Digitization is a structural change that impacts the Swedish economy more than other comparable countries. Physical goods are becoming digital services, and the marginal costs for copying and distribution are approaching zero. We discuss how this affects productivity, the labor market and inflation. The potential productivity gains are large, but data shows that Sweden is not fully capitalizing on this potential. Moreover, the productivity gains from digitization are difficult to measure and official statistics underestimate the consumption of digital services. To address these trends, which mean the elimination of jobs in certain industries, it is critical to focus on education, innovation and labor migration.

Since 2005 e-commerce has grown from three percent of global trade in goods to twelve percent in 2013. During the same period Skype’s share of all international phone calls has risen from three to 39 percent. International trade in services built on digital platforms has grown at the same time from 51 to 63 percent (McKinsey Global Institute 2014). The economy is constantly undergoing structural changes. Digitization is one example. We believe the effect on growth is underestimated in official statistics and has a high productivity potential (van Ark 2014). The structural change is broad and rapid and is affecting nearly every sector of the economy. Companies that don’t adapt are quickly being pushed aside. In a very short time, small businesses can outcompete industry giants thanks to low entry costs as well as low costs for copying and distribution. Two examples are Skype and Spotify, both of which have revolutionized their respective sectors.

Digitization’s impact on the economy can be divided into three main channels (McKinsey Global Institute 2014):

- Physical goods are becoming digital services. This means lower costs to use, copy, distribute and transport products. The marginal cost of production is falling. The classic examples are CDs, which have been replaced by streaming music, newspapers by online news and books by downloaded e-books. Traditional manufacturing is affected as well. In some areas of manufacturing such as medical technology, 3D printers can replace the physical transportation of goods by sending digital data to where it will be consumed and easily printed out on-site.

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1 Kodak is an example of this. The common denominator among these companies is that they don’t adapt their technology quickly enough to customers’ new and changing needs. The availability and development of software has been a key competitive factor.
• **Digital platforms are increasing efficiencies and internationalizing services that had once been local.** This applies to everything from buying airline tickets online to classified ad websites such as Tradera and Blocket in Sweden and Craigslist in many cities around the world. Middlemen are unnecessary when supply and demand meet more efficiently. Digital platforms such as oDesk, which are creating an international marketplace where employers and employees can meet without migrating between countries, are transforming employment opportunities.

• **Digitization improves efficiencies in traditional production.** This is being done, for example, by adjusting energy consumption more precisely to demand, simplifying logistics through digital tracking and taking industrial robots to a more advanced level through artificial intelligence.

1. Digitization has large productivity potential in a growing number of sectors

What distinguishes digitization from the IT era? And why is development accelerating right now? One possible explanation is that consumers and businesses have reached a higher level of technological and digital maturity. We constantly carry with us smarter, smaller and cheaper computers (mobile phones and tablets) and have adapted the way we live to have continuous access to software and the Internet. Digitization can potentially be compared to other technological innovations such as the steam engine or electrification, which lifted productivity to new heights. Digitization is now integral to nearly every sector of the economy and every company has to figure out how it is affected by key features of digitization; social media, mobile platforms and data analytics. In the future the economy's potential productivity growth will be determined in large part by how well each sector embraces digitization's potential (van Ark 2014). Investments, regulations and social structures will also have to adapt.

For example, durable goods companies not only offer e-commerce solutions but are now using social media as channels for marketing, familiarizing themselves with customers with the help of big data analytics, and allowing customers to track their orders by mobile phone. In the future products may partly consist of components that can be 3D printed.

According to Brynjolfsson and McAfee (2014), the digital development curve is exponential. This is partly explained by the low, practically nonexistent cost to copy and spread digital products and by the fact that innovations can be combined in infinite ways to create new innovations. In addition, the barriers to entry are low, making it easier for new companies to enter new markets. We are now harvesting the fruits whose seeds were planted during the IT era.

Digitization is reducing the marginal costs for distribution and copying to zero. We are transitioning from scarcity to abundance. In his book, *The Zero Marginal Cost Society* (2014), Jeremy Rifkin discusses the possibility of extreme productivity gains as the marginal costs for production fall to zero. Renewable energy, 3D printers in manufacturing and college educations through Massive Online Open Courses (MOOCs) are all examples of areas with significant potential. After the high initial cost of research and development, goods can be produced at a very low marginal cost. While we are far from seeing very low prices in the cases of energy, advanced 3D-printed goods and college educations, there are other areas where the trend toward low marginal costs is
evident for both producers and consumers. The most obvious cases so far are digital services such as e-commerce, media and music.

2. Digitization creates technological unemployment

Research shows that 53 percent of Swedish employees are at risk of being replaced by digital technology within twenty years. The corresponding figure for the US is 47 percent (Swedish Foundation for Strategic Research 2014; Frey and Osborn 2013). Although this mainly affects routine jobs in retail and administration, certain highly qualified jobs may disappear as well. After having replaced muscles, technology is now supplanting the human brain (Kurzweil 2005). Unemployment is increasingly concentrated among poorly educated workers who have difficulties meeting the demands of a changing job market. Sweden is probably impacted more than comparable countries by this technological job substitution, since it still has many industrial jobs that could potentially be automated (Fölster and Hultman 2014). During the financial crisis this structural change was partly hidden by high cyclical unemployment. As the recovery takes firmer hold, this difference in the labor market will probably be even clearer.

In the US a lively debate is under way among academics and policymakers on how the labor market and economic growth are affected by digitization and globalization (see, e.g., Moretti 2013; Brynjolfsson and McAfee 2014). Research shows that the US labor market is undergoing a momentous change (Moretti 2010, 2013; Moretti and Thulin 2013). New technology and new innovations have raised demand for qualified labor at the same time that demand for less qualified workers has fallen. Figures show that highly educated workers have seen their real wages rise by 32 percent since 1980, while real wages earned by white males with just a high school diploma are 8 percent lower today than in 1980 (Moretti 2013). One of the consequences of this is greater income inequality.

Table 1  Average monthly wages, women, by education level

<table>
<thead>
<tr>
<th>Education level</th>
<th>1991</th>
<th>2009</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 9 years</td>
<td>15,406</td>
<td>20,948</td>
<td>36%</td>
</tr>
<tr>
<td>9 years</td>
<td>15,336</td>
<td>22,104</td>
<td>104%</td>
</tr>
<tr>
<td>High school</td>
<td>16,074</td>
<td>23,288</td>
<td>45%</td>
</tr>
<tr>
<td>College (2 years or more)</td>
<td>NA</td>
<td>29,069</td>
<td>NA</td>
</tr>
<tr>
<td>Advanced level</td>
<td>25,275</td>
<td>40,634</td>
<td>61%</td>
</tr>
</tbody>
</table>

Note: Wages in 2009 prices.
Sources: Statistics Sweden (2013), own calculations.

Table 2  Average monthly wages, men, by education level

<table>
<thead>
<tr>
<th>Education level</th>
<th>1991</th>
<th>2009</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 9 years</td>
<td>17,475</td>
<td>24,510</td>
<td>40%</td>
</tr>
<tr>
<td>9 years</td>
<td>16,970</td>
<td>25,236</td>
<td>49%</td>
</tr>
<tr>
<td>High school</td>
<td>18,332</td>
<td>26,802</td>
<td>47%</td>
</tr>
<tr>
<td>College (2 years or more)</td>
<td>NA</td>
<td>36,618</td>
<td>NA</td>
</tr>
<tr>
<td>Advanced level</td>
<td>30,989</td>
<td>48,021</td>
<td>55%</td>
</tr>
</tbody>
</table>

Note: Wages in 2009 prices.
Sources: Statistics Sweden (2013), own calculations.
The same trend can also be seen in Sweden, where demand is increasing for well-educated labor at the same time that demand for workers without a high school degree is dropping (see figure 1). As in the US, there is a growing wage gap (see tables 1 and 2). Nearly 70 percent of all unemployed have a weak connection to the labor market. Unemployment among the college educated has remained steady at around five percent at the same time that unemployment among those without a high school degree has risen to about 20 percent (Figure 1). It is worth noting that this trend has persisted through both the financial crisis and subsequent euro crisis. Traditional manufacturing in Sweden, which is highly export dependent, has been hit hard by weak demand from abroad. Despite these crises, demand for highly educated labor has stayed strong at the same time that it has become harder for less educated workers to find a job.

Among the reasons why income inequality will increase in this technological revolution, according to Brynjolfsson and McAfee (2014), is that digitization is a complement to educated labor and a substitute for less educated labor, that the gains accrue to those who own the capital rather than wage earners, and that it gives rise to so-called superstars, a select few who take a disproportionate share of the pie (Rosen 1981; Berman et al. 1998). At the same time, however, the potential for higher productivity is impeded by a shortage of qualified labor. The critical factor looking forward is how we replace the jobs that are lost.

**Figure 1** Unemployment by education level, Sweden, 2005-2013

![Figure 1](image)


Another important aspect of how digitization is structurally transforming the labor market is how it affects businesses. Digitization democratizes entrepreneurship. Small startups can establish themselves internationally and challenge global giants right from the start. The entrepreneurial journey from idea to product is simplified, and the time from idea to product is shortened. As a result, we are seeing a new type of company, micromultinationals, small businesses with low production costs and low barriers to entry that are international from the start (SOU 2014:13; Anderson 2012; Agrawal et al. 2011, 2013).
Despite an economic rebound in Europe and Sweden, inflation remains low and unemployment is stuck at a relatively high level. In July the consumer price index (CPI) was 0.0 percent on an annualized basis in Sweden. At the same time the consumer price index with a fixed interest rate (CPIF) was 0.6 percent on an annualized basis. In March the CPIF was measured at 0.0 percent, the lowest reading since the measurement was first taken in 1988.

Falling inflation is not just a Swedish phenomenon. Figure 2 shows that inflation is below target in a number of developed economies. We should note, however, that Sweden is further from its inflation target than, for example, the Eurozone and Canada. The falling inflation trend seen in a number of developed economies is due to three factors. The first is a global decline in food and energy prices. Secondly, low capacity utilization and a surplus of labor resources since the financial crisis are keeping pressure on wages. Thirdly, the inflation trend can be attributed to the structural changes that digitization contributes to:

- Cross-border e-commerce is growing and Sweden is among the countries were e-commerce is strongest. As a result, Swedish inflation is exposed to a fairly high degree to digitization through competition, which can contribute to downward price pressure.

Figure 2 Deviations from inflation target

Note: Deviations from each central bank’s announced inflation target (in percentage points). The latest figures for Canada and the US are from June. Sources: Reuters Ecowin and Swedbank.
• An increasing number of small and medium-sized businesses are so-called born globals, i.e., digitization allows them to reach the entire international market immediately after startup. Digitization has exposed goods and service producers to international competition and price pressure. One example is movie rentals. Netflix now competes with the local video store. Streaming movies online reduces marginal costs. This increases competition and applies downward pressure to service prices. In addition, various goods in Statistics Sweden’s data are being reclassified as services when streamed online.

• The marginal costs to produce, copy and distribute digital services are falling towards zero. This increases the supply of digital services, similar to the supply shocks we see in other sectors. Furthermore, middlemen are unnecessary when supply and demand meet directly, creating additional downward price pressure. Niche producers gain access to customers they otherwise wouldn’t be able to reach (Thand Ringqvist 2014).

• Low wage pressures due to technological unemployment.

To estimate digitization’s impact on inflation, we divided the CPI basket into three categories. The first includes the goods and services that we feel are directly impacted by digitization. Our view is that they are usually purchased and consumed digitally (e.g., streamed music). In the second category we placed goods and services that we feel have been indirectly affected by digitization. We believe it is fairly common for households to compare prices and purchase these goods and services online (e.g., computers). The last category contains goods and services that we feel have not been greatly affected by digitization. This includes remaining product groups (e.g., daycare fees). By summing up the weights in each category, we estimate that 30 percent of the goods and services in the CPI basket have been directly or indirectly affected to date by digitization. With the same CPI basket, we have then tried to estimate whether the goods and services will be significantly affected by digitization during the next decade. Our estimate, based on this exercise, is that an additional 7 percent of the CPI basket will be appreciably affected directly or indirectly by digitization going forward.²

While the value of what can be digitized is falling towards to zero, the value of what can’t be digitized is on the rise. This is very clear in the music industry, where artists no longer earn money the same way on sales of CDs or music downloads but instead on concerts and endorsements. For example, we don’t have to pay anything to see an artist on YouTube, but are prepared to pay a great deal for a concert (Schlingmann and Nordström 2014). The price of theater tickets, for example, has risen by 7.6 percent in the last year.³

4. Digitization’s impact on economic development is difficult to measure in official statistics

Researcher Robert J. Gordon claims that declining productivity in recent years is evidence of the end of growth (Gordon 2012). His reasoning is that the productivity gains

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² The CPI basket we based on consisted of 360 different goods and services, three of which were directly affected, 113 indirectly affected and 244 not affected. In our estimates for the next decade we have included 10 that are directly affected, 148 that are indirectly affected and 202 that are not affected.

³ Swedbank’s estimates of detailed CPI data from Statistics Sweden.
from the IT era have slowed and that demographic trends, specifically an increase in the share of the older population, are leading to lower productivity. There are several factors, however, which indicate that potential productivity gains are actually being underestimated and that the trend is not slowing:

- Free digital services add value to the economy but this is not reflected in GDP numbers. Moreover, digital services are reducing consumption of traditional physical goods. For example, a free Skype call produces a value that isn’t included in GDP. At the same time a conventional telephone call is eliminated and GDP, all else being equal, decreases. In the same way the increased consumer value of being able to read the news free of charge on your tablet, instead of buying a newspaper, isn’t reflected in GDP, and the increase in GDP doesn’t materialize since you didn’t pay for a newspaper.

- Better optimization of our time produces efficiency gains. Today we can decide what we want to watch on television and when. The same applies to our consumption. We don’t have to shop in the middle of the day when we are most productive. The value of our time and productivity isn’t measured in official data, either (Hal Varian 2014).

**Figure 3** Productivity by sector in Sweden, base year 1980=100

*Note:* Calendar adjusted and fixed prices. National Institute of Economic Research’s (NIER) forecast dotted line.  

- As in every technological paradigm shift, there is a slight delay in productivity gains. It takes time for institutions and organizations to adapt to new conditions. Research shows that the impact on productivity of digitization may even be negative if the education level within the company is too low (Jacobsen et al. 2012). On the other hand, it is higher the more educated the company’s employees are.
Our hypothesis is that digitization leads to productivity gains that are difficult to capture in official statistics. This implies that GDP is being underestimated. The national accounts were developed to measure the production of physical goods (Coyle 2014). The methods have been continuously refined over time to adapt to changes in the economy, but when physical goods are converted to digital services there are difficulties measuring this in the national accounts.

Swedish productivity gains have been weak in recent years (see figure 3). At the same time we have experienced real wage increases. Unit labor costs are a company’s costs for salaries and benefits, adjusted for changes in labor productivity. Increases in Swedish real wages, coupled with low productivity gains, normally drive inflation. At the same time this cost pressure is not reflected in inflation. If productivity is being underestimated, the cost pressure is not as high and it may partly explain the discrepancy between the cost pressure and inflation.

We use streaming music as an example. Calculations of inflation are based on a CPI basket where various goods are weighted according to household spending. Inflation, measured by the consumer price index, is designed to show the average trend in consumer prices for all private domestic consumption: the prices consumers actually pay. Consumption of CDs is easy to report and include in measures of household consumption in the national accounts. Consumption of a digital service such as a subscription where you can listen to an unlimited amount of music is not as easy to measure. Nor is it as easy as before to transfer household spending to a CPI basket and measure the price trend.

Music and movie downloads and streaming are included in household consumption in the national accounts in the category “cultural services”. This category also includes a number of other services such as theaters, movies, libraries, museums, television, etc. When Statistics Sweden estimates the change in household consumption from streamed services, it is based on the revenues of the companies that provide these services to households. The revenues are reported in current prices and Statistics Sweden uses a consumption deflator to calculate the trend in fixed prices.

This means that Statistics Sweden captures whether more people are paying for subscriptions and whether these subscriptions are more expensive. But if the supply of music increases substantially for a given subscriber, or if this subscriber listens to more songs, it is difficult to capture this in the measure of household consumption. For the consumer, the marginal cost to listen to an additional song is zero. The consumer surplus that digitization represents is not captured in the national accounts and therefore is not directly evident in the GDP trend from the user side.

Another perspective on the difficulty of capturing digitization’s impact on the economy through the national accounts is the comparison between spending in the GDP statistics and in the CPI basket. The methods differ. How do you measure the price trend when the marginal price is falling towards zero? In the case of streaming music, Statistics Sweden uses the cost of a subscription to measure the price trend in the CPI basket. If the range of music available through the subscription increases, the subscription cost is adjusted to a certain extent.

Lastly, as we have mentioned before, goods that are free are not reported in household consumption in GDP since they do not entail spending. Digital services include news,
email, social media such as Facebook, and file sharing programs like Dropbox. These are services which previously did not exist or which we paid for. The value that these services represent for the consumer is not captured in the national accounts.

5. Policy measures determine digitization’s effect on growth

“It (GDP) is a measure designed for the twentieth-century economy of physical mass production, not for the rapid innovation and intangible, increasingly digital services.” (Coyle 2014, p. 6).

“The power of digitization comes especially from its marginal cost economics that reduce costs associated with access, discovery, and distribution of goods and services to nearly zero.” (McKinsey Global Institute, 2014, p. 11).

In this article we have described how digitization converts physical goods into services, how the marginal costs of production fall and how international competition increases, even in what have traditionally been protected service sectors. As the quotes above show, it is difficult to measure and analyze the ways and extent to which digitization affects economic development. To create a discussion on the opportunities and threats digitization presents, we have pointed to trends in the labor market, inflation and productivity which may be related to digitization.

Statistics show that we are not fully benefiting from digitization’s potential. Recent years have been characterized by weak productivity growth and increasing polarization in the labor market. Higher productivity in some industries is offset by the fact that employment is growing in service sectors with low productivity. The productivity gains that digitization can lead to are offset by challenges in the labor market.

To create new jobs and benefit from digitization’s potential requires innovation. This makes the climate for new businesses critical. A dynamic labor market is a key. Policymakers play a decisive role if Sweden is going to embrace the opportunities digitization offers. To replace the jobs that are lost will require investments in innovation and education. A dynamic and diversified labor market can be facilitated through openness to labor migration. Innovations drive productivity growth – and consequently economic growth and Sweden’s competitiveness in the long term. Digitization complements a well-educated workforce. Educational investment – both broad and targeted – will be crucial to neutralize technological unemployment. Diversity and excellence will be crucial to the future labor market. Labor migration offers untapped potential in this regard.

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4 See, e.g., Braunerhjelm et al. (2013).
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