the study. In the 2015 PISA study, however, the negative trend reversed, and the results were back to the levels of 2009, i.e. at or above the OECD average.[12]

The contribution of merchanting to productivity growth

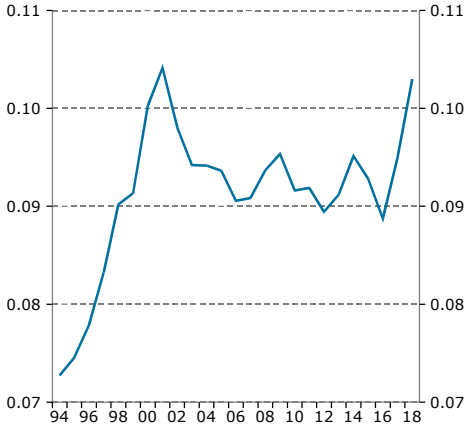
The value of merchanting increased from 1 per cent of value added in the Swedish business sector in 1994 to 3 per cent in 2018 (see LBR849 Diagram 24). Merchanting grew rapidly in the early 2000s before falling in the wake of the financial crisis. In 2013 and 2014, it grew strongly again.

Swedish merchanting occurs when a Swedish firm buys a good or service abroad and sells it on to a foreign customer without it entering Sweden – for example, when a Swedish firm buys a product from a supplier in India and sells it to a customer in Germany without it ever crossing the Swedish border. If the selling price is higher than the purchase price and any other costs, such as transport costs, the resulting profit will be recorded as a Swedish export. This trading is classified as exports of goods in the national accounts. Merchanting generates virtually no hours worked and so makes a positive contribution to productivity growth.[13]

Merchanting's contribution to business productivity growth averaged 0.2 percentage points a year in the period from 1993 to 2007. In other words, productivity growth would have been an average of 0.2 percentage points lower each year had merchanting been unchanged as a share of business sector output during the period. From 2010 to 2018, the contribution to productivity growth was smaller,

Diagram 22 Intangible investments in the business sector in Sweden

Share of value added in the business sector, current prices

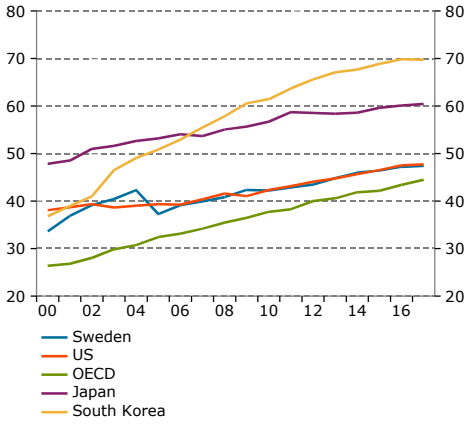


Intangible investments consist of investments in R&D, computer software/databases and other intangible assets.

Source: Statistics Sweden.

Diagram 23 Education levels

Percentage with post-secondary education, 25–34 years of age

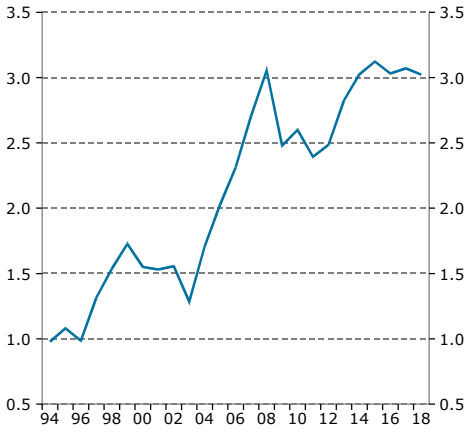


There are breaks in the time series in 2001 and 2005 due to changes in data collection and the classification of educational levels.

Source: OECD.

LBR849 Diagram 24 Merchanting trade

Percent of value added in the business sector, current prices



Sources: Statistics Sweden and NIER.

[11] See the special analysis "Utrikes födda och integration på den svenska arbetsmarknaden" [The foreign-born population and its integration into the Swedish labour market] in NIER (2018).

[12] See Swedish National Agency for Education (2019).

[13] The administration of this trading naturally requires some (but probably very little) input of labour in Sweden.

at less than a tenth of a percentage point. The slower growth in merchanting since 2010 can thus explain just over a tenth of a point of the decline in productivity growth since 2010 relative to the period from 1993 to 2007 (see Diagram 25).[14]

Productivity growth going forward

This section presents the NIER's forecasts for productivity in both the short and the long term. Forecasts of productivity growth are associated with considerable uncertainty, since productivity is affected by future technological advances, which are hard to predict. The NIER's projections of future productivity growth are therefore based to a great extent on the historical performance.

THE NIER'S METHOD FOR FORECASTING PRODUCTIVITY

The forecast for productivity over the next three to four years is based on the current trend in productivity growth, taking account of cyclical effects. The point of departure is that recent years' productivity growth should probably be a good indication of developments in the near term. Account is taken of contributions to productivity from capital formation, any temporary factors, and an analysis of the potential for current technological advances to raise productivity.

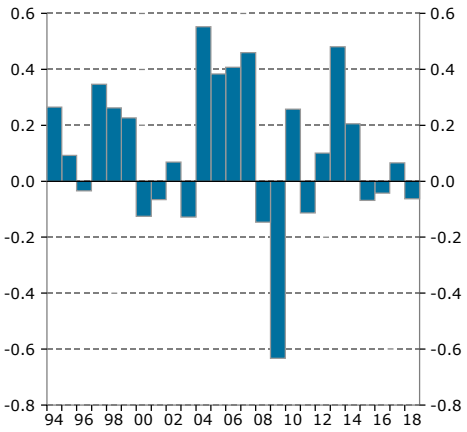
The assessment of cyclical effects on productivity is based on indicators of resource utilisation at firms. Examples of such indicators include capacity utilisation and survey responses on whether demand is a constraint on production. The correlation between these indicators and observed variations in productivity in previous business cycles provides guidance on future cyclical effects on productivity. The starting point in the forecasting process is an assessment of potential productivity growth (see Diagram 26).[15]

FURTHER LOW PRODUCTIVITY GROWTH IN THE SHORT TERM

The NIER does not currently see any strong reason why productivity growth should return in the short term to the high levels of the late 1990s and early 2000s. At present, there is much to suggest that current technological advances will not bring the same productivity gains in firms' production processes as the ICT revolution did previously. There are a number of

Diagram 25 Contribution from merchanting trade to the growth of productivity in the business sector

Percentage points

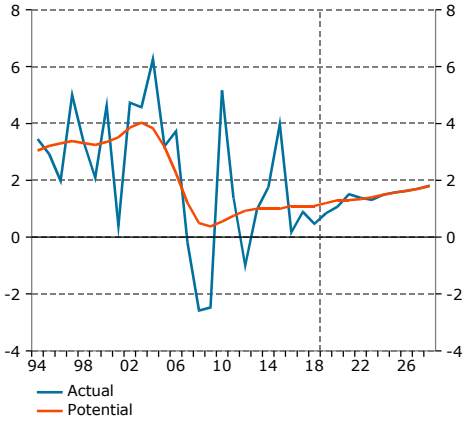


Calculated as the difference in the change in value added in constant prices with and without the value of merchanting.

Sources: Statistics Sweden and NIER.

Diagram 26 Actual and potential productivity in the business sector

Percentage change, calendar-adjusted values



Sources: Statistics Sweden and NIER.

[14] Calculated as the change in business sector value added in constant prices with and without the value of merchanting. Merchanting is also assumed not to entail any intermediate consumption or labour input.

[15] More than three to five years back in time, potential productivity is calculated using an adjusted Hodrick-Prescott filter.

areas of technology with considerable promise, such as artificial intelligence and robotics.[16] However, it is a relatively long process from research to the technology being adopted on a large scale and impacting on productivity growth. In the near term, there are no signs of these technologies being adopted widely in the business sector. For example, it has proved harder than expected to develop autonomous vehicles, for both legal and technical reasons.[17] In other areas, such as the Internet of Things and 3D printing, new technologies are being adopted in various quarters, but the productivity gains here are expected to be relatively modest. In addition, large parts of manufacturing are already highly automated.

From 2019 to 2023, the NIER expects calendar-adjusted productivity in the business sector to increase by an average of 1.3 per cent per year (see Diagram 26 and Table 2). This is slightly above the average for 2010 to 2018 of just under 1.1 per cent per year.

The labour force and employment are expected to grow more slowly than in recent years, while the capital stock has been growing more quickly for the past couple of years. The amount of capital per worker in the business sector is therefore increasing, which will boost productivity growth as early as this year. This will partially offset the negative productivity effects of the ongoing economic slowdown.

Table 2 Productivity growth in the business sector

Percentage change

Year	Potential	Calender-adjusted	Actual
2019	1,2	0,8	0,9
2020	1,3	1,1	0,7
2021	1,3	1,5	1,3
2022	1,3	1,4	1,4
2023	1,4	1,3	1,7
2024	1,5	1,5	1,5
2025	1,6	1,6	2,0
2026	1,6	1,6	1,2
2027	1,7	1,7	1,3
2028	1,8	1,8	2,2

Note. The table shows the growth in value added in constant prices per hour worked, for both the employed and self-employed. Potential refers to the change that would have been observed in the absence of cyclical variations and changes in the number of working days from year to year. Calendar-adjusted excludes systematic effects from differences in the number of working days during the year. Fewer working days tend to be associated with higher measured productivity.

Source: NIER.

[16] Artificial intelligence is normally meant to describe computers or machines with cognitive functionality similar to that of humans, such as the ability to learn or solve problems.

[17] See, for example, Wired (2019).

Productivity projections are subject to considerable uncertainty

Like all forecasts, our productivity growth forecasts are associated with uncertainty. The NIER's forecasts for productivity growth in the business sector at various points are presented in Diagram 27 and Diagram 28). On average, the NIER's forecasts and scenarios have overestimated annual productivity growth.[18] The main exception was 2015, when growth was temporarily high.

Since 2002, the forecasts for the next five years (excluding the year in which the forecast was made) in the NIER's medium-term scenarios each August have been at most 1.0 percentage points too low and at most 2.6 percentage points too high.[19]

The average error for the next five years has been +1.2 percentage points per year in these forecasts. This means that, on average, productivity has been overestimated by more than 1 percentage point per year. The root mean square error has been 1.6 percentage points. If future forecast errors are normally distributed with the same variance, a 90 per cent confidence interval for forecast errors would be ±2.6 percentage points per year.[20]

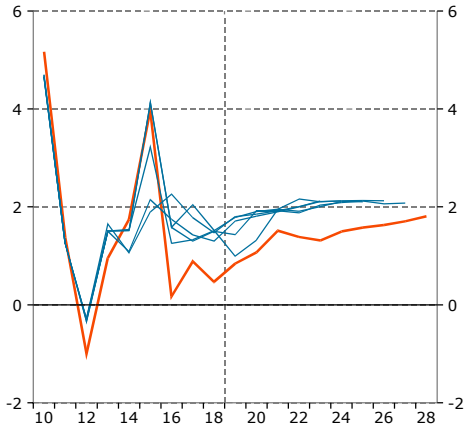
PRODUCTIVITY GROWTH IN THE LONGER TERM

When projecting productivity growth beyond three to four years, there is little information to go on. Technological progress is hard to predict, not least because Sweden's productivity growth is greatly affected by global technological developments. The obstacles with which new technologies are currently battling will probably be overcome in time. The forecast for productivity growth in the long term is therefore based largely on the long-term historical average. In our forecast for the longer term, we assume that technological progress makes gradually increasing contributions to productivity.

The NIER expects productivity growth in the business sector to accelerate during the course of the 2020s to reach 1.8 per cent in the long term (see Table 2). This is lower than the NIER's prediction a year ago. It is also below the average annual rate of business productivity growth of just over 2 per cent seen in the

Diagram 27 Productivity in the business sector

Percentage change

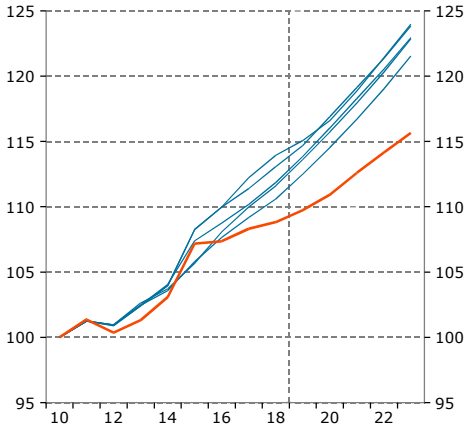


Note. Blue lines refer to outcomes and forecasts from 2014 to 2018. The red line is the latest outcome data and forecast.

Sources: Statistics Sweden and NIER.

Diagram 28 Productivity in the business sector

Index 2010=100, calender-adjusted values



Note. Blue lines refer to outcomes and forecasts from 2014 to 2018. The red line is the latest outcome data and forecast.

Sources: Statistics Sweden and NIER.

[18] The NIER's forecasts for more than one to three years ahead are normally referred to as scenarios. Generally, however, there is only a single scenario.

[19] The forecast error has been calculated here as the annual arithmetic mean of the forecast for productivity growth for the following five years minus the latest published data for the equivalent period.

[20] This calculation of a confidence interval for future forecast errors is conditional on forecast errors being normally distributed with an expected value of zero and having the same variance as they have historically.

period from 1980 to 2018.[21] The reason for this is that the structural transformation in the Swedish economy since the early 1980s will probably bring lower productivity growth in the future. Industries with higher trend productivity growth, such as manufacturing, have shrunk, while labour-intensive industries with lower trend productivity growth, such as health care, education and other services, have expanded (see Diagram 29, Diagram 30 and Diagram 31).[22]

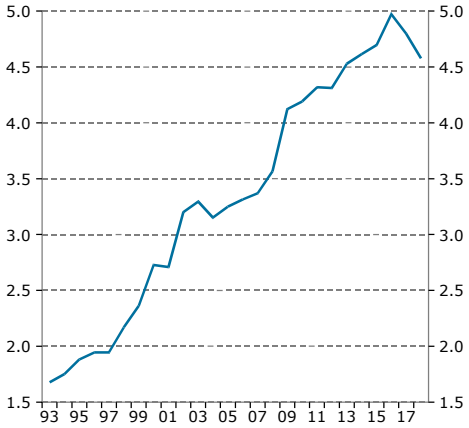
STRUCTURAL CHANGE AND PRODUCTIVITY GROWTH

The role of industry composition in productivity growth can be estimated in slightly different ways. Total productivity growth in the business sector can be approximated by weighing together the productivity growth in different industries based on their share of total value added in current prices. One measure of the impact of structural change on productivity growth can therefore be obtained by comparing the weighted productivity growth of a number of industries with the historical performance of the aggregate. This weighted productivity growth can be calculated using historical averages for each industry's productivity growth, but its current weight in business sector value added. This weighting shows approximately what productivity growth there would be going forward if productivity growth remains the same in each industry as it has been historically, and the industry composition of the business sector is unchanged from today.

Table 3 shows 27 industries' average productivity growth since 1980, their average share of business sector value added in the period from 2014 to 2018, and approximately what the weighted growth rate would be with these weights.[23] Previously published data for the period from 1980 to 1992 have been linked to current data for the period from 1993 to 2018. The table shows that future productivity growth in the business sector will be 0.4 per cent lower than before even if productivity growth in each industry continues on its historical trend. This presupposes that the business sector's industry composition remains unchanged from what it was in 2014-2018. If the structural transformation in Sweden continues at the same pace and in the same direction as it has over the past 15 years, productivity growth in the long term may be slightly lower again. The calculations thus show that there have already been fairly

Diagram 29 Value added in the healthcare and education industries in the business sector

Percent of value added in the business sector at basic prices, current prices

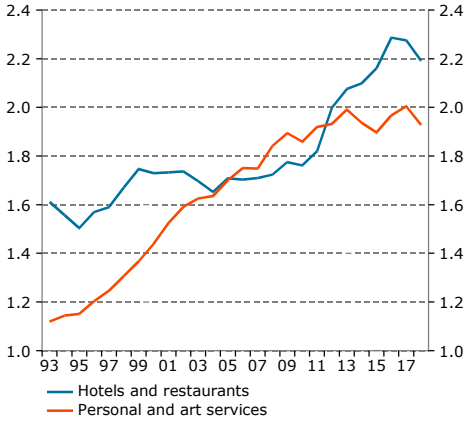


Note. Refers to sector P and Q respectively, according to SNI 2007. Does not include value added in the public agencies.

Source: Statistics Sweden.

Diagram 30 Value added in different service industries

Percent of value added in the business sector at basic prices, current prices

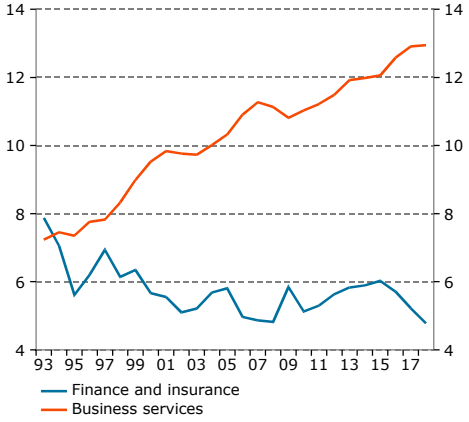


Note. Refers to sector I, and R + T respectively, according to SNI 2007.

Source: Statistics Sweden.

Diagram 31 Value added in different service industries

Percent of value added in the business sector at basic prices, current prices



Note. Refers to sector K and M + N respectively, according to SNI 2007.

Source: Statistics Sweden.

[21] The NIER has linked previously published data for 1980-1992 with current data for 1993-2018. Depending on which data are used for the linking, we obtain an estimated average change since 1980 for business productivity of 2.04 or 2.05 per cent based on the compound interest method.

[22] See also the special analysis "Klimatförändringen och klimatpolitikens effekter på arbetsproduktiviteten" [Climate change and the effects of climate policy on labour productivity] in NIER (2019) for an analysis of the role of climate change in long-term productivity growth.

[23] The industry weights have been calculated on the basis of a slightly longer period than just one year in order to reduce the impact of temporary changes in the relative size of different industries.

significant composition effects that could also result in permanently lower productivity growth going forward.

On the other hand, it is not a given that industries will have the same productivity growth in the future as they have had since 1980. The results are also affected by the industry aggregates and time periods used in the calculations. The table therefore gives only an indication of the size of composition effects on productivity growth in the Swedish business sector. The NIER has taken account of this, and it is the main reason why productivity growth in the business sector is projected to remain lower in the long term than it was in the period from 1980 to 2018.

Table 3 Historical productivity growth weighted with value-added weights

Annual percentage change and percentage units respectively

	Productivity growth 1980–2018	Weight 2014–2018	Contri-bution
Agriculture and fishing	2,4	1,0	0,02
Forestry	2,3	1,1	0,02
Other mining activities	0,5	0,7	0,00
Food and tobacco	1,3	1,4	0,02
Textile	2,0	0,1	0,00
Wood and paper products	2,3	2,2	0,05
Petroleum industry	6,4	0,3	0,02
Chemistry and pharmaceuticals	2,4	2,2	0,05
Rubber and plastic	1,5	0,5	0,01
Mineral products	1,4	0,5	0,01
Steel	1,9	1,0	0,02
Metal products	1,4	1,8	0,02
Computers and electronics	8,0	1,4	0,12
Machines	2,5	2,6	0,06
Transport	4,1	3,9	0,16
Furniture, repairs and more	1,8	1,0	0,02
Electricity, gas, waste and sewage	0,4	3,8	0,02
Construction	0,7	8,2	0,06
Trade	3,0	13,9	0,42
Transportation	1,2	5,5	0,07
Hotels and restaurants	–0,8	2,2	–0,02
Info- and communication services	3,7	9,4	0,35
Financial activities	2,6	5,5	0,14
Real estate activities	–1,0	10,6	–0,10
Business services	1,5	12,5	0,19
Care and education	–1,9	4,7	–0,09
Personal and art services	0,0	1,9	0,00
Sum		**100,0**	**1,64**
Total business sector	**2,1**	**100,0**	
Difference between weighted total and historical actual development			–0,41

Note. The weights are calculated as value added in each industry divided by value added in the business sector as a whole in current prices. Productivity growth is calculated as the geometric mean from 1980 to 2018. To calculate average productivity growth, NIER has linked previously published data for 1980-1992 with current data for 1993-2018. Some figures in the table do not sum due to rounding.

Sources: Statistics Sweden and NIER.

Varying views of future technological progress among researchers and other commentators

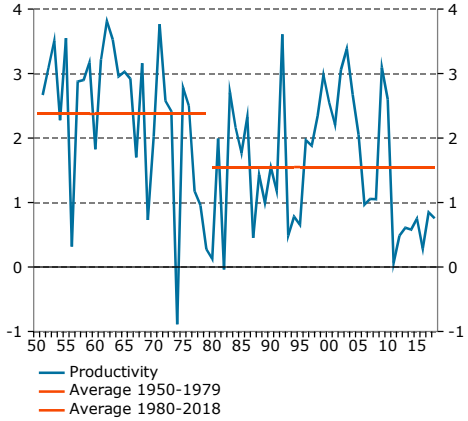
There is a large literature on what might explain the productivity slowdown and what might be expected to drive technological progress going forward. Opinions on future productivity growth are divided.

Some researchers are relatively pessimistic about future productivity growth. Gordon (2014) argues that today's innovations will not generate the same productivity gains as those in the late 19th and early 20th centuries. For example, electricity resulted in strong productivity growth for a large part of the 20th century. He therefore considers it unrealistic to expect productivity to return to its historical growth rate, at least in the near term. Another argument for this pessimistic view is that ICT generated considerable productivity gains in the 1990s and early 2000s, but these effects have faded. Productivity growth in countries such as the US during this period was therefore only temporarily high. In the light of this, Gordon predicted that productivity over the next ten years would instead grow at around the average rate of the previous 40 years. Based on statistics published to date, this would mean annual productivity growth in the US of just over 1.5 per cent (see Diagram 32).

Others are more optimistic and argue that the technological advances currently being made are considerable but have yet to show up in the statistics – see, for example, Brynolfsson and McAfee (2011) and Mokyr (2014). The drivers they mention include artificial intelligence, robotics and the Internet of Things. The potential for increasing use of technology in health care and education to drive productivity growth is also cited by Branstetter and Sichel (2017). These researchers argue that the reason why current innovations have yet to produce productivity gains in the statistics is that it often takes time for new technologies to be adopted and for the improvements to materialise. It is also argued that difficulties measuring ongoing productivity improvements mean that productivity growth is being underestimated in the statistics. Digital services that are free to the consumer are not measured in the national accounts and are not therefore captured in the productivity statistics, even though they generate consumer surplus.[24]

Diagram 32 Productivity in the whole economy in the US

Percentage change



Note. Refers to value added per hour worked.
Sources: The Conference Board and Macrobond.

OTHER COMMENTATORS' FORECASTS

A selection of other commentators' productivity forecasts are presented in Table 4. Only a few institutions publish forecasts

[24] See also Breman (2016).

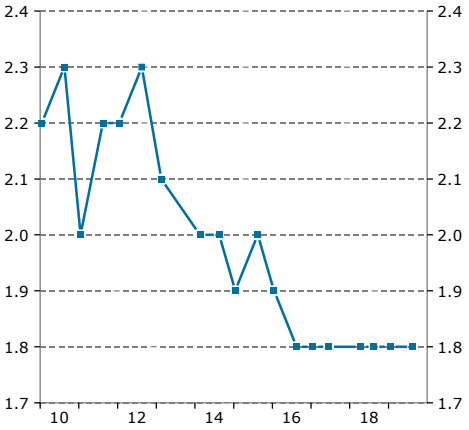
for productivity growth several years ahead.[25] In its latest update, the Congressional Budget Office (CBO) assumes potential productivity growth in the US business sector excluding agriculture of 1.8 per cent in the medium term (five to ten years ahead). This is the same rate that the NIER is assuming for Sweden in the long term.[26] In the short-to-medium term (2019-2027), the CBO's forecast for potential productivity growth in the US is slightly higher than the NIER's equivalent forecast for Sweden.

The CBO's forecasts for potential productivity growth in the medium term have come down since 2010 (see Diagram 33). After previously being above 2 per cent, they are now below 2 per cent.

Consensus Economics publishes the average expectations of a large number of institutions and firms. In the medium term (until 2026), the expectations in its survey – which cover the whole economy – are marginally higher than the NIER's corresponding forecast.[27] The OECD also publishes long-term forecasts for productivity growth for the whole economy. Its forecasts for Sweden are again slightly higher than the NIER's. All in all, the NIER is slightly more pessimistic about the outlook for productivity growth than most other forecasters, especially in the near term.

Diagram 33 Forecasts on potential labour productivity

Business sector excluding agriculture. Average annual percentage change, monthly values as of publication date



Note. Forecasts for the development in the US from about 5 to about 10 years ahead in time after publication date.

Source: Congressional Budget Office.

GRADUALLY ACCELERATING PRODUCTIVITY GROWTH

Technological progress is crucial for future productivity growth but is difficult to predict. As mentioned earlier in this chapter, researchers and commentators have varying views of future developments.

Given this uncertainty, the NIER has assumed that potential productivity in the business sector will increase in the long term at the average historical rate, adjusted for the effects of the structural changes in the relative size of different industries in the Swedish economy since the early 1980s. All else equal, this structural transformation will put a slight damper on productivity growth. Productivity growth in the short term is nevertheless expected to be muted. This is partly because we expect the economy to be in a slowdown phase for the next couple of years, when productivity growth is normally weak, but also because underlying productivity growth has been so weak in recent years.

[25] Different bodies publish slightly different variables for productivity. For example, some forecast GDP growth per worker rather than per hour worked.

[26] The NIER's forecast for the business sector includes agriculture.

[27] The NIER participates in Consensus Economics' surveys, which means that the NIER's forecasts are included in the averages from Consensus Economics.

Table 4 Forecasts of productivity growth

Average annual percentage change for the specified period

	Forecasting point	Country	Variable	Period	Forecast
NIER	October 2019	Sweden	GDP per employed	2019–2028	1,1
NIER	October 2019	Sweden	Potential productivity in the business sector	2019–2023	1,3
NIER	October 2019	Sweden	Potential productivity in the business sector	2024–2028	1,6
European Commission	November 2017	Sweden	GDP per hour worked	2021–2030	1,3
European Commission	November 2017	Sweden	GDP per hour worked	2031–2040	1,4
European Commission	November 2017	Sweden	GDP per hour worked	2041–2070	1,5
Consensus	August 2019	Sweden	GDP per employee	2022–2026	1,4
Consensus	August 2019	Sweden	GDP per employee	2027–2031	1,3
OECD	July 2018	Sweden	GDP per employed	2018–2030	1,7
OECD	July 2018	Sweden	GDP per employed	2030–2060	1,9
OECD	July 2018	OECD	GDP per employed	2018–2030	1,5
CBO	Augusti 2019	USA	Potential productivity in the business sector excl. agriculture	2019–2023	1,8
CBO	Augusti 2019	USA	As above	2024–2029	1,8

Note. Arithmetic means that include the change in the first year in the given interval, at least for the NIER's forecasts. Some other institutes are unclear about whether the first year is included or not. For the OECD, the forecast has been calculated by adding together the contributions from labour efficiency and capital per worker in Table 1 of OECD (2018).

Sources: OECD (2018), Congressional Budget Office (2019), Consensus Economics (2019), European Commission (2017) and NIER.

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