The new macroeconomic landscape after the global financial crisis

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In this article, we discuss some of the structural changes that have taken place in the macroeconomic environment after the global financial crisis that erupted with full power when the US investment bank Lehman Brothers went bankrupt in the autumn of 2008. The changes we address are the weaker productivity growth, the lower long-term real interest rate, the growing debts among households and states and the flattened Phillips curve. These changes have been important for monetary policy over the last ten years and will, in all likelihood, continue to be so in the period ahead.

1 Introduction

The Riksbank and other central banks that conduct inflation targeting strive to stabilise inflation at a certain level and to stabilise resource utilisation so that it develops in a balanced manner. To do this, central banks use a number of monetary policy tools such as the policy rate or purchases of financial assets that influence the economy via what is usually called the monetary policy transmission mechanism. In practice, this mechanism has many different parts or 'channels' that affect, in different ways, which decisions economic agents take. Changes of central banks' policy rates and purchases of financial assets work their way through the economy via these different channels and ultimately influence macroeconomic quantities such as inflation and output. In this way, monetary policy can stabilise fluctuations in the economy so that recessions do not have as great negative effects and booms do not end in price and wage spirals. One way to describe this is that the state of the economy varies with the economic cycle and that monetary policy helps stabilise this development around a 'normal' or long-term trend (the target level for inflation).

But not all changes are cyclical. Over time, fundamental changes can take place that affect how the economy functions on a structural level. This can be illustrated with an example. Assume it becomes easier for labour to move from country to country. This could mean that inflation does not rise as much in economic upswings as in earlier periods, as labour shortages in individual countries become less common. It also reduces the probability of rapid wage and price increases. Similarly, it could mean that inflation does not fall as much in recessions as in earlier periods. If more workers choose to move abroad when economic activity slows down, unemployment will not rise as much in an individual country, which will reduce downward pressure on wage and price increases. In other words, a structural change – greater international mobility – has taken place and this has affected the functioning of the economy with consequences for prices, wages, output and other factors.

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This article was written before the outbreak of the coronavirus pandemic. The potential effects of the pandemic on long-term economic development have therefore not been considered. Several of the changes discussed in the article do, however, affect the prevailing conditions for conducting effective economic policy and will probably continue to be important going forward. These conditions include the global trend towards lower real interest rates and the fact that public indebtedness has increased in many countries over recent decades.

Monetary policy neither can nor should hinder such long-term structural changes. However, monetary policy needs to consider these changes, as they may affect prices and output. In other words, the structural changes affect the conditions for monetary policy, which is to say the environment in which monetary policy acts.

The aim of this article is to describe a number of structural changes that have characterised the macroeconomic environment over the last ten years and which are also highly likely to be important for monetary policy and other economic policy areas in the future, even if the top priority for economic policy in the immediate future will naturally be trying to mitigate the economic effects of the spread of the coronavirus. The structural changes we are focusing on are the weak productivity growth, a lower long-term real interest rate, growing debts among households and states and the flattening of the Phillips curve.

Productivity growth has been weak both internationally and in Sweden over the last decade, without clear tendencies towards improvement. Various explanations have been suggested for this, with some analysts focusing on structural changes, such as less efficient allocation of resources, reduced transfers of technology and poorer dynamics in industries, and others seeing links to the tighter credit conditions during the financial crisis and the low demand connected to the economic downturn.

The **long-term real interest rate** has fallen around the world over the last 30 years, often by several percentage points. The real interest rate on savings has fallen correspondingly. Several structural changes have contributed to this global trend, including demographic changes and a high level of saving in China and other emerging economies in Asia.

We have seen growing indebtedness among households and states. Several studies show that households' mortgage loans, and variables linked to these loans, are important for the strength of the monetary policy transmission mechanism. It is not apparent that **higher indebtedness in the household sector** automatically results in a stronger effect on household consumption from changes in the interest rate. However, several studies show that highly indebted households with limited access to credit are those who change their consumption most when the interest rate changes.

Fiscal policy has also gained an increasingly important role in stabilising the economy in several countries due to the relatively low interest rates following the financial crisis and the fact that monetary policy tools are limited in a number of countries. For fiscal policy to be effective, it is important that households and companies have high confidence in it. One important factor in this connection is the **sovereign debt**. In conjunction with the global financial crisis, sovereign debt in the euro area, United States, Japan and United Kingdom increased to relatively high levels, where it has remained since. Sweden has coped better: sovereign debt did not rise significantly during the financial crisis and, compared with many other countries, it is relatively low at present. However, Sweden has high private indebtedness among households.

The **Phillips curve**, i.e. the relationship between prices and resource utilisation, weakened in many countries following the financial crisis. Before the financial crisis, the correlation between nominal wage growth and unemployment was negative in most cases. Since the crisis, it has become weaker and even slightly positive in Sweden. For central banks, it is important to understand what this is due to, as it could affect how well monetary policy works. There are various hypotheses concerning what may have caused the weaker relationship but no consensus.

In the rest of this article, we provide a more detailed description of these structural changes in order and conclude by drawing some conclusions over what the changes may mean for monetary policy going forward.

2 Weak productivity growth

Both in Sweden and internationally, productivity growth has been slow over the last decade, with no clear tendencies towards improvement. Before we describe this development and conceivable reasons for it, we present a brief explanation of the term productivity, as it can be measured in several different ways.

A common measure of productivity is **labour productivity**, which, put simply, specifies how much output an amount of labour produces. This output is then most often measured as value-added in fixed prices, while the amount of labour is usually measured per hour worked or per employed person.[1] This means that, if labour productivity increases, more is produced with the same amount of labour. This can be achieved in several ways. One is that the quality of the actual labour input is improved. Another is that the labour performed is the same but that the input from machinery and other equipment increases, i.e. the contribution made by capital per hour worked becomes greater. Finally, technological progress, improvements in how operations are led and the like can make production more efficient. This latter is its own measure of productivity, known as **total factor productivity** (TFP).[2]

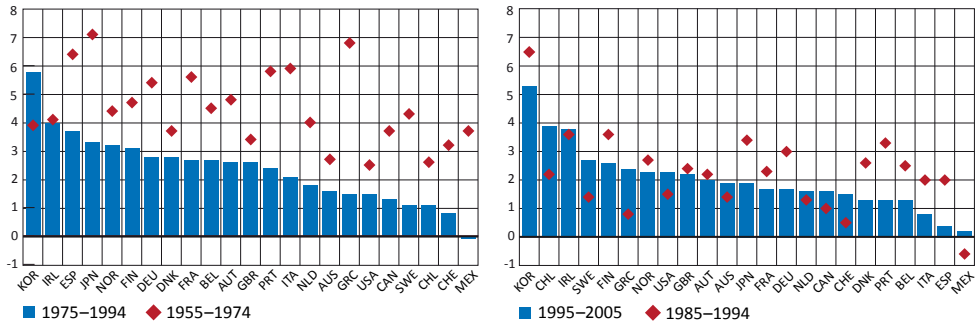
TFP is important because it is not affected by the *size* of the contributions made by labour, capital and other output factors, but only reflects how productive these contributions are when combined. As TFP is not directly observable, it is usually calculated as a residual item, which is to say the output increase that cannot be explained by contributions from labour, capital or any other factors. In practice, TFP therefore risks reflecting other factors, apart from technological progress and similar improvements. One example is capacity utilisation. Apart from adjusting the *amount* of labour and capital in production, companies can vary the degree to which labour and capital are *used*. Measures of both TFP and labour productivity will also reflect such variations, unless an active effort is made to consider them in the calculation of productivity.

2.1 Productivity growth up until 2005

To gain a perspective on developments over the last decade, we start by examining the historical background. Experiences naturally vary between individual economies, but it is possible to discern common trends that have characterised the general development of productivity.[3] To start with, productivity shifted downwards in the mid-1970s in conjunction with the first oil crisis and subsequent economic downturn. This slowdown meant the end of the golden age of strong productivity growth and high economic growth that started in the 1950s.[4] This is illustrated for a selection of OECD countries in the left-hand graph in Figure 1. On average, labour productivity increased significantly faster in 1955–1974 (the red marks) than in 1975–1994 (the blue bars). For many of the countries, the slowdown was significant and, in addition, the trend was negative – dividing the period 1975–1994 up further shows that productivity was weaker during the second half.

1 Value-added is the value of production with deductions for input goods and input services.
2 Sometimes also called multi-factor productivity (MFP). The concepts are used synonymously.
3 This description applies, above all, to OECD countries. Productivity growth in other parts of the world is not necessarily characterised by the same trends.
4 Crafts and Hjortshøj O'Rourke (2014).

Figure 1. Labour productivity (GDP per hour worked)
Annual percentage change



Note. The mean value of the annual percentage change in GDP per hour worked during each period. GDP is measured in fixed prices, converted to US dollars to facilitate comparisons between countries.
Source: Conference Board, Total Economy Database, April 2019

However, the following ten-year period, 1995–2005, differed from the previous decades. The right-hand graph in Figure 1 compares average productivity growth in 1985–1994 (red marks) with the average for 1995–2005 (blue bars) for the same OECD countries. The negative trend of falling productivity growth certainly continued in many countries, including several in southern Europe, and in other countries, the increase in productivity was approximately as large as previously. But in the United States and a couple of other countries, including Sweden, productivity growth shifted upwards, starting in the mid-1990s. This was remarkable, partly because it shifted up strikingly in the United States from the modest level seen over two decades, and partly because no equivalent upturn in productivity was seen in Europe, except for in isolated countries. Until then, the level of productivity in European countries had come closer and closer to the level of the United States, which is often assumed to reflect the technological frontier and the level towards which the productivity of other countries converges. It also meant that productivity in other countries had increased more rapidly than in the United States over a longer period. This changed in the 1990s.

The rapid improvement in labour productivity in the United States from the mid-1990s was largely linked to the arrival and diffusion of information and communication technology (ICT). Such technology had certainly started to spread significantly earlier – for example, computerisation had been in progress for a number of decades. But it was not until the mid-1990s that it seemed to affect productivity to any greater extent. Productivity in the United States then increased rapidly, partly as a result of technological progress in the production of ICT that led to a rapid upwards shift of TFP in the ICT manufacturing sector. This raised overall productivity growth in the entire economy. At the same time, prices for ICT products fell rapidly, which created an incentive for investment in the new technology. Companies in other sectors of the economy therefore invested in ICT on a broad front. This also contributed to labour productivity increasing more from the mid-1990s than in the decades before.[5] These two factors were some of the main explanations for the upward shift in productivity until 2000 when the so-called dot-com bubble burst.[6]

However, productivity also continued to increase rapidly in the United States after the start of the new millennium. Production of and investment in ICT contributed partly to this, but, above all, TFP increased rapidly in other sectors. One conceivable explanation for this is that the major investments in physical information and communication technology at the end of the 1990s required complementary investments in so-called intangible capital. For example, it became necessary to develop software, train staff and change organisational structures to take advantage of the new technology. For technology with broad areas of

5 See, for example, Timmer and van Ark (2005), Oliner et al. (2007) and Jorgenson et al. (2008).
6 Bosworth and Triplett (2007) point out that TFP growth also shifted upwards in several of the service sectors and that this was therefore a further important factor behind the rise in productivity in the United States in the second half of the 1990s – see below.

use, such as ICT, such investments can be particularly important.[7] The continued strong TFP growth after the start of the millennium could therefore be explained by delayed effects of the ICT investments in the 1990s. However, the results of studies investigating this are not unambiguous.[8] Other conceivable explanations for productivity growth holding up in the United States after the start of the millennium are that the competitive pressure for change was strong in individual industries and that there was a general shift of resources from low to highly productive industries.[9]

Productivity advances in Europe in 1995–2005 differed relatively substantially from country to country. In Sweden and Finland, labour productivity increased rapidly, and ICT production and ICT investments also developed in a similar manner to the United States. But many other countries had significantly weaker productivity gains. Comparisons show that ICT explained part of the differences, including lower ICT investments in some countries. But the greatest differences – both between individual EU countries and between the United States and the EU countries – were linked to TFP growth in other parts of industry, above all within private service sectors such as trade and transport and financial and businesses services.[10]

2.2 Weak productivity growth from the mid-2000s

Over the last decade, productivity gains in OECD countries have been weak in general. In the United States, where productivity increased rapidly in the years before and after the start of the millennium, growth has been significantly weaker since 2005. This also applies to other countries with a period of rapidly-increasing productivity, including Sweden. In economies where the rate of increase was previously more modest, productivity has continued to develop weakly over the last decade or has even shifted down further. Figure 2 illustrates how labour productivity and TFP have grown since 1995 in the United States, Sweden and the euro area and for the OECD as a whole. As the figure shows, the shift to lower average productivity growth largely coincided with the financial crisis of 2007–2009. The discussion of why productivity growth shifted down has partly focused on this connection. However, there are indications that productivity growth had already started to weaken in the years before the crisis, which suggests that the reasons may not necessarily be connected with the financial crisis.

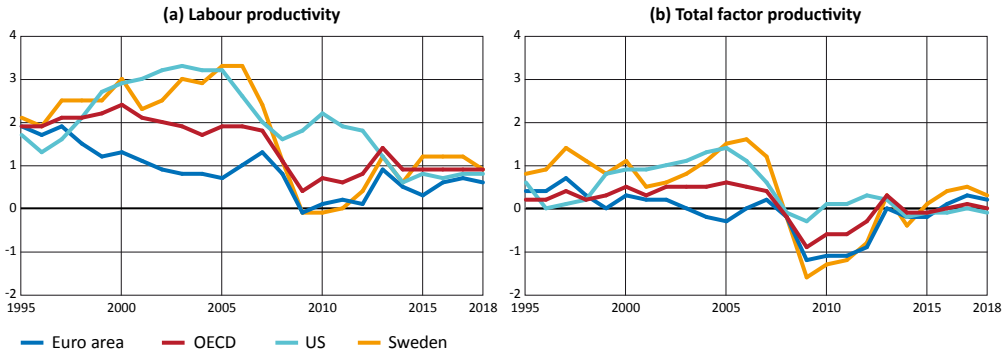
7 See, for example, Brynjolfsson et al. (2018). One frequently used expression for such technology is general purpose technology. In the national accounts, investments in intangible capital generally consist of expenditure for software and for research and development. However, other expenditure could also be considered as similar investments; see Corrado et al. (2005). Estimates indicate that investments in more broadly defined intangible capital may be significant; see, for example, Corrado et al. (2016).

8 Compare Basu and Fernald (2007) and Fernald (2015) with Bosworth and Triplett (2007) and Oliner et al. (2007).

9 Oliner et al. (2007)

10 van Ark et al. (2008). According to Inklaar et al. (2006), productivity growth in the service sector was generally stronger in Anglo-Saxon countries than in continental European countries.

Figure 2. Labour productivity and total factor productivity 1995–2018
Annual percentage change



Note. Moving average of the annual percentage change of labour productivity and TFP, respectively, over the last four years. GDP is measured in fixed prices, converted to US dollars to facilitate comparisons between countries. For the euro area and OECD, the calculations are based on GDP per employee and, for the United States and Sweden, on GDP per hour worked.
Source: Conference Board, Total Economy Database, April 2019

The problem of long-term weak productivity growth has received considerable attention in both international organisations and individual countries. Proposed measures to reverse the trend have also been put forward.[11] The reason for this concern is that productivity is one of the most important factors for the economy in the long term as it reflects how efficiently production is converting inputs to goods and services or, put differently, how many goods and services can be produced with the same amount of inputs. Seen over longer periods, the increase of GDP per capita can largely be determined by how much productivity has increased. How rapidly or slowly productivity increases thus determines how material prosperity in general changes. In addition, productivity affects how prosperity is distributed, as there is also a link between wage development and productivity growth on the company level.

For monetary policy, it is important how productivity develops, among other things as it determines how rapidly the economy grows in the longer term. This so-called potential growth rate may, in turn, affect the level of the real interest rate in the economy; see also section 3.2.1. There is also a link between productivity and companies' costs that could influence monetary policy in the shorter perspective. The stronger productivity grows, the faster output can increase without wage increases and inflation picking up.

2.3 Possible explanations for the weak development

Several possible explanations have been proposed for why productivity growth has been so weak over the last fifteen years.

2.3.1 Measurement problems

There are a number of measurement problems associated with productivity statistics. Measuring how real output, and thereby productivity, has changed requires price developments to be taken into account. One difficulty with this involves measuring how much of the price movements are due to improvements in the quality of various products. Another measurement problem is rooted in certain products having moved from costing money to basically being provided free of charge, which means that they no longer give rise to any transactions that can be measured and included in the statistics.

11 See OECD (2015) among others. The EU has recommended all countries in the euro area to create national productivity boards to analyse productivity nationally and has urged other EU countries to do the same; see European Council (2016). Reports from such boards have also been published in many countries; see, for example, Conseil National de Productivité (2019) for France and De Økonomiske Råd (2019) for Denmark. In the United Kingdom, the focus has long been on the 'mystery' of the area's long-term weak productivity; see, among others, HM Treasury (2015), McKinsey Global Institute (2018) and Haldane (2018).

A further measurement problem is linked to the transactions in the different operations of multinational companies, and how, and in which countries, they report revenues and assets.

One conceivable reason why the measured productivity growth has been weaker over the last decade could be that measurement problems have been exacerbated. This would mean, therefore, that the downturn is largely illusory. Research has shown that the problems in measuring productivity are relatively substantial. For example, estimates of quality improvements are definitely a concern when calculating the production of ICT goods and services and investments in ICT. At the same time, however, analyses of US data indicate that this problem may have been greater before 2005 than afterwards. Similarly, analysis indicates that the value of products 'absent' from output statistics is not sufficiently large to explain the difference between the output that is measured and the output that would have been recorded if TFP growth in the United States had not shifted down in the mid-2000s. The conclusions of the research are therefore that productivity statistics are undeniably linked with relatively large measurement problems but that it is not obvious that these problems have worsened recently.[12]

2.3.2 Effects of low demand during the deep recession

Financial crises often have major negative consequences, as the deep recessions that usually follow in their wake substantially reduce activity in the economy and often for a longer period than 'normal' economic slowdowns. It is also possible that crises can have permanent effects on labour productivity, as they can cause major interruptions in investment, less activity conducive to innovation and long-term unemployment that damages the skills and know-how of the labour force, to give a few examples.[13] However, such factors should affect the long-term *level* of productivity, rather than the long-term *growth rate* of productivity. This does not mean that the rate of increase is entirely unaffected. During a transitional period, it will be lower than normal, as the economy is adjusting from a higher level of productivity to a lower one. This period of adjustment may, however, be prolonged. It is possible that the weak productivity growth after the financial crisis partly reflected such an adjustment.[14]

2.3.3 Tighter credit conditions and impaired allocation of capital

There may also be other links between the financial crisis and the weak productivity growth. Credit conditions were tightened in conjunction with the crisis. Even if central banks around the world acted to reduce the problem, many smaller and medium-sized companies found it difficult to gain access to credit, particularly in the euro area countries impacted most heavily by the crisis. There seems to be an empirical relationship in which companies with higher indebtedness and more short-term funding also had weaker TFP growth after the crisis. This could be an effect of them cutting back on investments in intangible capital and research and development to a greater extent.[15]

Not just capital formation in companies, but also the allocation of capital between companies may have been a factor behind the weak productivity growth. If capital cannot be moved from low-productivity to high-productivity companies in a sector, the resources as a

12 See, for example, Byrne et al. (2016), Syverson (2017) and Guvenen et al. (2017).

13 Using data for about 60 countries, Oulton and Sebastiá-Barriel (2017) estimate that, historically, banking crises have cut the level of labour productivity, measured as GDP per employee, permanently by about 1 per cent per crisis year.

14 Reifschneider et al. (2015) argue that the effects of the crisis on long-term unemployment, the number and activity of newly started companies and investment in general have probably contributed to the weak productivity. Fernald et al. (2017), on the other hand, are more critical of the hypothesis that the fall in demand can explain the development of productivity in the United States and instead show that this is an effect of a shifting trend that began before rather than in conjunction with the crisis. Anzoategui et al. (2017) also find that the trend started to shift before the crisis, but that the development was exacerbated further after the crisis via mechanisms linked to the fall in demand. Referring to IMF studies, Obstfeld and Duval (2018) argue that the crisis had a long-term dampening effect on productivity, mainly in Europe, and discuss what role the expansionary monetary policy may have played. See also Jordà et al. (2020).

15 See Adler et al. (2017) and Duval et al. (2020).

whole will be used less efficiently in the sector, which affects productivity in total. Studies of companies and industries have shown that there is a relationship between such an increasing misallocation or low reallocation of capital and the weak development of TFP in certain countries, including in southern Europe. Different studies emphasise different conceivable mechanisms behind this relationship. Regulation on the product and labour markets is often pointed out as the reason for capital being reallocated more slowly in many European countries than in the United States. It may be one reason for why productivity was not lifted by ICT the same way in Europe as it was in the United States in the ten-year period around the start of the millennium. There also seem to be links between impaired reallocation and the strong credit growth ahead of the financial crisis, as well as the deep recession.[16]

2.3.4 Reduced technology diffusion between companies and less business dynamism

Studies of data on the company level have also noted other aspects of the allocation of resources between companies within sectors that may be significant for productivity growth on the aggregated level. The reallocation between companies and the sectoral productivity depend on the dynamism of the sector – whether new companies are established and what structure they have, which companies in the sector are expanding, which are shrinking and which are dropping out. Studies have shown that the differences in productivity between companies in a sector have become greater, and there are results that indicate that this mainly depends on widening differences between companies at the technological frontier, which is to say the companies with the highest productivity within each sector, and the other companies.[17] In the frontier companies, productivity does not seem to have shifted down, but increased at a healthy rate. In contrast, other companies have slipped further behind, which has increased the differences between companies within the sectors.

Several reasons for this development, which has been in progress for some time, have been proposed. It could partly be an effect of it having become increasingly difficult for companies with lower productivity to incorporate the technology available to highly productive companies, which is to say that the diffusion of new technology between companies has decreased.[18] It could also partly be explained by decreased dynamism in the business sector, where weaker companies with lower productivity are finding it easier to survive and fewer new companies are being established. This could indirectly be reducing the pressure on existing companies to improve their productivity and profitability.[19]

2.3.5 Unfavourable demographic development and increased production of services

Another structural change that has been mentioned as an explanation for the restrained productivity growth concerns changes in the age composition of the population – something that is also mentioned as an explanation for the low real interest rate (see section 3.2). The knowledge and skills of the workforce – its human capital – naturally affect productivity and there is reason to believe that there is also a link to the age composition of the workforce, even if the form of this link is not obvious. As work experience grows with age, productivity can increase as the average age of the workforce increases. On the other hand, younger individuals will more recently have completed education and training that better reflects

16 According to Cette et al. (2016) and Gopinath et al. (2017), the comparatively large capital inflows and falls in interest rate levels that followed the introduction of the euro in Italy and Spain amplified the problem with misallocations there, which impeded the countries' TFP growth. Gamberoni et al. (2016) show that the allocation of capital deteriorated in several large European countries before the financial crisis, above all in service sectors. They also find that the great uncertainty over the economic outlook during the deep recession impaired allocation. Corrado et al. (2019) also find that increased uncertainty has impeded the allocation of capital within and between sectors. However, in contrast to other studies, they find that low real interest rates can be linked with better allocation, rather than worse.

17 See Andrews et al. (2016) who study companies in about twenty countries between 2001 and 2013.

18 See, for example, Liu et al. (2019) who show that increasing differences between companies at the technological frontier and other companies may be due to the way an environment with low interest rates boosts incentives for leaders in a sector to increase their strategic advantage.

19 See, for example, Decker et al. (2014).

new knowledge and technology. Empirically, the results are mixed, but there are studies that indicate that an ageing population may have contributed to weaker productivity growth.[20]

Another structural change that may have contributed to holding back productivity over a longer period concerns the way in which the business sector has shifted its focus from the manufacturing industry to an increased focus on the production of services. This could mean that productivity in total has shifted downwards, as the manufacturing industry has historically had stronger productivity growth. However, the picture needs to be adjusted a little, for example as parts of the services industry had strong productivity growth in the United States and elsewhere at the start of the 2000s.[21] However, even if the changing composition of sectors may have affected productivity over a longer period, it is less probable that this has been the main explanation for the downward shift in productivity over the last decade.

2.3.6 Delayed or reduced effects on productivity of new technology

One conceivable reason for productivity not appearing to have been affected particularly much by ICT, except for during a limited period in some countries, and not by the ongoing technological advances, is that the substantial productivity gains of these innovations have not arrived yet. As we mentioned earlier, there are arguments indicating that it takes time for breakthrough technologies to make their mark on productivity – the technology improves later on and usage increases as prices fall, new areas of use are identified, complementary investments need to be carried out, organisational structures need to be changed and so on. There is support for this theory in studies that have investigated how productivity changed during previous technological advances, such as when steam engines and electrical technology were introduced.[22] According to this perspective, we should not expect periods of rapid technological development to be directly translated into periods of rapid productivity improvement and there is a lot to suggest that improvements will arrive as we go forward.[23]

In opposition to this optimistic picture, it has been argued that we should not expect any delayed effects on productivity growth from ICT and the innovations now being made, as the effects of this technological progress are quite simply not as great as the effects of electrification, the internal combustion engine, antibiotics or water and sewage treatment, for example, which fundamentally changed the conditions for companies and consumers in the first half of the 1900s. Computerisation and information and communication technologies have certainly also entailed major changes for parts of the business sector, but they have not been as revolutionary.[24] According to this more pessimistic view, the strong productivity growth around the turn of the millennium in the United States and other countries was the total effect of ICT – it was not just a period in which the very lowest-hanging fruits of the new technology were plucked. The subsequent downward shift of productivity reflects how the effects of the new innovations are now wearing off.

One link to the more pessimistic view of the possibilities for productivity to shift upwards noticeably going forward can be found in the observation that TFP growth was certainly strengthened temporarily around the turn of the millennium but that, seen over a longer period, it has been modest despite the simultaneous constantly increasing intensity of research and innovation efforts. One implication of this could be that the productivity of the

20 See Adler et al. (2017) and the studies to which they refer. However, the link between an ageing population and economic growth, via productivity effects, is questioned in a study by Acemoglu and Restrepo (2017).
21 See, for example, Duernecker et al. (2017).
22 See, for example, David (1990) and Crafts (2004). Brynjolfsson and Hitt (2003) investigate the computerisation of US companies in the late 1980s and early 1990s and find that the effects on TFP of investments in computers increased over time.
23 Brynjolfsson et al. (2018) show, in a model, how breakthrough technologies can involve measured productivity following a J-shaped curve over time. When the new technology is introduced, large follow-up investments are made in intangible capital, which is not measured properly in the official statistics, meaning that productivity is underestimated and seems to be falling. When the effects of the intangible investments later become visible, productivity rises and, in contrast, is overestimated in the statistics.
24 See Gordon (2015, 2018).

actual research is declining so that more and more innovation effort is needed to maintain a certain level of productivity growth.[25] However, this applies for a longer period and cannot be linked directly to the downward shift in productivity over the last decade.

3 Lower long-term real interest rate[26]

In most advanced economies, yields on treasury bills and government bond yields are currently considerably lower than they were at the start of the 1990s. In many countries, this means declines of 10–15 percentage points. A large part of this downturn in nominal interest rates can be explained by the transition from high to low-inflation regimes that took place in the 1980s and 1990s. But the interest rate has fallen, even after adjustment for expected or actual inflation. Real interest rates are currently lower than they were 30 years ago in almost all advanced economies and in many emerging market economies. However, the average, GDP-weighted decrease is smaller in the group of emerging market economies. The dispersion in returns among different countries is also greater in this group than it is in the group of advanced economies. Households and companies are also facing significantly lower real interest rates on loans and savings than they did 30 years ago.[27]

3.1 Data and estimated trends

Figure 3 shows three measures of real interest rates for government borrowing with long maturities, based on two overlapping groups of advanced economies. The first measure (the blue line) shows the median of the real return on government bonds with long maturities in a group of 16 countries, including Sweden. The real return is calculated as the difference between the nominal return on each debt instrument minus the expected inflation measured using the GDP deflator.[28] The second measure (the turquoise line) was created by King and Low (2014). This uses the return on what are known as real government bonds from six major industrialised nations. According to both of these measures, the global real interest rate on government borrowing has fallen, by 6 and 4 percentage points respectively since 1990.[29]

Figure 3 also shows the expected real return on Swedish government bonds (red line). According to this measure, the real yield on Swedish government bonds reached its highest level in the early 1990s in conjunction with the defence of the fixed exchange rate. Following this, the real interest rate on the government's borrowing fell quite substantially in conjunction with the transition to a new monetary policy regime with inflation targeting and a variable exchange rate. If the return is compared, it can be noted that the real yield on Swedish government bonds in the 1980s and early 1990s was occasionally slightly higher,

25 Bloom et al. (2017) claim that it seems to be becoming increasingly difficult to come up with ideas in the sense that research productivity seems to have fallen broadly, seen over a longer period. Through case studies of different products and using data for companies and sectors, they find that increasingly large efforts seem to be needed in research to maintain a certain level of productivity growth.

26 This section forms a summary of the article 'What is driving the global trend towards lower real interest rates?', also published in this issue of Sveriges Riksbank Economic Review.

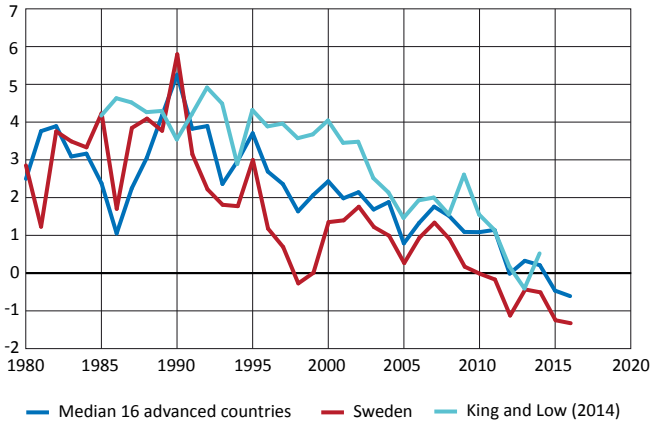
27 See Rachel and Smith (2015), sections A and D6.

28 Figure 3 shows three measures of real interest rates, two of which have been calculated by the authors using data for nominal return and inflation in various countries. The data has been taken from Jordà et al. (2019). The scientific literature often uses forecasts from simple autoregressive models as measures of expected inflation, and a variation of this approach has also been used here. For every year and country in the sample, an autoregressive model, AR(1), is estimated and forecasts from this model are then used to calculate the average expected inflation over the ten subsequent years. This forward-looking measure of expected inflation is combined here with a backward-looking measure (actual inflation during the 5 previous years) to calculate the expected real return on nominal government bonds. The two measures are given equal weight in the calculation. The 15 countries included in the calculation alongside Sweden are: Australia, Belgium, Denmark, Finland, France, Germany, Italy, Japan, the Netherlands, Norway, Portugal, Spain, Switzerland, the United Kingdom and the United States. The third measure shown in the figure has been calculated by King and Low (2014) and is based on the return on inflation-indexed (real) government bonds issued by Canada, France, Germany, Japan, the United Kingdom and the United States.

29 The median of the real return on government bonds in the group of 16 countries fell by about 6 percentage points between 1990 and 2015. According to the measure calculated by King and Low (2014), the real return fell by about 4 percentage points between 1990 and 2013.

occasionally slightly lower than it was abroad. Since 1992, the real interest rate in Sweden has constantly been lower than it has been abroad, according to these measures. Overall, however, a clear co-movement can be seen between the real rate of return that applies internationally and the one that applies in Sweden.

Figure 3. Real interest rates globally and in Sweden
Per cent



Note. For an explanation of the different measures of real interest rates that are shown in the figure, see footnote 28.
Sources: Jordà et al. (2019), King and Low (2014) and the authors' own calculations

How much of the total downturn in the global real interest rate since the 1990s is due to structural reasons and how much has cyclical causes? This question is difficult to answer, among other reasons because of the two powerful shocks that have affected the global economy since the mid-2000s: the global financial crisis, with subsequent deep recession, and the European sovereign debt crisis. When a large number of countries are affected by such powerful shocks, whose effects have also worn off slowly, it becomes more difficult to distinguish precisely between trends, driven by structural changes, and cyclical developments. In addition, most studies estimating trends in real interest rates have focused on development in individual countries, without explicitly considering that the downturn had a significant global component. However, with today's internationally integrated capital markets, where assets can be moved between different countries and currency areas rapidly and at a low cost, there are strong tendencies for real interest rates in different countries to converge. The results of a smaller number of studies estimating global trends in real interest rates show a decline in recent decades of between 2 and 3 percentage points. According to these studies, the level of the global trend was close to zero in the middle or in the second half of the 2010s.[30]

3.2 Explanations for the downturn in real interest rates

Most studies attempting to explain the negative trend in real interest rates focus on structural changes that have affected the supply of or demand for savings. As regards supply, the focus has often been on household saving, but government saving has also been discussed and, in practice, the rate of saving in the corporate sector is also important. Demand refers to total demand for investment. The idea is that the supply of saving and demand for investment must be balanced at the prevailing real interest rate and that there is a long-term equilibrium level at which the economy is in a cyclical balance. This long-term equilibrium level defines a long-term equilibrium real interest rate.

30 See Del Negro et al. (2019), Hamilton et al. (2016) and Kiley (2019).

The literature discusses about ten different structural changes that are conceivable driving forces behind the trend in real interest rates. Important examples are a presumed decline in potential growth, changes in the age composition and life expectancy of the population and a lasting increase in the premiums that investors are prepared to pay for safe assets. In addition, China and several other emerging market economies have increasingly been integrated into the global economy and have long had remarkably high levels of saving.[31]

3.2.1 Lower potential growth

Gordon (2015) is one example among several studies that argue that growth in the United States over the coming decades will probably be lower than the average growth rates experienced in the 1900s. According to macroeconomic theory, there is a close relationship between the level of expected growth and the level of the real interest rate. This is because lower expected growth dampens companies' willingness to invest, as future demand is expected to be lower. Demand for saved funds therefore becomes lower. However, worsened long-term growth prospects also make households more inclined to save. The supply of savings is therefore also affected.

The theoretical support for a link between the real interest rate and growth is very strong; it concerns a result that is key to pretty much all models with forward-looking households who take considered decisions on how much of their incomes to save. In recent years, a number of studies have been published that analyse the relationship in the data between trend or average growth and trends in the real interest rate. These studies generally indicate that the relationship is weak. Furthermore, the measured strength of the relationship can vary considerably, depending on which countries and periods are included in the data material.[32]

3.2.2 Demographics and high levels of saving in Asia

If the empirical support is weak concerning the relationship between trends in the real interest rate and potential growth, there is stronger support for such a relationship between the real interest rate and various demographic factors.[33] Changes in the age composition of the population are significant for a large number of macroeconomic variables, such as the labour supply and potential growth, companies' willingness to invest and households' average savings ratio, for example. Accordingly, there are several different channels through which demographic changes might affect the real equilibrium rate.

In US data, there is a fairly clear relationship between trends in the real interest rate and trend changes in the supply of labour. The real interest rate has often been comparatively high in periods when the trend increase in the number of hours worked has been high, and, conversely, low when the increase has been low. Something that has probably contributed to the real interest rate having fallen over recent decades is thus that the labour supply has grown comparatively slowly.

Another circumstance, often mentioned as a possible reason for low interest rates, is that an unusually large proportion of the population in recent decades has been in the age group 40 to 65, when saving tends to be high. According to one hypothesis, this should have led to an unusually high saving ratio, resulting in a greater supply of savings, with falling interest

31 Examples of other factors mentioned in the literature but not addressed here include falling relative prices for investment goods, a more uneven distribution of income among households and lower public investments. Rachel and Smith (2015) and Bean et al. (2015) provide non-technical overviews of the literature. Rachel and Smith's original study was published as a working paper by the Bank of England in 2015. A shorter version was published two years later in the International Journal of Central Banking (Rachel and Smith, 2017).

32 See Bosworth (2014), Goldman Sachs (2014), Hamilton et al. (2016) and Lunsford and West (2019).

33 Favero et al. (2016), Fiorentini (2018), Lunsford and West (2019), Poterba (2001) and Rachel and Smith (2015) are examples of studies that investigate the relationship in data between trends in real interest rates and various variables linked to the age composition of the population.

rates as a consequence. However, saving among G7 countries has shown a weak downward trend over the period in which real interest rates have had a falling trend. At the same time, these countries have reported significant deficits in the current account. A current account deficit means that total domestic saving is lower than total domestic investment and that saving in relation to the rest of the world is negative. The downward trend in saving and the current account deficit in G7 countries contradict the hypothesis that high levels of saving in these countries are an important force behind the global trend towards lower real rates.

However, over the same period, saving ratios have been remarkably high in China and several Asian emerging market economies, at the same time as they have reported large surpluses in international payments. A high level of saving in these countries, and in several petroleum-producing countries, has probably also helped push down the real required rates of return in the western world. Demographic changes are probably one of several factors that have contributed to the high level of saving in Asia. Other factors that have probably also contributed include the ambition among Asian public authorities to build up significant foreign exchange reserves, and the combination of high growth rates and relatively poorly-developed financial markets and collective insurance systems in Asia.[34]

3.2.3 Higher premiums on safe assets

So far, we have focused on trends in real government borrowing rates in advanced countries. This is a matter of interest rates on loans that are generally considered to be associated with low risk. Most investors consider bills and bonds issued by the governments of the United States and Germany, for example, to be safe assets, where the risk of payment suspensions is low. In recent years, increasing numbers of studies have analysed the difference between yields on such safe assets and the real return on higher-risk investments. Rachel and Smith (2015) analyse a large number of assets in several different countries and conclude that the average compensation for risk may have risen by as much as 1 percentage point since the 1980s. How then is the real interest rate for safe assets affected if the average compensation for risk rises?

Let us start with a simple example, where the difference in interest for two different loans depends on the probability of payment suspensions being greater for one of the loans. For example, this could be due to one borrower being a company with uncertain future prospects, and the other a state with well-functioning institutions. Assume now that a change takes place over time meaning that lenders, for some reason, become less willing to grant high-risk loans at each given interest rate level. Assume too that both the overall supply of savings and the overall demand for loans otherwise remain unchanged. At a given interest rate, both the state and the company wish to borrow as much as they did before the lenders changed their willingness to take on risk. Correspondingly, the lenders wish to lend as much money as before, even if they are now less willing to lend money to the company.

One reasonable consequence of such a change is that the interest rate for the state loan falls slightly and the interest rate for the corporate loan rises slightly. The reason is that the company must offer the lenders slightly greater compensation for the risk they run in providing the corporate loan. At the same time, the state, for its part, can borrow at a slightly lower interest rate than previously, as households value the security in the state loan more. In equilibrium, the interest rate on safe loans has thus fallen, at the same time as the return on high-risk assets has risen.

In the example, we assumed that the lenders had become less willing to bear risk, without specifying why. There are different hypotheses for the reasons that the compensation for risk has risen. One hypothesis concerns the chronic shortage of safe assets on the world's capital markets. The yield on a bond is partly determined by its price and becomes lower the higher the price is. According to the hypothesis, this chronic shortage

34 Bean et al. (2015), Bernanke (2005) and Coeurdacier et al. (2015).

of safe assets is leading to a trend of rising prices for safe bonds, entailing a trend towards increasingly low interest rates. Another hypothesis concerns increased uncertainty over future economic development.[35]

4 Growing debts among households and states

In recent decades, there has been a rising trend in indebtedness, among both households and states, in many countries. In this section, we show how indebtedness has increased and what consequences this may have for monetary policy.

4.1 Household debts and consumption's interest-rate sensitivity

Over the last 40 years, indebtedness among households has increased substantially in most advanced economies. Figure 4 shows households' total debt as a proportion of GDP in a group of about twenty advanced economies. The median debt ratio among these countries, shown by the black line, more than doubled between the years 1980 and 2010. It increased from a level of just over 30 per cent in 1980 to 77 per cent in 2010. The debt ratio certainly decreased in the United States in conjunction with and following the global financial crisis, and, in Europe, it decreased in a number of countries in conjunction with the so-called European sovereign debt crisis.[36] But, despite indebtedness having thus decreased in many places since 2008, the ratios remain high in comparison with the levels from 1980.

There are probably several different reasons behind many households today taking on more debt than households did 30 to 40 years ago.[37] One important reason is probably the trend decrease of real interest rates that we discussed in section 3. Lower interest rates, of course, mean lower borrowing costs. It therefore becomes possible for a household to borrow a larger amount, for example when purchasing a house or flat, without needing to cut back on other expenditure. It is also therefore natural for prices for properties and other assets to rise when interest rates are comparatively low, at the same time as the average debt-to-income ratio among households is rising. Another reason that may have contributed to the higher indebtedness is that the banks, at least in some countries, were less restrictive in their credit assessments in the years before the outbreak of the financial crisis in 2007, compared with previously.[38]

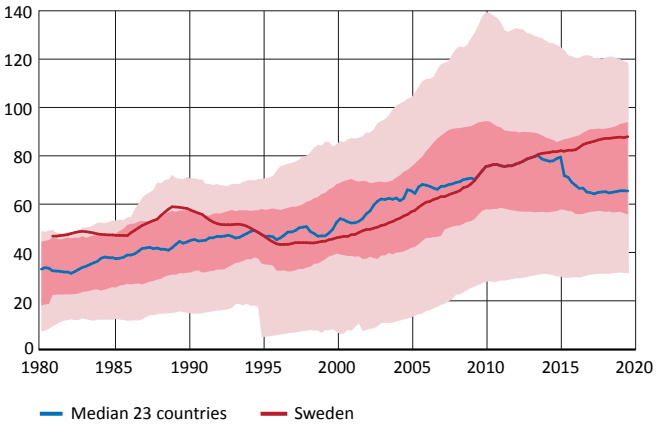
35 Caballero et al. (2017) and Marx et al. (2018).

36 In Greece, Portugal and Spain, the debt ratio decreased considerably in the years after the debt crisis broke out in 2010 and downturns also took place in some other European countries, for example the Netherlands and United Kingdom. Finland, Canada and Sweden are examples of countries where households' average debt ratio continued to increase, both during the financial crisis and in conjunction with the European sovereign debt crisis.

37 Figure 4 compares households' total debt with GDP in each country. Seen over longer periods, households' average incomes tend to grow at the same rate as GDP. The ratio of total debt to GDP may therefore provide a good idea of how total debt has developed in relation to households' average incomes when trends last for several decades.

38 See, for instance, ECB 2009.

Figure 4. Households' total debt as a proportion of GDP in a group of about twenty advanced economies
Per cent



Note. The light pink field shows the highest and lowest debt ratios in all countries in the sample. The dark pink field shows the gap between the 25th and 75th percentiles. The solid blue line shows the median of these 23 ratios and the red line shows the debt-to-GDP ratio for Sweden.
Sources: BIS and own calculations

4.1.1 How does indebtedness affect households' consumption decisions?

Households' high indebtedness and its macroeconomic consequences have been much discussed over the years, both in the scientific literature and in the wider debate on economic policy. One question concerns whether household consumption would be affected more by a given change in the interest rate if households were more indebted. Intuitively, it is easy to imagine that highly indebted households would adapt their consumption more following an interest rate adjustment than households that have low or no debts. After all, their disposable incomes, which is to say incomes minus borrowing costs, would be affected more by an interest rate adjustment if they had large debts, particularly if their loans were at a variable interest rate. However, even if the disposable incomes of highly-indebted households are more sensitive to interest rates, this does not automatically mean that their consumption is also more sensitive to interest rates.

Most households prefer to keep their consumption fairly steady over time. This gives them reason, therefore, to plan their economies so that both expected and unexpected changes in disposable income have a limited effect on consumption. If disposable incomes in a household with a large mortgage loan decrease due to an unexpected interest rate rise, the household could possibly counter this with consumption loans or a buffer of savings. These arguments suggest that the individual household's consumption would not be affected more by a given change in the interest rate, if the household is highly indebted.

Furthermore, when analysing the interest rate sensitivity of consumption, a distinction must be made between interest-rate sensitivity in individual households, on the one hand, and interest-rate sensitivity in the entire household sector, on the other. The interest expenses of an individual household are often equalled out by interest income in another household. An interest rate adjustment primarily entails the reallocation of incomes between different households. Although high indebtedness may mean that consumption becomes more sensitive to interest rates in households with high levels of debt, it does not need to entail higher interest-rate sensitivity in households' total, aggregate consumption.

4.1.2 Different households are reacting differently to changes in disposable income

For all that, there are mechanisms that suggest that households' total consumption could actually become more sensitive to interest rates if indebtedness is high. A couple of these mechanisms revolve around different households being able to adjust their consumption to differing extents following a given interest rate adjustment. For example, this could be

due to households with large debts finding it difficult to raise further loans. Such loan limits mean, in turn, that these households cannot maintain their consumption as evenly, as they are losing a way of countering changes in their disposable income. The consequences will be that the loan-limited households will, in practice be living 'hand to mouth', with their consumption being entirely determined by their disposable incomes. Every increase or decrease of these will entail a corresponding increase or decrease of consumption. If many households are highly indebted, the likelihood increases that more households will face loan limits and have to live hand to mouth. Households' total consumption could then become more sensitive to interest rate adjustments as fewer households would be able to even out their consumption effectively over time. This mechanism acts through the average household's ability to hold consumption steady, which could be limited if a large proportion of all households are living 'hand to mouth'.

Another mechanism that could make household's total consumption more sensitive to interest rates if indebtedness is high is what is known as the cashflow channel. In this case too, this basically means that highly-indebted households may have a poorer ability to keep their consumption steady, so that consumption among these households changes more when their disposable income changes. The cashflow channel acts through the redistribution of income between borrowers and lenders that arises when the interest rate changes. The higher the average indebtedness is and the more there are households that have loans at variable interest rates, the greater is the redistribution of incomes between households that borrow money and households that lend money. For example, if the interest rate is raised this will mean that greater amounts are redistributed from borrowing households to lending households. Given that, compared with non-indebted households, indebted households' consumption changes more when their disposable incomes change, the effects of the interest rate rise on total consumption will be greater when larger sums of money are redistributed.

4.1.3 Households' mortgage loans and the value of housing

Naturally, household consumption is also affected by the value of their assets. Two other mechanisms that can make household consumption more interest-rate sensitive act through housing. The first of these mechanisms, known as the loan collateral channel, is based on it often being the value of housing that determines the magnitude of loans that the household can raise in total. Most banks and other credit institutions set an upper limit, a ceiling, for the size of the loans they are prepared to grant individual households. The level of this ceiling generally depends on the size of the household's income and the value of its assets. As the most valuable asset a household owns is usually its home, it is often, in practice, precisely the value of the home that determines how high the ceiling is.

If a household is highly indebted, its ability to raise further loans may be limited by this loan ceiling, which is linked to the value of the home. Now, the thing is that interest rate adjustments affect the value of housing via the capital cost linked to home ownership. On an overall level, interest rate adjustments also affect the general level of demand in the economy, which can also affect housing prices. If many households are limited by the loan ceiling, adjustments of the interest rate may therefore have a greater effect on household consumption. This is because they affect the value of households' homes and thereby their chances of raising further loans.

Another mechanism, which is closely related to the loan collateral channel but still differs somewhat, concerns the relationship between the size of a household's mortgage loan and the value of the housing. If the housing is highly mortgaged, the household's net wealth will be affected more by a change in the housing price than if there is a small mortgage on it. One way of putting it is that a household with a higher loan-to-value ratio has more leverage against changes in the price of its home. Assume now that two different households have

mortgages of different sizes and that their economic situations are otherwise equivalent, so that the two households have about the same incomes and their respective homes are worth about the same amount. The net wealth of the more heavily indebted household will then change more, as a percentage, than the net wealth of the less heavily indebted household at each given change of housing prices. If consumption is proportional to net wealth, the leverage effect will mean that the more heavily indebted household will attempt to achieve a greater percentage change in its consumption than the less heavily indebted household. Even in this case, therefore, households' total consumption can increase more if the interest rate is adjusted when indebtedness among households is high.

4.1.4 Household debt and effects of interest rate adjustments

If high indebtedness among households makes consumption more sensitive to interest rate adjustments, this naturally has consequences for monetary policy. A given interest rate adjustment will then have a greater effect on household consumption in the short term, which could mean that monetary policy has a greater impact on total demand in the economy. Depending on the reasons for indebtedness being high, the risks inherent in large changes to household consumption may simultaneously be higher.

Studies investigating how households' indebtedness, and particularly their mortgages, affect monetary policy have identified certain effects, even if the conclusions are not clear-cut. Di Casola and Iversen (2019) show that households' average gross debt affects the pass-through of monetary policy in a modern macroeconomic model with indebted households and binding loan limits. One important assumption here is that different households adjust their consumption to different extents when the interest rate is adjusted: consumption among households with limited access to credit is more sensitive to changes in disposable income than that of other households. Another study by Calza et al. (2012) uses data from about twenty advanced economies to analyse how changes in the policy rate affect household consumption and other variables. They find that the effect of monetary policy on consumption is greater in countries where variable rates are common for mortgages and in countries where households can increase their borrowing when the value of their homes increases. In contrast, they do not find that the effect is greater in countries where total mortgage borrowing is large in relation to GDP, compared to countries with lower levels of indebtedness.

Flodén et al. (2017) analyse data over Swedish households' consumption and economic assets and find support for the cashflow channel. When the policy rate is raised, it is primarily highly-indebted households with mortgages at variable rates that cut back on consumption. These results indicate that the effects of monetary policy on consumption are strong if many households are highly indebted and have credit limits and if many households have variable rate mortgages. However, it should be pointed out that Flodén et al. (2017) do not study the total effect of adjustments to the policy rate on consumption; instead, their results concern the cashflow channel and how its effects on consumption vary between households with different types of characteristics.

Flodén et al. (2017) use an approach that, in many respects, resembles a previous study of US and UK data conducted by Cloyne et al. (2016). The authors of this study find that consumption expenditure is more sensitive to changes in the interest rate in those households with mortgages, as against households owning unmortgaged homes. However, they also find that the effects of a policy rate adjustment on household cashflows are small in comparison with the size of the change in their consumption expenditure. One interpretation of the results is that monetary policy primarily acts via household incomes and that the effect on consumption is greatest among households with limited access to credit.

There is reason to mention one more study, Walentin (2014), who uses Swedish data and a model in general equilibrium that includes a housing sector. Among other things, this

study investigates how the monetary policy transmission mechanism is affected by many households using their homes as collateral for their mortgages. Walentin (2014) finds that the effects of the policy rate on consumption and other variables become stronger if a household's loans are large in relation to the value of its home, as the leverage effect then affects the household's net wealth more.

Taken together, the results of these different studies thus indicate that it is highly indebted households with limited access to credit and households with variable mortgage rates that change their consumption the most when the policy rate is adjusted. It is not established, however, that a high average debt-to-income ratio would automatically involve households' total consumption becoming more sensitive to interest rate adjustments. It is also unclear how important the actual cashflow channel is. Monetary policy has an effect on household consumption via several other channels, for example via household incomes and via their net wealth. One reasonable conclusion is that the interest rate sensitivity of total consumption depends on several different factors that are linked to household indebtedness, in particular to mortgages. The matter of how many households have variable rate mortgages is apparently one of the most important of these factors. Another factor, which is also emphasised by Calza et al. (2012), concerns whether mortgage borrowers can increase the mortgage on an existing property when housing prices rise.

If indebtedness is high and many mortgages are at variable rates, there is thus reason to believe that total consumption will be affected more by changes to the policy rate than if debts are lower and most mortgages have fixed rates. Monetary policy can then be assumed to be more potent in the sense that an interest rate adjustment has a fairly large effect on resource utilisation. Under such circumstances, the central bank can stabilise resource utilisation and inflation by making comparatively small adjustments to the policy rate.

The combination of high indebtedness among households, credit limits and variable rates for mortgages can also entail greater risks. The results discussed here indicate that many households that are heavily indebted, and that have variable rate mortgages have relatively little scope to counter larger changes to disposable income. For example, if the central bank should need to raise the interest rate sharply to avoid a price and wage spiral, the most heavily indebted households will thus risk being forced to make large adjustments to their economies in a short time. This could involve them having to reduce their consumption abruptly or more or less being forced to sell their homes. If many households are forced to make large changes at the same time, there could also be additional negative consequences. For example, fluctuations in housing prices risk being greater if many households sell their homes approximately at the same time. In an adverse scenario, a significant number of households could encounter difficulties in meeting payments on their loans and, in such a situation, risks to financial stability will also arise.

4.2 High sovereign debt in many countries – Sweden being an exception

After the global financial crisis, government bond yields have fallen to historically low levels in several countries. The central banks' policy rates are also low and, in some cases, negative. In addition, the central banks have made comprehensive purchases of government bonds to hold interest rates down and have announced low policy rates in the period ahead. Taken together, the conditions for further monetary policy stimulation if economic activity declines may therefore be limited. This has brought fiscal policy's role in stabilising the economy into focus.[39]

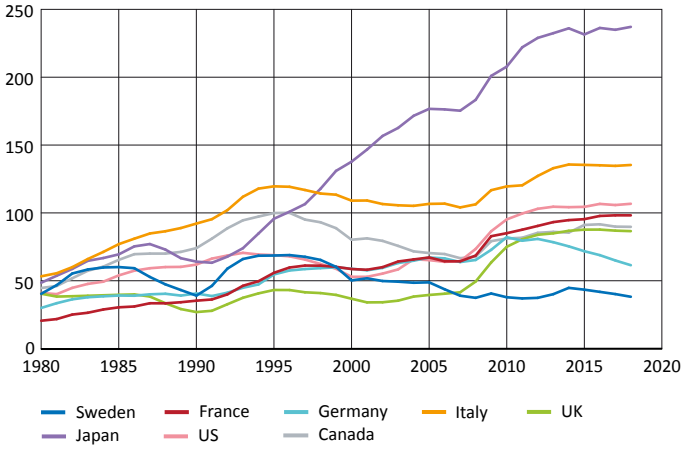
One important precondition for fiscal policy stimulation to be effective is that households and companies have a high level of confidence in fiscal policy. There are several factors that

39 See, for example Jansson (2018) and Lagerwall (2019).

can increase confidence. One is a low and stable sovereign debt. Another is a low budget deficit. One reason that the euro area introduced restrictions on both the sovereign debt, no more than 60 per cent as a proportion of GDP, and the budget deficit, no more than 3 per cent as a proportion of GDP, is to prevent confidence in the countries' fiscal policies from being undermined. These restrictions thus mean that the euro area as a whole can assure itself that fiscal policy in the various countries is being conducted responsibly. The fiscal policy framework in Sweden also includes a number of budget policy targets: a surplus target, a debt anchor, an expenditure ceiling and balanced local government finances. The debt anchor was introduced in the budget year 2019 and is set at 35 per cent of GDP. The debt anchor is a guideline for how large the consolidated gross debt can be over the medium term.

The sovereign debt can vary greatly from country to country. Sweden stands out currently by having a relatively low sovereign debt compared with many other countries. Figure 5 shows sovereign debt as a proportion of GDP in Sweden and the G7 countries since 1980. In Sweden, the debt-to-GDP ratio has fallen steadily since the mid-1990s and is currently just below 40 per cent as a proportion of GDP. Several other countries have experienced the opposite development. Developments in Japan are particularly striking. Since the start of the 1990s, the debt-to-GDP ratio has shown a rising trend, from just over 60 per cent to almost 250 per cent at present. The United States also has a relatively high sovereign debt of over 100 per cent as a proportion of GDP. Indebtedness in the euro area varies heavily from country to country. Greece and Italy in particular stand out with their high sovereign debts. Italy's sovereign debt as a proportion of GDP is almost 140 per cent.

Figure 5. Sovereign debt in Sweden and the G7 countries
Per cent



Note. Sovereign debt as a proportion of GDP.
Source: IMF DataMapper, General Government Debt

4.2.1 Low government bond yields are increasing the scope for fiscal policy

Two factors that could affect fiscal policy's room for manoeuvre are the interest rate that the government pays for its debt (the government bond yield) and the growth rate of the economy. This can be illustrated by the government's budget constraint,

$$(1) \qquad B_t = B_{t-1} + r_t B_{t-1} - S_t,$$

where B denotes the stock of nominal government bonds, the government's primary surpluses, which is to say the difference between government expenditure and tax revenues, and the government bond yield. The current debt is thus equivalent to the previous period's debt plus interest payments minus the primary surpluses. Dividing the budget constraint on both sides by GDP gives us an expression for the sovereign debt's share of GDP, b,

$$(2) \qquad b_t = \frac{1 + r_t}{1 + \gamma_t} b_{t-1} - s_t,$$

where γ denotes GDP growth and s the primary surpluses' share of GDP. From this expression, we can derive an expression for the *long-term* primary surplus ratio as a function of the *long-term* debt-to-GDP ratio,

$$(3) \qquad s^* = \frac{r^* - \gamma^*}{1 + \gamma^*} b^*,$$

where * denotes long-term values. The equation thus shows how the primary surpluses relate to the sovereign debt over the long term, given long-term levels of the real interest rate and the growth rate. Note that when the long-term real interest rate is lower than growth, a *positive* debt-to-GDP ratio is linked to a *negative* primary surplus ratio. In other words, the government can have a long-term deficit in its finances without the debt-to-GDP ratio increasing.

The relationship in equation (3) can be illustrated by a few mathematical examples. Assume that we have a long-term sovereign debt as a proportion of GDP in line with the debt anchor of 35 per cent. Let us also assume that we have a long-term GDP growth of 2 per cent and a long-term real interest rate close to the current level of around –2 per cent. A debt-to-GDP ratio of 35 per cent would then be compatible with a primary deficit of 1.4 per cent as a proportion of GDP. If the long-term real interest rate is changed, this affects the level of the budget balance. Table 1 shows how an increase of the long-term real interest rate from –2 to 3 per cent affects the primary budget balance. With a long-term real interest rate of 3 per cent, a primary surplus of 0.3 per cent as a percentage of GDP would be required to prevent the debt-to-GDP ratio rising above 35 per cent.

Table 1. Primary budget balance for various real interest rates
Per cent

Long-term real interest rate	Primary budget balance
−2.0	−1.4
−1.0	−1.0
0.0	−0.7
1.0	−0.3
2.0	0.0
3.0	0.3

Note. Primary budget balance is calculated as a percentage of GDP.
Source: The Riksbank

These examples provide a quantitative estimate of how changes in the long-term real interest rate can affect the primary budget balance as a proportion of GDP, as long as the debt-to-GDP ratio and long-term growth remain unchanged. In an environment in which the long-term real interest rate is lower than growth, the conditions exist for conducting an expansionary fiscal policy without the sovereign debt as a percentage of GDP rising. In itself, this could be an argument for using fiscal policy more actively to counteract economic slowdowns in a situation where monetary policy is restricted by the lower bound of the interest rate.[40] At the same time, however, it should be borne in mind that the examples above disregard various risks inherent in conducting an expansionary fiscal policy. For example, the long-term values of the real interest rate and growth may be affected by the level of indebtedness. Heavily rising debts may cause the long-term real interest rate to rise. High public debt can also restrain growth. These may therefore give reason to be cautious about conducting an excessively expansionary fiscal policy.

40 See, for example, Blanchard (2019).

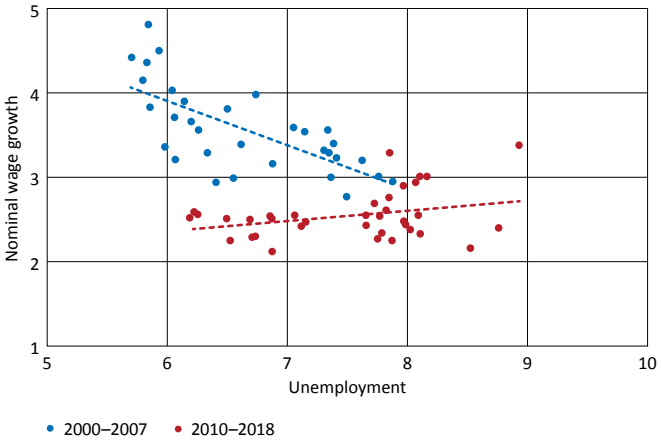
We have seen that household indebtedness has reached record levels in Sweden. This could be another reason to be cautious about an expansionary fiscal policy. If the government's indebtedness rises to excessively high levels when household indebtedness is also high, it could be particularly costly for households. Not only would the costs of households' own debts rise, but taxes could also rise and transfers fall when the government needs to fund a rising sovereign debt. There is thus reason to be particularly cautious with the government's finances in a situation when private indebtedness is high.[41]

5 The Phillips curve has flattened

The Phillips curve is a concept in economics that originally described the relationship between nominal wage growth and unemployment.[42] Subsequently, the term has been expanded and can now contain a number of different definitions. The relationship is often expressed in terms of inflation and some measure of resource utilisation, for example the deviation of output from its long-term trend (the output gap). The prevailing opinion is that the original relationship should be negative.[43] This can be explained as follows. Assume that unemployment falls. Companies then find it more difficult to recruit new employees, which tends to push wages up and thereby the companies' costs. The higher costs for companies lead to higher prices for consumers. Inflation therefore rises too. The relationship between inflation or nominal wage growth and unemployment therefore becomes negative.

Before the financial crisis, the correlation between nominal wage growth and unemployment was negative in Swedish data; see Figure 6.[44] However, this relationship changed in the period after the financial crisis. The negative correlation has not just become flatter but even positive. In other words, lower unemployment is linked to lower wage increases. The apparently weaker link between nominal wage growth and unemployment is not only a Swedish phenomenon. A flattening of the Phillips curve can also be seen in the euro area, the United States and the United Kingdom; see, for example, Cunliffe (2017).

Figure 6. Phillips curve prior to the financial crisis (blue line) and after (red line)



Note. Short-term wages. Annual percentage change and percentage of labour force, 15–74 years. Seasonally adjusted data.
Source: Ingves (2019)

41 For further risks inherent in excessively high state indebtedness, see Boskin (2020) and Rogoff (2019).
42 See Phillips (1958), who, with the help of British data for the period 1861–1957, demonstrated a negative correlation between nominal wage growth and unemployment.
43 However, the relationship between inflation and the output gap should be positive, as the correlation between unemployment and the output gap is generally negative and the correlation between nominal wage growth and inflation is positive.
44 See Jonsson and Theobald (2019) for an in-depth discussion of the relationship between wages and unemployment in the Swedish data.

For central banks, it is important to understand why the Phillips curve has become flatter, as this could have implications for monetary policy. The economic literature has suggested several reasons, but there is no consensus on what lies behind the flattening.

5.1 A successful inflation targeting policy may have flattened the Phillips curve

It has long been known that changes in the Phillips curve as we measure it in the data may be due to monetary policy; see, for example, Lucas (1976). One common explanation for the rapid increase of inflation in the 1970s and 1980s is that monetary policy systematically tried to utilise the Phillips curve to reduce unemployment. It was believed that an expansionary monetary policy that caused inflation to rise would lead to lower unemployment in the long term. But these attempts failed – except possible in the very short term – as inflation expectations were adjusted upwards. The expansionary monetary policy therefore only led to higher inflation, without unemployment falling significantly.

During the 1990s, many countries introduced inflation targeting. Sweden introduced an inflation target of 2 per cent that formally started to apply in 1995. The inflation target is intended to function as a guideline for household and corporate expectations of future inflation. It makes price setting and wage formation easier, along with other economic decisions.

In a recently published study, McLeay and Tenreyro (2018) show that it is not just deficient monetary policy – like that conducted in the 1970s and 1980s – that can lead to a flatter Phillips curve. Successful inflation targeting can also have this effect. In an economic model, they show that, if monetary policy succeeds in stabilising inflation so that it is constant at 2 per cent over time, the correlation between *inflation* and the *output gap* becomes zero, regardless of how the output gap develops.[45] It can also affect the relationship between nominal wage growth and unemployment. This relationship would probably also be weakened as the variations in nominal wages would only be due to variations in real wages.

5.2 The Phillips curve is affected by shocks to supply and demand

Another explanation for the flatter Phillips curve, which has some similarities to McLeay and Tenreyro (2018), has been put forward by Ingves (2019) and Jonsson and Theobald (2019). Just like McLeay and Tenreyro, they emphasise that the Phillips curve observed in the data is not a structural relationship but a correlation between two economic variables. However, unlike McLeay and Tenreyro, they emphasise that the reason for the flatter Phillips curve may lie in changes to the shocks to which the economy is exposed. In a dynamic and functioning market economy, changes of both short term and long term character occurs all the time. Technological development progresses, the demographic composition changes and households' preferences change, to give a few examples. These changes affect the correlation between economic variables such as that between nominal wage growth and unemployment. We can illustrate this with two simulations from an economic model. The first simulation shows how the Phillips curve is affected by shocks to labour force participation. The second shows how it is affected by shocks to productivity.[46]

5.2.1 Example 1: How labour force participation shocks affect the Phillips curve

When the labour force participation rate increases, it becomes easier and cheaper for companies to find new staff and vacancies are filled more quickly. But for those people

45 See also Adolfson and Söderström (2003).

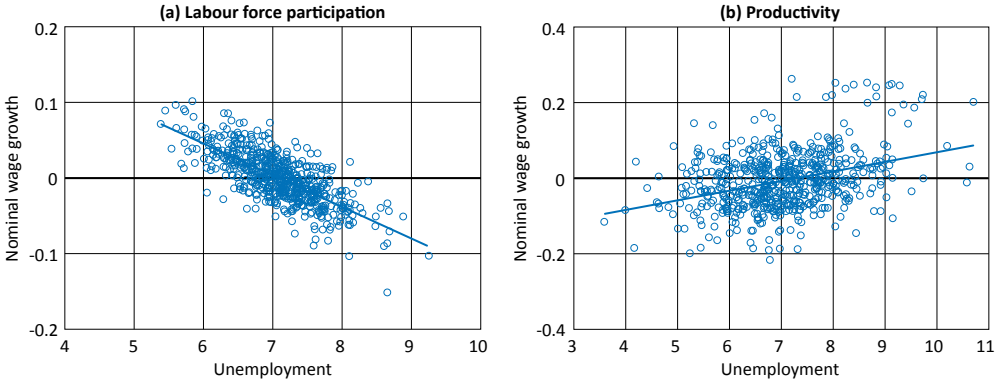
46 These illustrative calculations are from Ingves (2019). See also Jonsson and Theobald (2019) for an in-depth description of the assumptions and models forming the basis of the results of the calculations.

entering the labour force, it will nevertheless take some time to seek and find a new job. Unemployment may therefore increase, at least initially. When more people participate in the labour force, competition for jobs also increases. This holds employees' wage demands and wages back. Increases in labour force participation thus mean that **nominal wages** fall and **unemployment rises**, at least in the short term. Changes in labour force participation are thus in line with the prevailing view that the relationship between nominal wage growth and unemployment should be negative; see Figure 7a.

5.2.2 Example 2: How productivity shocks affect the Phillips curve

When productivity falls, companies' production costs become higher. Companies are therefore forced to raise prices to retain their profit margins. This reduces both demand and output, which ultimately also increases unemployment. A fall in productivity leads to lower real wages but, if prices rise faster than real wages falls, nominal wages will rise anyway. Over the short term, falling productivity thus means that both **nominal wages** and **unemployment rise**. In other words, the correlation between nominal wage growth and unemployment is positive; see Figure 7b. This illustrates the importance of not making make causal interpretations of correlations in the data. It is not the case that higher unemployment causes higher nominal wages, but rather that falling productivity causes both higher nominal wages and higher unemployment.

Figure 7. The Phillips curve when labour force participation and productivity changes



Note. Quarterly percentage change and share of labour force.
Source: Ingves (2019)

5.3 Structural changes in the functioning of the economy

Another explanation of the flatter Phillips curve is based on structural changes in the functioning of the economy, which is to say that household or corporate behaviour has changed in some way.

5.3.1 Increasing globalisation and digitalisation

One common explanation for the flatter Phillips curve looks at the increasing globalisation and digitalisation. Developments in information and communication technologies have been very rapid in recent decades and have led to faster digitalisation in many sectors; see also section 2.1. More and more working tasks have been automated and can be carried out by smart robots. This applies to both routine tasks and more advanced ones. Digitalisation also affects globalisation by facilitating trade and labour mobility as increasing numbers of countries become more closely integrated.

Globalisation can affect the Phillips curve through several different channels. One channel concerns international trade. Over the last 30–40 years, the increase of trade has entailed better competition and thereby downward pressure on global price levels. Import prices have therefore fallen in many countries. This has a direct dampening effect

on consumer prices, as these prices also include prices for imported goods and services. But there are also indirect effects. If cheaper import goods can replace domestic ones, a substitution effect arises in which households consume cheaper import goods at the expense of domestic goods. This increases the import share in consumer prices, which dampens inflation even more. These effects are temporary, but globalisation should be seen as an ongoing process that can dampen inflationary pressures over longer periods. If these price-dampening effects are not then reflected in changed resource utilisation, it will have an effect on the Phillips curve.

When trade increases, the exchange rate's influence on consumer prices becomes greater via effects from import prices. The exchange rate can therefore have a greater impact on inflation. From a monetary policy perspective, this could create some problems, as the development of the exchange rate is difficult to predict. The exchange rate is often affected by factors that do not necessarily have to be related to domestic monetary policy. For example, these could include monetary policy abroad, the economic outlook of different competitor countries and the degree of impact from changes in the exchange rate on inflation.

Another channel through which globalisation can affect the Phillips curve is linked to the labour market. When the labour market becomes tighter, companies can respond by using labour abroad, rather than raising wages. This can make inflation less sensitive to domestic conditions; see Auer et al. (2017).

The increasing **digitalisation** can also affect inflation and the Phillips curve. Some sectors and prices are affected more or less directly by digitalisation. Prices for goods such as mobile telephones and computers are showing a falling trend as prices for processors and other electronic components fall. The transition from physical to digital distribution is another factor that is dampening prices, e.g., the music, film and newspaper industries.

The Internet and e-Commerce improve the matching between producers and consumers, which should have a price-dampening effect. When an increasing amount of trade takes place on the Internet, new markets also become opened up for companies, and consumers' possible choices become greater. This leads to increased competition and, in many cases, to lower prices. In addition, it becomes easier for customers to compare prices, which can push prices down. There has certainly been a steady increase in e-Commerce in the 21st century, but its share of the total retail trade is still relatively small in Sweden.

Like globalisation, digitalisation should only have temporary effects on inflation, which should be possible to counteract with a more expansionary monetary policy. The effect of digitalisation on inflation is difficult to measure and varies across different studies. According to a study from the European Central Bank, the effects of the increased e-Commerce on consumer prices has been small; see ECB (2015). The direct effect of cheaper information technology on inflation has been negligible according to Charbonneau et al. (2017). In addition, they show that digitalisation has not, as yet, made any impression on the development of productivity. However, these conclusions have partly been challenged by Glosbee and Klenow (2018), who show that price movements on the Internet are 1.3 per cent lower per year than they are for the same goods categories in the CPI.

5.3.2 The Phillips curve may be non-linear

Unemployment in the United States and other countries increased heavily in connection with the financial crisis. Unemployment also remained on high levels over a longer period, at the same time as the rate of inflation only fell temporarily. This development surprised many economists and the phenomenon has been given its own name in the literature: *the missing deflation*. Some economists say that this was due to the long-term level of unemployment also rising. The downward pressure on prices was thereby not as great as the fall in unemployment indicated. However, this explanation turned out to be problematic, as

unemployment eventually started to fall below what many economists deemed to be the long-term level, at the same time as inflation remained stable.

Another explanation for the missing deflation is that the Phillips curve is non-linear instead of linear, which is a common assumption. According to this explanatory model, high unemployment has less effect on inflation than low unemployment. In addition, this non-linearity does not become clear until inflation is very low. Note that, in his original article, William Phillips suggested a highly non-linear relationship; see Phillips (1958). In a recently published working paper, Gagnon and Collins (2019) show that wage rigidities may provide one reason for the Phillips curve possibly being non-linear when inflationary outcomes are low. The authors show that inflation and unemployment have probably been in the flat part of the relationship over the last 20 years.

Lindé and Trabandt (2019) attempt to explain the missing deflation and the lack of inflation after the financial crisis with a non-linear Phillips curve. They emphasise the importance of non-linearity when companies set prices and wages at the same time as the economy is being exposed to large shocks. They show that a non-linear macroeconomic model with price and wage rigidities can explain *the missing deflation*, while the linear version of the same model fails to do so. In addition, the non-linear model is in line with a number of other relationships between various macroeconomic variables observed in post-war US data.

5.4 What are the monetary policy implications of the different explanatory models?

Empirical estimates indicate that the Phillips curve may have become flatter in Sweden and other countries after the financial crisis, even if the uncertainty of these estimates is high. Nominal wage growth, inflation and resource utilisation can be measured in different ways. The Phillips curve can also be specified in different ways as regards inflation expectations, the duration of inflation and the degree to which the relationship is linear. In addition, other factors apart from resource utilisation can affect wages and inflation. All of this makes it difficult to identify the relationship in the data. Bearing these reservations in mind – what are the implications for monetary policy of a flatter Phillips curve?

If the flatter Phillips curve is due to monetary policy having succeeded so well in stabilising inflation and inflation expectations that the relationship has disappeared in the data, this is good news. Monetary policy has been effective and has reached its goal: low and stable inflation. A similar conclusion can be reached if the flatter Phillips curve is due to various changes having taken place that cannot be affected by monetary policy. Such structural changes can affect the Phillips curve in different ways. As we have illustrated, some can give rise to a negative relationship, while others can give rise to a positive relationship. The changing relationship over time does not, therefore, itself have to be a sign that monetary policy is not functioning as intended.

A flatter Phillips curve does not, therefore, have to have any monetary policy consequences, but there are also arguments against such a conclusion. Monetary policy is assumed to have strong effects on demand and smaller effects on supply. A change in monetary policy would thus affect demand to a great extent, which, in turn, would affect inflation. If the relationship between demand – which can be measured with different measures of resource utilisation – and inflation or nominal wage growth has become weaker, it may become more difficult for monetary policy to affect inflation through that channel. Monetary policy would then have to create larger changes in demand to achieve the same change as previously. If the Phillips curve also changes over time, it may be more difficult to assess which effects monetary policy is actually having on inflation. One consequence could therefore be that monetary policy should place greater importance on stabilising various measures of resource utilisation, such as unemployment. Blanchard et al. (2015) show that

this is the case in a model in which monetary policy follows a simple policy rule, known as the Taylor rule. However, one consequence of placing greater importance on stabilising resource utilisation may be that inflation deviates from the target over longer periods that would otherwise have been the case.

6 Concluding remarks

In this article, we have described changes in a number of macroeconomic quantities and relationships occurring since the financial crisis that will probably be significant for the conditions for conducting monetary policy in the period ahead. We started by describing and discussing the slowdown of productivity that had taken place in the OECD. After this, we showed how the long-term real interest rate has fallen in advanced economies over a number of decades. The downturn in real interest rates has probably been a contributory reason behind the increase in both households' and states' indebtedness. However, Sweden differs here from many other countries, as its sovereign debt has, in contrast, showed a falling trend. Finally, we discussed the Phillips curve. In many parts of the world, this relationship has weakened, which, among other things, may mean that higher activity and rising resource utilisation in the economy may be linked to smaller than usual price increases.

Of all these changes in the macroeconomic environment, the downturn in the long-term real interest rate is probably the change that has had the greatest implications for monetary policy. This downturn has contributed to central bank policy rates being on historically low levels and, in some cases, even negative. In many cases, policy rates are thus close to the lower bound for how low they can be cut. This makes it more difficult to counteract future recessions and may lead to more and longer periods with negative interest rates and low inflation. In addition, since the financial crisis, several central banks have purchased large amounts of government bonds to make monetary policy even more expansionary. The balance sheets of these central banks are therefore at historically high levels.

The monetary policy tools may therefore be limited. However, scope remains to cut policy rates a little more before they reach the lower bound. There is also scope to increase government bond purchases. Central banks can also purchase other financial assets than government bonds, for example mortgage bonds and corporate bonds. However, these assets have higher risk than government securities and are normally only purchased when an individual market is exposed to shocks and the pass-through of monetary policy is not functioning normally. Another possibility for making monetary policy more expansionary is 'forward guidance', which is to say affecting expectations of future policy rates, for example through communication. For example, the central bank could promise that the policy rate will remain at the lower bound until economic activity stabilises and inflation reaches the target.

So there are still opportunities to make monetary policy more expansionary. However, in a deep economic downturn, it is possible that it will not be possible to make monetary policy sufficiently expansionary. In such a situation, fiscal policy may have to take greater responsibility for stabilisation policy – in addition to the effects of the automatic stabilisers. The scope for Swedish fiscal policy looks good: Our public finances are in good shape, interest rates on government borrowing are low and until recently, growth has been relatively stable. Nevertheless, there is reason for caution. If central government debt increases, it is households – which already have high debts of their own – that will have to pay for this through higher taxes, lower public consumption or lower public transfers.

References

Acemoglu, Daron and Pascual Restrepo (2017), 'Secular Stagnation? The Effect of Aging on Economic Growth in the Age of Automation', NBER Working Paper Series, no. 23077, National Bureau of Economic Research.

Adler, Gustavo, Romain Duval, David Furceri, Sinem Kiliç Çelik, Ksenia Koloskova and Marcos Poplawski-Ribeiro (2017), 'Gone with the Headwinds: Global Productivity', IMF Staff Discussion Note, SDM/17/04.

Adolfson, Malin and Ulf Söderström (2003) 'How is the economy affected by the inflation target?', *Sveriges Riksbank Economic Review* 1, pp. 50–75.

Andrews, Dan, Chiara Criscuolo and Peter Gal (2016), 'The Best Versus the Rest: The Global Productivity Slowdown, Divergence Across Firms and the Role of Public Policy', OECD Productivity Working Papers, no. 5, OECD.

Anzoategui, Diego, Diego Comin, Mark Gertler and Joseba Martinez (2017), 'Endogenous Technology Adoption and R&D as Sources of Business Cycle Persistence', NBER Working Paper Series, no. 22005, National Bureau of Economic Research.

van Ark, Bart, Mary O'Mahony and Marcel Timmer (2008), 'The Productivity Gap between Europe and the United States: Trends and Causes', *Journal of Economic Perspectives*, vol. 22, no. 1, pp. 25–44.

Auer Raphael, Claudio Borio and Andrew Filardo (2017), 'The Globalisation of Inflation: The Growing Importance of Global Value Chains', CESifo Working Paper no. 6387.

Basu, Susanto and John Fernald (2007), 'Information and Communications Technology as a General-Purpose Technology: Evidence from US Industry Data', *German Economic Review* vol. 8, no. 2, pp. 146–173.

Bean, Charles, Christian Broda, Takatoshi Ito and Randall Kroszner (2015), 'Low for Long? Causes and Consequences of Persistently Low Interest Rates', Geneva Reports on the World Economy, no. 17.

Bernanke, Ben S. (2005), 'The global saving glut and the U.S. current account deficit', remarks made at the Virginia Association of Economics, March 10.

Blanchard, Olivier (2019), 'Public Debt: Fiscal and Welfare Costs in a Time of Low Interest Rates', Policy Brief 19-2, Peterson Institute for International Economics.

Blanchard, Olivier, Eugenio Cerutti and Lawrence Summers (2015), 'Inflation and activity – two explorations and their monetary policy implications', NBER Working Papers Series no. 21726, National Bureau of Economic Research.

Bloom, Nicholas, Charles Jones, John Van Reenen and Michael Webb (2017), 'Are Ideas Getting Harder to Find?', NBER Working Paper Series, no. 23782, National Bureau of Economic Research.

Boskin, Michael (2020), 'Are Large Deficits and Debt Dangerous?', NBER Working Paper Series no. 26727, National Bureau of Economic Research.

Bosworth, Barry (2014), 'Interest rates and economic growth: are they related?', Working Paper no. 2014-8, Center for Retirement Research at Boston College.

Bosworth, Barry and Jack Triplett (2007), 'The Early 21st Century U.S. Productivity Expansion is Still in Services', *International Productivity Monitor*, no. 14 Spring, pp. 3–19.

Brynjolfsson, Erik and Lorin Hitt (2003), 'Computing Productivity: Firm-level Evidence', *The Review of Economics and Statistics*, vol. 85, no.4, pp. 793–808.

Brynjolfsson, Erik, Daniel Rock and Chad Syverson (2018), 'The Productivity J-curve: How Intangibles Complement General-Purpose Technologies', NBER Working Paper Series no. 25148. National Bureau of Economic Research.

Byrne, Daniel, John Fernald and Marshall Reinsdorf (2016), 'Does the United States Have a Productivity Slowdown or a Measurement Problem?' *Brookings Papers on Economic Activity*, Spring 2016, pp. 109–157.

Caballero, Ricardo J., Emmanuel Farhi and Pierre-Olivier Gourinchas (2017), 'The safe assets shortage conundrum', *Journal of Economic Perspectives*, vol. 31, no. 3, pp. 29–46.

Calza, Alessandro, Tommaso Monacelli and Livio Stracca (2013), 'Housing finance and monetary policy', *Journal of the European Economic Association*, vol. 11, no. 1, pp. 101–122.

Cette, Gilber, John Fernald and Benoît Mojon (2016), 'The pre-Great Recession slowdown in productivity', *European Economic Review*, vol. 88, pp. 3–20.

Charbonneau, Karyne, Alexa Evans, Subrata Sarker and Lena Suchanek (2017), 'Digitalization and Inflation: A Review of the Literature', Staff Analytical Note no. 2017-20, Bank of Canada.

Cloyne, James, Clodomiro Ferreira and Paolo Surico (2020), 'Monetary policy when households have debt: New evidence on the transmission mechanism', *Review of Economic Studies*, vol. 87, no. 1, pp. 102–129.

Coeurdacier, Nicolas, Stéphane Guibaud and Keyu Jin (2015), 'Credit constraints and growth in a global economy', *American Economic Review* vol. 105, no. 9, pp. 2838–2881.

Conseil National de Productivité (2019), 'Productivity and Competitiveness: Where Does France Stand in the Euro Zone? First Report'.

Corrado, Carol, Jonathan Haskel, Cecilia Jona-Lasinio and Massimiliano Iommi (2016), 'Intangible investment in the EU and US before and since the Great Recession and its contribution to productivity growth', EIB Working Papers no. 2016/08, European Investment Bank.

Corrado, Carol, Jonathan Haskel and Cecilia Jona-Lasinio (2019), 'Productivity growth, capital reallocation and the financial crisis: Evidence from Europe and the US', *Journal of Macroeconomics*, vol. 61, pp. 1–22.

Corrado, Carol, Charles Hulten and Daniel Sichel (2005), 'Measuring Capital and Technology. An Expanded Framework', in C. Corrado, J. Haltiwanger and D. Sichel (eds.) *Measuring Capital in the New Economy. NBER Book Series Studies in Income and Wealth* vol. 65, pp. 11–46. University of Chicago Press.

Crafts, Nicholas (2004), 'Steam as a General Purpose Technology: A Growth Accounting Perspective', *The Economic Journal*, vol. 114, pp. 338–351.

Crafts, Nicholas and Kevin Hjortshøj O'Rourke (2014), 'Twentieth Century Growth', in P. Aghion and S. Durlauf (eds.) *Handbook of Economic Growth* vol. 2, pp. 263–346, Elsevier.

Cunliffe, Jon (2017), 'The Phillips Curve: Lower, Flatter or in Hiding?', speech at Oxford Economics Society, 14 November.

David, Paul (1990), 'The Dynamo and the Computer: An Historical Perspective on the Modern Productivity Paradox', *The American Economic Review*, vol. 80, no. 2, pp. 355–361.

De Økonomiske Råd (2019), 'Produktivitet 2019' (Productivity 2019), Report from Danish national productivity board.

Decker, Ryan, John Haltiwanger, Ron Jarmin and Javier Miranda (2018), 'Changing Business Dynamism and Productivity: Shocks vs. Responsiveness', NBER Working Paper Series, no. 24236, National Bureau of Economic Research.

Del Negro, Marco, Domenico Giannone, Marc P. Giannoni and Andrea Tambalotti (2019), 'Global trends in interest rates', *Journal of International Economics*, vol. 118, pp. 248–262.

Di Casola, Paola and Jens Iversen (2019), 'Monetary policy with high household debt and low interest rates', Staff memo, Sveriges Riksbank.

Duernecker, Georg, Berthold Herrendorf and Akos Vantinyi (2017), 'Structural Change within the Service Sector and the Future of Baumol's Disease', CEPR Discussion Paper Series, no. 12467, Centre for Economic Policy Research.

Duval, Romain, Gee Hee Hong and Yannick Timmer (2020), 'Financial Frictions and the Great Productivity Slowdown', *The Review of Financial Studies*, vol. 33, no. 2, pp. 475–503.

ECB (2009), 'Determinants of bank lending standards and the impact of the financial turmoil', Financial Stability Review June 2009.

ECB (2015), 'Effects of E-Commerce on Inflation', *Economic Bulletin*, 2/2015: Box 6.

European Council (2016), 'Council Recommendation of 20 September 2016 on the establishment of National Productivity Boards', 10083/16.

Favero, Carlo A., Arie E. Gozluklu and Haoxi Yang (2016), 'Demographics and the behaviour of interest rates', *IMF Economic Review*, vol. 64, no. 4 , pp. 732–776.

Fernald, John (2015), 'Productivity and Potential Output before, during, and after the Great Recession', *NBER Macroeconomics Annual 2014*, vol. 29, pp. 1–51, National Bureau of Economic Research.

Fernald, John, Robert Hall, James Stock and Mark Watson (2017), 'The Disappointing Recovery of Output after 2009', *Brookings Papers on Economic Activity*, Spring, pp. 1–81.

Finocchiaro, Daria, Magnus Jonsson, Christian Nilsson and Ingvar Strid (2016), 'Macroeconomic effects of reducing household debt', *Sveriges Riksbank Economic Review* 2, pp. 57–88.

Fiorentini, Gabriele, Alessandro Galesi, Gabriel Pérez-Quirós and Enrique Sentana (2018), 'The rise and fall of the natural interest rate', Banco de España, Working Papers no. 1822.

Flodén, Martin, Matilda Kilström, Jósef Sigurdsson and Roine Vestman (2017), 'Household debt and monetary policy: Revealing the cash-flow channel', Working Paper Series no. 342, Sveriges Riksbank.

Gagnon, Joseph and Christopher Collins (2019), 'Low Inflation Bends the Phillips Curve', Peterson Institute for International Economics Working Paper no. 19-6.

Gamberoni, Elisa, Claire Giordano and Paloma Lopez-Garcia (2016), 'Capital and labour (mis)allocation in the euro area: some stylized facts and determinants', ECB Working Paper Series, No. 1981.

Goldman Sachs Global Investment Research (2014), 'Some long-term evidence on short-term rates', US Economics Analyst no. 14/25, The Goldman Sachs Group.

Goolsbee, Austan and Peter J. Klenow (2018), 'Internet Rising, Prices Falling: Measuring Inflation in a World of E-Commerce', AEA Papers and Proceedings vol. 108, pp. 488–492.

Gopinath, Gita, Şebnem Kalemli-Özcan, Loukas Karabarbounis and Carolina Villegas-Sanchez (2017), 'Capital Allocation and Productivity in South Europe', *The Quarterly Journal of Economics*, vol. 132, no. 3, pp. 1915–1967.

Gordon, Robert (2015), 'Secular Stagnation: A Supply-Side View', *American Economic Review: Papers & Proceedings*, vol. 105, no. 5, pp. 54–59.

Gordon, Robert (2018), 'Declining American economic growth despite ongoing innovation', *Explorations in Economic History*, vol. 69, pp. 1–12.

Guvenen, Fatih, Raymond Mataloni Jr, Dylan Rassier and Kim Ruhl (2017), 'Offshore Profit Shifting and Domestic Productivity Measurement', NBER Working Paper Series no. 23324, National Bureau of Economic Research.

Haldane, Andy (2018), 'The UK's Productivity Problem: Hub No Spokes', speech 2 June, Bank of England.

Hamilton, James D., Ethan S. Harris, Jan Hatzius and Kenneth D. West (2016), 'The equilibrium real funds rate: past, present, and future', IMF Economic Review vol. 64, no. 4, pp. 660–707.

HM Treasury (2015), 'Fixing the foundations: Creating a more prosperous nation', Cm9098

Ingves, Stefan (2019), 'Long-term trends – important pieces of the monetary policy analysis', speech at the Swedish Economics Association, 7 May, Sveriges Riksbank.

Inklaar, Robert, Marcel Timmer and Bart van Ark (2006), 'Mind the Gap! International Comparisons of Productivity in Services and Goods Production', Research Memorandum GD-89, Groningen Growth and Development Centre, University of Groningen.

Jansson, Per (2018), 'Monetary policy in less favourable times – what are the options?', speech at Swedish Insurance, 4 December, Sveriges Riksbank.

Jonsson, Magnus and Emelie Theobald (2019), 'Changed labour market – effects on prices and wages, the Phillips curve and the Beveridge curve', Sveriges Riksbank Economic Review, no. 1, pp. 28–49.

Jordà, Òscar, Katharina Knoll, Dimitry Kuvshinov, Moritz Schularick and Alan M. Taylor (2019), 'The rate of return on everything, 1870–2015', *Quarterly Journal of Economics*, vol. 134, no. 3, pp. 1225–1298.

Jordà, Òscar, Sanjay Singh and Alan Taylor (2020), 'The Long-Run Effects of Monetary Policy', NBER Working Paper Series 26666, National Bureau of Economic Research.

Jorgenson, Dale, Mun S. Ho and Kevin Stiroh (2008), 'A Retrospective Look at the U.S. Productivity Growth Resurgence', *Journal of Economic Perspectives* vol. 22, no. 1, pp. 3–24.

Kiley, Michael T. (2019), 'The global equilibrium real interest rate: concepts, estimates, and challenges', Finance and Economics Discussion Series no. 2019-076 , Washington: Board of Governors of the Federal Reserve System.

King, Mervyn and David Low (2014), 'Measuring the 'world' real interest rate', NBER Working Paper Series no. 19887, National Bureau of Economic Research.

Lagerwall, Björn (2019), 'Fiscal policy in a monetary policy perspective', *Economic Commentaries* no. 5, Sveriges Riksbank.

Lindé, Jesper and Mathias Trabandt (2019), 'Resolving the Missing Deflation Puzzle', CEPR Discussion Paper Series no. 13690.

Liu, Ernest, Atif Mian and Amir Sufi (2019), 'Low Interest Rates, Market Power, and Productivity Growth', NBER Working Paper Series, no. 25505, National Bureau of Economic Research.

Lucas, Robert (1976), 'Econometric policy evaluation: A Critique', *Carnegie-Rochester Conference Series on Public Policy* vol. 1, pp. 19–46.

Lunsford, Kurt G. and Kenneth D. West (2019), 'Some evidence on secular drivers of U.S. safe real rates', *American Economic Journal: Macroeconomics*, vol. 11, no. 4, pp. 113–139.

Marx, Magali, Benoît Mojon and Francois R. Velde (2018), 'Why have interest rates fallen far below the return on capital?', Working Paper no. 2018-01, Federal Reserve Bank of Chicago.

McKinsey Global Institute (2018), 'Solving the United Kingdom's Productivity Puzzle in a Digital Age', Discussion Paper September.

McLeay, Michael and Silvana Tenreyro (2018), 'Optimal Inflation and the Identification of the Phillips Curve', CEPR Discussion Paper no. 12981, Centre for Economic Policy Research.

Obstfeld, Maurice and Romain Duval (2018), 'Tight monetary policy is not the answer to weak productivity growth', column at voxeu.org, 10 January.

OECD (2015), 'The Future of Productivity'.

Oliner, Stephen, Daniel Sichel and Kevin Stiroh (2007), 'Explaining a Productive Decade', *Brookings Papers on Economic Activity*, 1:2007, pp. 81–137.

Oulton, Nicholas and María Sebastiá-Barriel (2017), 'Effects of Financial Crises on Productivity, Capital and Employment', *Review of Income and Wealth*, vol. 63, Supplement 1, pp. 90–112.

Phillips, William (1958), 'The Relation Between Unemployment and the Rate of Change of Money Wage Rates in the United Kingdom, 1861–1957', *Economica*, vol. 25, no. 100, pp. 283–299.

Poterba, James M. (2001), 'Demographic structure and asset returns', *Review of Economics and Statistics*, vol. 83, no. 4, pp. 565–584.

Rachel, Lukasz and Thomas D. Smith (2015), 'Secular drivers of the global real interest rate', Staff Working Paper no. 571, Bank of England.

Rachel, Lukasz and Thomas D Smith (2017), 'Are low real interest rates here to stay?', *International Journal of Central Banking*, vol. 13, no. 3, pp. 1–42.

Reifschneider, Dave, William Wascher and David Wilcox (2015), 'Aggregate Supply in the United States: Recent Developments and Implications for the Conduct of Monetary Policy', *IMF Economic Review*, vol. 63, no. 1, pp. 71–109.

Rogoff, Kenneth (2019), 'Government Debt Is Not a Free Lunch', column, Project Syndicate, 6 December 2019.

Schivardi, Fabiano, Enrico Sette and Guido Tabellini (2019), 'Credit Misallocation During the European Financial Crisis', CEPR Discussion Paper, no. 11901, Centre for Economic Policy Research.

Sichel, Daniel (2019), 'Productivity Measurement: Racing to Keep Up', NBER Working Paper Series no. 25558. National Bureau of Economic Research.

Syverson, Chad (2017), 'Challenges to Mismeasurement Explanations for the US Productivity Slowdown', *Journal of Economic Perspectives*, vol. 31(2), pp. 165–186.

Timmer, Marcel and Bart van Ark (2005), 'Does information and communication technology drive EU-US productivity growth differentials?', *Oxford Economic Papers* vol. 57, pp. 693–716.

Walentin, Karl (2014), 'Housing collateral and the monetary transmission mechanism', *Scandinavian Journal of Economics*, vol. 116, no. 3, pp. 635–668.