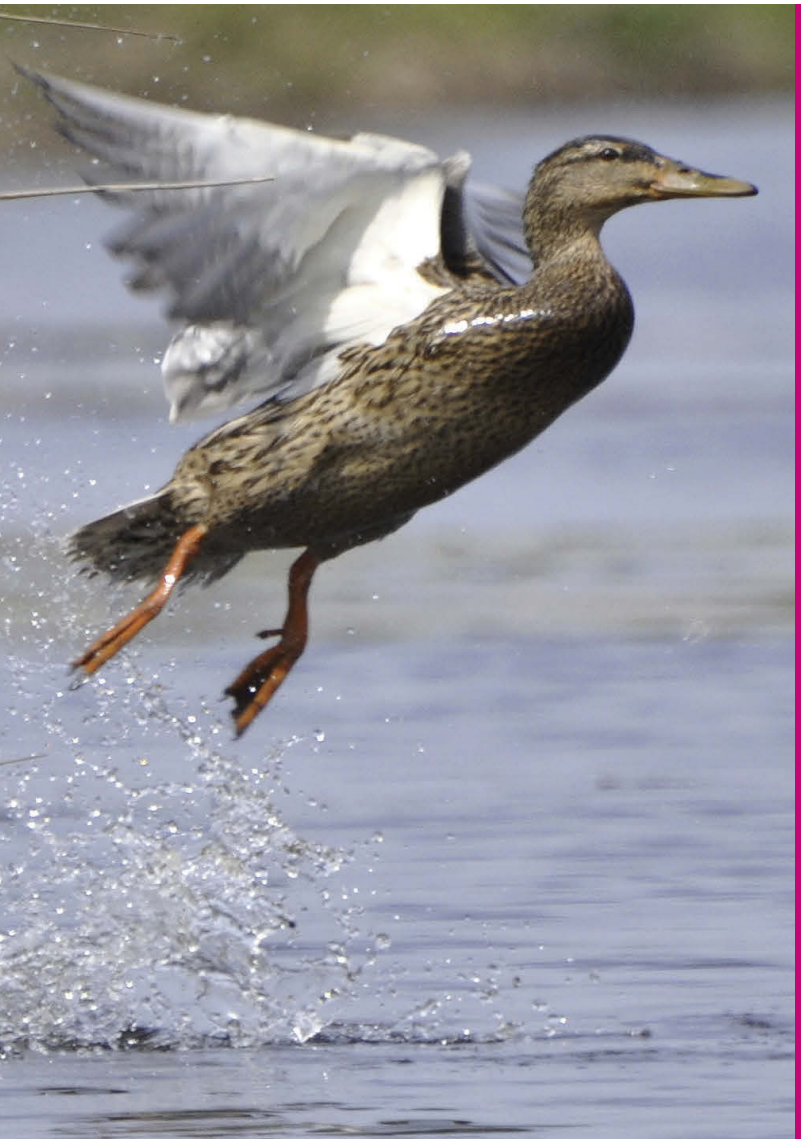
CPB Netherlands Bureau for Economic Policy Analysis

Uncertain supply | *Fragile demand*



Roads to recovery

Chapter 4

Productivity after the Great Recession

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4 Productivity after the Great Recession

Bert Smid, Adam Elbourne and Rob Luginbuhl

- Dutch labour productivity declined 3.5% in just three quarters after the onset of the Great Recession and there has been no rapid recovery since.
- On average, banking crises are associated with large, permanent declines in productivity relative to the previous trend.
- There is no evidence that banking crises have a long-run effect on the growth rate of productivity.

4.1 Introduction

Gross domestic product (GDP) is the product of total hours worked and the value added per hour worked, or labour productivity. Put differently, GDP can be increased by working more hours or by producing more output per hour. It is the latter which is important for our long-run living standards. That is because long-run developments in wages are driven by improvements in labour productivity. Labour productivity itself is a function of the capital intensity, the amount of capital each worker has available, and total factor productivity, or TFP. Growth in TFP is the part of productivity growth that is not due to increases in factor inputs (e.g. more physical capital or better educated workers). For a given size of the labour force and capital stock, a higher level of TFP results in a higher level of output.

The link between productivity and living standards is, in the current circumstances, cause for concern, because labour productivity in the Netherlands declined 3.5% in just three quarters after the onset of the Great Recession. As with the long lasting impact on GDP shown in Chapter 1, there has been no rapid recovery in labour productivity: four years after the trough the level of productivity was still below its pre-crisis level and the average growth rate has been less than 1%, much lower than before the crisis.

How can the substantial fall in labour productivity and subsequent slow recovery be explained? Which mechanisms are behind the fall and will there be a permanent loss of labour productivity? These issues are discussed in this chapter. In the next section we describe in more detail the recent developments in Dutch productivity, capital intensity and TFP, all three of which have fallen significantly below their pre-crisis trend. We review the empirical literature that investigates the effects of financial crises on labour productivity and then discuss a number of mechanisms that may account for the productivity declines since the start of the Great Recession. We then turn our attention to the possibility that the long-run growth rates of these three variables may be declining, as some have recently argued in

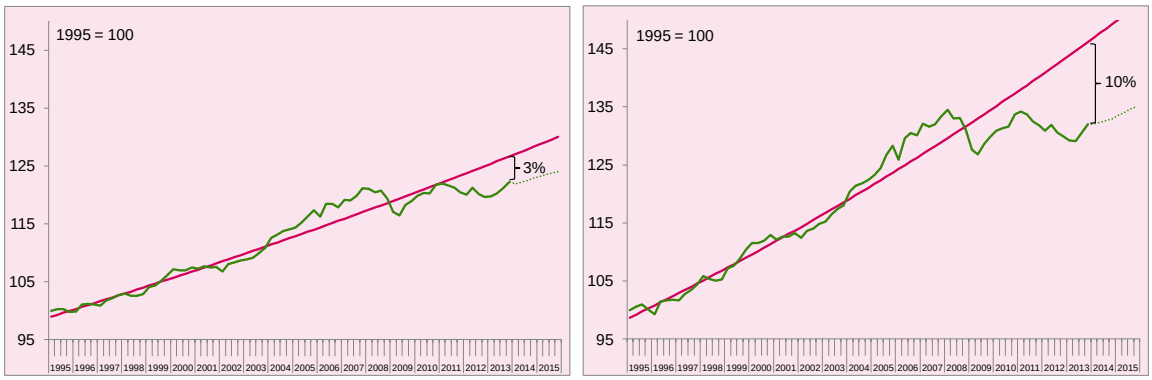
the literature. Finally, this chapter concludes by describing three paths for each of labour productivity, capital intensity and TFP, which give an indication of the possible developments in productivity over the coming ten years.

4.2 Dutch labour productivity and the Great Recession

As introduced above, labour productivity can be decomposed into TFP, the quality of labour inputs and capital intensity. This section will first discuss recent developments in measures of labour productivity and TFP, before turning our attention to investment, which is the key factor behind the level of capital intensity in an economy. Finally, this section takes a look at productivity developments across the different sectors of the Dutch economy.

For advanced countries that are close to the technology frontier, the average growth rate of labour productivity over longer periods has been between 1.5 and 2.5% annually.[29] There can be substantial cyclical fluctuations around the average growth rate, however, because labour productivity declines in a typical recession. Compared to the magnitude of typical fluctuations, the onset of the Great Recession coincided with exceptional declines: labour productivity in the Netherlands declined 3.5% in just 3 quarters. In the market sector, the decline was even bigger at 4.7%.

Figure 4.1 Labour productivity total economy (left) and market sector below pre-crisis trend



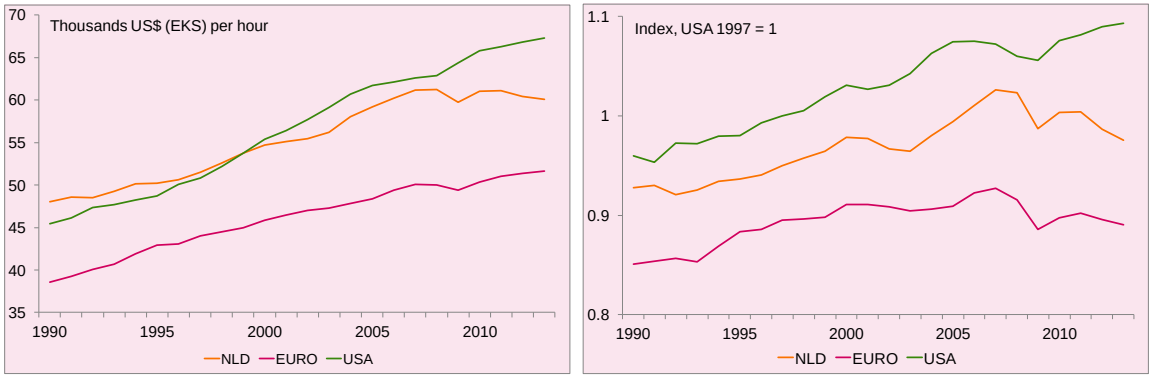
Index of labour productivity per fte, 1995.1 = 100. The trend is based on the period 1995-2004, the 10-year period that ends three years before the onset of the crisis. The dotted lines are CEP 2014 forecasts.

Figure 4.1 compares labour productivity in the total economy (left) and in the market sector (right) to a trend for 1995-2004.[30] By the end of 2013, the difference between observed productivity and the pre-crisis trend had accumulated to 10% for the market sector, which is substantial. For the whole economy the difference was smaller at 3%.[31] The size of these

[29] See Smid (2005) for an overview of growth rates of labour productivity since 1870 in advanced countries.
[30] This is the pre-crisis trend based on the ten-year period ending three years before the onset of the crisis, using the same method as in IMF (2009).
[31] The difference is lower in the total economy, mainly due to an increase in growth of the labour productivity in the health care sector since 2004. The pre-crisis trend in the health care sector is downward sloping i.e. labour productivity was actually falling in the health care sector before 2004. It is implausible that the recent increase in productivity growth is related to the credit crisis.

deviations from trend depends critically on the time period chosen for calculating the trend. For example, if we calculate the pre-crisis trend over 1998-2007, the loss for the whole economy in 2013 is 8%.

Figure 4.2 Dutch labour productivity falls behind United States (left), TFP gap widens



Source: Total Economy Database, GGDC-paper benchmark level TFP 1997.

The Netherlands is not the only country to have experienced falling productivity levels since the onset of the crisis. Figure 4.2 puts Dutch productivity in an international context by comparing recent developments to those in the United States and the euro area, where TFP has also fallen. The level of Dutch labour productivity is high and followed the level of the United States until the onset of the crisis. Whereas productivity in the United States subsequently continued to grow, Dutch productivity is still below its 2007 level. A similar pattern is visible in the level of TFP: according to data from The Conference Board, Dutch TFP is 5% lower than its peak in 2007. That is similar to that of the euro area as a whole, which has fallen 4%. However, in contrast to the Netherlands, the euro area started in 1990 at a significantly lower productivity level than the United States. Moreover, over the period 1990-2007, Figure 4.2 shows that the euro area as a whole did not catch up with the productivity level of the United States.

Statistics Netherlands also publish a decomposition of changes in value added in the Growth Accounts, as shown in Table 4.1. The table confirms that the larger part of the decrease in value added since the crisis was due to multifactor productivity, which is a similar concept to TFP.[32] Out of a total decline in output from 2008 to 2012 of -2.7%, declining multifactor productivity accounted for -1.9% points of the fall. In fact, annual growth of multifactor productivity was fully 2% points lower than the average from before the crisis. Besides multifactor productivity, labour also contributed to the decline.

In contrast, the contribution of capital was positive at an average annual contribution of 0.1%. However, this was still significantly lower than in the pre-crisis period when annual growth in the capital stock contributed 0.7% points to value added. The lower contribution of capital is, of course, the result of lower investment during the Great Recession, as described in Chapter 1. A large part of that fall can be explained by investment in dwellings,

[32] Statistics Netherlands do not adjust labour inputs for composition effects, e.g. due to education. Therefore increases in educational attainment are part of multifactor productivity growth. Apart from this, multifactor productivity resembles TFP.

which has declined substantially since the onset of the crisis and will be treated in more detail in Chapter 3.

Difficulties in measuring productivity

Labour productivity (value added or GDP (Y) per hour worked (L)) depends on total factor productivity (A), labour quality (Q) and capital intensity (K/L). Total value added is

$$Y = AF(L \cdot Q, K)$$

where $F()$ is the production function.In growth accounting exercises, in general, constant returns to scale and perfect competitive factor markets are assumed. In that case, it is possible to write

$$\Delta \ln\left(\frac{Y}{L}\right) = \Delta \ln A + v_l \Delta \ln Q + v_k \Delta \ln\left(\frac{K}{L}\right)$$

This equation decomposes labour productivity growth into the contribution of total factor productivity (TFP or $\Delta \ln A$), the contribution of the quality of labour and the contribution of capital intensity.[a] Statistics Netherlands do not separate the effect of the quality of the labour inputs, their multifactor productivity is the sum of total factor productivity and the contribution of the quality of labour.

In practice it is difficult to measure these variables. Labour productivity should be measured per hour worked. During recessions employers will tend to cut overtime and may even practice labour hoarding: temporarily keeping workers idle either because it is too expensive to fire them, or because employers may anticipate that the workers will soon be needed when economic conditions improve. When labour hoarding occurs, measured labour productivity will decline because there are workers standing idle not producing, even though they are officially continuing to work the same number of hours. During an economic boom, the opposite may occur.

Capital intensity is difficult to measure primarily because the level of the capital stock is not generally directly measured. Instead the capital stock is typically a constructed by cumulating investment in capital over time, while also allowing for the depreciation in the capital stock each period. The rate of depreciation in the capital stock is itself uncertain. It is generally thought to vary over the various types of capital, and there is little consensus about the correct rate for any of these types. Even if we had an accurate measure of the capital stock, this measure would still be subject to variable capital utilisation: during recessions an increased fraction of the capital stock stands idle, not producing anything due to insufficient demand.

In general total factor productivity (TFP) is the most difficult to measure accurately. This is due to the fact that it is obtained as the residual in the equation above. Once we 'know' labour productivity Y/L and capital intensity K/L and make an assumption about $f()$ it is possible to calculate A. This means that measurement errors in the other variables will also influence TFP. This residual is also dependent on the functional form of the production function assumed, and on whether other factors have been taken into account such as a correcting for capacity utilization or the level of human capital in the labour force.

TFP is also strongly influenced by the business cycle. Once the raw residual has been calculated the HP filter is typically used to remove the business cycle, leaving the trend. Filtering, however, only diminishes the extent to which the business cycle affects the trend, but cannot eliminate it. This is particularly the case at the end of the sample period when the HP filter is less effective at distinguishing between changes in the trend and temporary changes due to the business cycle.

[a] See The Conference board (2014) for a useful methodological note on measuring TFP.

Investment in dwellings will have an effect on the production of the construction sector, but not on the productivity of the market sector, which depends on investment in productive machinery. However, as Figure 4.3 shows, investment excluding dwellings also declined (and also relative to GDP) in the Great Recession, which has resulted in the capital stock growing

at a slower rate than before the crisis. Nonetheless, according to Statistics Netherlands the net contribution to growth was still positive in 2009-2012.

Table 4.1 Decomposition of lower level of value added of the commercial sector

	Level 2012 vs. level 2008 in %	Annual growth 1996-2008 % per year	Annual growth 2009-2012 % per year
Value added commercial sector	- 2.7	3.1	- 0.7
Contribution of			
Labour	- 1.1	0.9	- 0.3
Capital	0.4	0.7	0.1
Multifactor productivity	- 1.9	1.5	- 0.5

Source: Statistics Netherlands. The commercial sector roughly equals the market sector plus mining and the health-care sector.

The ratio of investment to gross value added has decreased since 2000.[33] This is mainly driven by lower relative prices of capital goods, especially of ICT, although this effect has diminished somewhat recently. Figure 4.3 shows the ratio of investment to gross value added since 1969. From 1974 onwards the ratio remains reasonably constant: there does not seem to be a declining trend. However, since 2002, the ratio has been below the long-term average. It may be that the ratio (excluding dwellings) will stabilise at a level lower than the average over the last 40 years. In addition, investment in dwellings has decreased substantially since the start of the Great Recession.

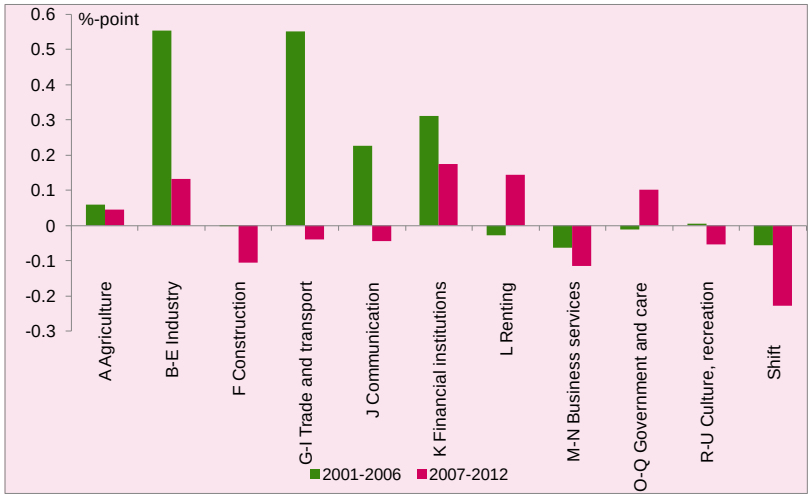
The ratio of investment to gross value added also fell in the Great Recession. However, investment is procyclical and more volatile than GDP, which implies that the investment-output ratio falls in recessions. In the Great Recession it is not clear if the fall was due to lower aggregate demand reducing the demand for investment or credit restrictions reducing the supply of funding for investment projects. As Chapter 2 showed, there is evidence that credit restrictions are real and that SMEs have had difficulties obtaining credit because of problems within the banking system. However, as Figure 4.3 shows, the fall in the investment-output ratio during the great recession is no larger than the fall during the economic slowdown in the early 1990s. In contrast, one would expect *a priori* that investment, which is often dependent on external finance, would be harder hit following a banking crisis than in a typical economic slowdown. Unfortunately, we don't have a counterfactual for what would have happened to the investment-output ratio in such a recession without problems in the banking system - it could have been that it would have risen back towards its long-run average. Therefore, it is difficult to explain the macro level investment data, which remains a puzzle.

[33] See the box "Wat bepaalt de sterke daling van de Nederlandse investeringsquote?" in CPB (2014), p. 41.

Figure 4.3 Nominal investment to gross value added ratio (left) and real investment by firms (right)

Which sectors of the economy were behind the productivity slowdown in the Great Recession? The average productivity growth of the total economy was 1.6% per year in 2001-2006 but only 0% in 2007-2012. Figure 4.4 decomposes these total growth rates into the contribution of different sectors.[34] Except for renting of dwellings and government and health care, all sectors contributed to lower productivity growth in 2007-2012. The effect was largest in the manufacturing sector, which had a 0.4%-point lower contribution, and the wholesale and retail trade sector with a 0.6%-point lower contribution.

Figure 4.4 Contributions to labour-productivity growth by sectors, 2001-2012



In summary, during the Great Recession, there was a large decrease in labour productivity and slow growth in the years after the crisis. In the market sector, labour productivity is now about 10% below the pre-crisis trend and the stalled productivity growth is widely spread across sectors.

[34] The figure shows the results of a shift-share analysis that decomposes the total growth into two parts. The first part is the contribution of a sector to total productivity growth. This is the productivity growth multiplied by the employment share of the sector, assuming a constant employment share of the sector. The second part is the composition effect of changes in employment across the sectors.

4.3 Empirical analyses of productivity losses in financial crises

The previous section described the substantial decline in Dutch productivity levels since the start of the Great Recession; this section places those declines in context by comparing them with other financial crises. There is, in fact, a considerable literature that examines the effects of financial crises on macroeconomic performance. The majority of these studies focus on the consequences for GDP, which is only a rough proxy for what happens to labour productivity. A clear result that arises from this literature is that, as introduced in Chapter 1, financial crises are not ordinary recessions — they tend to cause large, permanent falls in the levels of both GDP and productivity, without affecting growth rates permanently. The main findings of selected papers are shown in Table 4.2.

Table 4.2 Effect of banking crises on macroeconomic aggregates

	Variable	Sample	Effect
Reinhart and Rogoff (2009)	GDP	14 banking crises	9.3% peak-to-trough
Cerra and Saxena (2008)	GDP	Industrialised countries	6% permanent loss
Teulings and Zubanov (2013)	GDP	54 non-African countries	6% fall after 9-10 years
IMF (2009)	GDP	88 banking crises	10% fall after 7 years
Abiad *et al.* (2009)	TFP	27 banking crises	5% fall after 1 year
Oulton and Sebsatiá-Barriel (2013)	Labour productivity	61 countries	About 1% permanent loss

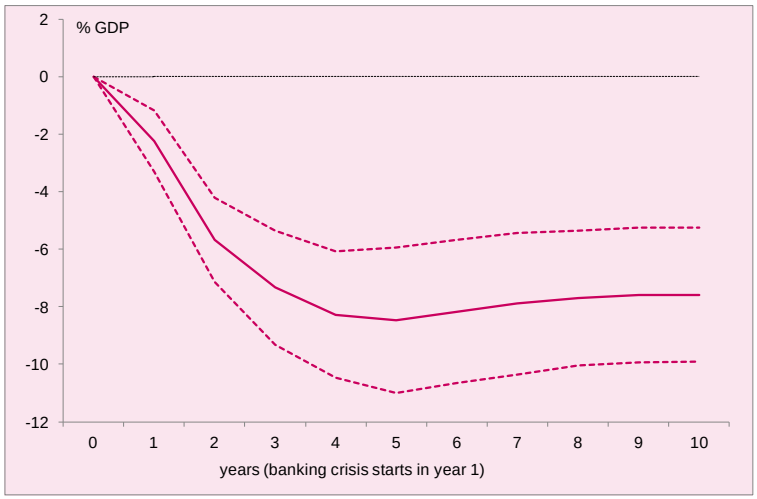
Reinhart and Rogoff (2009) look at fourteen major banking crises and find that banking crises cause deep, long recessions. Further analysis in CEP (2009) showed that for these fourteen cases the average growth rate of GDP in the ten years before the crisis (3.9%) was about the same as in the ten years after the trough (4.1%). That implies that the 9.3% peak-to-trough reported by Reinhart and Rogoff is largely permanent.

Other authors have also found that banking crises have large, permanent effects on GDP. Cerra and Saxena (2008) report that, using a sample of 112 banking crises distributed over 125 countries, the average effect of a banking crisis is that GDP falls permanently by about 8%. They find no evidence that the growth rate of GDP after the crisis is higher or lower than before the crisis, on average. For the subset of industrialised countries they find a similar result as for the full sample, with a permanent loss of about 6% of GDP. Their findings for the average effects of a banking crisis on GDP are shown in Figure 4.5.

This picture has been confirmed by other studies. For example, Teulings and Zubanov (2013) undertake a similar exercise to Cerra and Saxena and find that in non-African countries the average effects of an average banking crisis is a loss of about 6% of GDP 9-10 years after a banking crisis. IMF (2009) also finds large medium-term effects of banking crises. They compare growth rates before and after banking crises based on a sample of 88 banking crises and find an average deviation of 10% of GDP relative to its pre-crisis trend. Like the other studies listed above, they find that the growth rate returns to its pre-crisis level in the medium-term. They also provide evidence that the individual country experiences around

the average are extremely varied. Only the middle 50% of cases lie between 6% above and 26% below the pre-crisis trend after seven years - the other 50% are more extreme.

Figure 4.5 Effect of a typical banking crisis on GDP (Authors own reproduction of Cerra and Saxena, 2008)



The evidence for productivity is less compelling – there are fewer studies and more problems with data definitions. Abiad *et al.* (2013) is one study that looks at the consequences of a banking crisis for TFP by comparing TFP before and after a banking crisis. On average, they find that TFP drops immediately to a new level 5% below the old trend in the year after the crisis hit and then stays there. In the long-run, both average GDP growth and average TFP growth rate is the same as before the crisis.

There is also evidence that banking crises have permanent effects on labour productivity. Oulton and Sebastiá-Barriel (2013) find that each year of crisis reduces long-run labour productivity relative to the pre-crisis trend by between 0.8% and 1.1%. They argue that this effect is at least partly explained by a lower capital-labour ratio, which they find falls on average by about 1%. Oulton and Sebastiá-Barriel also look at the effects of financial crises on GDP for which they find a similar result to the other studies mentioned above: a permanent loss relative to the pre-crisis trend.

As highlighted in the discussions of both Cerra and Saxena and Teulings and Zubanov above, there may be differences in the effects of banking crises between rich and poor countries. In both these studies the point estimates of the permanent loss of GDP was smaller in developed countries, although the differences were statistically insignificant. Abiad *et al.* contains relatively many developing countries in their analysis so, if there are important differences in the effects of banking crises between rich and poor countries, there results may be less relevant for the current situation in the Netherlands. Oulton and Sebastiá-Barriel perform regressions for different subsamples of countries. When they focus on developed countries only, banking crises no longer have a statistically significant effect on labour productivity or capital per worker, although they still find a statistically significant effect on GDP per capita, albeit lower than for the whole sample. Oulton and Sebastiá-Barriel caution

against concluding that developed countries can expect less damage from a banking crisis because, they argue, most banking crises in developed countries have been relatively mild or have been set against a relatively benign international environment, something that is not the case for the Great Recession.

Given that output falls persistently after a financial crisis it follows that at least some of the components of GDP also fall. A banking crisis is typified by disruptions in credit intermediation, hence it seems natural to expect that investment, the component of GDP most heavily reliant on external finance, would be sensitive to a banking crisis. Abiad *et al.* find that to be the case. They find that investment falls on average by about 30% relative to the pre-crisis trend in the year following the crisis and that the effect is roughly the same after seven years. Such large effects seem to be driven by countries in their sample that had experienced investment bubbles prior to their banking crises. Another study that finds a qualitatively similar result is Rioja *et al.* (2014), who find that an average banking crisis lowers the investment-GDP ratio by 1.7% for eight years following the start of the crisis - a magnitude more in line with the results of Oulton and Sebastiá-Barriel.

In summary, the empirical evidence on the effects of past banking crises on productivity is that they are, on average, associated with large, permanent declines in productivity relative to the previous trend. As with the effects on GDP, there is no evidence to suggest that banking crises have a long-run effect on the growth rate of productivity, on average.

New research into productivity declines after financial crises

In this section, we present two new pieces of analysis concerning the effects of banking crises on labour productivity. The first is a descriptive analysis looking at the Reinhart-Rogoff systemic banking crisis episodes. The second new analysis is an econometric analysis based on a panel of countries that experienced banking crises.

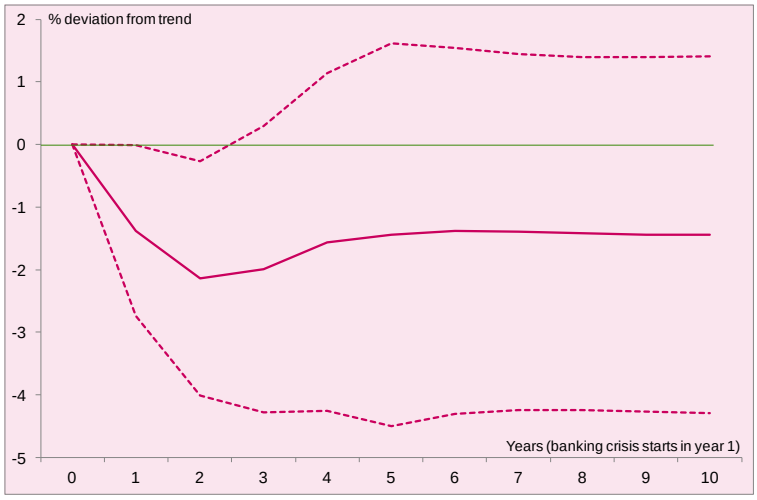
Reinhart and Rogoff (2009) identified 15 systemic financial crises and analysed the consequences they had on macroeconomic variables. They focus on the differences from peak to trough, and find that GDP per capita falls on average 9%, the unemployment rate increases by 9% points and real house prices fall 36%. We look at the same financial crises and compare labour productivity and TFP growth in the ten years before the peak to the ten years after the trough. Like Reinhart and Rogoff, peaks and troughs are based on GDP per capita. Table 4.3 shows that the average growth rate of labour productivity was 1%-point lower after the crises, for TFP the growth rate was slightly higher (based on a smaller sample). However, the variation is large; four of the eleven countries had a higher growth rate of labour productivity after the trough compared to before the peak. The average level of labour productivity is actually higher after the crisis, but this result is influenced by an increase of almost 13% in Finland. All countries (in the smaller subsample) had TFP losses. The main lesson is that the effects of financial crises on labour productivity can vary widely.

Table 4.3 Labour productivity and TFP before and after systemic financial crises

	Labour productivity per hour			TFP		
	10 years to peak	10 years after trough	peak to trough	10 years to peak	10 years after trough	peak to trough
Spain (1977)	5.9	4.0	6.6			
Japan (1992)	3.5	1.9	4.4			
Norway (1987)	2.7	3.1	0.3			
Sweden (1991)	1.0	2.6	4.2			
Hong Kong (1997)	2.8	3.3	-4.6	1.0	2.5	-7.4
Colombia (1998)	0.4	0.8	-2.1	-0.8	-0.1	-4.9
South Korea (1997)	5.4	4.7	4.2	2.0	2.6	-2.6
Malaysia (1997)	4.5	3.3	-7.3	1.1	2.2	-11.8
Finland (1991)	3.1	2.6	12.6			
Thailand (1997)	7.4	2.7	-7.6	1.1	1.9	-14.4
Argentina (1998)	2.1	-2.3	-2.4	2.6	-0.5	-13.1
Average	3.5	2.4	0.7	1.2	1.4	-9.0

Source: Total economy database (The Conference Board). This database has no data on Norway (1899), United States (1929), Indonesia (1997) and Philippines (1997).
Peaks and troughs are based on GDP per capita.

Figure 4.6 Average effect of a banking crisis on labour productivity per hour



Note: Dashed lines indicate 90% bootstrapped confidence interval.

Using the method of Cerra and Saxena (2008),[35] we have estimated the effect of a banking crisis on labour productivity per hour using data from the Conference Board. The results, based on a panel of 58 countries and the same banking crisis dummy as in Cerra and Saxena, are shown in Figure 4.6. As with the Cerra and Saxena results for GDP, our estimates suggest that banking crises may have permanent effects on labour productivity, although due to the

[35] Specifically, we estimate equation (1) from Cerra and Saxena (2008): $g_{it} = a_i + \sum_{j=1}^{4} \beta_j g_{i,t-j} + \sum_{s=0}^{4} S_j D_{i,t-s} + e_{it}$. In our specification we simply replace the growth rate of real GDP in country i, g_i, by labour productivity. The remaining variables remain the same and are: a_i, fixed effect for average growth in labour productivity in country i, β_j, coefficients on lagged growth in labour productivity, S_j, coefficients on current and lagged banking crisis dummy, $D_{i,t}$, banking crisis dummy and e_{it}, an error term. We also keep the same lag structure since the coefficients of higher lags are insignificant.

smaller sample size the confidence bands are wide and the estimated effects are not statistically significantly different from zero. Qualitatively these results are consistent with those of Abiad *et al.* (2013) and Oulton and Sebastiá-Barriel (2013) described above — on average there is a level shift but no long-run effect on the growth rate of labour productivity.

Comparing the Netherlands to empirical averages

So how do the experiences in the Netherlands since the start of the Great Recession compare to the averages in tables 4.2 and 4.3? Unfortunately, making such a comparison is not straightforward. For starters, as this book makes clear, the crisis in the Netherlands is not yet over, which makes it difficult to estimate the long-run effects. Furthermore, the averages in Table 4.2 are relative to different trend measures, which means we would also have to take a stand on the relevant trend concept for the Netherlands. For the Netherlands this is complicated because some of the pre-crisis period coincided with, for example, increasing female labour force participation, which inflated GDP growth in the pre-crisis years. Using the average pre-crisis growth rate would therefore mean using an unreasonably high benchmark.

What we can do, is to compare peak-to-trough measures in a similar vein to the analysis of Reinhart and Rogoff (2014) and Table 4.3. In the Great Recession the peak-to-trough fall in GDP per capita in the Netherlands was 5.3%, which is less than the average reported by Reinhart and Rogoff (2009). The comparable number for labour productivity is 1.9%, whilst for TFP it is 4.7%. The experiences of the Netherlands since the Great Recession are, therefore, not unusual, since IMF (2009) and Table 4.3 make clear that the variation in experiences after banking crises is large.

4.4 Theoretical explanations for productivity losses in financial crises

As shown in the previous section, the level of productivity declines on average following a financial crisis, and this has recently been the case in the Netherlands since the Great Recession. To some extent the effects of a financial crisis on the level of productivity will be temporary and to some extent they will be permanent. The temporary effects may be related to labour hoarding and consolidation. Other mechanisms produce longer-lasting effects. Lower investment in physical or human capital or in research and development may decrease long-run productivity. Other mechanisms decrease the level of organisational capital through disruptions to supply chains and the existence of zombie firms.

In this section, we discuss these economic mechanisms and the extent to which these declines will tend to be temporary or permanent. We start by briefly discussing the mechanisms behind temporary changes before turning our attention to those mechanisms which result in longer-run, persistent changes in productivity levels.

There are a number of reasons why a decline in labour productivity may be temporary. Employers may not reduce their labour force when faced with falling demand for their products if, for example, they expect the downturn to be short-lived or they are concerned about being able to hire appropriately skilled workers when the recovery starts. They may also retain idle workers if it is costly to lay off workers due to contractual severance pay or labour market regulations. This decision to retain idle workers is called labour hoarding and is examined in more detail in Chapter 5. At the start of the crisis in the Netherlands, labour hoarding played a role in limiting the increase in unemployment. These workers were not solely committed to producing output, which implies that the effective labour force was smaller than that measured by the number of people employed. As a result measured labour productivity fell, simply because we did not measure the effective labour force well. However, firms cannot hoard labour indefinitely, since it clearly isn't profitable to do so. Hence, labour hoarding will only cause temporary declines in labour productivity. Labour hoarding is one of a number of reasons why it is hard to measure labour productivity accurately, see the box "It is difficult to measure productivity" for more details on measurement issues.

Consolidation may be another reason to expect temporary effects on labour productivity. There is a large literature concerning the effects of changes in government spending, which comes to widely differing conclusions (see Lukkezen (2013) for an overview). One thing they do typically agree on, however, is that changes in government expenditure only have temporary effects. Government cut-backs will not have long-term effects on TFP or the factors of production, and so will not affect the economy's long-run production capacity.[36] Unlike cut-backs to government spending, higher tax rates could well have long-run effects on the level of output because they distort economic decisions about, for example, how much labour to supply. However, there is little evidence that higher tax rates lower the long-run growth rate: countries with widely differing tax regimes all grow at rates following the growth of global technology. That developed countries can have different levels of output and productivity but have the same growth rates can be seen in Figure 4.2.

Whilst some of the effects of the crisis will only be temporary, the empirical literature consistently finds evidence that banking crises have permanent effects on the levels of GDP. There is also some evidence of permanent effects on labour productivity. Permanent effects can arise from permanent changes to any of the three production factors: the quality or quantity of labour employed, the quantity of capital employed or the level of TFP.

The effect of long lasting periods of high unemployment, which tend to follow a financial crisis, is straightforward: it lowers the level of labour productivity because unemployed workers miss out on work experience that would otherwise have increased their level of human capital. Ultimately this effect disappears once the affected workers leave the labour force, but could be long-lasting because youth unemployment often rises more during periods of deep economic downturn. Chapter 5 investigates the likely consequences of the crisis for long-run labour supply in more detail.

[36] The literature does not typically examine the effects of cut-backs in the middle of deep recessions, however.

The capital stock falls following a financial crisis due to lower levels of investment. These declines in investment can occur for a number of reasons. The price of risk tends to increase dramatically during a financial crisis, as does the level of uncertainty. On the other hand, expectations of future output tend to fall. These three factors reduce the incentive to invest in the capital stock. In their study Abiad *et al.* (2013) also cite a number of other factors from the literature which can adversely affect investment by firms. These include tighter lending standards, lower firm profit rates, and lower asset prices that weaken corporate balance sheets and reduce the value of firms' collateral. These mechanisms apply to investments in physical capital, in-firm training and research and development.

There are other factors that can adversely affect technology in times of crisis. The general argument is that the amount of innovation during economic downturns is reduced, see Corrado *et al.* (2009) and Marrano *et al.* (2009) for a more detailed discussion. Changes in the rate of firm entry and exit in times of crisis might be expected to improve efficiency via the process of creative destruction first discussed by Schumpeter (1942). Millard and Nicolae (2012) however discuss studies indicating that the opposite may be the case: in times of crisis less innovative so-called zombie firms may be propped up by bank forbearance, while new firms using new technology or business methods and creating new products may not be able to obtain the credit they need to get started. Ohanian (2001) also cites a number of studies arguing that increased firm bankruptcies involve breakdowns in relationships between suppliers and between firms and their customers. This may force managers to shift time away from production and into search activities. Increased numbers of firm bankruptcies during a crisis also results in the loss of productive capital as factories are permanently closed.

Financial crises can have temporary and permanent effects on labour productivity. Temporary effects may be related to labour hoarding and consolidation. Other mechanisms have permanent effects. Lower investment in physical or human capital or in research and development may decrease long-run productivity. Other mechanisms decrease the level of organisational capital through disruptions of supply chains and the existence of zombie firms.

Clearly there are a considerable number of theoretical mechanisms that can influence the path of productivity during financial crises. However, it is difficult to quantify the effects of these mechanisms. Ohanian (2001) studied the decline in TFP during the Great Depression and concludes that of the decline of 18%, only 5% can be accounted for. This is an illustration that economists still do not fully understand the causes of productivity declines during financial crises.

4.5 Have the long-run growth possibilities declined?

So far, we have discussed the typical effects of financial crises on the level of productivity relative to trend: the average financial crisis has a negative effect on the level of labour productivity, with little or no catching-up to the pre-crisis trend. However, the trend growth of labour productivity may have also decreased, irrespective of the crisis. If there is indeed a productivity slowdown, this will have important consequences for living standards in the decades to come.

The literature mentions a number of reasons why there might be a productivity slowdown. The first reason is a lower contribution from innovation. Robert Gordon (2014) sees the post-1974 productivity slowdown as the best available evidence that the third industrial revolution (mainly digital, post-1972) was a mere shadow of the second industrial revolution (multi-dimensional, 1875-1972). Others, like Brynjolfsson and McAfee (2014), are more optimistic and expect an inflection point because of computers. "The key building blocks are already in place for digital technologies to be as important and transformational to society and the economy as the steam engine."

Secondly, increases in educational attainment will slow and eventually stop. Therefore the contribution of labour composition on productivity will decrease. Byrne, Oliner and Sichel (2013) write that this contribution might decline by 0.27%-points. OECD (2014) assume that the annual contribution of human capital to productivity growth in the United States remains 0.1%-point until 2030. For the euro area they expect a decline from 0.5%-point in 2000-2007 to 0.3%-point in the period 2014-2030. For the Netherlands, they expect a contribution of 0.3%-point until 2030, and 0.2%-point afterwards. On top of that, Fernald and Jones (2014) expect that the growth of R&D intensity and population in the developed economies will slow. In a semi-endogenous growth model, this will decrease the rate of future productivity growth. They see the rapid growth in the number of researchers worldwide, which has been driven by the rise of China and India, as a counterbalancing factor.

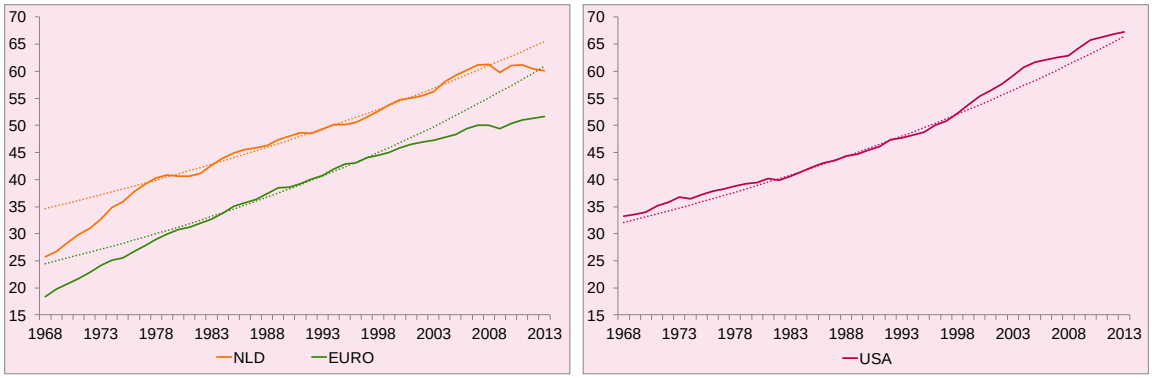
What do the data tell us about a possible productivity slowdown? Table 4.4 shows growth rates of labour productivity since 1968. In the euro area, average productivity growth was higher than in the United States until the mid 1990s. However, in each decade the growth rate was lower than in the previous period. In contrast, this was not true for the economies of the Netherlands and the United States, where productivity growth increased in the last decade before the crisis.

Table 4.4 Labour productivity growth 1968-2007

	Netherlands	Euro area	United States
Labour productivity growth			
1968-1977	4.8	4.9	1.7
1978-1987	1.6	2.7	1.3
1988-1997	1.2	1.9	1.6
1998-2007	1.7	1.3	2.1

The thick lines in Figure 4.7 are the productivity trends based on the period 1980-2000. The average growth in the euro area was 2.0% per year in that period. The figure shows that the euro area has not kept up with that trend. This is despite the fact that the level of productivity in the euro area was still well below that in the United States, as Figure 4.7 shows. From 2000 onwards, Dutch labour productivity growth has been slightly above the 1980-2000 trend, which has 1.4% growth. For the United States, labour productivity growth was on average 1.6% in 1980-2000, it accelerated afterwards until the start of the Great Recession.

Figure 4.7 Labour productivity per hour since 1968, compared to trend 1980-2000, the Netherlands and euro area (left) and United States (right)



Will there be a productivity slowdown? The growth rate slowed in the euro area in the decade before the crisis. However, this did not occur in the Netherlands and the United States. Also, the cause of the slower growth rate in the euro area is uncertain. The contribution of future innovations from the digital revolution to productivity growth is hard to assess. Though the future contribution of educational attainment to productivity growth may decline, this is unlikely to have a large influence on productivity growth in the next decade. In summary, there is no consensus in the literature about the direction of future productivity growth. There are upward and downward risks, irrespective of the aftermath of the crisis.

4.6 Productivity after the Great Recession

This chapter has described the substantial effects of banking crises on productivity and highlighted some of the mechanisms that may be at work. This chapter has also looked at the key uncertainties surrounding labour productivity in the coming ten years. In the Netherlands since the onset of the Great Recession, there have been substantial declines in productivity relative to the pre-crisis trend. These declines have been broadly based across most of the major sectors of the Dutch economy. The key empirical result from past banking crises is that, on average, they have large effects on the level of productivity, but that there is no evidence that a typical banking crisis changes the long-run growth rate of productivity.

Applying those lessons to the Netherlands suggests that the deviations from the pre-crisis trend might be largely permanent. For the Netherlands the average productivity growth in the twenty years preceding the start of the Great Recession was 1.4%, there is no hard evidence that productivity growth in the Netherlands will be lower in the long-run, although there is some debate about possible lower long-run productivity growth worldwide. Furthermore, there is uncertainty about dating the end of the banking crisis and when the normal growth of productivity will resume.

In the next decade, productivity growth may be higher or lower than the long-run average; in the scenarios in Chapter 8 we consider a range between 1% and 1¾% per year. It can be higher if part of the current loss with respect to the pre-crisis trend turns out to be temporary. This can be the case if the losses are the result of labour hoarding or consolidation. If the Dutch economy manages to adopt technologies of the technological frontier and catch-up with the productivity level of the United States, productivity growth will turn out to be higher as well. The Netherlands has followed the productivity level of the United States for years, but recently the productivity gap has widened and it is uncertain if the Netherlands can catch-up again.

There are also downside risks to the development of productivity. Chapter 2 has highlighted the uncertainties concerning the health of banks in the Netherlands and the rest of the euro area, which clearly pose a risk to future productivity growth, by either limiting funding for R&D or for new investment. Slower technological advances or a decreasing contribution from educational attainment, as discussed in Section 5.4, are additional downward risks.

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Financial crisis, euro crisis what's next? The title of this book suggests an answer: recovery. Yet, what road will it take? Recovery of the financial sector, the labour market and the housing market? Originating from resilience of the European and Dutch economies? Leading to the return of pre-crisis consumption growth? Recovery is a plausible road for the economies of Europe and the Netherlands in the next decade. But it's not the only road. Continuing demand shortfalls may delay the recovery.

Roads to recovery focuses on the Dutch economy in a European context. The book reviews the impact of the Great Recession and paints a picture of the economy today. It gives an outlook into the next decade by means of three scenarios for the European and Dutch economies.

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