

■ Digitisation and inflation

One of the structural changes that has attracted attention recently is the development of digital technology and its expansion into different areas of application in the economy. This article describes various channels through which this so-called digitisation could influence inflation. However, our knowledge is still incomplete. It seems reasonable that digitisation has a dampening effect on inflation, but exactly how much is difficult to say. The Riksbank's assessment is that the decline in the rate of inflation in recent years is primarily connected with other factors.

Structural changes can influence inflation

Inflation is affected by the business cycle and various types of price and supply changes. For example, the low inflation that can currently be observed in many countries is largely due to demand having recovered more slowly than expected after the financial crisis, and to a surprisingly heavy fall in the oil price.

Inflation can also be influenced by structural changes of a more long-term nature. Examples discussed in recent decades are globalisation and the deregulation of various markets.³⁷ Stabilisation policy also needs to take structural changes into account. For example, if a structural change can be expected to have a dampening effect on inflation, this can be compensated for by a more expansionary monetary policy.

The effects are basically temporary but can be difficult to predict

However, structural changes and their effects are not always easy to identify, even though they often impact the economy for a long period of time. Even in cases in which the economy is being affected by an underlying structural change, such as globalisation, the effects can vary over time and be so complex and unpredictable that full consideration of them cannot be taken in economic policy. Structural changes can thus contribute towards inflation not developing as expected.

However, it is important to realise that the possible effects on inflation of a structural change will essentially be temporary, even if they may be relatively long-lived. A structural change influences inflation for as long as it lasts, until a new equilibrium is reached in the economy. However, in the really long term, inflation does not depend on structural changes or any other development in the real economy.³⁸

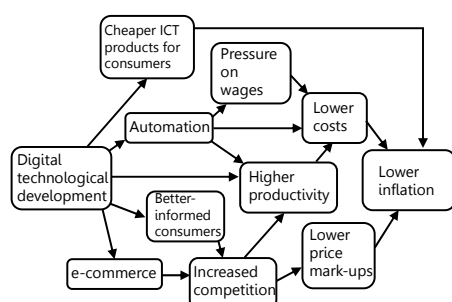
An example of a structural change – the development of digital technology

One of the structural changes that has attracted attention recently is the development of digital technology and its expansion into different areas of application in the economy, for the sake of simplicity referred to here as digitisation.³⁹ The debate on digitisation and its effects on the

³⁷ The difference between a structural change and a so-called supply shock is not always obvious, and is largely a matter of time perspective. A structural change such as globalisation is a process that stretches over decades, while a supply shock, such as a drastic change in oil prices, will typically affect the economy over a significantly more limited period.

³⁸ The way this is usually put is that inflation in the long term is a monetary phenomenon, which means that ultimately depends on growth in the amount of money in the economy.

³⁹ Even though the term digitisation is used relatively widely today, it is not always clear exactly what it means. The traditional meaning of the term refers to the conversion of information from physical to digital form, for example scanning books and images for conversion to data files (series of ones and zeroes) to preserve them

Figure A25. The effects of digitalisation on inflation

Source: The Riksbank

economy is nothing new. Around the turn of the millennium, there was a similar discussion on information and communication technology (ICT) and what was then called "the new economy".⁴⁰ That time, developments were expressed by excessive optimism in the stock market and the possibilities of new technology, which eventually ended in what was known as the IT crash. However, even if this had a dampening effect on the discussion of the economic effects of ICT, the digital technological development itself continued. In recent years, the debate has again picked up, albeit in a different form.

In recent years' discussion of digitisation, the possible effects on inflation have so far not been a main topic. Instead, the focus has been on the consequences of digitisation for growth, for welfare and for the gap between those groups and industries that are able to adapt and take advantage of digitisation and those that are not. Recently, however, the effects on inflation have also started to gain some attention, particularly in the debate in Sweden.⁴¹

The effects of digitisation on inflation – an outline

Figure A25 provides a brief description of the channels through which digitisation may influence inflation. The different parts of the figure are discussed below. The review is principled and qualitative, but not quantitative as we still know too little about the effects of digitisation on inflation. However, in some cases, developments are illustrated with examples.

It is worth emphasising that the description should not be regarded as an exhaustive review. This would require a far more in-depth analysis and considerably greater scope. The channels described are the most intuitive and probably the most important.

Is digitisation a strong enough driving force?

One indication that our knowledge of digitisation is incomplete is the current international debate on the future impact of digital technological developments productivity or GDP growth. Some observers suggest that the rate at which the economy is able to generate important innovations has declined. Technological advances such as electricity and the internal combustion engine, made at the end of the 19th century, together with spin-off effects from these, are assumed to have had considerably greater and more permanent effects on productivity and growth than digital technological developments have had and will have. According to some observers, the world has reached a "technological plateau".⁴²

Others are significantly more optimistic and argue that, so far, we have only seen the start of the technological progress and innovations

for prosperity and make them available on the Internet. The debate sometimes refers to social digitisation, which is to say increased usage of IT in a broad sense by society (see "En digital agenda i människans tjänst" (A digital agenda in the service of the people), interim report from the Committee for Digitization, SOU 2014:13). This article uses the term in an even broader sense to cover not just the use but also the development of digital technology.

⁴⁰ See, for example, Lindbeck, A. "ICT och den Nya Ekonomin" (ICT and the New Economy), *Ekonomisk Debatt*, no. 6 2000, for an overview that is also relevant to today's situation. See also Eriksson, J. A. and M. Ådahl, "Is there a 'new economy', and is it coming to Europe?", *Sveriges Riksbank Economic Review* 1/2000, Sveriges Riksbank.

⁴¹ See, for example, Breman, A. and A. Felländer, "Diginomics – nya ekonomiska drivkrafter" (Diginomics – new economic driving forces), *Ekonomisk Debatt*, no. 6 2014.

⁴² See, for example, Gordon, R. "Is U.S. Economic Growth Over? Faltering Innovation Confronts the Six Headwinds", NBER Working Paper 18315, 2012 and Cowen, T. *The Great Stagnation: How America Ate All the Low-Hanging Fruit of Modern History, Got Sick, and Will (Eventually) Feel Better*, Dutton, 2011.

that digitisation will generate.⁴³ Digital technology, it is claimed, is what is known as a General Purpose Technology (GPT) – a technology affecting society as a whole and leading to productivity gains in many parts of the economy – to at least the same degree as previous innovations. The apparent dampening of overall production growth over the last decade is regarded as a temporary phenomenon, partly due to the deep global downturn. In Sweden, trend production growth has decreased after the peak around the turn of the millennium and is presently lower than it was in the 1980s (see Figure A26).

There is thus no definitive answer as to whether the rate of innovations has slowed down permanently and economists' opinions are divided on the issue.⁴⁴ Before continuing, it may thus be worthwhile to bear in mind that the actual starting point of Figure A25 is itself a matter of discussion.

Effects via automation and productivity-enhancing innovations

One type of channel, which is closely related to the question of digitisation as a driving force for GDP growth and productivity, works through the various ways in which digitisation impacts companies' production possibilities in a physical sense (see Figure A27). According to growth theory, technological innovations form the basis for long-term productivity growth, which, in turn, is the reason that countries become prosperous and standards of living increase.

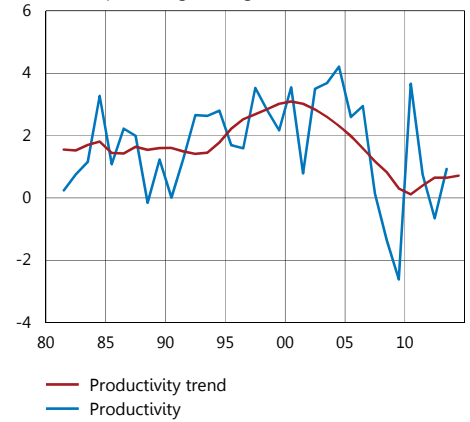
Technological innovations can increase productivity in companies through various channels. This can take place through innovations acting as complements to labour. In the figure, this is represented by the arrow going directly from digital technological development to productivity. It can also take place through innovations acting as substitutes for labour, known as the automation of production. The development of costs is dampened in both cases.

Through these channels, digitisation can lead to inflation temporarily being unexpectedly low if productivity growth is stronger than expected. If policy makers do not realise that the production capacity of the economy has increased, demand will not be stimulated as much as would have been possible, and there will be a downward pressure on inflation.

Does automation create long-term "technological unemployment"?

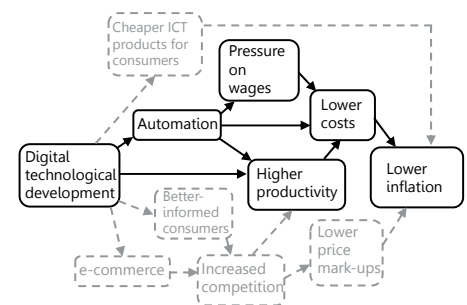
The replacement of labour by machinery is no new phenomenon. This has been the case ever since the start of the industrial revolution. Until fairly recently, the unemployment created when a new sector or industry was automated was considered to be temporary. As the economy grows, job opportunities will arise in other parts of the economy for those being made redundant. This is how it seems to have worked for about two hundred years. In other words, all in all, technological developments do

Figure A26. Productivity trend
Annual percentage change



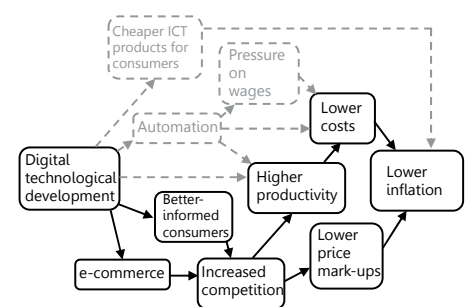
Note. The productivity trend is calculated as the GDP trend divided by the trend in hours worked. The GDP trend is calculated with the aid of a production function and the trend for hours worked is assessed by the Riksbank.
Source: Statistics Sweden and the Riksbank

Figure A27. Effects via technological innovations



Source: The Riksbank

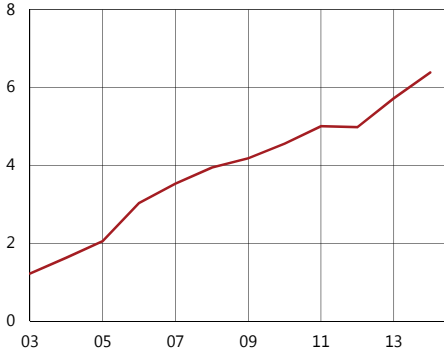
Figure A28. Effects via the internet



Source: The Riksbank

⁴³ See Brynjolfsson, E. and A. McAfee, *The Second Machine Age*, W. W. Norton & Company, 2014.
⁴⁴ However, the optimists have a slight majority in one panel of academic economists (IGM Economic Experts Panel). A majority of respondents are uncertain, but those believing that future innovations will be able to generate as much permanent growth in GDP per capita over the coming century as innovations made in the last 150 years outnumber those believing that this will not be the case (<http://www.igmchicago.org/igm-economic-experts-panel>). See question from 11 February 2014 on "Innovation and Growth".

Figure A29. E-commerce turnover as a percentage of total turnover
Per cent



Source: HUI Research

not seem to have reduced job opportunities faster than they have created them.

However, recently a debate has started on whether this pattern will change in the future and whether this change may possibly already have started. Over the last decades, digital technological development has rapidly made ICT products cheaper and therefore increasingly attractive as a replacement for human labour. From a purely technological point of view, these innovations have also made it possible to replace an increasing number of types of labour. Many people expect this development to continue and even accelerate.⁴⁵ And the faster technological progress, the harder it will be for people and institutions to adjust to it. It is therefore not necessarily an iron law that technological developments create at least as many jobs as they destroy. It could instead be that "technological unemployment" due to automation will become a more commonplace phenomenon than it has been so far.

To the extent that this is the case, broader groups in the economy than previously may experience downward pressure on their wages. This may, in turn, have a restraining effect on inflation.

Effects via e-commerce and better-informed consumers

Another type of channel through which digitisation can influence inflation primarily acts through the Internet's effects on interaction and matching between producers and consumers (see Figure A28).

An obvious example is e-commerce. In approximately the same way as globalisation, e-commerce, which in many ways is part of globalisation, has opened up new markets and increased consumer choice. In many cases, companies are no longer competing with companies in their immediate geographical vicinity but with companies from more or less the entire world. In Sweden, e-commerce has increased steadily during the current century, but its share of the total retail trade is still relatively small (see Figure A29).

The Internet also increases the possibilities for customers to compare the price and quality of products. This applies not only to those products purchased over the Internet but also to others, such as many services.

More price- and quality-conscious consumers and more options for consumers mean that companies experience more competition and have less market power. This makes it more difficult for them to raise their prices and encourages them to increase productivity to press costs to maintain or increase their margins.⁴⁶

Neither e-commerce nor the possibility of comparing products over the Internet are particularly new phenomena. In the near future, possible effects through these channels are therefore a matter of producers and consumers increasingly adjusting to already-existing technology, with

⁴⁵ According to general calculations for Sweden and the United States, it should be possible to replace about half of today's jobs with robots and computers over the next twenty-year period (see Swedish Foundation for Strategic Research, "Vartannat jobb automatiseras inom 20 år – utmaningar för Sverige" (Every other job will be automated in 20 years – challenges for Sweden), 2014, and Frey, C. B. and M. A. Osborne, "The Future of Employment: How Susceptible are Jobs to Computerisation?", unpublished manuscript, Oxford Martin School, Oxford, respectively).

⁴⁶ The Riksbank's Business Survey quotes companies, particularly in the retail sector, stating that they feel competition has increased as a result of e-commerce and price comparison websites.

increasing numbers of companies starting e-commerce and increasing numbers of consumers looking for and comparing products on the Internet. But it is also conceivable that future interaction and matching between producers and consumers will be affected by further advances in digital technology that are difficult to anticipate at present.

Direct effects via components in the CPI

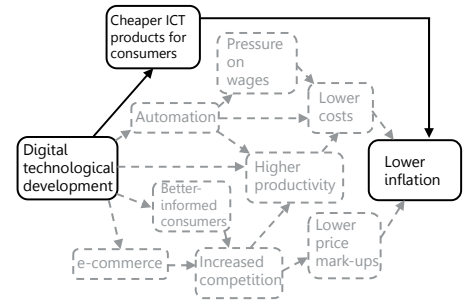
Digitisation's most obvious channel so far is the way that the price development of certain items in the CPI's basket of goods is more or less directly influenced by digitisation (see Figure A30). Firstly, production costs for certain goods are decreased by the trend fall in prices for advanced electronic components such as processors. This category includes mobile telephones, computers and so on. Secondly, the changeover from physical to digital distribution is also leading to falling costs. Goods affected by this include daily newspapers and films. This development has been underway for some time and it is possible that it will continue to press prices and costs for some time to come.

Weighing the prices of products in these two categories reveals that the products related to digitisation have, on average, fallen significantly in price over the last 15 years (see Figure A31) and their contribution to the CPI has been negative (see Figure A32). However, in the years 2013–2014, this contribution has been smaller than before and the dampening of inflation has primarily been caused by the weak development of the rest of the CPI.

Qualitative effects of digitisation are reasonable, but quantitative effects are uncertain

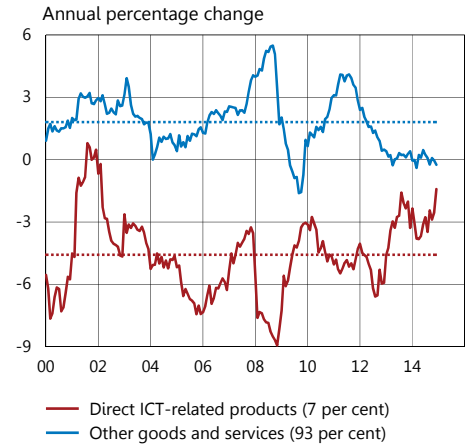
This article has highlighted various channels through which digitisation can influence inflation. Some channels are relatively obvious, while others are more speculative. The review indicates that the effects of digitisation on inflation and the economy as a whole are complex and difficult to assess. It seems reasonable to suppose that digitisation is overall having a dampening effect on inflation, but it is very uncertain how great these effects are. The Riksbank's assessment is that the decline in the rate of inflation in recent years is primarily due to other factors.

Figure A30. Direct effect of digitisation



Source: The Riksbank

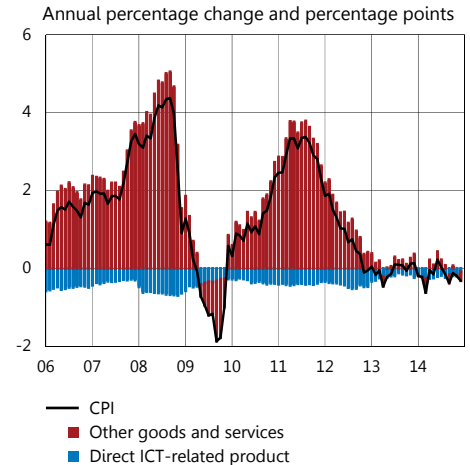
Figure A31. Development of prices of directly digitisation-related products in relation to rest of CPI



Note. The broken lines refer to the average for the period 2000 to the last outcome. The figures in brackets refer to the weight in the CPI. Direct ICT-related products include household appliances, telephony, TVs, cameras, CDs, DVDs, toys, books and newspapers.

Sources: Statistics Sweden and the Riksbank

Figure A32. Contributions to the rate of increase in the CPI



Note. The figures in brackets refer to the weight in the CPI. Direct ICT-related products include household appliances, telephony, TVs, cameras, CDs, DVDs, toys, books and newspapers.

Source: Statistics Sweden and the Riksbank.