Chapter 6

Productivity, Income and Technological Change in the Netherlands: Causes and Explanations of Divergent Trends

Bart van Ark and Jakob de Haan
Department of Economics, University of Groningen

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Abstract: This paper reviews the sources of the acceleration of economic growth in the Netherlands since the early 1980s. In particular the paper focuses on the downside of this growth acceleration, which is the slowdown in productivity growth. We argue that transitory shifts towards a greater share of lower productive employees and lower productive (service) sectors do not provide a full explanation. Hence we investigate to what extent the productivity growth slowdown can be explained from a slow diffusion of technology. Again we find only limited evidence for this hypothesis. We argue that human capital creation and structural reforms in labour and product markets are key elements to exploit the potential for a productivity acceleration in particular in services.

1. INTRODUCTION

Since the late 1980s, the Dutch economy has outperformed neighbouring countries in several respects (see Table 1). It has achieved higher employment and GDP growth in combination with low inflation, and it had the lowest long-term interest rates in the European Union (EU). Dutch per capita GDP growth, which was well below the Northwest European average during the first half of the 1980s, is now almost back to that average. The economy of the Netherlands also suffered less than other European economies from the recessions in 1992-93 and 1995. This performance represents a marked turnaround from the early 1980s, when the country faced a deep recession, the profitability of firms was close to zero, unemployment had risen sharply, and the fiscal deficit amounted to 9½ percent of GDP. Indeed the turnaround has been so remarkable that it has been referred to as a "Dutch miracle" (or the "Delta model") by parts of the media.

In earlier papers we have argued that in fact there has been no miracle (van Ark and de Haan, 1999, 2000).[1] In our view, the recent growth performance of the Netherlands has primarily been the result of a correction of the below-average growth during earlier decades, *i.e*. the 1970s and early 1980s. In van Ark and de Haan (1999) we showed that two fundamental changes in the Dutch economy, namely a policy of almost continuous wage cost moderation since 1982 (the time of the "Wassenaar agreement" between employers, unions and the government in 1982) and a substantial increase in the labour supply (especially caused by a higher participation rate), accounted for the recovery. In van Ark and de Haan (2000) we extended the argument further by formally analysing the effect of wage moderation on the change in employment. In the latter paper we also discussed in more detail labour market reforms and the creation of a more effective wage negotiation structure since the "Wassenaar agreement."

In our earlier papers we also observed another striking feature of the recovery since the 1980s, namely that the acceleration in per capita income went together with a slowdown in labour productivity growth (see Table 1). Whereas during the late 1970s and 1980s per capita income growth had slowed down to well below the average Northwest European growh rate, it accelerated substantially during the late 1980s and early 1990s. In contrast, productivity growth has been faster than per capita income growth between 1973 and the mid 1980s, but the opposite appeared to be the case since then.

[1] For a more long-term view, covering the period since 1913, see van Ark and de Jong (1996).

In this paper we go more deeply into the divergent trends in productivity and per capita income. There are a number of hypotheses that explain these opposite trends in income and productivity performance in the Netherlands.

Table 1. Growth of GDP and GDP per Capita, 1960-1997

	GDP (constant prices)				GDP per Capita			
	Netherlands	Northwest Europe (a)	European Union (b)	OECD (c)	Netherlands	Northwest Europe (a)	European Union (b)	OECD (c)
1960-1997	3.2	2.9	3.3	3.4	2.4	2.2	2.8	2.8
1960-1973	4.9	4.5	5.3	5.3	3.6	3.5	4.6	4.4
1973-1979	2.6	2.3	2.7	2.8	1.9	1.7	2.1	2.1
1979-1987	1.5	2.0	1.9	2.2	0.9	1.5	1.6	1.8
1987-1997	2.9	2.1	2.4	2.4	2.2	1.3	2.0	1.9

	Total Number of Hours Worked				GDP per Hour Worked			
	Netherlands	Northwest Europe (a)	European Union (b)	OECD (c)	Netherlands	Northwest Europe (a)	European Union (b)	OECD (c)
1960-1997	0.1	-0.2	-0.2	0.1	3.2	3.2	3.6	3.5
1960-1973	0.3	-0.4	-0.5	0.0	4.5	4.9	5.8	5.3
1973-1979	-0.5	-0.5	-0.3	0.0	3.2	2.8	3.0	2.8
1979-1987	-1.3	-0.2	-0.4	0.1	2.8	2.3	2.3	2.1
1987-1997	1.1	0.2	0.3	0.4	1.7	1.9	2.1	2.0

(a) unweighted average for Austria, Belgium, Denmark, West Germany, Finland, France, Netherlands, Norway, Sweden, Switzerland and United Kingdom; (b) excluding Luxembourg; (c) unweighted average for 20 OECD member states (pre-1995 membership, excluding Luxembourg, Iceland, New Zealand and Turkey)
Source: 1960-1990 (except Netherlands) from Maddison (1995), linked to 1990-1997 from OECD *National Accounts 1960-1996* (Paris, 1998) and OECD *Economic Outlook* (Paris, June 1998). Netherlands from CBS, *Nationale Rekeningen 1997* (and previous issues) and *Arbeidsrekeningen 1997* (and previous issues). Trend in working hours 1960-1987 are for contractual hours from CBS (unpublished).

One explanation concerns the changing contribution of labour input to growth. Whereas labour force participation fell during the 1970s and 1980s, thus reducing the capacity of the economy to expand, it improved since the late 1980s. The decline in the labour force participation in the 1970s and 1980s went hand in hand with high labour productivity growth, as less productive workers lost their jobs. Many of those workers shifted to early retirement or disability schemes. Under the new labour market regime since the 1980s new cohorts of workers entered the labour market, including long-term unemployed, low skilled workers and women

A second hypothesis, which may be related to the first one, is that the share of lower-productivity service industries in the economy has increased due to deindustrialisation. This negative shift-effect occurs when service sectors have not only experienced slower real output growth, but also have lower productivity levels relative to commodity sectors, in particular industry.

In our earlier papers we found only limited evidence for these two transitional sources of the productivity slowdown, *i.e* shifts to lower productive people and lower productive sectors. This paper therefore further develops the third explanation, namely that the productivity growth within individual sectors and industries slowed down. This is a more serious scenario than the explanations mentioned above, because a "within-industry" productivity slowdown will affect per capita income growth in the long run, even though it may be temporarily offset by an increased activity/non-activity ratio.

The structure of the paper is as follows. In Section 2 of the paper we will review how much of the recent improvement in GDP per capita in the Netherlands can indeed be traced to increased labour participation. We then look in some greater detail at the productivity performance at the macro level, including total factor productivity growth, the role of physical and human capital in the growth process, and the performance of R&D as a typical technology variable. In Section 3 we shift the attention to the industry level. We review the evidence on the impact of shift effects on productivity growth, and then continue by focusing on the slowdown in total factor productivity growth by industry. This evidence tells us whether the slowdown has been across the board, or that it was concentrated in particular sectors of the economy, for example in services.

Finally, in Section 5 we will investigate the factors that are most closely associated with the technology performance of the Dutch economy, including the change in human capital intensity, R&D intensity and the intensity of investment in new technologies. We will argue that on the basis of these indicators no evidence can be found of lack of investment in intangible capital. Nevertheless we argue that to turn around the productivity slowdown, human capital creation needs to be brought in better balance with other intagible investment, so that a shift towards new and higher productivity activities can be more easily realised. We also argue that structural reforms in labour and product markets are needed to support high productivity activities in particular in the services sector.

2. LABOUR INPUT AND ITS IMPACT ON THE RISE IN INCOME AND SLOWDOWN IN PRODUCTIVITY GROWTH

The relatively rapid acceleration of growth in the Dutch economy is confirmed by a comparison of growth rates of GDP and GDP per capita vis-à-vis to the averages for Northwest Europe, the European Union and the OECD (Table 1). Compared to Northwest Europe, growth of real GDP and GDP per capita in the Netherlands has been 0.9 percentage points higher between 1987 and 1997. Table 2 presents corresponding figures in terms of relative levels. Whereas GDP per capita in 1997 was still around 4 percent below the Northwest European average it came up from a level of 11 percentage points below the Northwest European level in 1987. In 1987 Dutch GDP per capita was at the bottom of the league of the 11 Northwest European countries, whereas in 1997 it was in 8th place behind Norway, Switzerland, Denmark, Belgium, Austria, France and Germany, although the differences between the latter five countries and the Netherlands were within a range of 1.5 percentage points.[2] The estimates lead to the conclusion that between 1987 and 1997 the Netherlands has been in the process of making up for what it had lost in terms of relative income per capita compared to the rest of Northwest Europe between the late 1970s and 1980s.

The increase in labour input has been one of the main components of the acceleration in GDP growth. Table 3 decomposes the growth of the total number of hours worked since 1960 into the contribution of employment and

[2] The internationally comparative national accounts measures in Tables 1, 2, 4 and 5 are according to the System of National Accounts 1968 and purchasing power parities for the year 1993. In 1999 most OECD countries introduced revised GDP measures using the new System of National Accounts 1993 (or, for Europe, the European System of Accounts 1995) and purchasing power parities for 1996. We have not yet used these latest estimates in this paper, partly because the periods for backward extrapolation are not equal across countries, and partly because it is not clear why the most recent purchasing power parities show rather different results in particular relative to the USA than the earlier PPPs for 1990 and 1993. See the Groningen Growth and Development Centre Database (http://www.eco.rug.nl/ggdc/Dseries/dataseries.html) for the most recent updates. However, in the second half of this paper we use the revised Dutch national accounts figures since 1995. The perspective of a per capita income acceleration and productivity slowdown in the Dutch economy has not changed according to these new measures. The selection of the subperiods in Tables 1, 2, 4 and 5 is based on the identification of turning points in an international comparative perspective (see Maddison, 1995). For the Netherlands, the periodical distribution of GDP grwoth between peak-to-peak points in the cycle might have been as follows: 1960-1976: 4.5%; 1976-1989: 2.0%; 1989-1997: 2.9%. This reduces the growth differentials between subperiods somewhat, but does not fundamentally change the perspective of a change towards faster output growth since the 1980s (see Tables 7 and 8).

average hours worked. The number of persons employed has accelerated to 1.8 percent per year on average since 1987, which is equivalent to an increase by almost 1.2 million people. The growth in total working hours has been slower (1.1 percent per year on average), because of the decline in average annual hours per person.

Table 2. Relative Level of GDP per Capita, Northwest Europe=100

	Netherlands	Northwest Europe (a)	European Union (a)	OECD (a)
1960	96	100	79	87
1973	95	100	85	92
1979	95	100	86	93
1987	89	100	85	93
1997	96	100	89	95

(a) See Table 1 for definitions
Source: see Table 1. GDP in national currencies converted to US$ with EKS PPPs for 1993.

Table 3. Labour Input Indicators, Netherlands, 1960 to 1997

	Total hours worked	Employ-ment	Average hours worked		Employ-ment-Population (15-64) ratio (%)	Average hours worked
	(annual compound growth rates)					
1960-1997	0.1	1.3	-1.2	1960	61.9	2,051
				1973	56.2	1,751
1960-1973	0.3	1.6	-1.2	1979	53.3	1,611
1973-1979	-0.5	0.9	-1.4	1987	58.6	1,387
1979-1987	-1.3	0.6	-1.9	1992	64.5	1,344
1987-1997	1.1	1.8	-0.7	1997	67.5	1,297

Source: CBS, *Arbeidsrekeningen 1997* (and previous issues); Maddison (1995); OECD, *Employment Outlook*, various issues

Since 1987 the average number of hours per person employed declined at 0.7 percent a year in the Netherlands. In 1997 the average number of hours per person employed that were actually worked (*i.e.* hours which are paid *and* worked) was less than 1,300 hours per person in the Netherlands compared to approximately 1,540 hours for Northwest Europe as a whole. This low level for the Netherlands is mainly caused by the extraordinary rapid increase in part-time labour from 21.2 percent of total employment in 1983 to 36.5 percent in 1996. The participation rate, defined as persons employed as a percentage of the working age population from 15-64 years old, has gone up from less than 55 percent by the end of the 1970s to 67.5 percent in 1997.

The 1997 participation rate is only marginally lower than the average of 68.1 percent for Northwest Europe. Only Norway, Denmark, Sweden, Switzerland and the United Kingdom still have higher employment/ population ratios.[3]

The rise in labour force participation is mainly caused by an increase in the female participation ratio (women employed as a percentage of the female population from 15-64 years) from 30.5 percent in 1975 to about 49.9 percent in 1996.[4] This increase accounts for about two thirds of the rise in employment since the early 1980s. All other effects on employment growth are much smaller. Only since the mid 1990s some decline in the number of people with unemployment benefits or social assistance can be observed. There has not been much decline in the relatively large number of persons on disability benefit except for a brief once-for-all effect following medical re-examinations of persons in this scheme during the early 1990s. Recent estimates suggest that there are still almost 900 thousand people receiving a disability benefit, which is still as much as one third of all people on inactivity benefits (including unemployment benefit, sickness benefit, pre-pension schemes and social assistance). Finally, an important remaining group of unemployed persons concerns those older than 55 years in the Netherlands. In 1997, labour force participation of this group was 32.7 percent compared to an unweighted average of 47.7 percent for the 11 Northwest European countries.[5]

Table 4. Contribution of Labour Input Growth to Real GDP and GDP per Capita Growth

	Netherlands		Northwest Europe	
	%-contribution of hours worked		%-contribution of hours worked	
	to change in real GDP	to change in real GDP per capita	to change in real GDP	to change in real GDP per capita
1960-1997	1	-18	-4	-24
1960-1973	5	-18	-7	-28
1973-1979	-19	-62	-21	-55
1979-1987	-78	-180	-16	-43
1987-1997	37	22	7	-49

(a) See Tables 1 and 3 for definitions and sources

Table 4 shows that between 1987 and 1997 the increase in total hours worked contributed as much as 37 percent to overall GDP growth and 22 percent to the rise in GDP per capita. For both variables this represented a major turnaround compared to the strongly negative contribution of slow

3 See, OECD, *Employment Outlook* (June 1998, Table B).

4 Sociaal Cultureel Planbureau, *Sociale en Culturele Verkenningen 1997*, Table 2.5, Rijswijk.

5 Sociaal Economische Raad, *Advies Sociaal-economisch beleid 1998-2002*

labour input growth to per capita income growth during the late 1970s and early 1980s. It is also striking that, in comparison with Northwest Europe, the much larger negative contribution of labour input growth in the Netherlands between 1979 and 1987 turned into a much larger positive contribution between 1987 and 1997.

In van Ark and de Haan (2000) we have argued that the policy of moderation of wage costs, that started in the beginning of the 1980s has been an important factor explaining the increase in labour input. The obvious next step is to consider the impact of wage cost moderation and the consequent rise in labour input on productivity.

Figure 1a shows that between 1973 and 1985, labour productivity grew substantially faster than per capita income, whereas it has increased at a slower rate than per capita income since 1985, and in particularly during the 1990s (Figure 1b; see also Table 1). Table 5 shows labour productivity levels in an international comparative perspective. Between 1973 and 1987 the level of labour productivity in the Netherlands moved ahead of the average Northwest European level by 7 percentage points to 115 percent. However, after 1987 the gap narrowed again by 3 percentage points to 112 percent in 1997.

Table 5. Relative Level of GDP per Hour Worked, Northwest Europe=100

	Netherlands	Northwest Europe (a)	European Union (a)	OECD (a)
1960	112	100	81	94
1973	108	100	89	94
1979	110	100	90	94
1987	115	100	90	93
1997	112	100	92	93

(a) See Table 1 for definitions
Source: see Table 1. GDP in national currencies converted to US$ with EKS PPPs for 1993.

On the basis of this evidence, one might hypothesise that there is a negative relation between the acceleration in employment growth and the deceleration in productivity growth. One possibility is that lower labour costs have caused a substitution of labour for capital and a corresponding decline in capital intensity and total factor productivity growth. To test this we specify a translog production function, in which the growth of labour productivity is decomposed into the contribution of human capital, physical capital, the stock of research and development and total factor productivity. In a discrete time perspective this translog production function can be formulated as:

$$\ln \frac{P_{t+1}}{P_t} = w^l \ln \frac{h_{t+1}}{h_t} + w^k \ln \frac{k_{t+1}}{k_t} + w^r \ln \frac{r_{t+1}}{r_t} + \ln \frac{A_{t+1}}{A_t} \quad (1)$$

with P as output per hour worked, h as human capital per person employed, k as the physical capital stock per hour worked, r as the stock of research and development per hour worked, A as total factor productivity, and w^l, w^k and w^r as the weights for labour, physical capital and R&D capital, respectively; t and $t+1$ represent time.

Table 6 shows that for the total economy, growth in value added per hour worked (P) slowed down from 4.5 percent between 1960 and 1973 to 1.7 percent between 1987 and 1997. The human capital stock estimates are based on a weighted average of years of primary, secondary and tertiary schooling of the working population, which shows a moderate increase over the period. The estimates of the physical capital stock are constructed with the perpetual inventory method, which implies an accumulation of gross investment using assumptions on the average life times of nonresidential structures and machinery and equipment.[6] In contrast to the human capital intensity, the growth rates of physical capital intensity indeed declined very rapidly over the past four decades. The stock of R&D is constructed on the basis of accumulating R&D investment by private business, research institutes and universities using a life time of R&D investment of 15 years.[7] The decline in R&D intensity is very substantial.

Table 6 shows three concepts of total factor productivity, ranging from considering only nonresidential capital as an input, to also treating human capital and the R&D stock as separate inputs. The contributions of human and physical capital to output growth are based on the factor share of labour and capital in the national product, with an imputation for the labour compensation of self-employed persons. The weight for the R&D stock is assumed to be 0.05 on top of the average factor shares for labour and capital.[8] According to all three TFP concepts a substantive slowdown in TFP growth occurred over the period as a whole.

The bottom panel of Table 6 shows the percentage contribution of each factor to labour productivity growth. Whereas the contribution of physical capital declined slightly, the contribution of human capital rapidly increased, and the contribution of R&D capital halved between the subperiods 1960-73 and 1987-97. Meanwhile the contribution of total factor productivity growth (excluding the contribution of the R&D stock) to labour productivity growth declined from 41 percent during the subperiod 1960-73 to 27 percent during 1987-97.

6 Updates from Groote, Albers and de Jong (1996)
7 Updated from Minne (1995)
8 See sources of Table 6 and van Ark and de Jong (1996) for details of the calculations

Table 6. Labour Productivity, Capital Intensity and Various Concepts of Total Factor Productivity, Netherlands, 1960-1997

Value Added per Hour Worked (a)	4.5	3.2	2.8	1.7
Nonresidential Capital Stock per Hour Worked (b)	5.5	4.4	3.6	1.7
Human Capital Stock per Hour Worked (c)	1.0	1.4	1.4	1.6
R&D Stock per Hour Worked (d)	10.8	5.4	3.9	1.5
Total Factor Productivity (e)				
- incl. Nonresidential (NRS) Capital	2.8	2.1	1.7	1.1
- incl. NRS Capital and Human Capital	2.4	1.5	1.1	0.5
- incl. NRS Capital, Human Capital and R&D	1.8	1.2	1.0	0.4
Percentage Contribution to Growth Rate of Value Added per Hour Worked of:				
1) nonresidential capital stock	38	35	39	34
2) human capital stock	9	19	21	36
3) total factor productivity, incl. R&D stock	53	46	41	31
Total contribution (1+2+3)	100	100	100	100
4) R&D stock	12	8	7	4
5) total factor productivity, exl. R&D stock	41	38	34	27

Source notes:
(a) Value added per hour worked, see Table 1.
(b) Capital stock based on perpetual inventory method from Groote, Albers and de Jong (1996) for 1938-50. Investment was accumulated on the basis of 39 and 14 years life assumptions for nonresidential structures and machinery and equipment, respectively
(c) Human capital stock was constructed on the basis of estimates from Maddison (1987, 1991 and 1996) and OECD (1998). These estimates represent educational attainments of the working-age population (15-64 years) distinguished according to primary, secondary and tertiary education, which were weighted at 1.0, 1.4 and 2.0, respectively in line with evidence on relative earning differentials
(d) R&D stock was constructed on the basis of R&D expenditure deflated at the GDP deflator, and accumulated on the basis of a 15-year life time for each R&D investment.
(e) TFP estimates were obtained by applying a translog index based on a Solow-type production function, using average factor shares for each current year and the previous year as weights. Labour compensation weights were augmented with labour compensation for selfemployed persons on the basis of imputed employee compensation. TFP 'incl. NRS capital, Human Capital and R&D' is derived by taking into account the change in the R&D stock using a weight of 0.05 on top of the average factor share. For details, see van Ark and de Jong (1996).

These results suggest that despite the decline in labour cost, the contribution of physical capital to labour productivity growth did not fall much and the human capital contribution even increased. If R&D and TFP are interpreted as technology variables, the cause of the slowdown in labour productivity would be due to a slowdown in innovation. This hypothesis will be further analysed in the next two Sections which looks at the productivity and technology performance by industry.

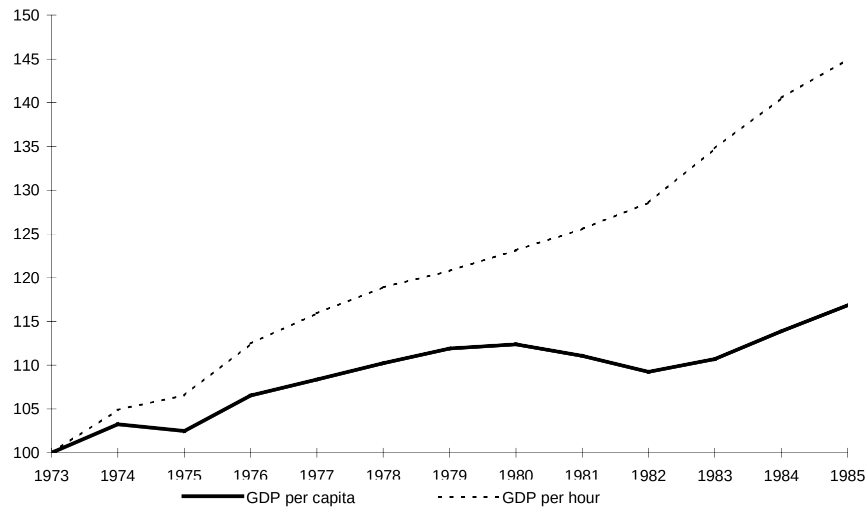

Figure 1a. GDP per Capita and GDP per Hour Worked, Netherlands 1973-85 (1973=100)

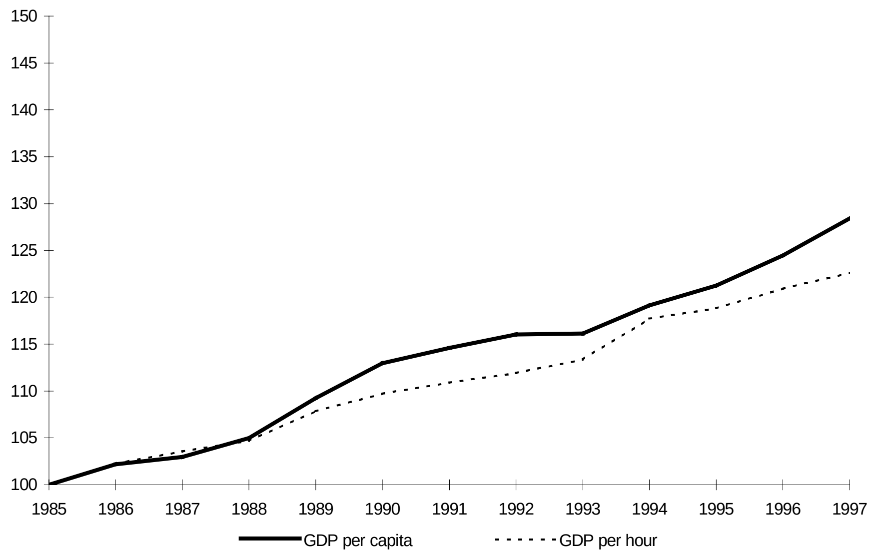

Figure 1b. GDP per Capita and GDP per Hour Worked, Netherlands 1985-97 (1985=100)

3. PRODUCTIVITY PERFORMANCE BY INDUSTRY

On the basis of the evidence from the previous section, one might hypothesise that at the macro level there is a negative relation between the acceleration in employment growth and the slowdown in productivity growth. This might have been caused by a net expansion of labour in industries which are characterised by an above-average share of low-skilled labour or which, for any other reason, have lower productivity growth rates than the average for the economy as a whole. Even with similar growth rates between industries, productivity growth for the economy as a whole might slow down when an increased concentration of economic activity occurs in activities with low productivity levels.

To measure the effect of labour input shifts on the overall productivity growth, one may express the productivity for the economy as a whole as the productivity level by sector weighted by the sectoral employment shares:

$$P_m = \frac{Y_m}{L_m} = \sum_{k=1}^{n} \left(\frac{Y_k}{L_k}\right)\left(\frac{L_k}{L_m}\right) = \sum_{k=1}^{n} \left(P_k S_k\right) \qquad (2)$$

with Y and L representing output and labour input by sector ($k=1..n$) and the total economy (m), P representing productivity (Y/L) and S representing the sectoral labour input share (L_k/L_m). In a time perspective this expression can be rewritten as:

$$\Delta P_m = \sum_{k=1}^{n} \left(\Delta P_k * S_k\right) + \sum_{k=1}^{n} \left(P_k * \Delta S_k\right) + \sum_{k=1}^{n} \left(\Delta P_k * \Delta S_k\right) \qquad (3)$$

The first term on the right-hand side of Equation (3) represents the intrasectoral productivity growth, which is the part of the overall productivity change due to productivity growth within each of the sectors. The second term is the net shift or static effect, which measures the effect of the change in sectoral employment shares on overall productivity growth. The net shift effect may also be called "static" because it measures the effects due to higher or lower productivity levels between sectors. This effect is positive when labour moves into sectors with higher levels of productivity. In contrast, the second term is negative when the new activities have lower productivity. The third term is the interaction or dynamic effect, which represents the joint effect of changes in employment shares and changes in sectoral productivity growth. This effect may be called "dynamic" because it measures the effect due to higher or lower productivity growth rates between sectors. The interaction effect can be either negative or positive, depending on whether sectors with a falling (rising) share show rising (falling) productivity (then it is negative) or sectors with a falling (rising) share show falling (rising) productivity (then it is positive).[9]

Table 7 shows the percentage contributions of the three effects to the overall labour productivity growth for ten sectors.[10] We chose the sub-periods according to the peak points in the business cycles in the Netherlands. When looking at the first subperiod (1976-1989) we find that 85 percent of productivity growth is explained by growth within each sector. However, the net shift effect accounted for 18 percent of productivity growth during this period. This positive static effect is in particular the result of higher productivity levels in financial and business services for which the share in employment rose. The dynamic effects are very small during this period.

During the second sub-period (1989-1998) the positive effect due to the increased importance of financial and business services was even stronger, but this was offset by an equally strong outflow of labour from other high productivity sectors, such as manufacturing and government services. Hence the net shift was small at the level of the economy as a whole.[11] Together with the small interaction effect, this implies that “within sector”-productivity growth was the dominant driving force behind the (slower) productivity growth at macro level during the second sub-period.

Hence the conclusion from Table 7 is that there is little support for the view that the slowdown in productivity growth is related to an increase in low-productivity activities. The positive sign of the net shift effect during the first sub-period helped productivity to accelerate instead of to decelerate. This perhaps somewhat counterintuitive result can be explained by the fact that, even though productivity *growth* in many service sectors was *slower* than in commodity sectors, the absolute *level* of value added per hour in

9 See van Ark (1996) and Timmer (2000) for details on the shift-share method.

10 Compared to our previous work (van Ark and de Haan, 1999, 2000) we refined our shift-share calculations following Timmer (2000). The refinement allows us to show the percentage contribution of each effect by sector. In our previous estimates we showed larger positive static and negative dynamic effects for both subperiods, but these were largely offsetting each other, in particular during the second period. The dominant role of intrasectoral effect is clear from both methods.

11 When excluding government from the calculations, the net shift from 1989 to 1998 turns negative to minus 7 percent, which in combination with an interaction effect of minus 4 percent, would suggest that both shift effects together take 0.1 percent per year of the productivity growth rate in the market sector. See also CPB (1998a) which shows a small negative net shift effect from sectoral reallocations. However, like in this study, the main explanation for the productivity slowdown according to the CPB study is the decline in “within-sector” growth rates.

finance and business services and other market services was *higher* than in agriculture or manufacturing.

Table 7. The Percentage Contribution of Intra-Sectoral Effect, Net-Shift Effect and Interactive Term by Sector to Growth Rates of Labour Productivity, Netherlands, 1976-89 and 1989-98

	Intra-Sectoral Effect	Net shift Effect	Interaction Effect	Total %-Contri-bution
	1976-1989			
Agriculture (a)	11.4	-2.1	-0.2	9.2
Mining	-11.4	8.4	-1.0	-4.1
Manufacturing	37.2	-17.0	-0.7	19.4
Public utilities	1.9	-0.9	-0.1	0.9
Construction	8.0	-8.0	-0.6	-0.6
Wholesale and retail trade	20.9	-0.5	-0.1	20.3
Transport and communication	10.9	0.9	0.0	11.8
Finance, insurance and business services (b)	-1.3	24.5	-0.1	23.1
Other market services	-2.7	9.5	-0.2	6.7
Government services	10.3	3.0	-0.1	13.3
Total sectors	85.3	17.9	-3.1	100.0
Productivity growth rate (c)	1.6	0.3	-0.1	1.9
	1989-1998			
Agriculture (a)	11.0	-6.8	-0.4	3.8
Mining	4.3	-2.6	-0.2	1.5
Manufacturing	37.7	-25.4	-1.0	11.2
Public utilities	6.1	-4.3	-0.3	1.4
Construction	-2.6	-2.3	0.0	-4.9
Wholesale and retail trade	12.1	6.9	0.0	19.0
Transport and communication	20.5	-0.9	-0.1	19.6
Finance, insurance and business services (b)	-4.5	43.9	-0.6	38.8
Other market services	2.4	8.7	0.0	11.1
Government services	14.9	-16.1	-0.4	-1.6
Total sectors	101.8	1.1	-2.9	100.0
Productivity growth rate (c)	1.4	0.0	0.0	1.4

(a) includes forestry and fisheries; (b) excluding real estates; (c) the estimates of value added per hour worked in this table are based on sectoral accounts, which differ slightly from those for the total economy (Tables 1 and 6 and Figures 1a and 1b). Firstly, the sectoral accounts use the trend in GDP and labour input for 1995-1998 based on the most recent national accounts revision. Secondly, the accounts here exclude the letting and sale of real estate. Thirdly, the trend in sectoral estimates of working hours, which are based on the change in contractual hours, suggests a somewhat more moderate decline of working hours than the trend in actual hours which we used for the economy as a whole.
Source: Up to 1995 from CBS, *Nationale Rekeningen 1997* and *Arbeidsrekeningen 1997* (and previous issues). From 1995 onwards from CBS, *Nationale Rekeningen 1998.* Trend in working hours 1960-1995 are for contractual hours from CBS (unpublished).

However, further research is required to settle the issue of the shift-share effect. Firstly, as will be discussed in more detail below, measurement problems may lead to an understatement of productivity growth in services with substantial technological or organisational changes. Secondly, the assessment of the productivity slowdown may be expanded to measuring the impact of variables other than the distribution of employment by sector. For example, CPB (1997a, 1998b) also accounted for shift effects from changes in composition of educational levels, age, sex and the share of part-time labour in the labour force. These estimates suggest some small negative shift effects for the 1980s (in particular in services). However, since 1990 the shift towards more highly trained people and a more experienced labour force positively contributed to labour productivity growth.

The most important message that follows from the foregoing analysis is that the productivity slowdown has been across the board. This is confirmed by Table 8, which shows that with the exception of mining, public utilities, transport and communication and government services, labour productivity growth during the period 1989-98 was slower than during the period 1976-89. The slowdown was particularly large in construction, trade and other market services. The finance, insurance and business services sector, which was the sector with the most rapid increase in labour input, had negative labour productivity growth during both subperiods.

To some extent the slow or even negative productivity growth in services is related to measurement problems, in particular in sectors in which the share of new or improved products, for which the output growth is difficult to measure in real terms, increased. For example, the negative productivity growth rates registered in the banking sector are strongly affected by measurement problems. Traditionally, real output growth in banking has been calculated on the basis of the sum of the real value of intermediate inputs and labour cost, thus implicitly imposing productivity growth on the output indicators. Recent experimental calculations by Statistics Netherlands, based on weighted volume indicators, which represent interest margins and procuration, suggest an increase in labour productivity in the banking sector of 3.6 percent per year over the period 1987-1995 (CBS, 1997; Hogenboom and van de Ven, 1998).[12] However, it seems unlikely that corrections for mismeasurement will be as large for other service sectors. The traditional method for banking appeared to miss a particularly large amount of innovation and efficiency improvement in the sector. Recent studies for other sectors, such as business services, do not suggest the same kind of improvements (CPB, 1998c; van der Wiel, this volume).

[12] These corrections have been integrated in the most recent national accounts of Statistics Netherlands but have not yet been worked back for years before 1995.

Table 8. Sectoral Labour Productivity, Capital Intensity and Total Factor Productivity Growth, Netherlands, 1976-1989 and 1989-1998

	Value added per hour worked		Nonresidential Capital per hour worked		Total Factor Productivity	
	1976-89	1989-98	1976-89	1989-98	1976-89	1989-98
Agriculture (a)	5.3	4.3	5.5	3.0	3.4	3.1
Mining	-3.3	1.0	1.3	2.6	-4.5	-1.9
Manufacturing	3.6	3.1	3.2	2.8	2.8	2.1
Public utilities	1.4	4.7	0.1	3.2	1.4	2.6
Construction	2.1	-0.7	3.3	1.2	1.8	-0.9
Wholesale and retail trade	2.6	1.1	3.6	1.5	1.9	0.7
Transport and communication	2.7	3.8	2.4	1.7	2.0	3.2
Finance, insurance and business services (b)	-0.3	-0.5	-0.4	-0.7	-0.2	-0.6
Other market services	-0.4	-1.0	1.0	0.7	0.2	0.7
Government services	1.4	2.0	(c)	(c)	(c)	(c)
Total sectors (d)	1.9	1.5	2.2	1.1	1.4	1.1

(a) includes forestry and fisheries; (b) including real estates; (c) included in other market services; (d) productivity growth rates for the total GDP differ slightly from those reported at the aggregate level as explained in Table 7.

Source: GDP and labour input, see Table 7. Capital stock based on perpetual inventory method as calculated by Ronald Albers (DNB) and Joost Beaumont (UvA) using investment in nonresidential capital stock from CBS for 1921-38 and from 1950 onwards, and from Groote, Albers and de Jong (1996) for 1938-50. Investment was accumulated on the basis of 39 and 14 years life assumptions for nonresidential structures and machinery and equipment, respectively. TFP on the basis of translog production function with changing sectoral labour compensation weights averaged derived from CBS, *Nationale Rekeningen* (various issues), augmented with labour compensation for self-employed persons on the basis of imputed employee compensation.

Sectoral estimates of the capital stock are still difficult to obtain for the Netherlands because of serious data problems concerning the time series on investment. The capital stock figures used for the construction of total factor productivity estimates in Table 8 are based on the perpetual inventory method.[13] The figures in Table 8 show that the accumulation of fixed capital per hour worked and total factor productivity growth slowed down in most sectors since 1989.

[13] These estimates have been kindly supplied by Ronald Albers (Netherlands Central Bank) and Joost Beaumont (University of Amsterdam) who (mainly) used official investment data from Statistics Netherlands (CBS). These estimates are subject to revision in particular because the official investment figures pre-1987 and post-1987 are not fully consistent and require further adjustment (see CPB, 1998a). For the post-1995 period only the trend in investment is used, not the level.

Slow total factor productivity growth should not be interpreted rightaway as a sign that the Dutch economy suffers from slow technological progress. Firstly, it has been well established that TFP growth, as obtained from Tables 6 and 8, is not an adequate measure of technological change because it is derived as a residual from deducting the change in capital intensity from the change in labour productivity. Hence, the residual reflects the impact of growth from quality change of production factors (including education and training of the labour force), and from a variety of other factors ranging from the impact of research and development, managerial skills, entrepreneurial innovation, externalities and scale economies.[14] In contrast, a substantial part of investment in physical and human capital may be interpreted as embodied technological change.[15]

Secondly, even if we accept that TFP growth rates can serve as proxies for technological change, a striking observation is that, during the period 1989-1998, a dichotomy arose between the performance of the sectors. On the one hand, even though agriculture, manufacturing, public utilities and transport and communication experienced slower capital intensity and TFP growth than during the previous period, they continued to increase at a rate higher than the economy-wide growth rate. On the other hand, major parts of services (including trade, finance, insurance and business services, other market services and government services) were characterised by below-average growth of capital intensity and TFP. On the basis of a stylised distinction, one might argue that the first group typically represents sectors which can be characterised as "technology creators" whereas the second group consists of typical "technology users".[16] This suggests that the explanation behind the productivity slowdown may come from inadequate technology use rather than lack of invention and innovation. This hypothesis will be further investigated in the final section of the paper by looking into the role of indicators of technology and human capital creation.

14 See, for example, Maddison (1987) and Abramovitz (1991).

15 See, for example, Jorgenson (1995).

16 See, for example, Papaconstantinou, Sakurai and Wyckoff (1996) who, on the basis of input-output analysis of purchases of intermediate and capital inputs determine clusters mainly consisting of service industries as being typical technology users, whereas manufacturing industries are typically classified as technology performers. This distinction does not imply that innovation in services is unimportant. Instead it suggests that the positive productivity effect from innovation in these sectors strongly depend on their ability to successfully use technology from elsewhere.

4. THE ROLE OF INVESTMENT IN INTANGIBLE CAPITAL IN TECHNOLOGY DIFFUSION

Technological change is often equated with invention and innovation. In this line of thinking expenditure on research and development, licensing and patenting are mostly taken as variables to proxy the dynamics of the process of technology creation. Various scholars have argued that the process of diffusing new technologies and adapting these to local circumstances and within firms are crucial to reap substantial productivity gains from technological change.[17] The improvement of skills of the labour force is an important driving force behind the technology diffusion process. “Upskilling” and “reskilling” are seen as necessary conditions for productivity growth, either through the ability of workers to apply new productivity-enhancing technologies or through their greater capacity to improve work organisation.[18]

Table 9 shows the total investment in intangible capital since 1975 and its percentage distribution across various categories. When looking at formal education, government expenditure declined from 6.3 percent of GDP in 1975 to 4.6 percent in 1997. This decline in expenditure on education is partly determined by demographic developments. However, even after a correction for the decline in the share of 0-19 years olds in the population, the share of expenditure on primary and secondary education in GDP still shows a decline of 0.5 percentage points compared to the late 1970s. Meanwhile the share of all intangible investment in GDP remained relatively constant at between 10 and 11 percent until the beginning of the 1990s. Since then it has risen by a full percentage point. This implies the increased importance of other types of intangible investment, including R&D, licenses, software as well as marketing and technical services and consultancy, in both relative and absolute terms.

[17] See, for example, Stoneman (1983, 1987) and Dosi, Pavitt and Soete (1990). For a more historical account of the importance of technology diffusion see, for example, Mansfield (1968) and David (1975).

[18] See, for example, Nelson and Phelps (1966), Bartel and Lichtenberg (1987), Benhabib and Spiegel (1994) and OECD (1997, 1998). For a discussion of this relation more specifically focussed on a comparison of the Netherlands and Germany, see Cörvers**,** de Grip and Orbon (1995). However, the relation between human capital, technology use and productivity growth is a complex one, in particularly in services. Whereas the direct relation between these factors may be a positive one, there may also be a more neutral effect as the rise in technology and productivity raises income and therefore increases demand for relatively low-skilled services jobs. See also Jacobs, Nahuis and Tang (in this volume) for a more negative view on the complimentarity of human capital creation and technology diffusion.

Table 9. Investment in Intangible Capital and Percentage Contribution of Individual Components, 1975-1997

	1975	1979	1982	1987	1991	1997 (a)
Total Human Capital Investment (mln. DFL)	23,015	34,315	39,505	47,715	59,541	83,551
as a % of GDP:						
- only education	6.3	6.5	6.1	5.2	4.8	4.6
After adjustment for change in share of 0-19						
Year olds in population since 1975 (b)	*6.3*	*6.9*	*6.8*	*6.6*	*6.4*	*6.4*
- all intangible investment	10.5	10.9	10.7	10.8	11.0	11.8
	Share in Total Human Capital Investment (%)					
Education (c):	59.8	59.8	56.5	48.1	43.3	38.8
Universities	6.3	6.1	4.3	4.1	3.9	3.8
Other High Education	4.3	4.9	4.5	3.8	4.1	3.8
Primary and Secondary Education	45.2	44.6	43.3	35.4	29.9	26.9
Company Training	4.0	4.3	4.5	4.8	5.3	5.6
Technology:	25.8	25.0	27.8	34.6	35.7	40.5
Research and Development:	19.3	17.3	18.4	21.0	17.4	18.0
Business	10.1	8.7	9.4	12.3	9.2	9.8
Public Research Institutes	4.9	4.5	4.4	4.4	4.1	3.2
Universities	4.3	4.1	4.7	4.3	4.1	4.9
Software	4.2	4.4	4.9	5.8	8.2	10.5
Licenses	2.3	3.3	4.4	7.8	10.1	12.1
Other:						
Marketing	14.0	14.9	15.4	16.9	19.1	20.2
Technical Services and Consultancy	0.5	0.4	0.3	0.4	0.6	0.5

(a) provisional estimates.
(b) assuming an unchanged share of 0-19 year olds in the total population since 1975.
(c) only current expenses on education, excluding public subsidies for students.
Source: Estimates up to 1991 from Minne (1995), Annex A; extrapolated to 1997 estimated, mostly on the basis of sources quoted by Minne (1995) derived from Statistics Netherlands. GDP and population distribution also from Statistics Netherlands.

In the remainder of this section we will look in some more detail at three crucial components of intangible investment. Firstly, we will examine human capital creationin more detail. Secondly, we will focus on a typical indicator of technology creation, *i.e.* the investment in research and development. Finally, we will concentrate our attention on technology use, and more specifically on whether service sectors have made sufficiently use of new technologies to create new service concepts. In this framework we will also discuss the role of investment in information and communication technology.

Table 10. Skill Proportions of the Workforce, Netherlands, UK, Germany and USA

	Netherlands			UK	USA	Germany
	Total Economy	Exposed Sector (a)	Sheltered Sector (b)	Total Economy	Total Economy	Total Economy
	1979	*1979*	*1979*	*1978/79*	*1978/79*	*1978/79*
Low skills	52.4	65.2	57.4	71.5	72.8	34.5
Intermediate skills	32.5	28.0	34.7	21.8	11.4	58.5
High skills	15.1	6.8	7.9	6.8	15.8	7.0
	1993	*1993*	*1993*	*1993*	*1993*	*1993*
Low skills	34.6	44.6	38.4	55.7	60.4	27.8
Intermediate skills	42.8	41.2	45.2	30.9	17.5	60.7
High skills	22.5	14.0	16.3	13.5	22.1	11.4

(a) refers to agriculture, industry, public utilities and transport and communication.
(b) refers to trade, finance, insurance and business services, "other" market services and households.
Higher skills are defined as "degree and above," for the Netherlands all higher education; intermediate skills are "vocational qualifications above high school but below degree," for the Netherlands advanced general secondary education (havo and vwo above 4 years) intermediate vocational qualifications (mbo) and most apprenticeship education; low skills is the remainder, for the Netherlands including only primary education, lower vocational education (lbo), lower general secondary education (mavo) and schools for less-abled pupils.
Source: Netherlands from CBS (1996); UK, USA and Germany from O'Mahony (1998)

The human capital measures which are used for the growth accounting approach in Tables 6 and Table 9 for the distribution of expenditure are necessarily crude, as they only distinguish between primary, secondary and tertiary education, and do not reflect differences in the educational levels of the various schooling systems. Moreover, these measures relate to the total working age population. In particular, differences in the organisation of general education vis-à-vis vocational education are insufficiently reflected. Table 10 therefore provides an international comparison of skills of employees between the Netherlands, Germany, the United Kingdom and the United States.[19] The table clearly shows that the Dutch labour force is relatively well-educated. In 1979, the share of the labour force with high skills, *i.e.* higher vocational education or university, was almost as high as in the United States, and in 1993 it was even higher. Intermediate skills, which include a large share of employees with intermediate vocational skills, were better represented in the Netherlands than in the United Kingdom and the

[19] The measures are somewhat at odds with those used by the OECD, which are based on the International Standards Classification of Education (ISCED). The latter refers mainly to years of study and age associated with an educational cycle, rather than actual contents (OECD, 1998).

United States, but lower than in Germany. These figures reflect the large share of vocationally trained people in the Dutch and German labour force relative to the other two countries, even though there are also important differences between the German and Dutch systems of vocational education. Whereas the German system is characterised by an extensive dual schooling system, combining learning in schools with in-company training, the Dutch system relies to a much larger extent on full-time vocational training in schools with only relatively short periods of practice. Indeed, in 1994 as much as 55 percent of pupils in upper secondary education in Germany were classified as apprentices against 25 percent in the Netherlands. The German apprenticeship system has been praised by many scholars[20], but others have criticised it for its very high cost and for its lack of flexibility in an environment of a rapid structural change.[21]

One might expect that the greater reliance of the United States and the United Kingdom on general rather than vocational education is compensated by a greater amount of job-related training. Indeed, the International Adult Literacy Survey suggests that 46 and 52 percent of workers in the United States and the United Kingdom, respectively, spend about 100 hours on job-related training during the first twelve months in a new job. In the Netherlands, the percentage of new workers in training during the first year is lower (only 32 percent), but they spend more than 150 hours on training.[22]

When looking at the sectoral distribution of skills in the Netherlands, it also appears that not only the technology-creating industries, but also the technology-using industries are characterised by high skill levels. The shares of high and intermediate skilled people in the sheltered sector, which mainly consists of services, are even higher than in the exposed sector, which includes agriculture, manufacturing, public utilities and transport and communication. Furthermore, participation in company training is higher than average in transport and communication (52 percent) and financial services (84 percent), but lower in business services, where the percentage is 31 percent (CBS, 1996a). This evidence does not support the hypothesis that there is a technology use problem due to human capital shortages.

The share of R&D expenditure in GDP has shown an interesting pattern since the mid 1970s. R&D intensity by business and government together increased to about 2.2% by the late 1980s. This was lower than in other Northwest European countries, which is mainly due to the relatively small share of typical high-tech industries (such as pharmaceuticals, electronics,

[20] See, for example, CPB (1997b), pp. 319-329.
[21] See OECD (1994) and Paqué (1998).
[22] See OECD (1998), Table A3.4. According to CBS (1996a) 35 percent of all workers in 1993 followed company training, of which about 60% was offered externally and 40% internally.

etc.) in Dutch manufacturing. Since the late 1980s business R&D intensity declined for about a decade whereas government R&D intensity remained fairly constant. Since 1992 total R&D intensity has begun to accelerate once again up to more than 2 percent in 1997. Strikingly much of the recovery in R&D intensity is due to a rise in R&D in services, in particular in business services.[23]

Technological and organisational innovations in services are becoming increasingly important overall performed as the share of this sector in GDP and total employment rises. R&D expenditures are only a very crude indicator of services innovation, but fortunately recent innovation surveys provide evidence on other innovation measures, such as investments in design, licenses, marketing and training. Table 11 compares the percentage of firms in manufacturing and services that innovate, the share of each innovation activity in total innovation expenses, and the innovation intensity of each activity in both sectors. Even though innovation intensity in services is still much lower than in manufacturing (colum 3), an equal percentage of firms (namely 89%) in manufacturing and services are engaged in innovative activities (colum 1). The distribution of innovation expenses is quite different, as service firms spend more in relative terms on anything else than R&D (colum 2).[24]

As the innovation surveys are harmonised across European countries by Eurostat, it is possible to compare innovation efforts in services with those in other countries. Such comparisons suggest that the Netherlands is somewhat behind the European on average services innovation (Foyn, 1999). For example, the percentage of services firms that has introduced new or improved products or processes is 36 percent for the Netherlands compared to an EU average of 41 percent. In financial services the gap is bigger at 40 percent for the Netherlands compared to 55 percent for the EU average In contrast the number of innovating firms in manufacturing is reported to be higher in the Netherlands than in the EU as a whole, namely 62 percent of all firms against 53 percent.

Much of the innovation activities in services are related to expenditure on and investment in information and communication technology (ICT). Table 12 shows the share of services in intermediate use of and investment in ICT goods and services from 1990 to 1998. Whereas the share of intermediate use in services of ICT goods has declined somewhat, the use of ICT services increased beyond the share of services in GDP. Similarly investment in ICT goods and in particular ICT services increased rapidly.

[23] See, for example, OECD (1999) . It should be emphasized that part of this rise is due to the fact that R&D in services was not properly measured before.

[24] See also van Ark, Broersma and de Jong (1999).

Table 11. Innovators and Innovation Expenses in Manufacturing and Services, Netherlands, 1996

	Percentage of Firms making Innovation Expenses	Share in Total Innovation Expenses	Innovation Expenditure as % of Value Added
	(1)	(2)	(3)
Investment in equipment destined for innovation			
Manufacturing	61	33	3.7
Market Services	64	44	1.3
R&D expenditure with own personnel			
Manufacturing	67	46	5.2
Market Services	46	17	0.5
Purchased R&D			
Manufacturing	30	7	0.8
Market Services	26	5	0.2
Technical design and other development costs			
Manufacturing	20	3	0.3
Market Services	31	8	0.2
Licenses, consultancy, software not related to R&D			
Manufacturing	10	1	0.1
Market Services	23	8	0.2
Marketing			
Manufacturing	23	4	0.5
Market Services	24	5	0.2
Training			
Manufacturing	42	6	0.7
Market Services	53	12	0.4
All Innovation Activities			
Manufacturing	89	100	11.2
Market Services	89	100	3.0

Services include trade, hotels and restaurants, transport and communication, financial and business services and other market services
Source: CBS (1996a), CBS (1998)

Table 12. Share of services in total ICT expenditure and investment, 1990-1998 (%)

Intermediate use of ICT goods and services in the service sectors			
ICT goods	40	29	31
ICT services	75	80	79
Investment of ICT goods and services in the service sector			
ICT goods	n.a	72	74
ICT services	n.a	67	76(a)

(a) 1997

Services include trade, hotels and restaurants, transport and communication, financial and business services and other market services and government. The definitions of ICT goods and services have changed somewhat between 1990 and 1995-98. ICT goods roughly include computers and telecommunication equipment. ICT services include ICT services and software producers.

Source: CBS (1996b, 1999)

In conclusion, the evidence from this section does not strongly point towards an underperformance in terms of intangible investment in services. This, however, does not yet answer the question on how the average investment performance can be related to the relatively slow productivity growth in services. One reason might be that a better balance between technological change and improvement in human capital is needed. Hence, from a policy perspective, the slowdown in the GDP share of educational investment to 4.6 percent, which is also lower than the average education share in GDP of 5.1 percent in the EU in 1995, is a matter of concern.[25] Moreover, as the human capital theory also points to high "consumption value" of education, these investments also contribute directly to a better use of ICT by consumers.

5. CONCLUSION AND DIRECTIONS FOR FURTHER RESEARCH

This paper started form the observation of the strikingly divergent trends in income per capita and productivity in the Netherlands since the mid 1980s. We show that the acceleration in per capita income and the slowdown in labour productivity growth is related to a strong increase in labour force participation. As much as 37 percent of the growth rate of real GDP (and 22

[25] See OECD (1999), table 2.1.11

percent of the growth rate of GDP per capita) since 1987 is due to the rise in labour input. As shown in earlier papers (van Ark and de Haan, 1999, 2000) the policy of wage moderation since the early 1980s has contributed to the strong employment creation.

In this paper we focused on explanations for the downside of the growth acceleration story, which is the slowdown in productivity growth. We show that the (combined) effect of changes in the composition of the labour force and a greater concentration of labour in services, which are typically characterised by lower productivity growth, explains little of the productivity slowdown. Even though there is some evidence of an underestimation of productivity growth in services (in particular in the banking sector), the slowdown in productivity growth is unlikely to be explained entirely by measurement problems.

Measures of total factor productivity growth show that that despite a slower growth of capital capital intensity, the contribution of capital intensity to labour productivity growth has only slightly declined. Hence the claim that wage moderation led to a fall in capital-output ratios seems unjustified.

We also found that the productivity slowdown affected all sectors of the economy, and that this concerns both labour productivity and total factor productivity. Sectoral analysis, however, shows that the productivity growth rates in typical technology-using industries, such as trade, finance, insurance and business services, were below the economy-wide growth rate. In contrast, growth rates in typical technology-creating industries, such as manufacturing and agriculture, also show a slowdown, but these were still above the economy-wide average. As the diffusion and use of technology is related to the performance of human capital as a production factor, we analysed the hypothesis that the contribution of human capital to growth might have faltered. This hypothesis is again not confirmed by the evidence. Most of our evidence points to the contrary. The human capital intensity, in particular in services, has substantially improved.

However, we do find shifts in the composition of intangible capital, showing that the share of investment in software, licenses, marketing and (most recently) even R&D has risen at the expense of the share of investment in education. This may have slowed the capability to develop new products and processes in services. For example, we find that the innovative capability of the service sector is somewhat below the average European performance. Other studies have pointed towards the possibility of substantive X-inefficiencies in service sectors and a lack of organisational innovation.[26] Further research on micro-data from production and innovation statistics is needed to shed light upon how widespread these problems are.

[26] See, for example, CPB (1998b, 1998c) and the contribution by van der Wiel (2000) to this volume.

In earlier papers (van Ark and de Haan, 1999, 2000) we also looked at the possible contribution of structural reforms to employment growth and found that the evidence is inconclusive. We also noted that various measures concerning liberalisation of product markets, including the extension of opening times of shops, privatisation of public transport services and the abolition of regulations etc. in many areas of services, have mostly been taken in recent years, and that it is unlikely that such measures will have a large impact on growth in the short term. However, Koedijk and Kremers (1996) find a significant relation between productivity growth and product market regulation for 11 EU member states over the period 1980-94. Hence a further monitoring of the effects of product market regulation and deregulation is another fruitful avenue for further research.

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