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Evidence on Dutch macroeconomic and sectoral productivity performance:

Some stylised facts

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1 Introduction

Productivity is the key driver of long-run living standards. However, there are concerns of secular stagnation in the developed world and decreasing sources of technological innovation (Gordon, 2012), although this pessimistic view is hotly disputed (Brynjolfsson and McAfee, 2014). In the Netherlands, productivity growth has indeed slowed down after the recent crisis. Whether this effect is cyclical, and therefore temporary, or is the result of a long-lasting malaise is of great importance for the future of Dutch living standards. As a first step in understanding Dutch productivity developments, this document aims to provide a summary of the key data concerning productivity. Of course we are not the first to look at these issues. For example, De Bondt (2015) looks at Dutch productivity growth between 2002 and 2014 and notes the negative effect of the Great Recession on productivity. Our contribution is to place both macro and detailed sectoral developments in an international context.

We start this memo by examining macro level data in an attempt to identify key stylised facts. Next, we delve into sectoral data, in order to unravel typical patterns and identify sectors with strong and weak productivity performance. We perform the analysis based on OECD data¹ and we provide some robustness analysis using the WIOD/KLEMS dataset. Further, we provide some tentative explanations for these observations, relate them to the existing literature and identify areas that require further research.

The document is organised as follows. Section two presents the evolution of Dutch productivity over time and places these developments in an international context. We identify three key stages: catch up until 1980, the Netherlands being close to the frontier between 1980 and 2008 and a significant relative decline from 2009. Section three delves into sectoral developments. We present the evolution of productivity relative to the same sectors in other OECD countries, which we use as a benchmark; we identify trends found in each sector and discuss important developments. Furthermore, we examine the extent to which sectoral data can help in explaining puzzles found in the aggregate data. Finally, section four summarises and identifies puzzles for future research.

¹ The OECD data is derived from the Annual National Accounts, tables 4, 6 and 7.

2 Development of macroeconomic productivity

In this section, we discuss aggregate productivity – both level and growth – in the Netherlands and put them in an international context. We show that the Netherlands is a highly productive economy. Between 1980 and 2007 the Netherlands was as productive as the US and was one of the most productive OECD countries. In 2014 labour productivity in the Netherlands was 33% higher than the OECD average, 29% higher than the EU average and 11% higher than the euro area average. However, since the Great Recession the Netherlands has fallen behind the US. Having said that, the Netherlands is not the only country to have experienced a productivity slowdown since the Great Recession and is still one of the most productive countries.

To come to these conclusions we use GDP per hour worked as our measure of productivity. Distinguishing between the series per hour worked and per employee is especially important for countries with flexible (including part-time) working time arrangements, such as the Netherlands. We perform the analysis based on annual OECD data from 1970 to 2014 (or the last available year), although due to data availability and comparability when we look at a panel of countries our data runs from 1995 to 2014. For many countries, hours worked statistics are not available before 1995. Robustness checks are performed on the annual KLEMS/WIOD data (see box on p. 13), where the last observations are for 2011. We also compare with data from The Conference Board. The analysis is based on simple techniques such as descriptive statistics or correlations. Given the short time series sample, we refrain from filtering the series.

A first step is to describe the evolution of productivity in the Netherlands, the US and Germany. We compare the Netherlands to the US and Germany because the US is widely used a productivity benchmark and Germany is widely seen as the leading European economy, especially because of its relatively strong economic performance since the Great Recession. Although using the US as a benchmark is a common choice, the US is no longer the most productive country. Therefore we also use a dynamic benchmark composed of the most productive OECD countries and we allow its composition to change each and every year. This guarantees that the comparison group is composed of the most productive economies.

2.1 The evolution of productivity

Figure 2.1 shows GDP per hour worked converted in constant price PPPs in the Netherlands, Germany and the US. The US increased fastest over the period 1998-2014, whilst before the Great Recession Germany increased the least, although only slightly less than the Netherlands. The Great Recession, however, changed the dynamics. In 2009 US productivity growth actually sped up, leaving the Netherlands and Germany behind. In contrast to the US, many European countries experienced an unprecedented dip in productivity. Then, 2011 brought stagnation for all three countries. Productivity barely grew in the US and the growth rate was low in both Germany and, to an even greater extent, the Netherlands². Two key questions arise from Figure 2.1. First, will growth rates return to levels seen either side of 2000? Second, will the Netherlands and Germany catch up what has been lost since the Great Recession?

Figure 2.1 also shows the much debated productivity slowdown. Between 1995 and 2000 GDP per hour worked grew 10.9% in the Netherlands, followed by 8.9% in the following six years (2001-2007). After the Great Recession productivity growth has been even lower at only 3.9% (2009-2014). A similar pattern can be observed over a longer period and for many countries. For example, the same numbers for Germany are 10%, 8.3% and 6.2%, respectively. Whether this is a long-run trend of slowing productivity growth or a temporary slowdown has been much debated (see Gelauff et al., 2014, for more on the debate). Especially for the Netherlands, the evidence for a long-run productivity slowdown is not clear cut since its appearance depends critically on the years chosen.





Data source: OECD Statistics.

² Data from the Conference Board using 2014 EKS PPPs show the same developments.

Constant price PPPs are most useful for looking at changes over time within one country. Current price PPPs are the most useful measure for comparing countries (see appendix – for recent years both series show a similar picture since the difference between them only builds up over time). Thus, Figure 2.2 shows the same statistics in current prices. We observe that, historically, productivity levels in the US and the Netherlands have been very similar. Germany has had marginally lower productivity. After the recession, the US has become more productive than the Netherlands, whilst Germany is still slightly less productive. However, these differences are relatively small. Both figures show the same key information: before the Great Recession productivity growth was continuous and similar in all three countries, but the Great Recession had a much bigger impact on productivity in the Netherlands and Germany than in the US.



Figure 2.2 GDP per hour worked, in current prices

Data source: OECD Statistics.

Figure 2.3 shows GDP per hour worked in the Netherlands as a percentage of US GDP per hour worked, using the current price PPP exchange rate (see appendix on current or constant PPP exchange rates). PPP exchange rates are an imperfect measure of true purchasing power (OECD 2003, Van Ark, 2004, Naess-Schmidt, 2006), hence Figure 2.3 also contains a +/- 5% confidence band to take into account measurement error in the PPP exchange rate. In the 1970s the Netherlands caught up with the US. Between 1980 and 2007 productivity fluctuated around 100, which, since none of the fluctuations were more than 5%, implies that on average the Netherlands and the US were equally productive. However, from 2008 to 2014 relative productivity fell 8% from 104% to 98%. Whilst 98% is still less than 5% from 100%, the fall from the level in 2008 is more than 5% - that fall is less likely to be a statistical artefact.





Data source: OECD Statistics.

Explanations of the increased productivity gap vis-a-vis the US since the Great Recession

In the Great Recession, labour productivity fell in European countries but continued growing in the US. One of the possible explanations discussed in the literature is labour hoarding (see Van den Berge et al. 2014 and references therein for a flavour of the discussion). Labour hoarding is when firms choose not to fire workers in a downturn in the expectation that those workers will be needed when the economy recovers. If firms make large use of it and do not adjust their labour input, fluctuations in unemployment are smaller, but fluctuations in productivity are larger and more procyclical. The existence of such a trade-off would be in line with relatively small increase in unemployment, given the size of the recent crisis. Erken et al. (2015) report that among a selection of developed OECD countries, only Belgium and Switzerland had a smaller increase in unemployment than the Netherlands, while their GDP losses in 2009 were much smaller. Crucially, labour hoarding was likely much more prevalent in Europe than the US: European employers decided to retain surplus workers, whilst the flexible labour market in the US adjusted quickly, resulting in a temporary increase in unemployment and no fall in labour productivity. In fact, the growth rate of productivity in the US between 2009-2011 was markedly higher than average and may have been driven by lay-offs of less productive groups of workers. Although labour hoarding explains the differences during the Great Recession, it is a highly unreasonable explanation for the productivity performance seven years after the start of the crisis. That's because labour hoarding is essentially a temporary phenomenon: either the economy recovers and idle workers are put back to work or firms realise the output loss is persistent and they fire the idle workers. In both these cases labour productivity would recover. We do not see this in the data, we see a persistent increase in the productivity gap to the US. Therefore we must look for another explanation.

There are a number of other explanations that have been put forward. First, European employment growth after 2008 involved the continued entrance of female and older workers

that, at least in the short-run,³ seem to be less productive (Dew-Becker and Gordon, 2008; Gros and Mortensen, 2004). Second, the difference between the US and Europe is especially pronounced in the services sector (Mas, 2012) where the US makes more and better use of ICT capital as well as high-skilled labour, which has enabled them to fully benefit from the latest technological advances. Furthermore, adoption of the knowledge economy in Europe has been lagging as manifested, for example, by relatively low and stagnant R&D expenditures. Moreover, EU countries were not eager to adopt supply side reforms, which might be necessary to fully profit from the latest technological advances, especially those concerning the use of ICT. For example, without better implementation of the common market for services firms in service industries are often limited by the size of their national markets (see, for example, Gelauff et al., 2014). Since gains from supply-side policies tend to materialise in the long-run, these developments do not suggest strong future productivity growth. Finally, differences may be attributed to measurement error. Measured labour productivity is pro-cyclical because labour effort isn't measured well⁴. Therefore, that the US and the Netherlands are experiencing different stages of the business cycle may explain some of the observed difference.

2.2 Alternative data choices

For our main analysis we used GDP per hour worked based on OECD data as our measure of productivity and we have compared the Netherlands to the US as benchmark. However, other countries can serve equally well as the benchmark and there are other measures of productivity. This section takes a look at these alternatives.

Is the US the most appropriate benchmark?

Historically the US used to be the productivity leader, making it the natural choice for benchmark. However, as the other OECD economies caught up, this choice of benchmark has become less obvious. Comparison to any other country is possible, which is what this section does.

Figure 2.4 presents the evolution of the gap between the Netherlands and the five most productive countries in any given year (out of the set of forty OECD countries, excluding Luxembourg and Norway. Luxembourg is excluded because of its small size and the dominance of the financial sector in Luxembourg. Norway is excluded because its high productivity level is determined to a large extent by the oil and gas production in its large mining and quarrying industry). Given the margin of error caused by statistical discrepancies, there is not enough evidence to conclude that the Netherlands was not equally productive as the five most productive OECD countries since 2000. Slow productivity growth

³ In the US, the labour force participation rate fell from 66% in 2008 to 63% in 2015 (Bureau of Labor Statistics). These discouraged workers are presumably more likely to be relatively low productivity workers. In contrast, in the Netherlands participation increased from 71% in 2008 to 72% in 2015 (Statistics Netherlands). Moreover, the labour force participation rates of older workers and women have grown much faster in the Netherlands and Germany than in the US since the Great Recession.

⁴ Whilst hours worked is measured, the amount of effort that labour expends during those hours is unobserved.

since the financial crisis has been seen in many countries, the Netherlands is at or close to this productivity frontier before and after the crisis.



Figure 2.4 Dutch productivity compared to a relevant dynamic benchmark, GDP per hour in current prices, PPP

Data source: OECD Statistics.

The Netherlands is one of the top five countries for almost all the years included in the sample. Figure 2.5 shows all of the countries that make up the frontier in at least one year plus Luxembourg and Norway. The composition of the most productive countries group changes little over time. Norway and Luxembourg are the two most productive economies. The upsurge of Norway can be explained by oil and gas prices. The Netherlands, the US, Germany, France, Denmark and Belgium are on par with each other. Nonetheless, there are interesting developments within this group. There are growing discrepancies between the leaders. Luxembourg used to be a clear leader. However, Luxembourg is such a small country which makes it an outlier that we did not include it as a part of productivity benchmark. Since the mid 2000s Norway caught up with Luxembourg, mainly due to the increasing price of oil and gas. The others remain, on average, equally productive as the US. Relative productivity in Belgium has fallen: in 1995 it used to be more productive than all countries except for Luxembourg but it has fallen back towards the others. In the early 2000s, Denmark was consistently the least productive, but has caught up since 2008.





Data source: OECD Statistics.

Value added as an output measure

In the following section we will look at sectoral productivity levels. Sectoral data is based on value added at basic prices in each sector (basic prices are the prices received by sellers of goods and services). This section compares productivity measured by GDP per hour worked with value added per hour worked at the macro level. By definition, GDP at market prices is the total sum of gross value added at basic prices plus indirect taxes minus subsidies on products, so the difference between the two statistics reflects differences in the amount of indirect taxes raised in a country (that is, market prices versus basic prices). Since the US raises relatively little revenue from indirect taxes, when the productivity gap is measured in terms of value added instead of GDP, relative Dutch productivity shifts downwards from the about 100% to about 90% of the US level. In general, GDP gives a better measure of the output that is relevant for living standards since households value goods and services from both the market and provided by the government. For example, if a country moved from a consumption tax financed health system to a market based health system with compulsory insurance, households would still enjoy the same amount of health care but gross value added would rise while GDP would remain constant. Hence, when using value added to calculate the productivity gap there is a downward bias. However, the correlation coefficient between the two series is above 0.99. Also, given the level shift, the growth rates are unaffected.





Data source: OECD Statistics.

Total factor productivity (TFP)

For the majority of this document we look at labour productivity per hour worked as our measure of productivity. There are other measures available, such as total factor productivity. Whereas labour productivity measures how much output is produced per unit of labour input, total factor productivity measures how much output is produced given all of the inputs to the production process. Simply investing in more capital will raise labour productivity, since each unit of labour has more capital to work with, but it will not raise TFP. TFP is the portion of output that is not explained by production inputs: that is, it measures how efficiently the inputs are turned into outputs. Figure 2.8 decomposes the growth of value added in the Netherlands into the contributions of all of the underlying factors: labour, capital (IT capital, non-IT capital) and total factor productivity (TFP). Over the whole sample, developments are dominated by the contributions of hours worked and TFP. In contrast, labour composition and capital are minor contributions to output growth. This is also the case for the other economies, such as Germany and the US. The contribution of hours worked is most visible in the period from 1995 to 2000, when many women entered the labour force. Between 2004 and 2007 TFP growth became the most important driver.

Data robustness

In this box, we present an alternative data source: the KLEMS/WIOD Database developed by the Groningen Growth and Development Centre. Both data sources involve PPP correction (based on the current prices). KLEMS/WIOD data is not used in our main analysis, because it stops between 2009 and 2011, depending on the country and statistics in question.

In the main text, value added per hour fluctuated around 0.9. With KLEMS/WIOD it is also true from about 1991. In earlier periods Dutch productivity was slightly higher according to KLEMS/WIOD.

In both datasets the fall in relative productivity from 2008 to 2010 is more than 5%, it is therefore significant.

Figure 2.7 Dutch productivity gap with the US, based on value added per hour worked expressed in current prices PPPs



Data source: OECD, EU KLEMS.





Data source: Conference Board, own calculation.

Furthermore, if we compare TFP growth rates across countries as we do in Figure 2.9, then the productivity slowdown story is not so clear cut. For the Netherlands, Germany and the US fluctuated around about 1% growth per year until 2007. Thereafter, average TFP growth has been lower, but this appears to have been driven by more negative years rather than the whole distribution moving downwards.





Data source: Conference Board.

2.3 Summarising the macro data

In summary, the Netherlands caught up to US productivity levels in 1970s and until 2008 productivity was roughly equal. Afterwards we see a sizeable downward shift of the productivity trend. The Netherlands is not unique in that respect; when we define the benchmark as the five most productive OECD countries excluding Luxembourg and Norway the fall is much less pronounced. Several explanations for the gap with the US have been put forward including labour hoarding, less productive people entering the labour market in Europe, sluggish uptake of ICT in European services and a lack of meaningful supply side reforms in Europe. We can get a deeper understanding of productivity developments by looking at sectoral data, which we do in the following section.

3 Sectoral productivity developments

So far we have discussed the development of productivity at the macroeconomic level. That hides a wide array of different sectoral patterns, which may be potentially informative. In particular, identifying productive and unproductive sectors and their characteristics can provide some guidance for explaining differences at the macro level.

In this section we look at sector level data. We perform our analysis based on annual OECD data for the time period from 1995 to 2014 (or last available data). The sectoral analysis is based on a decomposition into 20 sectors excluding mining and quarrying and the real estate sector because they are characterised by extremely large capital stocks, low employment and value added that depends on volatile prices. Thus, they are clear outliers that blur the picture instead of helping to explain productivity. Robustness checks are performed on the annual KLEMS/WIOD data, which is based on a decomposition into 34 sectors. We also benchmark Dutch sectors with the most productive sectors in the OECD (with the exception of the US and Japan, for which detailed statistics on hours worked are not available – for a comparison with the US and Germany excluding the self-employed see the box on p. 21). The analysis is based on simple techniques such as descriptive statistics and correlations.

3.1 Structural or cyclical?

The wider productivity gap since 2009 with the US has coincided with a much more sluggish recovery in Europe. This suggests that our lacklustre productivity performance may simply be cyclical and the macro productivity gap with the US will disappear with economic recovery. One way to get an idea of how much cyclical issues are behind the macro numbers is to look at sectors with more procyclical productivity since productivity developments are not the same for every sector (Mas, 2012): some sectors display markedly pro-cyclical productivity. For example, sectors producing investment and durable goods are hit harder in recessions than sectors producing basic services, because investment and durable goods purchases can be postponed. Figure 3.1⁵ presents value added per hour worked in 2007 and 2014, a period we characterise as a severe recession and anaemic recovery where procyclical sectors should perform poorly. For the Netherlands, two highly procyclical sectors are manufacturing and retail trade⁶. Nonetheless, as Figure 3.1 shows, productivity in manufacturing was 8% higher in 2014 than in 2007 and productivity in wholesale and retail trade increased by 13%. In contrast, macroeconomic value added per hour worked grew by only 1.4%. Since the most procyclical sectors actually displayed faster productivity growth than the economy as a whole, this suggests that something more than a cyclical phenomenon is at hand.

⁵ For brevity, we use shorter names of the sectors for figures. Full names are presented in the Appendix 5.3.

⁶ The correlation of their growth rates with total value added between 1995 and 2008 are 0.86 and 0.79, respectively.





Data source: OECD Statistics.

Not all sectors saw increases in productivity: labour productivity fell in the electricity and water supply sectors, accommodation and food supply, and other service activities. These sectors have no obvious link to the crisis itself and are much less procyclical than manufacturing.⁷⁸ The sector with the most obvious link, financial services actually saw productivity grow by 17%⁹. This also suggests something more structural is happening.

Figure 3.1 is based on economy wide PPPs. However, this may not be appropriate at the sector level since prices of the goods and services produced by each sector differ. To address this issue, Figure 3.2 depicts value added per hour in each sector, with adjustment based on 15 sectoral PPP exchange rates. These PPPs take 2005 as the base year and have been computed by Inklaar and Timmer (2012). The results are robust to use of PPP exchange rates. Even a visual inspection reveals that the differences between the two statistics are minor and the conclusions are unaltered. The correlation coefficient between Figures 3.1 and 3.2 is 0.98.

⁷ Sectoral productivity data can be more prone to mistakes than aggregate data. However, the statistics we look at here are robust: when comparing OECD data with the KLEMS data for 2007, the correlation coefficient between the two series is 0.97.

⁸ The growth rate correlations are all below 0.6.

⁹ This is driven almost entirely by a 14% fall in hours worked in financial services.



Figure 3.2 Value added per hour worked in the Netherlands, constant sectoral PPPs (2005)

Data source: OECD Statistics, Inklaar and Timmer (2012).

3.2 Thinking about innovation and diffusion of new technology

Structural productivity issues

To guide our thinking about sectoral productivity it is useful to have a theoretical framework in mind. Figure 3.3 shows a representation of the factors driving aggregate productivity growth (adapted from OECD, 2015a). Firstly, innovations and new technology are invented and used by firms at the global frontier¹⁰, which is shown at the top of Figure 3.3. Thereafter, the rate of growth of aggregate productivity depends first on the diffusion of these ideas to the most productive firms in a country: the firms at the national technology frontier. Only once the leading technology has been adapted to suit the unique circumstances in a country by the firms at the national frontier does this technology filter through to the remaining firms in that country: the laggards (see OECD, 2015a, and references therein). Aggregate productivity can increase. This framework, therefore, splits productivity growth into two factors: developments at the frontier and the diffusion of those new ideas to other firms.

¹⁰ Of course, not only firms at the frontier innovate. However, the key idea here is that there are group of firms currently at or near the frontier, or who, due to their innovations will soon be at the frontier, that do a lot of the innovation that takes place. The corollary is that there is a group of firms who mainly copy the innovations of other firms.

Sectors are, of course, made up of firms. So this firm level theoretical framework is also a useful guide to thinking about sectoral productivity. If a country is the most productive for a given sector, productivity growth in that sector will depend more on innovation and developing new technologies since the scope for spillovers and adoption is smaller. In contrast, in lagging sectors there are more laggard firms or the laggards firms are further from the frontier, or both. In that case productivity gains can be more easily made through the adoption of frontier technologies.



Figure 3.3 The process behind aggregate productivity growth

When thinking about diffusion it is often useful to remember that some technology is general in that any firm in any industry can use it, whereas some is sector specific. A good example of the former is something like a spreadsheet for keeping accounts – it is potentially useful for any firm. On the other hand, new engine technology is much more useful to firms in the transport industry than to hairdressers. The more general a technology is the easier it is for laggard firms to adapt it from a different sector. Sector specific technology is clearly important since, as Figures 3.1 and 3.2 show, there are large differences in productivity between sectors, even after excluding mining and the real estate sector.¹¹ For example, the ICT sector is twice as productive as administrative services or construction. Other sectors that exhibit higher productivity are financial and insurance activities, manufacturing, water

¹¹ Differences in average labour productivity per hour can sometimes be hard to interpret since some sectors are capital intensive and some labour intensive: capital intensive production processes will tend to have higher average labour productivity due to the extra capital they have to work with. A similar point can be made about the use of skilled vs unskilled labour in the production process. These difficulties, though, further highlight the importance of sector specific technology: the state of the art technology in some sectors is capital intensive whilst in others it is skilled labour intensive.

supply, R&D and public administration. Trade and the other services are less productive. Due to the importance of sector specific technology, when we compare the productivity of a given sector in the Netherlands to some benchmark, the benchmark we choose will be the most productive of that same sector among all of the countries we have data for.

3.3 Leading and lagging sector developments

The frontier

As Section 2 showed, the Netherlands is a highly productive economy. Figure 3.4 shows sectoral productivity relative to the most productive and the 5th most productive OECD countries in 2013 (excluding the US and Japan¹², for which detailed statistics on hours worked are not available). This is a sectoral version of the dynamic benchmarking we did in Section 2.¹³ In general, countries with high macro productivity consistently have high sectoral productivity. The most productive sectors are found in Belgium, Norway, Denmark, Germany, France and the Netherlands. The Netherlands is in the top five for all sectors: it is even the productivity leader in agriculture and various service activities. However, differences between the countries in the top five are often large. The most productive country for a given sector is often more than 50% more productive from the fifth most productive. How such large sectoral productivity differences can be sustained with competitive markets is a key question. In fact, such wide dispersion is also observed at the firm level within the same sector of a given country (see Syverson, 2004, who reports that within narrowly defined US manufacturing industries the 90th percentile firm is almost twice as productive as the 10th percentile firm).

As the sector data suggests, it should come as no surprise that the Netherlands is in fact home to frontier firms in a number of different sectors. For example, Andrews et al. (2015) show that the Netherlands is home to frontier firms across a wide range of different sectors.

¹² The high macro productivity of the US suggests that excluding the US is likely to mean that we are excluding one of the five most productive countries in each industry from our analysis. That is not the case for excluding Japan. Data from The Conference Board put macro labour productivity in 2015 for both the US and the Netherlands at \$67 per hour, whilst in Japan it is only \$43 per hour. Hence our benchmark can be thought of as a top six.

¹³ OECD data is available for each year between 1994 and 2013. We chose 2013 as representative. Although a comparison to the five most productive countries for a given sector can provide further insight, the analysis should be treated with some caution, as sectoral productivity statistics can be prone to errors and national incomparability. We have shown that ratios of value added to GDP are not equal and differ between the countries. Some other sources may include hedonic pricing and exchange rates.



Figure 3.4 The most productive sectors in 2013 (value added per hour worked, current PPPs)

Data source: OECD Statistics. Lagging sectors

Whilst Dutch sectors are always in the top five, there are also sectors where the Netherlands is behind the frontier. The largest room for productivity improvement can be found in construction, water supply and other service activities. In that case, one thing that can be done to improve productivity is to improve the rate of diffusion of technology.¹⁴ To give us an idea of what could be gained, if all Dutch sectors had productivity equal to the most productive of that sector shown if Figure 3.4, in 2013 total value added would have been 12% higher with the same labour distribution. The next section will cover issues related to the diffusion of technology to laggard firms and the reallocation of resources from laggard firms to more productive firms in more detail.

¹⁴ There may be other factors behind low productivity such as regulation or a lack of competition.

Comparing Europe to the US

On average, European productivity levels are lower than the US, that's why the US is typically used as a benchmark for the sort of analysis we presented in Section 2. However, the analysis in section 2 already showed that the Netherlands had a similar productivity level to the US until the Great Recession. Therefore, other European countries must be significantly less productive to bring the European average down. This box looks at the comparison of Europe to the US in more detail. However, a comparison of European countries to the US is not straightforward since neither OECD nor KLEMS have data for the hours worked by the self-employed in the US for sectoral data.





How big a difference does this make? In the US the self-employed make up about 7% of the workforce according to OECD data. To make the available data comparable we take value added per hour worked for European sectors and we assume that total hours worked of all workers in the US in 7% higher than the total hours worked of employees. For the purposes of the comparison here, assuming that the self-employed are evenly distributed across US sectors is a reasonable approximation. As reported in Hipple (2010), the share of self-employed in US manufacturing is lower than 7%, but the share in construction is higher. Likewise, some service sectors have more than 7% self-employment and some less, so assuming an even share isn't a bad approximation. A comparison of European countries with the US for labour productivity in industry and services is shown in the Figure 3.5 for 2013. European countries trail US productivity in both industry and services – and Southern European countries are especially far behind. This contrasts with Duarte and Restuccia (2010) and Mas (2012) who argued that the difference between productivity in the US and Europe was due to services, rather than manufacturing or agriculture. The difference between these studies and the results presented here can be explained by the continued growth of labour productivity in the US during the Great Recession.

Data source: OECD Statistics.

3.4 Productivity growth

Productivity growth is a dynamic concept since it concerns changes over time. This section will focus on the dynamic aspects of sectoral productivity in the Netherlands. Since sectoral level data does not exactly pinpoint where the global frontier firms in the Netherlands are, we will restrict our analysis to the processes shown in the bottom half of Figure 3.3: the diffusion of existing technologies.

OECD (2015a) argue that three key factors enhance the diffusion of new technology: i) openness to trade; ii) reallocation of resources and the potential for up-scaling; and iii) investment in knowledge based capital. The following sections take a look at these factors in the Netherlands.

Reallocation

One of the key elements of up-scaling is allowing firms that are more productive to be able to employ resources required for their growth (OECD, 2015a). Productivity-enhancing reallocation means that high productivity firms expand and low productivity firms shrink or exit. Similarly, young companies either become productive and grow or stop existing. A detailed analysis of these issues requires firm-level data. Instead this section presents a shiftshare analysis using sector level data. Since aggregate productivity is a weighted average of industry-level productivity, where the weights are shares of industry employment in total employment, the growth rate of aggregate productivity depends not only on the productivity growth rate of each sector but also the changes in allocation of labour between the sectors. The shift-share analysis presented in this section decomposes the growth rate of productivity into three components: the growth rate of the industries (so-called within effect), which assumes that the labour composition is fixed; a reallocation effect (so-called shift effect or static shift) that measures changes in productivity due to the reallocation of labour between the industries and a residual (dynamic shift, interaction or cross-term effect) that measures the interaction between the within-industry and shift-effect. Algebraically, it holds that:

Productivity growth rate = within-industry effect + shift-effect + cross-term effect

Table 3.1 shows a productivity growth decomposition for the Netherlands and Germany. In the Netherlands and Germany, as in most countries, productivity growth is dominated by the within effect, i.e. productivity growth within sectors and not reallocation of labour (see, for example, OECD, 2014, who find that the within effect dominates for most countries). We further observe that in both periods and for both countries, the within effect was larger than overall productivity growth. If there was no structural change, i.e. the structure of the economy would have remained fixed,¹⁵ Dutch productivity growth would have been somewhat higher than observed. That implies that labour reallocates from highly

¹⁵ In other words, there would be no changes in the sectoral employment shares.

productive sectors to less productive sectors. For example, they move from manufacturing to services. The cross-effect (or the interaction effect) is usually negative (OECD, 2014). In other words, productivity growth is more positive in industries where the labour share is contracting (such as agriculture) and less positive in expanding industries (such as services).¹⁶

	The Netherlands 2000-2007	2007-2014	Germany 2000-2007	2007-2014
Productivity growth	5,03	2,12	4,60	2,69
Within effect	5,34	2,09	4,51	2,87
Shift effect	-0,23	0,04	0,11	-0,15
Cross effect	-0,07	-0,03	-0,02	0,01
Data source: OECD Statistics, own calculations.				

Table 3.1Productivity growth decomposition: shift-share analysis.

These results can be sensitive to the choice of cut-off points. Therefore, we perform this analysis for the one year periods, i.e. from 1995 to 1996, 1996 to 1997 etc. Effectively, we create a time series of the growth decomposition. The results are depicted in Figure 3.6. In the Netherlands, the shift effect is negative for all years except 1998, 2002, 2009-2010, 2013. The last of these three were recessions. That implies that during recessions the structural change effect reallocates labour from less productive to more productive sectors. This favourable restructuring does not continue when the economy is in the recovery or expansion phase.¹⁷

¹⁶ Research into global value chains shows that the output of manufacturing sectors embodies a significant component of service inputs. (see, for example, Lanz and Maurer, 2015). This may weaken the general finding that productivity in services is lower than in manufacturing somewhat, since the service component of manufacturing may be responsible for some of the productivity growth of manufacturing.

¹⁷ For the Netherlands we have performed a similar analysis for 61 ISIC rev 4 sectors instead of the 20 sectors used in the baseline analysis and the overall results are very similar: total productivity growth is dominated by the within effect and the shift effect is negative in most years. As with the baseline analysis the shift effect is positive in 2009 and 2013. Interestingly, if we look at manufacturing and services separately, the shift effect for manufacturing is marginally positive on average, which indicates that labour is leaving the least productive manufacturing sectors. Also, in contrast to the effect in the economy as a whole and in services, the shift effect for manufacturing was negative in 2009, the only year since 2008 where it was not positive. Still, to really take a detailed look at reallocation would require this to be repeated on firm-level data.





Data source: OECD Statistics.

The cyclical pattern of labour reallocation is far from universal. Figure 3.7 shows an international comparison of shift effects. The first striking observation is that in the Netherlands and Belgium the shift effect is rarely positive indicating that there is less productivity enhancing labour reallocation between the sectors than in Germany, France or Denmark. Second, the timing of the shift effects is largely uncorrelated across countries despite EU countries having correlated business cycles. However, in the recessions following the fall of Lehman Brothers the shift effect peaked in the three smaller economies.





Data source: OECD Statistics.

In summary, we observe that reallocation of labour does not enhance productivity. This is because both levels and growth rates of productivity in service sectors are lower. Therefore, increasing the productivity of service sectors is an international challenge. What is peculiar for the Netherlands is the fact that productivity-enhancing reallocations occur during crises. Why Dutch workers only move to more productive sectors during recessions, whereas workers in other countries move in other periods to more productive sectors is an interesting question.

Which sectors are displaying the fastest productivity growth?

Figure 3.8 shows the productivity growth of sectors from 2007 to 2014 ordered by their distance to the frontier in 2007. The sectors furthest from the frontier are on the left and those closest to the frontier are on the right. In fact, the last four sectors were the most productive sectors in 2007. Figure 3.8 clearly shows that aggregate productivity growth has been driven more by sectors closer to or at the frontier. The correlation coefficient between the productivity gap in 2007 and the growth of productivity within that sector until 2014 is 0.44. It is statistically significant at the 10% significance level. Instead of catching up, those sectors furthest from the frontier have often become less productive. In the other countries these correlations are also positive but they are lower and not statistically significant (see Table 3.2). The finding that already productive sectors have grown the fastest is consistent with OECD (2015a) who report that productivity growth in frontier firms has remained robust – the aggregate productivity slowdown has been caused by a breakdown in diffusion of technology to less productive firms. The puzzle is why this is so much stronger in the Netherlands.





Data source: OECD Statistics.

Table 3.2Correlation between the productivity growth and gap (on current price PPPs) with the
most productive sector (p-values in parentheses)

Country	Correlation coefficient
Netherlands	0.57* (0.04)
Belgium	0.31 <i>(0.21)</i>
Denmark	0.15 (0.55)
Germany	0.18 <i>(0.49)</i>
France	0.24 (0.33) – based on 2013 data

Openness

The Netherlands is an open economy, so trade openness is especially important for the growth of the firms. As the effective market size grows, both firms' size and their investment decisions are affected. More trade openness translates into more product market competition and productivity-enhancing reallocation (Melitz and Trefler, 2012). According to Saia et al. (2015), the Dutch economy scores highly on trade openness, which provides a channel for knowledge transfers and catching-up possibilities. However, they also report an indicator for how much domestic firms trade with frontier firms, which facilitates the adoption of technologies developed by those frontier firms. On this indicator the Netherlands is the second worst performer after Austria.

Figure 3.9 is based on the EU-KLEMS input-output tables. It presents the ratio of exports to value added by sector in 2007. Both agriculture and manufacturing export more than half of their production. Naturally, as services are less tradable, significantly smaller proportion of their value added is traded abroad. That may imply that there are more obstacles to knowledge transfer in services and that further integration of the services market in the EU would speed diffusion of the latest technology (see also Gelauff et al., 2014).



Figure 3.9: Proportion of exported value added in 2007, current prices

Data source: EU KLEMS/WIOD.

Investment in knowledge-based capital

Textbook macroeconomic theory doesn't distinguish between types of capital: all output that is used to increase consumption possibilities tomorrow is considered investment. However, when measuring investment it isn't always obvious where to draw the line between what is investment and what is not. Traditionally that means that measures of investment and capital have been dominated by tangible capital, in large part because it is easier to measure. Recent attempts have seen statistical agencies have seen improvements in measures of intangible capital, especially for some components such as R&D, but systematic data on intangible investment (also referred to as knowledge-based capital) are scarce.

Investment in knowledge-based capital, such as management training, R&D or investment in organisational capital, may be particularly important for improving productivity since it is often directly related with how to combine the traditional factors of production in new or better ways. This is especially true for advanced countries that are capable of producing global leaders, since global leaders need to rely on innovation or to adopt new technology from other leading firms to keep producing more efficiently.

Despite the relative scarcity of data on intangible investment there are some estimates. This section relies heavily on the estimates OECD (2015b), Corrado et al. (2012) and Saia et al. (2015). Figure 3.10 presents tangible and intangible investments in year 2013 based on OECD (2015b). When compared to the other developed economies, the Netherlands invests relatively little in machinery and equipment, but about average intangibles. Investment in intangibles is about 11% of gross value added in the Netherlands, which is similar to

Germany and France, more than in Southern Europe (about 6-7%) but significantly less than in Belgium, the UK, the US and Sweden (more than 14%). This pattern is present in the other studies as well. Corrado et al. (2012) shows that before the crisis the Netherlands had less investment in intangibles than the UK, the US and Sweden, but a lot more than Southern European countries. Furthermore, Saia et al. (2015) rate the Netherlands in the top countries in terms of managerial quality and business R&D, which are indicators of knowledge-based capital.





Source of data: OECD calculations.

We can see a similar story if we look at the contribution of tangible and intangible investment to labour productivity growth in 1995-2007, which is shown in Figure 3.11 based on data from Corrado et al. (2012). Once again the Netherlands is about average, with investment in intangible capital contributing 0.5%-points per year to labour productivity growth. This is less than a number of countries where investment in intangibles contributed 0.7-0.8%-points per year, but more than in Southern Europe where it was only 2-3%-points per year.





Source of data: Corrado et al. (2012).

Given the scarcity of data on intangible investment, a much narrower alternative is to look at R&D data. In general, Dutch R&D expenditures are below other European countries. They are also significantly lower than spending in Germany or the US. Figure 3.12 presents the share of R&D expenditures in the value added of selected sectors in the Netherlands, Germany and the US. Manufacturing has by far the highest share of R&D. In 2013 total R&D expenditures were lower in the Netherlands than in both Germany and the US. As Figure 3.12 shows, this is mainly a consequence of low R&D expenditures in manufacturing and information and communication sectors, which are also the sectors that do the most R&D. Dutch manufacturers invested 7% of their value added compared to a little over 10% in Germany more than 11% in the US. The ICT sector in both the Netherlands and Germany did less R&D than in the US.



Figure 3.12: Share of R&D expenditures in value added in selected sectors, 2013

Data source: OECD Statistics.

Summarising the sectoral data

In summary, all Dutch sectors are among the top five most productive in the OECD dataset we are using. However, being in the top five hides a lot of detail: often the most productive country for a given sector is more than 50% more productive than the fifth most productive. If all Dutch sectors were as productive as the most productive of that sector in the OECD (excluding the US and Japan) then total value added in the Netherlands would be about 12% higher. When looking for why some sectors don't adopt technology from that sector in other countries, we looked at three factors: openness, the ability to reallocate resources and investment in knowledge based capital. Whilst the sector level data supports some of the conclusions from the literature, to really get to the bottom of what is happening requires firm level data.

4 Summary and further research

This document has taken a broad look at productivity developments in the Netherlands and placed them in international context. At the macro level we identified the widening productivity gap with the US since 2009 and the slowdown of productivity growth in developed countries as the most important developments of recent years. Notwithstanding this slowdown, the Netherlands is still one of the most productive economies. We also looked at sector data, where Dutch sectors are always in the top five most productive of the OECD countries (excluding the US and Japan), and noted the significant differences in productivity across countries for a given sector. The statistics presented in this document do not point to clear causes of these observations.

At the macro level, this document has highlighted a number of key questions. How long will the recent slowdown in productivity growth in the developed world last and why is it occurring? Will European countries make good the increased productivity gap relative to the US that has developed since the Great Recession? How extensively will the effects of the productivity slowdown be felt in the Netherlands?

Key questions at the sector level also deserve further investigation. First, when we decomposed productivity growth we still found that the vast majority of productivity growth was hidden within the sectors as opposed to resulting from resource allocation across sectors. The productivity enhancing reallocation that did take place between Dutch sectors happened almost exclusively in recessions; in other countries there was more reallocation across sectors outside recessions. This naturally highlights two questions: what drives productivity growth within sectors and why does the Netherlands have less reallocation across sectors in normal times? Second, a recent finding from firm level data (OECD, 2015a) is that whilst frontier firms are still showing robust productivity growth, the aggregate productivity slowdown is due to lagging firms falling further behind. In this document we looked at this issue at the sector level. In the Netherlands, the sectors that are the most productive in the OECD for that sector have been growing faster than the sectors where the Netherlands is behind the frontier. Moreover, although this observation can be made for other countries too, the excess productivity growth of leading Dutch sectors relative to the average Dutch sector is bigger than in the other countries we compared. Is this phenomenon likely to continue and is there a way that the Dutch economy can benefit more from the productivity growth of its frontier sectors and firms? Useful insights into these issues might be gained from looking at firm level data.

5 Appendices

5.1 Current versus constant prices PPPs for productivity comparisons

This appendix compares two methods for removing the effects of nominal inflation from measures of economic activity. Constant prices are best for tracking changes in production over time within one country, whilst current price PPPs are best for comparing countries with each other.

The problem is that current economic data measured in current prices mix real changes over time with the effects of nominal inflation – i.e. the units used to measure prices change because money loses value. This makes it unsuitable for comparing the actual quantity of goods and services someone can buy over time. To make a comparison across time we need to strip out the effects of nominal inflation. This appendix describes two ways of doing this: using constant price PPPs or current price PPPs. In this box we will focus on GDP instead of productivity for simplicity – in any case, productivity is simply an output measure divided by an input measure (such as the number of people employed) and the issue of how to remove the effects of nominal inflation only concerns the output measure.

For single country analysis the standard method for doing this is to use constant prices – that is, pick a base year, hold those prices constant and only track the changes in the quantities of goods and services produced. Effectively this is using a basket of goods and services in the same country from a previous year. To compare this measure of output with output in a second country the volume of output is converted using the PPP exchange rate in the base year. This method keeps track of how much you produce – however, the down side of this approach is that any real (relative) price changes are ignored. The equation is shown below:

$$Constant_PPP_GDP_t = \frac{Volume_GDP_t}{PPP_{year=base}} = \frac{\frac{Nominal_GDP_t}{GDP_Deflator_t}}{PPP_{year=base}}$$

If we do the same for our benchmark country (the US) we get:

$$US_Constant_PPP_GDP_t = \frac{US_Volume_GDP_t}{US_PPP_{year=base}} = \frac{\frac{US_Nominal_GDP_t}{US_GDP_Deflator_t}}{US_PPP_{year=base}} = \frac{US_Nominal_GDP_t}{US_GDP_Deflator_t}$$

since the PPP exchange for the US with itself is 1. If we want to compare our output to that of the benchmark country we divide one by the other, which gives us:

$$\frac{Constant_PPP_GDP_t}{US_Constant_PPP_GDP_t} = \frac{\left(\frac{Nominal_GDP_t}{US_Nominal_GDP_t}\right)}{\left(\frac{GDP_Deflator_t}{US_GDP_Deflator_t}\right)}$$

$$\frac{PPP_{year=base}$$

However, when our focus is on a cross-country comparison there is another option for stripping out the effects of nominal inflation. That option is to use a basket of goods and services from a second country and see how many of that basket the production in the home country can purchase. By comparing the ratio of current PPP nominal output measures we also strip out nominal inflation. The result is how many multiples of the second country's output is produced in the first country. In other words: how many times could you buy the output of the second country using the output of the first country. This method does not track the volume of the things produced but the real value of production and, hence, living standards.

$$Current_PPP_GDP_t = \frac{Nominal_GDP_t}{PPP_{year=t}}$$

Once again, for comparing the two countries we divide one output measure by the other:

$$\frac{Current_PPP_GDP_t}{US_Current_PPP_GDP_t} = \frac{\left(\frac{Nominal_GDP_t}{US_Nominal_GDP_t}\right)}{PPP_{year=t}}$$

As can be seen from comparing the two equations the difference between the two measures is how well the ratio of GDP deflators tracks the changes in the PPP exchange rate. When making a cross-country comparison we are directly interested in converting output measured in one currency with output measured in another. The direct and best way to do that is to use the current PPP exchange rate. In contrast, since different types of output are produced in each country the GDP deflator baskets will differ for each country too. GDP deflators are less comparable due to different techniques being used: Van Ark (2004) points out that US productivity seems to be inflated compared to the EU15 due to, for example, the hedonic pricing of IT products and the classification of IT as an investment versus an intermediate input. Therefore the ratio of the two countries' GDP deflators is only a proxy for what we really want to know, which is the current PPP exchange rate.

For the Netherlands, current and constant price PPPs tell different stories before 2008. Productivity measured with current prices PPPs fluctuates around the level of the US, whilst productivity measured at constant prices follows a downward trend. This is driven entirely by the ratio of the GDP deflators evolving differently from the PPP exchange rate. From 2008 onwards, both series tell a very similar story – our productivity has fallen relative to the US and remained lower.



Figure 5.1 **Productivity gap in current versus constant PPPs**

Data source: OECD Statistics.

5.2 Shift share analysis

Aggregate productivity is a result of the aggregation on the industry-level, as described by the formula:

$$P = \sum_{i=1}^{N} P_i$$

Alternatively, the aggregate productivity is a weighted average of industry-level productivity, where weights are shares of industry employment in total employment. Thus, the growth rate of productivity is determined not only by the growth rate of each given sector, but also by the changes in allocation of labour between the sectors. Algebraically, it holds that:

Productivity growth rate = within-industry effect + shift-effect + cross-term effect

In mathematical terms:

$$\frac{P_t - P_{t-1}}{P_{t-1}} = \sum_{i=1}^N \frac{P_{i,t} - P_{i,t-1}}{P_{i,t-1}} * \frac{Y_{i,t-1}}{Y_{t-1}} + \sum_{i=1}^N \frac{P_{i,t-1}}{P_{t-1}} * (\frac{H_{i,t}}{H_t} - \frac{H_{i,t-1}}{H_{t-1}}) + \sum_{i=1}^N \frac{1}{P_{t-1}} * (P_{i,t} - P_{i,t-1}) * (\frac{H_{i,t}}{H_t} - \frac{H_{i,t-1}}{H_{t-1}})$$

Where productivity is defined as:

$$P = \frac{Y}{H}$$

5.3 Sectoral abbreviations – as used on the text (graphs)

Abbreviation (as used in the text)	Full name
Agriculture,	Agriculture, forestry and fishing
Manufacturing	Manufacturing
Electricity and gas	Electricity, gas, steam and air conditioning supply
Water supply	Water supply, sewerage, waste management and remediation activities
Construction	Construction
Trade	Wholesale and retail trade, repair of motor vehicles and motorcycles
Transport	Transportation and storage
Accomodation and food	Accommodation and food service activities
ICT	Information and communication
Finance and insurance	Financial and insurance activities
Professional activities	Professional, scientific and technical activities
Administrative services	Administrative and support service activities
Public administration	Public administration and defence, compulsory social security
Education	Education
Health	Human health and social work activities
Arts	Arts, entertainment and recreation
Other services	Other service activities
Households as employers	Act. of HH as employers, undif. G&S-producing activities of HH

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