WORKING PAPER

Intangible Capital in the Netherlands and its Implications for Future Growth

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About This Report
This report, which was commissioned by the Dutch Innovation Platform as part of their Knowledge Investment Agenda (KIA), was developed by The Conference Board. The aims of the report are to measure the overall size and impact of intangible investments and capital in the Dutch economy since 1995, to analyze their impact on economic growth, and to sketch a number of growth scenarios aimed at identifying how an increase in public expenditure on intangibles would affect future growth. The approach and conclusions from this report do not necessarily reflect the views of the Innovation Platform.

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About the Dutch Innovation Platform
The Dutch Innovation Platform is a national body designed to unite companies, knowledge institutes and government to promote innovation and encourage initiative. The platform includes the participation of 17 key figures from the world of government, business, science and academia, and education. It also includes members from specific sectors, including healthcare and the water industry. They take part in the platform in a personal capacity and enjoy support from their own specific sectors. The Dutch Innovation Platform is headed by the Dutch Prime Minister, who serves as the platform's chairman. The platform is supported by a project office.

Table of Contents

Summary

This study is concerned with the role of intangible capital in the Dutch economy. We estimate how much the private and public sectors in the Netherlands invested in intangible assets until 2008. Using the growth accounting methodology, we compute the contributions of labour, physical capital, and intangible capital to economic growth from 1995-2008. We also compute scenarios aimed at quantifying the effects of different trends in intangible investment on economic growth until 2020.

A unique feature of this report is the combined study of investment in intangibles in the commercial and public sectors of the economy. We highlight the effects of investment in public R&D and education. Total investment in the commercial sector amounted to 49 billion euros in 2008 and 35 billion euros in the public sector, of which 25 billion was for education. This is equal to 14.2 percent of GDP, of which 8.3 percent came from intangible investment in the commercial sector and 5.9 percent came from public intangible investment.

Intangibles accounted for 1.4 percentage points or almost half of the 3 percent output growth in the total economy from 1995 to 2008. Public intangibles, including education and public R&D (reflecting internal and external effects), made up for about one-third of the intangibles' growth contribution, and commercial sector investment accounted for the remainder. Our base scenario from 2010 to 2020 posts a GDP of 1.9 percent, relative to 2.2 percent from 2000 to 2008. The slower growth is mainly the result of a decline in the contribution of labour input, but the intensity of intangible per unit of labor is assumed to remain stable in the base scenario. According to the most optimistic growth scenario, which assumes an increase in the share of public intangible investment in GDP by 1 percentage point (equal to about 7 billion euro) by 2020, and a corresponding increase in private intangible investment, GDP growth will improve by 0.2 percentage points relative to the base scenario, increasing the level of GDP in 2020 by 15.5 billion euro, which equals 2.2 percent of total GDP. In contrast, keeping public intangible investments in real terms constant at the current level could have devastating effects on GDP growth from 2010-2020, slowing it to between 1.5 percent in a lower pessimistic scenario and 1.7 percent according to an upper pessimistic scenario. It should be noted that the effect of higher investment in education will only pay off beyond 2020. With a slowing labor force, these investments will be even more important after 2020 to keep the growth rate of the economy at sustainable levels.

In conclusion, the study shows that continued investment in intangibles is a key part of keeping the growth of the Dutch economy on track. A destruction or slowdown in creation of intangible capital would hamper the ability to keep economic growth at sustainable rates. An accelerated investment in public intangibles equal to 1 percent of GDP will raise GDP growth permanently. The caveat is that the commercial sector needs to be able and willing to step up their investments to the same degree. While investment in public intangibles is an important factor in raising the potential for faster growth, the overall business environment will determine if the commercial sector is able to strengthen and exploit their own capabilities in this field to realize this potential.

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I. Introduction

Innovation is not free. While in the past, innovation and technological progress was sometimes treated as “manna from heaven,” such as in the traditional neoclassical model of economic growth, economists and other scholars have come to realize that innovation requires a long-term investment strategy that involves both the private (or commercial) and the public (or government) sectors of the economy. This study looks at the role of innovation, as measured by the contribution of intangible capital, to economic growth in the Netherlands from 1980 to 2020. The contribution of innovation and knowledge to growth and the implication for the Dutch public budget is of great interest, as a new prioritizing in government finances is currently underway. Even though information on public investment in knowledge and intangibles and their implications for economic growth is needed to make adequate policy decisions, detailed studies on how such investments impact the growth performance at the macro level are scarce. In addition, while studies often look at components of the innovation spectrum (for example public innovation programs or private expenditure), the combined effects of such inputs on the output of the economy are rarely studied comprehensively.

There is a long history of attempts to measure intangible investment, including Howitt (1996), Croes (2000), Lev (2001), and Khan (2001). Minne (1995) took a first step in measuring the effect of intangible expenditure and investment in the Netherlands, using research and development data from private, public and research organizations; education data and investments in software, marketing, licenses and patents; and technical service-providing and organizational advice. Since the late 1990s, Statistics Netherlands (CBS) has published these numbers on a regular basis in the *Kennis en Economie* series. Van Ark and de Haan (2000), while updating the work from Minne (1995), adopt a growth accounting approach to measure the impact of intangible capital in growth in the Netherlands from 1975 to 1997.

A significant step in measuring investments in intangible capital in the business sector was made more recently by Corrado, Hulten and Sichel (CHS 2005, 2009). CHS have argued that an input should be treated as an investment as long as it reduces current consumption with the aim to generate revenues in the long term. This has also been recognized in national accounting practice, since software is already included as an asset in aggregate accounts, and there has recently been a move to capitalize R&D (Hulten, 2008; van Rooijen-Horsten et al., 2008b).

There is, of course, more to intangibles than software and R&D. CHS advocate broadening the list of capitalized intangibles and classified expenditures on intangible assets in three categories (computerized information, innovative property and economic competencies). The authors have developed a methodology to measure and "capitalize" them, so that they appear as investment rather than expenditure in the national accounts. They have also formalized how intangible capital may be incorporated into the conventional GDP/GDI national accounting identity. The key to this extension is that the flow of new intangibles must be included *both* on the product side of the accounts and on the input/income side via the flow of services from the intangible stock.

Corrado, Hulten and Sichel (2005, 2009) and Marrano, Haskel and Wallis (2007, 2009) have also extended the growth accounting methodology to estimate how much investments in intangible assets contributed to the growth of the private sector in the United States and the United Kingdom, respectively. The methodology was extended to the Netherlands by van Rooijen-Horsten et al. (2008a and 2008b) and CBS (2009). Recent studies by The Conference Board have extended the existing estimates and provided an international comparison for eleven countries, including Austria, Denmark, Germany, Greece, France, Italy, Slovakia and Spain (Hao et al. 2009; van Ark et al. 2009). These studies show significant differences in the share of intangibles in total GDP. For example, in the United States, the private non-farm business sector invested 11.5 percent of conventionally measured GDP in intangible assets in 2006. In that year, the United Kingdom, the private sector invested 10.5 percent of GDP in intangibles, while Germany (7.2 percent), France (7.9 percent), Italy (5.0 percent) and Spain (5.5 percent) invested less. At 9.1 percent of GDP, according to CBS (2009), the Netherlands seems to occupy the middle ground. Indeed, there seems to be a positive relationship between intangible investment and the level of economic development of a country, although the research into how this relationship exactly comes about, and what the direction of causality is, is still in its early days (van Ark et al., 2009). The results of the studies mentioned above are summarized in Table 1.

A limitation of all of the studies cited above is that they focused entirely on intangibles in the commercial sector of the economy only. In this study, we include measurements of intangible assets in the public sector of the economy, including public R&D and general education. In Section 2, we present our measures of intangible investment in the commercial sector, as well as in the aggregate total economy in the Netherlands up to 2008. In Section 3, we use growth accounting methodology to compute the contributions of labour, physical capital and intangible capital to economic growth in the Dutch commercial sector and total economy. In addition to the aggregate contributions of intangibles and knowledge to growth, we also look at the growth contributions of the individual components of intangible capital. In Section 4, we offer three scenarios for future growth based on plausible assumptions about the growth pattern of intangible investments and their potential contribution to economic growth until 2020. We differentiate between a business-as-usual base scenario, an optimistic scenario (or "accelerated investment in intangibles") and a pessimistic scenario (or "stagnating investment"). The latter scenario offers some clues about the impact of different intangible investment scenarios on the growth performance of the Dutch economy.

II. Private and public investment in intangibles

Before we turn to intangible capital in the Netherlands, an explanation of the difference between investment and expenditure is required. The System of National Accounts (SNA, 1993) recommends that an expenditure that has long-lasting effects should be treated as an investment where the acquisition or own account production of an asset is concerned. The convention is that if the spending benefits the spender for more than one year, the spending is an investment (CHS, 2005). Treating expenditures on intangibles as investments also makes economic sense from a business strategy point of view. Outlays on software, R&D, advertising, training, organizational capital, etc., are critical investments that sustain a firm's market presence in future years, by reducing costs and raising profits beyond the current accounting period. Similarly, such investments are carried out with the expectation that they will increase the future profit of a firm, an expectation that has been validated in the studies that examine the positive correlation between R&D and patents and stock prices (Hall, 1999). Moreover, marketing intangibles (brand equity, customer satisfaction) determine whether or not a firm is competitive in the long run.

In a series of reports (van Rooijen-Horsten et al., 2008a; van Rooijen-Horsten et al., 2008b; and CBS, 2009), Statistics Netherlands has focused on the measurement and analysis of intangible investment in the Netherlands. Van Rooijen-Horsten et al. (2008a) discussed in detail conceptual and measurement issues and present time series of investment in intangibles (including by industry) until 2004. Van Rooijen-Horsten et al. (2008b) updated the estimates through 2005. The latest publication from Statistics Netherlands (CBS, 2009) publishes preliminary investments in intangibles up to 2008. The CBS study concludes that the Dutch commercial sector invested 9.1 percent of GDP (48.9 billion euros) in intangible assets in 2006. Table 1 summarizes the results from van Ark et al. (2009) and CBS (2009).

In order to estimate how much the Dutch economy invested in intangible assets in 2008, we extended the numbers for the commercial sector used by van Rooijen-Horsten et al. (2008a) and CBS (2009) to include intangible investment by the Dutch public sector. For the commercial sector, we largely follow the methodology laid out by Corrado, Hulten and Sichel (2005, 2006, 2009) and van Rooijen-Horsten et al. (2008a). The primary difference from the latter study is that we use a different definition of the commercial sector than that used by CBS. While CBS excludes “other industries,” such as real estate activities, renting of movables and private households with employed persons, from the commercial sector, we have included this category in our analysis.[1] We distinguish between the commercial sector and the aggregate economy as follows:

Industry classification:

1.	Agriculture, forestry and fishing	Commercial sector
2.	Mining and quarrying	Commercial sector
3.	Manufacturing	Commercial sector
4.	Electricity, gas and water supply	Commercial sector
5.	Construction	Commercial sector
6.	Trade, hotels, restaurants and repair	Commercial sector
7.	Transport, storage and communication	Commercial sector
8.	Financial and business activities	Commercial sector
9.	General government	Public sector
10.	Care and other service activities	Commercial sector
11.	Other industries	Commercial sector

[1] CBS justifies the exclusion of other industries with the argument that output and inputs are not measured independently in these industries. For the same reason, they exclude the public sector from their analysis.

We first estimated how much the Dutch public sector invested in the traditional CHS categories of intangibles (computerized information, innovative property, and economic competencies). (Our estimates for intangible investment in 2007 and 2008 are preliminary, as the commercial and the aggregate economy were approximated according to their shares of the total economy GDP in 2006.) We then added public investment in intangibles to the traditional CHS categories and education to arrive at investment in intangibles for the whole economy. To our knowledge, no recent study has combined public spending in knowledge and intangibles with measures for the commercial sector for the Netherlands.

Measuring intangible investment

As no formal statistical framework for the comprehensive measurement of intangibles exists, we had to resolve a number of problems to obtain these estimates. They should therefore be considered preliminary findings rather than definitive measurements.

Public R&D

De Haan and van Rooijen-Horsten (2004) and Tanriseven et al. (2008) emphasize that the capitalization process (i.e., transforming expenditure into investments) aims at identifying the part of R&D output that leads to the creation of a knowledge asset in the sense of the System of National Accounts. But is a broader capital concept that includes knowledge capital without any form of enforceable ownership rights desirable? For example, the government is not necessarily the owner of the knowledge that it creates in the public domain, even when it is financed and performed by the government. Thus, no ownership rights can be enforced when the knowledge is made freely available. Tanriseven et al. (2008) discussed the conflicting views in the literature about how R&D without enforceable ownership should be treated. According to their 2008 report, proponents of the inclusion of R&D output without enforceable ownership rights in the capital concept argue that the fact that the ownership rights cannot be enforced does not change the asset nature of R&D. They draw a parallel to roads and other public assets, which are also considered as an asset owned by the government on behalf of the community even though the services are provided at no charge. Dissenters to this idea point out that roads could be sold and still be still owned by the public sector. This would not be possible for knowledge once it has been made freely accessible to the public.

There has been a great deal of debate whether or not public R&D should be regarded as investment. Statistics Netherlands and others have argued that at least the pieces of public R&D that are not used in the production process of the owner (e.g., agriculture-technology research by universities that is not used in the production process of the government) should not be capitalized.[2] From this point of view, public R&D violates the definition of a fixed asset—an asset that is used in the production process for more than one year and generates benefits to its owner—used by the System of National Accounts. According to the EU R&D Taskforce, however, all R&D should be capitalized except for market R&D used in the R&D industry (that is, ISIC 73 in the 1993 classification). The latter is in all cases "subcontracting" and is therefore intermediate consumption in the production of R&D. The relevant OECD Manual (Handbook on Deriving Capital Measures of Intellectual Property Products) has also adopted this view. This position has also been adopted by the ISWGNA (Intersecretariat Working Group on National Accounts) and will therefore be included in the European System of Accounts. In the near future, all EU countries (including the Netherlands) will capitalize all R&D except for market-R&D used in the R&D industry.

We therefore deviate from CBS's definition and follow the new international guidelines described above. We treat "use of other R&D by general government" and "government consumption of non-market R&D" as public R&D and "investment in R&D on own account in all industries excluding public" and "investment in other R&D in all industries excluding public" as commercial sector R&D. We exclude R&D in the R&D industry (outsourced R&D that is incorporated in other R&D – meant for sale to other industries than the R&D industry) from our estimates.[3]

Overlap issues concerning R&D

1. Software with R&D Besides being a tool included in the total R&D expenditure, software may also be the subject of R&D (software R&D). This overlap only arises when internally produced software is taken into account. Expenditures for the development of internal software may be substantial and have to be subtracted when investments in software are

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[2] For a detailed discussion, see CBS (2009).

[3] R&D outsourced by the R&D industry to other industries is also included in our measure. Our output is not only based on expenditure alone, as sales and purchases by industry are taken directly from the R&D survey. R&D output in the R&D industry (including the outsourced R&D) is partly consumed by the general government industry and partly used by other industries. Because both parts are capitalized, all R&D investments are taken into account in the calculations.

estimated. Van Rooijen-Horsten et al. (2008a) emphasize that empirical evidence for the Netherlands indicates a substantial overlap between R&D and computer software development, and a double count in the gross fixed capital formation figures of the national accounts may be caused through the capitalization of R&D output. Both the Dutch R&D survey for enterprises and the survey for research institutes therefore included a question on the percentage of total R&D labour input that is devoted to ICT (in full-time equivalents).[4] This percentage is used to subtract software R&D from own-account R&D investment to avoid double counting.

2. R&D with education There are two overlap issues between R&D and education according to Croes (2000). First, training can be a spin-off or result of investment in R&D. R&D employees are likely to experience training by finding solutions. As training is related to many other activities in the creation of knowledge, it is linked to almost every intangible and is hard to capture. The second and more important overlap arises because many R&D expenditures are already included in public educational expenditure. In general, a correction (subtracting R&D expenditures in higher education from total public expenditure) may lead to an underestimation of total public educational expenditures. Nevertheless, Croes (2000) chose to subtract higher education R&D for all countries (including the Netherlands), despite the fact that this could lead to underestimation for investments in education.

For the purposes of this report, when we calculated educational expenditures for tertiary education, we deducted the overlapping R&D expenditures by higher education institutions from public expenditures on tertiary education.

Education

Economists assume that individuals choose the level of education resulting in the highest level of lifetime wealth (e.g., leisure activities or earnings). Thus, education can be regarded as an investment made early in life in order to maximize students' later standards of living and quality of life. Students attending institutions of higher education derive a wide range of monetary and nonmonetary benefits.[5]

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[4] This question was only included for a few years, the last time being 2001.

[5] See, for example, Chen and Chevalier (2008), Fang (2006) and Harmon et al. (2003).

Our measure for investment in education only distinguishes between expenditure on primary, secondary and tertiary education. In general, expenditure on education comprises all expenses on labour (teachers and other personnel) and all intermediate consumption. For capital such as buildings, only the consumption of fixed capital is taken into account. This is in accordance with the SNA, which states that nonmarket production should be valued as the sum of labour cost, intermediate consumption and consumption of fixed capital.[6] Primary education includes kindergartens and primary schools (i.e., everything until you are 12). Tertiary education includes research universities and universities of professional education (HBOs). The remainder of subsidized education (high schools and middle-level applied education (MBOs), which represent intermediate vocational education) is classified as secondary education.

Results and comparison with estimates from Statistics Netherlands

In Table 2 , we present investment in intangible investment in the Dutch commercial sector, public sector, and the total economy in 2000, 2004, 2006, and 2008 in million euros (current prices). In Table 3 , we present the same estimates as a percentage of current-price GDP. Appendix Table A.1 contains investment in intangibles in constant 2006 prices. These tables show that public spending in intangibles is considerably lower than spending in the commercial sector. In 2008, total intangible spending in the commercial sector amounted to 49,394 million euros and 34,763 million euros, which includes education in the public sector (9,798 million euros excluding education). This is equal to 8.3 percent of GDP for commercial intangibles in 2008 and 5.9 percent of GDP (1.7 percent excluding education) for public intangible spending. With education taken into account, the Dutch economy invested a total of 14.2 percent of GDP in intangibles in 2008 (without education, it is 10 percent). Due to the different definition of the commercial sector and public R&D our results for spending in the traditional CHS categories in the total economy are 0.7% higher compared to those of Statistics Netherlands in 2008 (CBS, 2009).

Our estimates of R&D for the total economy (consisting of the commercial sector and the public sector) are considerably higher compared to those created by CBS because of the different treatment of public R&D. Statistics Netherlands regards only the "use of other R&D by the general government" as an investment in intangibles and so far has excluded government consumption of non-market R&D that is produced by the R&D industry (general

[6] From a growth accounting perspective, this means effectively that the discount rate is set to 0 percent.

government including universities).[7] We deviate from the definition used by CBS and follow the new international guidelines as described above. Thus, we treat 'use of other R&D by general government' and government consumption as public R&D and 'investment in R&D on own account in all industries excluding public' and 'investment in other R&D in all industries excluding public' as commercial sector R&D. We also exclude market R&D in the R&D industry (outsourced R&D that is incorporated in other R&D meant for sale to other industries than the R&D industry) from our estimates.

The composition of intangible assets for the commercial sector, public sector and total economy is also shown in Table 4 and Figures 1 and 2 .[8] In both sectors, computerized information is the smallest part of intangible investment. Its share of total investment has continuously grown in the commercial sector since the mid-1990s, whereas computerized information in the public sector has remained constant over the same period. The Dutch private sector invested only 1.4 percent of GDP in computerized information in 2008. Economic competency, at about 60 percent of total intangible investment and about 5 percent of GDP, is the largest part of intangible investment in the commercial sector. As expected, educational investment is dominant in the government sector, accounting for 72 percent of total intangible investment in 2008 (4.2 percent of GDP) and followed by innovative property.

III. Growth accounting

In addition to providing an adequate measure of public and private intangible investment in the Netherlands, another goal of this study is to measure the contribution of intangible investment as a source of economic growth. Thus, we integrated the measures discussed above into a growth accounting framework that provides a picture of how much factors of production (such as labour and capital) contribute to economic growth, but hardly considers intangible assets.[9] As intangibles create output and increase in importance over time, they add

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[7] As discussed above, after a revision of their system, CBS will only exclude R&D purchases in the R&D industry in the future. Thus, all R&D use in the general government industry, R&D use by universities and the use of nonmarket R&D by the general government (now regarded as government consumption) will be capitalized henceforth.

[8] The development of computerized information, innovative property, economic competencies and education in the total economy in constant 2006 prices between 1987 and 2008 is shown in Figure 3.

[9] When using GDP as an output concept, the contribution of intermediates (such as energy, materials and service inputs) are not accounted for. In many growth accounting studies, measures of labour input such as hours worked or total employment are often adjusted for changes in average labour composition. The labour composition index

to GDP growth. In contrast, when ignoring intangible assets we usually overstate multifactor productivity (MFP) growth and the contribution of tangible capital and labour composition to GDP growth. Adding intangible assets usually decreases the contribution of MFP growth because the contribution of intangible assets is no longer hidden in the MFP residual. Adding intangible assets decreases the contribution of tangible capital and labour growth because their compensation shares decrease.

Whereas an increasing number of studies focus on investment in intangible assets in the private sector and its contribution to economic growth, the analysis of the impact of public investment in innovation and knowledge on growth is still underdeveloped, including in the Netherlands. In this study, we have made some adjustments to the standard growth accounting model for the private sector to compute growth accounts for the total economy that comprise the public sector.

There are several issues that have to be dealt with when growth accounts include the public sector. For example, there are spillover effects from public investments on private economy growth that are not internalized by private agents and, therefore, provide a growth bonus beyond what is actually measured. On the other hand, the risk that public investment in intangibles crowds out the possible effect of private investment (i.e., overstating the impact on growth) should not be understated.

Sources, assumptions and methodology

To obtain measures for output and non-ICT inputs and separate the commercial sector from the total economy, we used the EU KLEMS database (November 2009 release), which provides value added, total hours worked and total labour compensation by industry from 1995 to 2007. To compute growth accounts up to 2008, we extrapolated the available time series with information from the latest national accounts. As labour input series—in terms of hours worked by high-, medium- and low-skilled labour and their compensation—were only available until 2005 in the EU KLEMS March 2008 release. The missing observations for 2006–2008 were extrapolated accordingly.

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in this study is constructed on the basis of weighted measures of different skill-level groupings in the labor force. It is the weighted summation of the percentage of labor force in low, medium and high skill levels with relative wages being weights for the three skill levels respectively (low-, medium- or high-skilled labor compensation as a share in total labor compensation).

The data sources for investment and the stock of tangible assets is EU KLEMS from 1995 to 2007 and extrapolated figures for 2008. We measure two groups of tangible assets. ICT tangible assets include computing equipment and communications equipment (software is included with intangible assets). Non-ICT tangible assets include nonresidential buildings and other tangible assets. We exclude residential structures because they are not used in production. EU KLEMS also provides data on the investment and stock of software. The data source of education for the total economy estimates is Statistics Netherlands (CBS).

A number of computational steps are needed to transform the data on intangible investments into the capital stocks and capital service prices. We used a perpetual inventory method to measure the stocks of intangible capital. This step involved adding each year's investment in each type of intangible to the depreciated amount of the preceding year's capital stock. We use a geometric depreciation pattern for all tangible and intangible assets, which is also the common depreciation technique for the perpetual inventory method in the literature.

Table 5 shows the values of all of the depreciation rates applied. Relatively little is known about depreciation for intangibles, so we followed the assumptions by CHS (2006, 2009) and van Ark et al. (2009), which use an annual rate of 31.5 percent for computerized information, 60 percent for advertising and 40 percent for firm specific resources. Depreciation rates for R&D capital are extensively discussed in the literature, where reported depreciation rates range from 5 percent to 25 percent.[10] A 15 percent depreciation rate for R&D is widely used in the literature (Griliches, 2000; Mead, 2007). We deviated from CHS and van Ark et al. (2009) by using a depreciation rate of 15 percent, instead of 20 percent, for R&D.

For each asset type, we create initial capital stocks in the beginning year, which, in our case, is 1995, by cumulating investments over previous years. Given the relatively high depreciation rates for intangibles, most of each investment is depreciated away within five years, so it is sufficient to extrapolate the investment series back to 1990. Education is depreciated over 40 years, so investment in primary, secondary and tertiary education had to

[10] Estimates by Coe and Helpman (1995) and Coe et al. (2009) are at the lower end of 5 percent depreciation rate for R&D, Nadiri and Prucha (1996) offer a figure of 12 percent, Bernstein and Mamuneas (2004) find a depreciation rate for the United States of 18 percent and Pakes and Schankerman (1986) obtain a depreciation rate for R&D of 25 percent.

be reconstructed back the 1950s to construct the educational capital stocks.[11] In contrast to other assets, we did not immediately depreciate the educational stock but considered the average time between the investment and the time it pays off through providing capital services. We assumed that primary education will pay off after 9 years and investment in a 12-year-old pupil will provide output to the labour market after approximately 5–12 years. The gestation for secondary schooling is six years because a 16-18 year old will see investment paid off after between 2 and 9 years. Investment in a 20-year-old student at the tertiary level will pay off after about three years.

Primary, secondary and tertiary educational levels are weighted differently within the share for human capital defined by van Ark and de Haan (2000). Primary, secondary and tertiary educational levels are weighted at 1.0, 1.4 and 2.0, respectively, in line with evidence on relative earning differentials. All factor shares for the total economy that include intangibles add up to 1.33 and 1.12 for the commercial sector. Table 6 shows the factor shares for the total economy and the average factor shares from 1988 to 2008 for the commercial sector.

The next step in our calculations was to compute the user cost of each asset type, including intangibles. The user cost is made up of the rate of return, the depreciation rate and a capital gains term. For the rate of return, we assumed the same rate for intangible capital as for tangible capital, assuming that businesses arbitrage their investments across all types of capital and invest in each type until the rate of return for all assets is equal (CHS 2009, footnote 23, p. 677).[12] The income accruing to each type of capital in each year was then found by multiplying the quantity of stock by the corresponding user cost. Following this step, the cost shares could then be calculated.

The resulting cost shares were used as weights for the commercial sector, for which we assumed constant returns to scale. We applied weights based on the Mankiw, Romer and Weil (MRW, 1992) approach, which includes the effect of education. However, in contrast to

[11] A vintage depreciation pattern (slower in the beginning and faster later on) of education seems to be plausible for education as old knowledge becomes less relevant and is compensated for by worker training. However, a vintage depreciation pattern for education is technically difficult to combine with a geometric depreciation profile. As we choose not to use two different depreciation models for one asset, we depreciated primary, secondary and tertiary education geometrically (as for all other assets) over 40 years.

[12] Of course the rates of returns can vary, depending on the risk. Since investment in R&D is riskier than investment in tangible capital, the expected rate of return on R&D capital is higher than on tangible capital. We have abstained from that additional complexity in the computations here.

MRW, who assigned a 1/3 share to human capital (excluding primary and secondary education), the weight for human capital here is 4/9, which is supported by most of the literature on human capital (Donselaar and Segers, 2006). We used 3/9 for physical capital and 2/9 for raw labour. The weights for human capital and raw labour in our analysis summed up to a total weight for labour composition per unit of labour quantity of 2/3 (4/9 + 2/9). The subcategories of physical capital are proportionally adjusted according to the commercial sector cost shares from 1988 to 2008, which added up to 1/3. The weights for the total economy, including intangible capital, are derived by using the proportional shares between labour composition, physical capital and intangible capital from the commercial sector.[13] The subcategories of physical capital and intangible capital were again proportionally adjusted according to their cost shares from 1988 to 2008 so that they added up to the aggregate weight.

The calculation of the impact of public investment (after adjustment for double counting) on growth is more complicated. As we assumed that public investments will somehow create spillovers for the economy as a whole (otherwise the government should not make these investments), we had to move beyond the constant returns framework. Thus, we deviated from constant returns to scale by adding additional growth effects derived from external effects. These effects, also referred to as spillovers, reflect the societal value of investments that are not directly captured by the investors, who are individuals investing in education or businesses investing in intangible assets. The fraction that was used for R&D in the commercial sector including intangibles was augmented by 0.12 as in the total economy to allow for external effects. All of the literature shows a strong effect of domestic and foreign R&D capital on productivity MFP growth. For example, the elasticities for domestic R&D found in Coe and Helpman (1995) and Coe et al. (2009) are 0.08 and 0.10 (with 5 percent depreciation), respectively. In the 1995 study, the effect was 0.11 (with 15 percent depreciation). Guellec and Van Pottelsberghe (2001, 2004) found an elasticity for public R&D (0.17) that is even higher than that for private R&D (0.13). In contrast, Donselaar and Segers (2006) found private R&D elasticity higher (0.12) than public R&D elasticity (0.05) because the latter is smaller in size.

[13] The weights for the commercial sector including intangibles are shown in the last column of Table 6 .

The relationship between public and private R&D investment has also been discussed in the economic growth and innovation literature. The primary concern is whether public R&D spending is complementary and thus additional to private R&D spending or whether it is a substitute that tends to crowd out private R&D. Among others, David et al. (2000) and David and Hall (2000) argue that public funding of R&D can contribute indirectly by complementing and thus stimulating private R&D expenditures, even if it has been undertaken with other purposes in view. Public R&D expenditure may generate social benefits in the form of knowledge and training spillovers that cause positive external effects on the knowledge accumulation of the private sector. They enhance private sector productive capabilities and promote R&D investments by firms that lead to technological innovations. On the other hand, some authors have argued that public expenditure might have an adverse effect on growth by "crowding out" efficient and potentially profitable private investment. Even though public investment is mostly assumed to have positive external effects, they might also cause market failures (Almus and Czarnitzki, 2002). R&D projects that do not cover the private cost might not be carried out even though they would have positive effects to the society. The quantity of innovations may therefore remain below the socially desirable level. When such projects are carried out, public funding is provided to reduce the price for private investors. Even if a private investor could carry out an R&D project using his or her own funds, he or she has an incentive to apply for public R&D support and, thereby, save money. If public support is granted, then a firm might simply substitute public for private investment.

For education, we assumed an external growth effect of 16 percent, which represents spillovers that go beyond the internalized effects of higher wages that result from improvements in labour composition and worker training effects that raise returns to investing firms. The measure of 16 percent was derived from Bassanini and Scarpetta (2001, 2002) and Arnold et al. (2007), which estimated standard growth regression using Pooled Mean Group (PMG) estimators on OECD countries.[14]

[14] Bassanini and Scarpetta (2001, 2002) estimate an elasticity of between 0.4–0.5 percent (consensus is 4/9 = 0.44) and Arnold et al. (2007) arrive higher elasticities of between 0.74 and 0.95 for the impact of human capital (proxied by the average number of years of schooling) on economic growth in the long run. If we assume these to be the externalities, the effect would be between 0.24 (0.74 − 0.5) and 0.45 (0.95 − 0.5). The average of the latter is exactly 0.33. If we then deduct the effects from R&D mentioned above, which are 0.17 (0.05+0.12), we end up with 0.16.

Results from growth accounting

We constructed growth accounts excluding and including intangibles for the commercial sector and the total economy for the sub-periods 1995–2000, 2000–2005 and 2005–2008, as well as for the longer time frames 1995–2005, 1995–2008 and 2000–2008. We also demonstrated how the inclusion of intangibles affects the growth rate of GDP in the same periods.[15]

Table 7 shows the contributions of labour, MFP and tangible and intangible capital to GDP growth in the total economy, and Table 8 shows the contributions of these categories to the commercial sector.[16] The contribution of intangible capital was broken down in the subcategories of software, innovative property, economic competencies and, for the total economy, education. The contribution of R&D to GDP growth was differentiated into internal effects and external effects.

The first observation from both tables is that the inclusion of intangibles in general has a positive effect on GDP growth. From 1995 to 2008, the inclusion of intangible assets increased the GDP growth rate for the total economy by 0.23 percentage points (from 2.75 percent to 2.9 percent in Table 7) and by 0.18 percentage points for the commercial sector (from 3.07 percent to 3.25 percent in Table 8).[17] Intangibles contributed 1.4 percentage points to GDP growth in the total economy between 1995 and 2008, compared to 1.1 percentage points in the commercial sector. The contribution to output growth was highest from 1995 to 2000, due to the large contribution of software capital, but diminished afterwards. The contribution of intangibles was lower from 2000 to 2005. At the same time, multifactor productivity growth slowed and, after accounting for intangibles, even turned slightly negative for the total economy. During the 2005–2008 period, multifactor productivity (MFP)

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[15] Results for contributions to labour productivity growth are shown in Tables A3 and A4.

[16] The following industries are included in our estimates for the commercial sector: Agriculture, hunting, forestry and fishing; mining and quarrying; total manufacturing; electricity, gas and water supply; construction; wholesale and retail trade; hotels and restaurants; transport and storage and communication; financial intermediation; renting of M&EQ and other business activities; other community, social and personal services; private households with employed persons; and extra-territorial organizations and bodies (industries AtB, C, D, E, F, G, H, I, J, 71t74, O, P, Q). To be consistent with our estimates on intangible investment, the commercial sector also comprises Health and Social Work (industry N). The Total Economy includes public administration and defense, compulsory social security, education, health and social work (industries L, M, N) in addition to the commercial sector.

[17] The exception periods are 2000–2005 (for both the total economy and the commercial sector) and 2000–2008 (for the commercial sector only), during which growth of output was slower with intangibles than without. This implies that intangible investment has contributed less to the level of output over the course of these sub-periods.

accelerated while the contribution of intangible investment stabilized. Although the acceleration in MFP growth after 2005 may in part be related to a cyclical peak, as can be observed from the strong acceleration in GDP growth, there may also have been positive effects from intangible investment on MFP growth, even though such effects are not tested for in this study (see Brynjolfsson and Saunders, 2009).

Figures 4 through 7 graphically present the results from Tables 7 and 8. In Figures 4 and 6, we show the contribution of all contributors to GDP growth, whereas Figures 5 and 7 depict the subdivision between the contribution from computerized information, innovative property, economic competencies and education (for the total economy). The latter figures reveal that private R&D has the highest impact on output growth within intangible capital.

Statistics Netherlands has made reference to the important contribution of intangibles to output growth in all its publications, but generally found somewhat lower contributions from intangibles (van Rooijen-Horsten et al., 2008; CBS, 2009). For example, according to CBS studies, intangibles contributed 0.5 percentage points to consolidated output growth from 1996 to 2000 (1.8 percentage points in the present study, of which 0.7 percentage points refer to external effects on R&D, which are by definition excluded from the CBS study) and only 0.15 percent for 2001–2005 (0.6 percentage points in the present study, of which 0.4 percentage points refer to external effects on R&D). However, just as in the current study, the CBS studies exhibited a slowdown in the contribution of intangibles after 2000. The intangible contributions are higher in our report because we include a spillover (external) effect for private R&D, but we show a similar slowdown for the commercial sector after 2000. This slowdown in the contribution of intangibles, however, is not observed for the total economy because the contribution of education has stabilized since 2005.

Van Rooijen-Horsten et al. (2008) found the largest contribution to consolidated output growth stemmed from economic competencies and, more precisely, brand equity in 1996–2000 and organizational structure in 2001–2005. However, if we include the external effects from private R&D, as in this study, the contribution of intangibles to growth is dominated by innovative property rather than economic competencies. It should be stressed that the measurement of external effects is one of the more uncertain estimates in this study.

IV. Scenarios for future growth and implications

We have developed three different growth trajectories for the Netherlands (base, optimistic and pessimistic), which are based on plausible assumptions on a range of indicators, including the effect of demographic developments on labour markets and the number of students, the growth rate in tangible and intangible investment and multifactor productivity growth. For our scenario development, we left the growth rates for tangible investment and multifactor productivity constant relative to those for the 2000–2008 period. The scenarios differ only in the assumed growth rate of the intangible investments and their contributions to growth. The base scenario examines "unchanged policies towards intangible investments," the two optimistic scenarios analyze the effects of an "accelerated investment in intangibles" case and both pessimistic scenarios explore the impact of a "constant investment level as in 2008." All five scenarios measure the effects on labour productivity growth and GDP growth for the periods 2010–2015 and 2015–2020, as well as the average for 2010-2020.

The **base scenario** (Table 9) for the total economy essentially depicts "business as usual." It is constructed based on the same growth accounting approach as above, using the 2000–2008 growth developments as the benchmark. For intangible capital, we assume that the growth rate in real investment in intangibles per hour worked for 2000–2008 applies to the 2010–2020 period.

We also assumed that total hours worked grow at the same rate as the labour force aged 15–65 until 2020 and that investments in tangible capital and labour composition and multifactor productivity until 2020 will grow at the average annual growth rate of 2000–2008. The projections for the labour force are derived from Statistics Netherlands (StatLine database). We adjusted the rise in total expenditure on education for the slowdown in 15–24 year olds relative to the decline in total population. To obtain our estimates of capital, we applied the same depreciation rates and factor weights as for the growth accounts on a historical basis (see Table 5 and columns 2 and 3 of Table 6).

In this scenario, public and private intangible investments will grow on average 2.8 percent (11.6 billion euros, including education) and 1.8 percent (10.3 billion euros), respectively, between 2010 and 2020, and the share of intangibles in total economy GDP will grow from just below 15 percent in 2010 to 16.2 percent in 2020. Despite the slight increase in intangibles, GDP growth in Table 9 slows somewhat for 2010–2020 (1.9 percent), compared to 2.2 percent for 2000–2008. This is primarily the result of a decline in the growth of the labour force and total working hours from 2010 to 2020. The growth contribution of intangibles remains fairly stable—0.9 percentage points from 2010 to 2020 versus 1 percentage point from 2000 to 2008.

The upper and lower **optimistic scenario** (Tables 10 and 11) consider accelerated investment in intangibles. Assumptions about tangible capital, labour composition and MFP remain the same as in the base scenario, but are different for intangible capital. Both optimistic scenarios raise the projected share of public intangible investments in GDP from the base scenario by 1 percent in 2020 (from 6.9 percent in the 2020 base scenario in to 7.9 percent). The two scenarios differ with regard to their assumptions about how private investments will react to the acceleration of public investment. The upper scenario assumes that intangible investment in the commercial sector will grow at the same rate as the public sector until 2020, which will lead to an output growth of approximately 2.1 percent from 2010 to 2020. The lower optimistic scenario assumes only a 30 percent complementary effect from public investment on all private intangible expenditures, which means that labour productivity growth will be somewhat lower in the same period (1.9 percent). In the optimistic scenarios, intangibles contribute around 50 percent of the growth of labour productivity.

The **pessimistic scenarios** assume that intangible expenditures (in constant prices) are kept constant, which would result in a lower level of public intangible investments (13.9 billion euros) or 1.8 percent lower public intangible investments as a percentage of GDP relative to the base scenario in 2020. The upper pessimistic scenario in Table 12 assumes that only public expenditures are held constant and that it will work through the private expenditures by reducing them 30 percent. For the lower pessimistic scenario in Table 13 , we assume that all expenditures (public and private) are being held constant. Just as for the optimistic scenarios, the contributions of tangible capital, labour composition and multifactor productivity remain unchanged. In the upper negative scenario, the growth rate of GDP is 0.2 percentage points lower than the base scenario, and the contribution of intangibles declines from 0.9 percentage points in the base scenario to 0.7 percentage points. However, the effect of the lower pessimistic scenario on labour productivity growth is quite large, leading GDP growth to slow down from 2.2 percent from 2000 to 2008 to 1.5 percent from 2010 to 2020. The contribution of intangible capital to labour productivity growth also falls to an average of 0.5 percentage points between 2010 and 2020.

Figure 8 illustrates the contribution of labour, MFP and physical and intangible capital for all scenarios in the 2010-2020 period. The scenarios differ only in the contribution of education and intangibles; the contributions of tangible capital, labour composition and multifactor productivity remain unchanged for the positive and negative scenarios compared to the base scenario. Figure 8 shows how the contribution of intangibles gradually decreases from the upper optimistic scenario (1.1 percentage points) to the lower pessimistic scenario (0.5 percentage points).

Figure 9 projects future GDP in constant 2006 prices until 2020 based on the growth rates of GDP from 2010 to 2020 in the five scenarios. Depending on the choice of the future growth trajectory, GDP in 2020 could amount to 688 billion euros in the base scenario, 693 or 703 billion euros in the positive cases, and 664 or 675 billion euros in the worst case scenarios, compared to 572 billion euros in 2008 (all in 2006 constant prices). Table 14 illustrates the implications of the base, optimistic and pessimistic scenarios for output gains and losses in constant 2006 prices. Comparing the optimistic scenarios with the base scenario, the output gains amount to 15.5 billion euros for the upper optimistic scenario and 5.5 billion euros for the lower optimistic scenario in 2020. This compares with a loss of 13 billion euros for the upper pessimistic scenario and 23.6 billion euros for the lower.

We also calculated a very tentative scenario for the 2010–2050 period in order to take account of the long-run effects of the higher investments in education. A rise in education expenditure would both generate an increase in labor composition in the long term and increase the external effects from education. Keeping other investments and other factors constant in the same way we did for the medium-term scenarios for 2010–2020, we find an increase in the annual average growth of GDP of 1.6 percent, with a contribution of education of 0.37 percentage points and of labor composition of 0.38 percentage points (Table 15). GDP growth from 2010 to 2050 slows to 1.6 percent, as labor growth (hours worked) declines faster after 2020, but the contribution of intangibles stays about the same, so the intensity of intangibles actually increases. Of course, this long-term scenario is very uncertain and dependent on many more factors than the growth rate of the labour force and the rise in intangibles.

V. Conclusions

This study is concerned with the contribution of innovation and knowledge to past, current and future growth**.** We measured how much the commercial sector and the total economy in the Netherlands invested in intangible assets up to 2008. Total spending in intangibles amounted to 84.2 billion euro in 2008, which equals 14.2 percent of GDP. For the same period, the commercial sector amounted to 49 billion euros (8.3 percent of GDP) and the public sector amounted to 35 billion euros (5.9 percent of GDP), including education (which accounts for 25 billion euros).

Economic competency, at about 60 percent of total intangible investment, is the largest part of intangible investment in the commercial sector and about 5 percent of GDP. Computerized information is the smallest part of intangible investment (1.4 percent of GDP), and innovative property accounts for slightly more (1.7 percent of GDP). In the public sector, innovative property (0.8 percent of GDP) was relatively more important than two other categories (computerized information and economic competencies), but educational investment is obviously the dominant source of intangible investment. The latter accounted for 72 percent of total intangible investment in the governmental sector in 2008 (4.2 percent of GDP).

Using the growth accounting methodology, we computed the contributions of labour, physical capital and intangible capital to economic growth in the Dutch commercial sector and total economy. The inclusion of intangibles in general has a positive effect on GDP growth. Intangibles contributed 1.4 percentage points to GDP growth for the total economy between 1995 and 2008, compared to 1.1 percentage points in the commercial sector. The growth contribution of intangibles was highest from 1995 to 2000, which was followed by a decline and then a slight increase again in 2005.

In addition to the aggregate contributions of intangibles and knowledge to growth, we have also demonstrated the growth contributions of the individual components of intangible capital and different segments of the economy. With regard to public intangibles, education and public R&D (including internal and external effects) account for approximately one-third of the contribution of all intangible investment to growth, whereas commercial sector intangibles account for the rest. Within the commercial sector, the largest contributions come from investment in economic competencies, including workforce training, organizational innovation and marketing and branding.

Finally, we developed three scenarios for future growth based on plausible assumptions about the growth pattern of the latter contributors and its implications for government expenditures until 2020. We differentiate between a "business-as-usual" base scenario, two optimistic scenarios ("accelerated investment in intangibles") and two pessimistic scenarios ("stagnating investment in intangibles"). According to the base scenario, GDP growth slows somewhat from 2010 to 2020 (just below 1.9 percent) compared to 2000-2008 (2.2 percent), as the contribution of labour input to growth declines. The intensity of intangibles and other capital per unit of labour, however, slightly increases. A 1 percent higher investment in public intangibles as a percentage of GDP compared to the base scenario until 2020 leads to a GDP growth rate of approximately 2.1 percent from 2010 to 2020 in the upper optimistic scenario and a 1.9 percent growth rate in the lower optimistic scenario (i.e., a positive effect of about 0.1 to 0.2 percent growth in GDP per year). On the other side of the spectrum, the effect of the pessimistic scenarios on GDP growth is quite large. A stalling in the growth of intangibles below the current growth rate could lower GDP growth by almost 0.4 percent from 2010 to 2020, relative to the base scenario. In order to take account of the long-run effects of the higher investments in education, we also calculated a long-run base scenario for the 2010–2050 period. While the results of such long term scenarios should be interpreted as very tentative, it suggest that GDP growth is likely to slow as labor growth (hours worked) will continue to decline after 2020. Meanwhile, the contribution of intangibles to growth will only strengthen further to 0.9 percentage point ouf of the projected 1.6 annual average growth in GDP from 2010-2050.

These results imply that an accelerated investment in public intangibles (of up to 7 billion euros extra annually by 2020) can generate significant additional GDP—up to an additional benefit of 15.5 billion euros or 2.2 percent of the GDP level—by 2020. In other words, an extra euro invested in public intangible capital, can add three times as many euros in GDP. However, much will depend on the willingness and the ability of the commercial sector to match public intangible euros. If the private sector only raises its intangibles investment by 30 percent of the government's increase, the effect would be much smaller and each additional euro of intangible in 2020 would only raise GDP by about the same amount. Keeping public intangible investment constant in real terms could have a devastating impact on GDP, creating a loss of between 13 billion to more than 24 billion euros by 2020, and take off as much as 3.6 percent of the GDP level.

Investment in intangibles, therefore, is a key part of keeping the growth of the Dutch economy on track, and a slowdown in or ceasing of the creation of intangible capital would seriously affect economic stability. An accelerated investment in public intangibles, notably education and public R&D, by 7 billion euro per year by 2020 could raise GDP growth permanently, provided the commercial sector is able and willing to step up their investments to the same degree. While investment in public intangibles is an important factor in raising the potential for faster growth, the overall business environment will determine if the commercial sector is able to strengthen and exploit their own capabilities in this field to realize this potential.

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Tables and Figures

Table 1: Intangible Investment in the Market Sector in 2006 (as Percentage of GDP)

	DE	FR	IT	ES	UK	US	AT	CZ	DK	GR	SK	NL
Type of Investment	2006	2006	2006	2006	2006	2006	2006	2006	2006	2006	2006	2006
1. Computerized information	**0.73**	**1.42**	**0.64**	**0.79**	**1.55**	**1.61**	**0.89**	**0.71**	**1.87**	**0.34**	**0.37**	**1.4**
a) Software	0.71	1.37	0.63	0.76	0.00		0.85	0.71	1.85	0.33	0.37	
b) Databases	0.02	0.05	0.01	0.03	0.00		0.04	0.01	0.03	0.01	0	
2. Innovative property	**3.59**	**3.18**	**2.21**	**2.78**	**3.16**	**4.37**	**3.14**	**2.8**	**3.06**	**0.62**	**1.76**	**1.9**
a) R&D*	1.72	1.3	0.58	0.63	1.07		1.74	1.03	1.68	0.18	0.21	1.0
b) Mineral expl. and evaluation	0.01	0.04	0.09	0.04	0.04	2.25	-	-	-	-	-	0.0
c) Copyright and license costs	0.21	0.31	0.1	0.18	0.22		0.1	0.04	0.16	0.02	0.04	
d) Dev. costs in financial ind.	0.75	0.6	0.58	0.52	0.07	2.12	0.63	0.55	0.54	0.16	0.37	0.9
e) New arch. and engin. designs	0.9	0.93	0.86	1.41	1.74		0.66	1.18	0.69	0.27	1.15	
3. Economic competencies	**2.84**	**3.3**	**2.19**	**1.9**	**5.84**	**5.50**	**2.42**	**2.93**	**2.93**	**0.63**	**2.39**	**5.7**
a) Brand equity	0.56	0.99	0.71	0.42	1.15	1.47	0.25	1.37	0.63	0.15	1.04	2.2
Advertising expenditure	0.41	0.73	0.47	0.19	0.91		0.15	0.94	0.36	0.08	0.46	
Market research	0.15	0.26	0.24	0.23	0.24		0.11	0.43	0.27	0.06	0.59	
b) Firm-specific HC	1.29	1.51	1.02	0.81	2.54		0.79	0.63	1.49	0.19	0.51	1.1
Continuing voc. training	0.65	1.25	0.71	0.71			0.46	0.63	1.07	0.17	0.51	
Apprentice training	0.64	0.26	0.32	0.1		4.03	0.33	0	0.42	0.02	0	
c) Organizational structure	1	0.81	0.45	0.68	2.14		1.38	0.93	0.81	0.29	0.83	2.4
Purchased	0.54	0.32	0.15	0.27	0.51		0.93	0.26	0.45	0.06	0.25	
Own account	0.46	0.49	0.3	0.41	1.63		0.44	0.67	0.36	0.23	0.58	
Total Investment	**7.16**	**7.9**	**5.04**	**5.47**	**10.54**	**11.48**	**6.46**	**6.45**	**7.86**	**1.59**	**4.53**	**9.1**
pro memoria												
Total Spending	**7.55**	**8.51**	**5.43**	**5.70**	**11.56**		**6.67**	**7.24**	**8.19**	**1.70**	**4.98**	

Sources: van Ark et al. (2009) and CBS (2009).
Note: *R&D includes social sciences and the humanities.

Table 2: Intangible Investment - Million euros (Current Prices)

	Commercial Sector				Public Sector				Total Economy			
	2000	2004	2006	2008*	2000	2004	2006	2008*	2000	2004	2006	2008*
Computerized information	**5,526**	**5,730**	**6,724**	**8,319**	**600**	**714**	**986**	**1,220**	**6,126**	**6,444**	**7,710**	**9,539**
Software and Databases	*5,526*	*5,730*	*6,724*	*8,319*	*600*	*714*	*986*	*1,220*	*6,126*	*6,444*	*7,710*	*9,539*
Innovative property	**7,519**	**8,237**	**9,503**	**10,144**	**3,426**	**4,093**	**4,620**	**4,932**	**10,945**	**12,330**	**14,123**	**15,076**
a) R&D including social science and humanities	*4,239*	*5,021*	*5,203*	*5,571*	*2,804*	*3,369*	*3,823*	*4,094*	*7,043*	*8,390*	*9,026*	*9,664*
R&D in the financial industry	361	326	407	436					361	326	407	436
b) Mineral exploration and evaluation	*208*	*195*	*250*	*210*					*208*	*195*	*250*	*210*
c) Other innovative property	*3,072*	*3,021*	*4,050*	*4,347*	*622*	*724*	*797*	*855*	*3,694*	*3,745*	*4,846*	*5,202*
Copyright and license costs	847	731	1,373	1,219					847	731	1,373	1,219
New architectural and engineering designs	2,225	2,290	2,677	3,070	622	724	797	914	2,847	3,014	3,473	3,983
Economic competencies	**24,350**	**26,637**	**27,659**	**30,931**	**2,634**	**2,771**	**3,261**	**3,646**	**26,984**	**29,408**	**30,920**	**34,577**
a) Brand equity	*10,694*	*11,473*	*11,993*	*13,116*	*110*	*140*	*154*	*168*	*10,804*	*11,614*	*12,147*	*13,284*
Advertising expenditure	9,666	10,334	10,858	11,825	60	75	88	96	9,726	10,410	10,946	11,920
Market research	1,028	1,139	1,136	1,289	50	65	66	74	1,078	1,204	1,201	1,363
b) Firm-specific human capital	*3,454*	*4,043*	*3,882*	*4,397*	*1,712*	*1,672*	*2,141*	*2,425*	*5,166*	*5,715*	*6,024*	*6,823*
Direct firm expenses	1,679	1,897	1,797	2,035	631	619	781	884	2,310	2,516	2,577	2,919
Wage and salary costs of employee time	1,775	2,146	2,086	2,362	1,081	1,053	1,361	1,541	2,856	3,199	3,447	3,904
c) Organizational structure	*10,201*	*11,121*	*11,783*	*13,375*	*812*	*959*	*966*	*1,096*	*11,014*	*12,080*	*12,749*	*14,471*
Purchased	5,237	6,041	7,041	7,992	255	344	407	462	5,492	6,385	7,448	8,454
Own account	4,964	5,080	4,742	5,383	557	615	559	634	5,521	5,695	5,301	6,017
Total - CHS categories	**37,395**	**40,604**	**43,886**	**49,394**	**6,660**	**7,578**	**8,867**	**9,798**	**44,055**	**48,182**	**52,752**	**59,192**
Education					**16,238**	**20,929**	**22,418**	**24,965**	**16,238**	**20,929**	**22,418**	**24,965**
Primary / Secondary					13,631	17,723	18,984	21,046	13,631	17,723	18,984	21,046
Tertiary					2,607	3,206	3,434	3,919	2,607	3,206	3,434	3,919
Total	**37,395**	**40,604**	**43,886**	**49,394**	**22,898**	**28,507**	**31,285**	**34,763**	**60,293**	**69,111**	**75,170**	**84,157**

Notes: * Preliminary results for 2007 and 2008, which include an approximation of the commercial and public sectors according to shares of total economy in 2006.

Commercial sector also includes other industries and health care

Data source: Statistics Netherlands.

Table 3: Intangible Investment - Percentage of GDP (Current Prices)

	Commercial Sector				Public Sector				Total Economy			
	2000	2004	2006	2008*	2000	2004	2006	2008*	2000	2004	2006	2008*
Computerized information	**1.32**	**1.17**	**1.24**	**1.40**	**0.14**	**0.15**	**0.18**	**0.20**	**1.47**	**1.31**	**1.43**	**1.60**
Software and Databases	*1.32*	*1.17*	*1.24*	*1.40*	*0.14*	*0.15*	*0.18*	*0.20*	*1.47*	*1.31*	*1.43*	*1.60*
Innovative property	**1.80**	**1.68**	**1.76**	**1.71**	**0.82**	**0.83**	**0.86**	**0.86**	**2.62**	**2.51**	**2.61**	**2.57**
a) R&D including social science and humanities	*1.01*	*1.02*	*0.96*	*0.96*	*0.67*	*0.69*	*0.71*	*0.70*	*1.69*	*1.71*	*1.67*	*1.66*
R&D in the financial industry	0.09	0.07	0.08	0.07					0.09	0.07	0.08	0.07
b) Mineral exploration and evaluation	*0.05*	*0.04*	*0.05*	*0.04*					*0.05*	*0.04*	*0.05*	*0.04*
c) Other innovative property	*0.74*	*0.62*	*0.75*	*0.72*	*0.15*	*0.15*	*0.15*	*0.15*	*0.88*	*0.76*	*0.90*	*0.87*
Copyright and license costs	0.20	0.15	0.25	0.20					0.20	0.15	0.25	0.20
New architectural and engineering designs	0.53	0.47	0.50	0.52	0.15	0.15	0.15	0.15	0.68	0.61	0.64	0.67
Economic competencies	**5.83**	**5.42**	**5.12**	**5.18**	**0.63**	**0.56**	**0.60**	**0.62**	**6.46**	**5.99**	**5.72**	**5.80**
a) Brand equity	*2.56*	*2.34*	*2.22*	*2.20*	*0.03*	*0.03*	*0.03*	*0.03*	*2.59*	*2.36*	*2.25*	*2.23*
Advertising expenditure	2.31	2.10	2.01	1.98	0.01	0.02	0.02	0.02	2.33	2.12	2.03	2.00
Market research	0.25	0.23	0.21	0.22	0.01	0.01	0.01	0.01	0.26	0.25	0.22	0.23
b) Firm-specific human capital	*0.83*	*0.82*	*0.72*	*0.74*	*0.41*	*0.34*	*0.40*	*0.41*	*1.24*	*1.16*	*1.12*	*1.14*
Direct firm expenses	0.40	0.39	0.33	0.34	0.15	0.13	0.14	0.15	0.55	0.51	0.48	0.49
Wage and salary costs of employee time	0.42	0.44	0.39	0.40	0.26	0.21	0.25	0.26	0.68	0.65	0.64	0.66
c) Organizational structure	*2.44*	*2.26*	*2.18*	*2.24*	*0.19*	*0.20*	*0.18*	*0.18*	*2.64*	*2.46*	*2.36*	*2.43*
Purchased	1.25	1.23	1.30	1.34	0.06	0.07	0.08	0.08	1.31	1.30	1.38	1.42
Own account	1.19	1.03	0.88	0.90	0.13	0.13	0.10	0.11	1.32	1.16	0.98	1.01
Total - CHS categories	**8.95**	**8.27**	**8.12**	**8.29**	**1.59**	**1.54**	**1.64**	**1.68**	**10.54**	**9.81**	**9.77**	**9.97**
Education					**3.89**	**4.26**	**4.15**	**4.19**	**3.89**	**4.26**	**4.15**	**4.19**
Primary / Secondary					3.26	3.61	3.51	3.53	3.26	3.61	3.51	3.53
Tertiary					0.62	0.65	0.64	0.66	0.62	0.65	0.64	0.66
Total	**8.95**	**8.27**	**8.12**	**8.29**	**5.48**	**5.80**	**5.79**	**5.87**	**14.43**	**14.07**	**13.91**	**14.16**

Notes: * Preliminary results for 2007 and 2008, which include an approximation of the commercial and public sectors according to shares of total economy in 2006.

Commercial sector also includes other industries and health care

Data source: Statistics Netherlands.

Table 4: Composition of Intangible Investment (Percentage of Total Intangible Investment)

	COMMERCIAL SECTOR			PUBLIC SECTOR				TOTAL ECONOMY			
	Computerized Information	Innovative Property	Economic Competencies	Computerized Information	Innovative Property	Economic Competencies	Education	Computerized Information	Innovative Property	Economic Competencies	Education
1987	8	29	64	2	16	10	72	5	23	38	34
1988	7	36	58	2	16	10	72	5	27	36	32
1989	9	29	63	2	16	10	71	6	23	39	32
1990	9	28	63	2	19	10	69	6	24	40	30
1991	9	26	64	2	19	11	67	6	23	41	29
1992	10	26	64	2	18	13	67	6	23	41	30
1993	10	23	67	2	19	12	67	6	21	43	30
1994	9	22	69	2	18	12	69	6	20	44	30
1995	9	24	68	1	18	13	68	6	21	44	30
1996	9	26	65	2	18	12	67	6	23	43	28
1997	10	24	65	3	17	12	68	7	22	44	27
1998	13	24	63	3	17	12	68	9	21	44	26
1999	13	24	63	3	16	11	69	10	21	43	26
2000	15	20	65	3	15	12	71	10	18	45	27
2001	15	19	66	3	15	11	72	10	17	45	28
2002	14	20	66	3	14	11	72	9	18	44	29
2003	14	21	66	3	15	11	72	9	18	43	30
2004	14	20	66	3	14	10	73	9	18	43	30
2005	15	20	65	3	14	10	73	10	18	42	30
2006	15	22	63	3	15	10	72	10	19	41	30
2007*	15	21	63	3	14	11	72	10	18	41	30
2008*	17	21	63	4	14	10	72	11	18	41	30
Average	15	20	65	3	15	11	72	10	18	43	29

Notes: * Preliminary results for 2007 and 2008, which include an approximation of the commercial and public sectors according to shares of total economy in 2006.
Commercial sector also includes other industries and health care
Data source: Statistics Netherlands.

Table 5: Depreciation Rates for Growth Accounting

Asset	Depreciation Rate
Intangible Assets	
Software and databases	0.315
R&D	0.15
Copyright and license costs	0.2
Development costs in financial industry	0.2
New architectural and engineering designs	0.2
Advertising expenditure	0.6
Market research	0.6
Firm-specific human capital	0.4
Organizational structure	0.4
Primary education	0.025
Secondary education	0.025
Tertiary education	0.025
Tangible Assets	
Computing equipment (IT)	0.315
Communications equipment (CT)	0.115
Transport equipment (TraEq)	0.185
Other machinery and equipment (OMach)	0.123
Non-resident structures (OCon)	0.032
Other assets. (Other)	0.123

Table 6: Factor Weights – Total Economy

	Total Economy		Commercial Sector	
	Excluding Intangibles	Including Intangibles	Excluding Intangibles	Including Intangibles
Labour composition	0.667	0.633	0.714	0.633
Tangible Assets				
Computing equipment (IT)	0.015	0.012	0.012	0.011
Communications equipment (CT)	0.011	0.008	0.011	0.010
Transport equipment (TraEq)	0.045	0.036	0.045	0.039
Other machinery and equipment (OMach)	0.065	0.051	0.070	0.060
Non-resident structures (OCon)	0.169	0.114	0.120	0.100
Other assets. (Other)	0.027	0.021	0.027	0.023
Intangible Assets				
Software		0.013		0.013
Databases		0.012		0.013
R&D private, internal		0.011		0.014
R&D private, external		0.12		0.12
R&D public, internal		0.008		
R&D public, internal		0.05		
Copyright and license costs		0.003		0.004
Development costs in financial industry		0.001		0.001
New architectural and engineering designs		0.007		0.007
Advertising expenditure		0.026		0.029
Market research		0.002		0.003
Direct firm expenses		0.006		0.005
Wage and salary costs of employee time for training		0.008		0.006
Organizational Structure – purchased		0.012		0.014
Organizational Structure – own account		0.015		0.016
Primary + secondary education		0.06		
Tertiary education		0.10		
Total	1.0	1.33	1.0	1.12

Note: Items may not add up due to a rounding error.

Table 7: Growth Accounting – Total Economy

	1995-2000	2000-2005	2005-2008	1995-2005	1995-2008	2000-2008
Excluding Intangible Capital						
GDP growth (excl. software and education)	3.79	1.39	3.31	2.59	2.75	2.11
Hours growth	2.35	-0.31	1.74	1.01	1.18	0.45
Labour Productivity growth	1.49	1.67	1.62	1.58	1.59	1.65
Contributions to GDP growth						
ICT Capital (excl. software)	0.54	0.27	0.25	0.41	0.37	0.26
Non-ICT Capital	0.75	0.21	0.29	0.48	0.43	0.24
Labor Composition	0.12	0.38	0.32	0.25	0.07	0.12
Hours Worked	1.52	-0.18	1.12	0.66	0.77	0.30
Multifactor Productivity (excl. effects of software and education)	0.85	0.72	1.32	0.79	1.10	1.18
Including Intangible Capital						
GDP growth (incl. Intangibles)	4.28	1.35	3.59	2.80	2.98	2.18
Hours growth	2.27	-0.27	1.66	0.99	1.14	0.45
Labour Productivity growth	1.97	1.63	1.89	1.80	1.82	1.73
Contributions to GDP growth						
ICT Capital (excl. software)	0.44	0.22	0.20	0.33	0.30	0.22
Non-ICT Capital	0.56	0.15	0.21	0.35	0.32	0.17
Intangible Capital	2.13	0.94	1.14	1.53	1.44	1.01
Software	0.37	0.10	0.14	0.23	0.21	0.11
Innovative Property	1.01	0.47	0.49	0.74	0.68	0.48
Private R&D	0.70	0.40	0.29	0.55	0.49	0.36
Internal effect	0.06	0.03	0.02	0.05	0.04	0.03
External effect	0.64	0.37	0.27	0.50	0.45	0.33
Public R&D	0.22	0.07	0.15	0.15	0.15	0.10
Internal effect	0.03	0.01	0.02	0.02	0.02	0.01
External effect	0.19	0.06	0.13	0.13	0.13	0.09
Economic Competencies	0.42	0.03	0.16	0.22	0.21	0.08
Educational Capital	0.32	0.34	0.35	0.33	0.34	0.34
Labor Composition	0.12	0.36	0.31	0.24	0.07	0.11
Hours Worked	0.70	-0.08	0.52	0.30	0.35	0.14
Multifactor Productivity (final residual)	0.33	-0.24	1.21	0.05	0.50	0.53

Data sources: Statistics Netherlands and EU KLEMS database, November 2009, at http://www.euklems.

Note: Items may not add up due to a rounding error. Public and private R&D do not add up to innovative property because innovative property also comprises other categories such as copyright and license costs.

Table 8: Growth Accounting – Commercial Sector

	1995-2000	2000-2005	2005-2008	1995-2005	1995-2008	2000-2008
Excluding Intangible Capital						
GDP growth (excl. software)	4.25	1.54	3.71	2.88	3.07	2.35
Hours growth	2.59	-0.37	1.95	1.10	1.30	0.50
Labour Productivity growth	1.67	1.96	1.77	1.81	1.81	1.89
Contributions to GDP growth						
ICT Capital (excl. software)	0.49	0.21	0.18	0.33	0.29	0.20
Non-ICT Capital	0.77	0.11	0.22	0.44	0.38	0.14
Labor Composition	0.13	0.42	0.38	0.28	0.52	0.14
Hours Worked	1.83	-0.30	1.34	0.75	0.89	0.32
Multifactor Productivity (excl. effects of software)	1.01	1.10	1.57	1.08	0.99	1.53
Including Intangible Capital						
GDP growth (incl. Intangibles)	4.82	1.32	3.87	3.06	3.25	2.27
Hours growth	2.54	-0.41	1.90	1.05	1.25	0.45
Labour Productivity growth	2.23	1.74	1.94	1.99	1.97	1.81
Contributions to GDP growth						
ICT Capital (excl. software)	0.43	0.18	0.15	0.28	0.24	0.17
Non-ICT Capital	0.65	0.08	0.17	0.36	0.32	0.12
Intangible Capital	1.78	0.63	0.80	1.21	1.11	0.69
Software	0.40	0.14	0.21	0.28	0.26	0.17
Innovative Property	0.86	0.43	0.39	0.64	0.58	0.41
R&D	0.74	0.44	0.33	0.59	0.53	0.40
Internal effect	0.08	0.05	0.03	0.06	0.06	0.04
External effect	0.66	0.39	0.30	0.53	0.48	0.36
Economic Competencies	0.52	0.06	0.20	0.29	0.26	0.11
Labor Composition	0.12	0.37	0.34	0.25	0.46	0.13
Hours Worked	1.32	-0.21	0.97	0.54	0.64	0.23
Multifactor Productivity (final residual)	0.53	0.27	1.45	0.41	0.47	0.94

Data sources: Statistics Netherlands and EU KLEMS database, November 2009, at http://www.euklems.
Note: Items may not add up due to a rounding error. Public and private R&D do not add up to innovative property because innovative property also comprises other categories such as copyright and license costs.

Table 9: Total Economy - Base Scenario

	2010-2020	2010-2015	2015-2020
Excluding Intangible Capital			
GDP growth (excl. software and education)	1.73	1.67	1.79
Hours growth	-0.13	-0.17	-0.08
Labour Productivity growth	1.86	1.84	1.88
Contributions to GDP growth			
ICT Capital (excl. software)	0.26	0.26	0.26
Non-ICT Capital	0.24	0.24	0.24
Labor Composition	0.14	0.12	0.16
Hours Worked	-0.09	-0.13	-0.05
Multifactor Productivity (excl. effects of software and education)	1.18	1.18	1.18
Including Intangible Capital			
GDP growth (incl. Intangibles)	1.86	1.81	1.92
Hours growth	-0.13	-0.17	-0.08
Labour Productivity growth	1.99	1.98	2.00
Contributions to GDP growth			
ICT Capital (excl. software)	0.21	0.21	0.21
Non-ICT Capital	0.17	0.17	0.17
Intangible Capital	0.87	0.84	0.90
Software	0.11	0.11	0.10
Innovative Property	0.34	0.33	0.36
Private R&D	0.18	0.18	0.19
Internal effect	0.02	0.01	0.02
External effect	0.17	0.16	0.17
Public R&D	0.14	0.13	0.15
Internal effect	0.02	0.02	0.02
External effect	0.12	0.11	0.13
Economic Competencies	0.07	0.07	0.07
Educational Capital	0.34	0.33	0.36
Labor Composition	0.14	0.12	0.15
Hours Worked	-0.06	-0.06	-0.04
Multifactor Productivity	0.53	0.53	0.53

Data sources: Statistics Netherlands and EU KLEMS database, November 2009, at http://www.euklems.
Note: Items may not add up due to a rounding error. Public and private R&D do not add up to innovative property because innovative property also comprises other categories such as copyright and license costs.

Table 10: Total Economy – Upper Optimistic Scenario

	2010-2020	2010-2015	2015-2020
Excluding Intangible Capital			
GDP growth (excl. software and education)	1.73	1.67	1.79
Hours growth	-0.13	-0.17	-0.08
Labour Productivity growth	1.86	1.84	1.88
Contributions to GDP growth			
ICT Capital (excl. software)	0.26	0.26	0.26
Non-ICT Capital	0.24	0.24	0.24
Labor Composition	0.14	0.12	0.16
Hours Worked	-0.09	-0.13	-0.05
Multifactor Productivity (excl. effects of software and education)	1.18	1.18	1.18
Including Intangible Capital			
GDP growth (incl. Intangibles)	2.09	2.08	2.12
Hours growth	-0.13	-0.17	-0.08
Labour Productivity growth	2.21	2.25	2.20
Contributions to GDP growth			
ICT Capital (excl. software)	0.21	0.21	0.21
Non-ICT Capital	0.17	0.17	0.17
Intangible Capital	1.09	1.00	1.19
Software	0.12	0.12	0.12
Innovative Property	0.48	0.42	0.55
Private R&D	0.28	0.24	0.32
Internal effect	0.02	0.02	0.03
External effect	0.25	0.22	0.29
Public R&D	0.18	0.15	0.21
Internal effect	0.02	0.02	0.03
External effect	0.15	0.13	0.18
Economic Competencies	0.14	0.13	0.15
Educational Capital	0.35	0.33	0.37
Labor Composition	0.14	0.12	0.15
Hours Worked	-0.06	0.04	-0.14
Multifactor Productivity	0.53	0.53	0.53

Data sources: Statistics Netherlands and EU KLEMS database, November 2009, at http://www.euklems.
Note: Items may not add up due to a rounding error. Public and private R&D do not add up to innovative property because innovative property also comprises other categories such as copyright and license costs.

Table 11: Total Economy – Lower Optimistic Scenario

	2010-2020	2010-2015	2015-2020
Excluding Intangible Capital			
GDP growth (excl. software and education)	1.73	1.67	1.79
Hours growth	-0.13	-0.17	-0.08
Labour Productivity growth	1.86	1.84	1.88
Contributions to GDP growth			
ICT Capital (excl. software)	0.26	0.26	0.26
Non-ICT Capital	0.24	0.24	0.24
Labor Composition	0.14	0.12	0.16
Hours Worked	-0.09	-0.13	-0.05
Multifactor Productivity (excl. effects of software and education)	1.18	1.18	1.18
Including Intangible Capital			
GDP growth (incl. Intangibles)	1.94	1.92	1.98
Hours growth	-0.13	-0.17	-0.08
Labour productivity growth	2.07	2.09	2.07
Contributions to GDP growth			
ICT Capital (excl. software)	0.21	0.21	0.21
Non-ICT Capital	0.17	0.17	0.17
Intangible Capital	0.95	0.89	1.01
Software	0.11	0.11	0.11
Innovative Property	0.41	0.37	0.46
Private R&D	0.21	0.19	0.22
Internal effect	0.02	0.02	0.02
External effect	0.19	0.18	0.20
Public R&D	0.18	0.15	0.21
Internal effect	0.02	0.02	0.03
External effect	0.15	0.13	0.18
Economic Competencies	0.08	0.08	0.08
Educational Capital	0.35	0.33	0.37
Labor Composition	0.14	0.12	0.15
Hours Worked	-0.06	-0.01	-0.09
Multifactor Productivity	0.53	0.53	0.53

Data sources: Statistics Netherlands and EU KLEMS database, November 2009, at http://www.euklems.

Note: Items may not add up due to a rounding error. Public and private R&D do not add up to innovative property because innovative property also comprises other categories such as copyright and license costs.

Table 12: Total Economy – Upper Pessimistic Scenario

	2010-2020	2010-2015	2015-2020
Excluding Intangible Capital			
GDP growth (excl. software and education)	1.73	1.67	1.79
Hours growth	-0.13	-0.17	-0.08
Labour productivity growth	1.86	1.84	1.88
Contributions to GDP growth			
ICT Capital (excl. software)	0.26	0.26	0.26
Non-ICT Capital	0.24	0.24	0.24
Labor Composition	0.14	0.12	0.16
Hours Worked	-0.09	-0.13	-0.05
Multifactor Productivity (excl. effects of software and education)	1.18	1.18	1.18
Including Intangible Capital			
GDP growth (incl. Intangibles)	1.67	1.64	1.71
Hours growth	-0.13	-0.17	-0.08
Labour productivity growth	1.79	1.81	1.79
Contributions to GDP growth			
ICT Capital (excl. software)	0.21	0.21	0.21
Non-ICT Capital	0.17	0.17	0.17
Intangible Capital	0.67	0.70	0.65
Software	0.10	0.10	0.10
Innovative Property	0.19	0.20	0.17
Private R&D	0.13	0.14	0.13
Internal effect	0.01	0.01	0.01
External effect	0.12	0.12	0.12
Public R&D	0.03	0.04	0.02
Internal effect	0.00	0.01	0.00
External effect	0.03	0.04	0.02
Economic Competencies	0.06	0.06	0.06
Educational Capital	0.32	0.33	0.32
Labor Composition	0.14	0.12	0.15
Hours Worked	-0.06	-0.09	-0.01
Multifactor Productivity	0.53	0.53	0.53

Data sources: Statistics Netherlands and EU KLEMS database, November 2009, at http://www.euklems.
Note: Items may not add up due to a rounding error. Public and private R&D do not add up to innovative property because innovative property also comprises other categories such as copyright and license costs.

Table 13: Total Economy – Lower Pessimistic Scenario

	2010-2020	2010-2015	2015-2020
Excluding Intangible Capital			
GDP growth (excl. software and education)	1.73	1.67	1.79
Hours growth	-0.13	-0.17	-0.08
Labour productivity growth	1.86	1.84	1.88
Contributions to GDP growth			
ICT Capital (excl. software)	0.26	0.26	0.26
Non-ICT Capital	0.24	0.24	0.24
Labor Composition	0.14	0.12	0.16
Hours Worked	-0.09	-0.13	-0.05
Multifactor Productivity (excl. effects of software and education)	1.18	1.18	1.18
Including Intangible Capital			
GDP growth (incl. Intangibles)	1.51	1.50	1.52
Hours growth	-0.13	-0.17	-0.08
Labour productivity growth	1.63	1.67	1.60
Contributions to GDP growth			
ICT Capital (excl. software)	0.21	0.21	0.21
Non-ICT Capital	0.17	0.17	0.17
Intangible Capital	0.51	0.56	0.47
Software	0.07	0.08	0.06
Innovative Property	0.11	0.14	0.07
Private R&D	0.07	0.08	0.05
Internal effect	0.01	0.01	0.00
External effect	0.06	0.08	0.04
Public R&D	0.03	0.04	0.02
Internal effect	0.00	0.01	0.00
External effect	0.03	0.04	0.02
Economic Competencies	0.01	0.02	0.01
Educational Capital	0.32	0.33	0.32
Labor Composition	0.14	0.12	0.15
Hours Worked	-0.06	-0.09	-0.01
Multifactor Productivity	0.53	0.53	0.53

Data sources: Statistics Netherlands and EU KLEMS database, November 2009, at http://www.euklems.
Note: Items may not add up due to a rounding error. Public and private R&D do not add up to innovative property because innovative property also comprises other categories such as copyright and license costs.

Table 14: Implications of Base, Optimistic, and Pessimistic Scenarios for Output Gains and Losses, Million €, Constant 2006 Prices

	GDP gained	GDP gained	GDP lost	GDP lost
	Upper optimistic compared to base	Lower optimistic compared to base	Upper pessimistic compared to base	Lower pessimistic compared to base
2010	-	-	-	-
2011	1298	463	-1111	-2029
2012	2648	943	-2262	-4126
2013	4050	1442	-3452	-6293
2014	5507	1959	-4684	-8532
2015	7020	2496	-5958	-10845
2016	8590	3052	-7276	-13233
2017	10220	3628	-8639	-15698
2018	11910	4226	-10047	-18243
2019	13664	4844	-11503	-20869
2020	15482	5485	-13006	-23579

Data sources: Statistics Netherlands and EU KLEMS database, November 2009, at http://www.euklems.

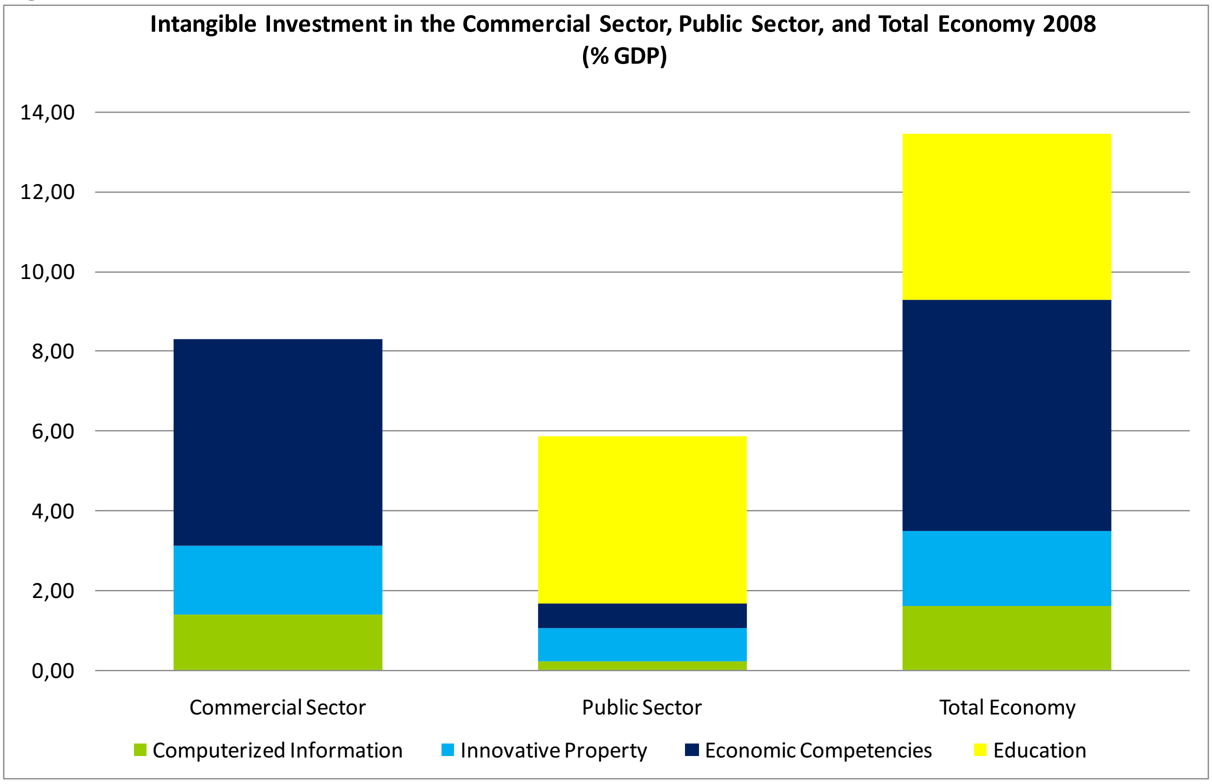
Table 15: Total Economy – Long Run Base Scenario

	2010-2050
Excluding Intangible Capital	
GDP growth (excl. software and education)	1.42
Hours growth	-0.72
Labour productivity growth	2.14
Contributions to GDP growth	
ICT Capital (excl. software)	0.26
Non-ICT Capital	0.24
Labor Composition	0.40
Hours Worked	-0.66
Multifactor Productivity (excl. effects of software and education)	1.18
Including Intangible Capital	
GDP growth (incl. Intangibles)	1.60
Hours growth	-0.72
Labour producitivity growth	2.32
Contributions to GDP growth	
ICT Capital (excl. software)	0.21
Non-ICT Capital	0.17
Intangible Capital	0.90
Software	0.10
Innovative Property	0.35
Private R&D	0.18
Internal effect	0.02
External effect	0.17
Public R&D	0.15
Internal effect	0.02
External effect	0.13
Economic Competencies	0.07
Educational Capital	0.37
Labor Composition	0.38
Hours Worked	-0.59
Multifactor Productivity	0.53

Data sources: Statistics Netherlands and EU KLEMS database, November 2009, at http://www.euklems.

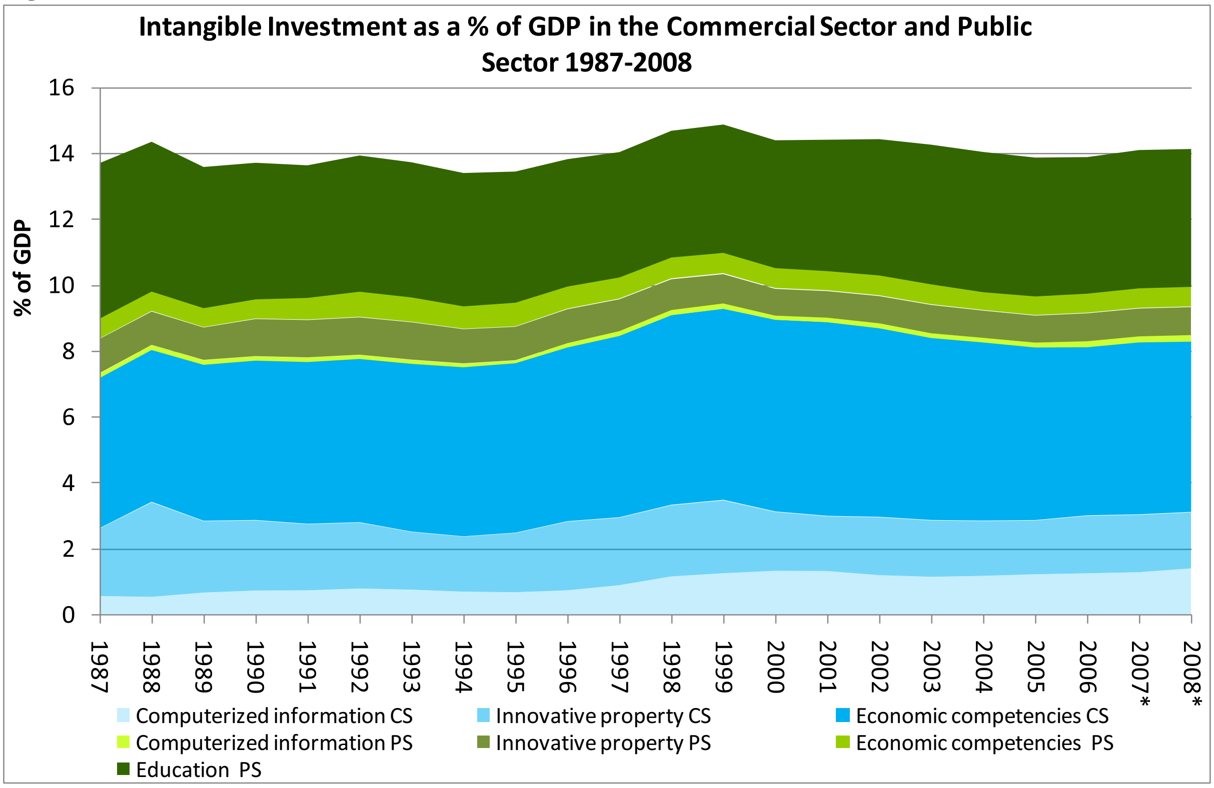
Note: Items may not add up due to a rounding error. Public and private R&D do not add up to innovative property because innovative property also comprises other categories such as copyright and license costs.

Figure 1



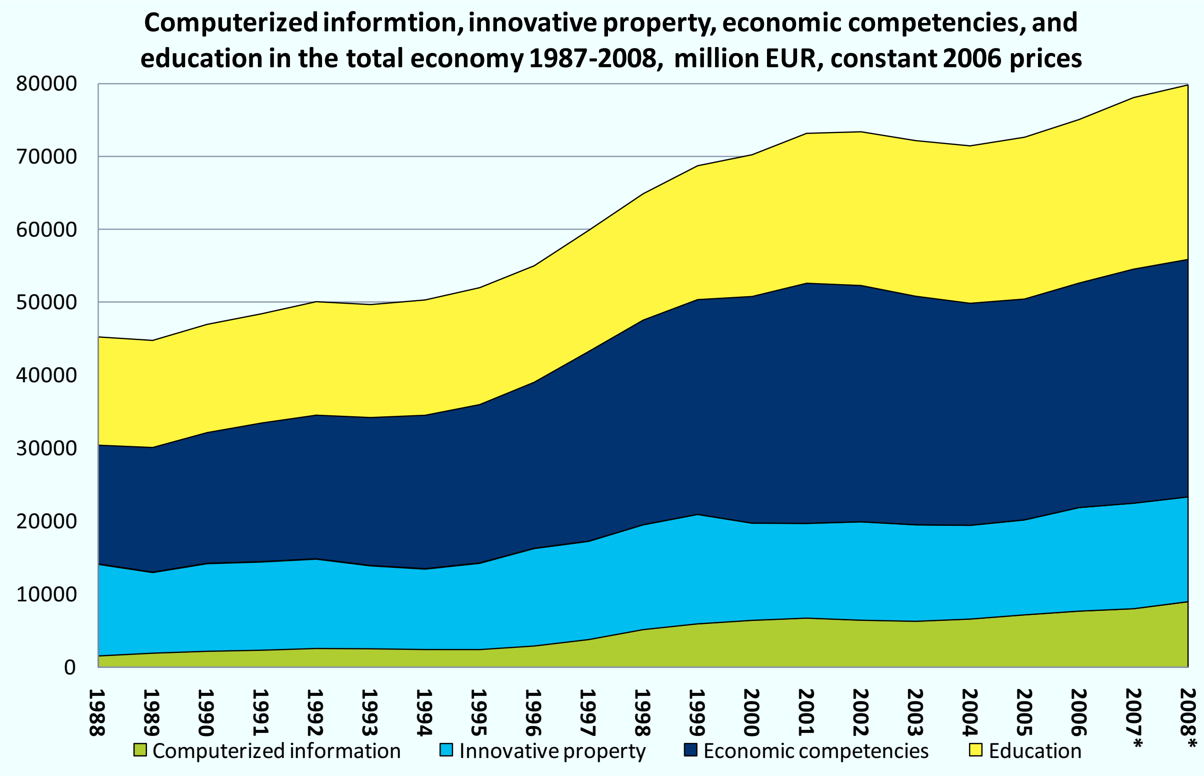
Data source: Statistics Netherlands
Note: GDP is conventionally measured GDP (as published from Statistics Netherlands)

Figure 2



Data source: Statistics Netherlands
Note: GDP is conventionally measured GDP (as published from Statistics Netherlands)

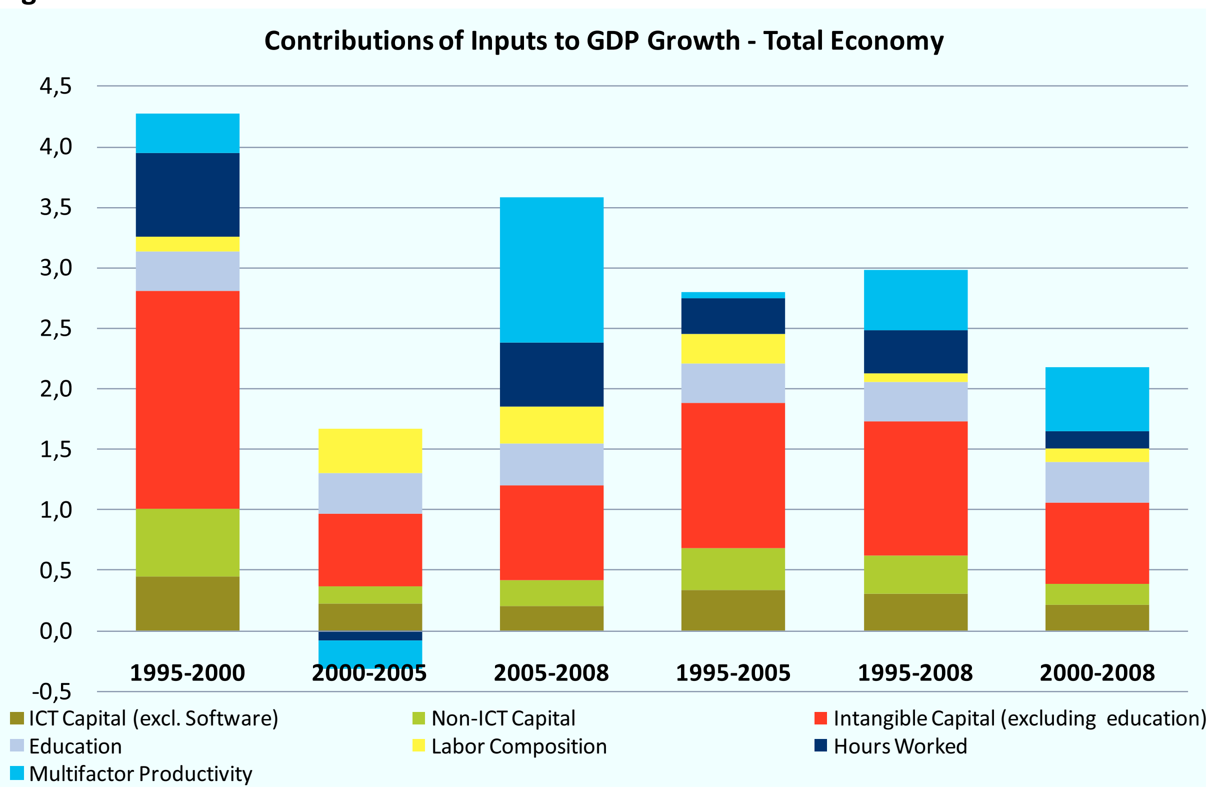
Figure 3



Data source: Statistics Netherlands

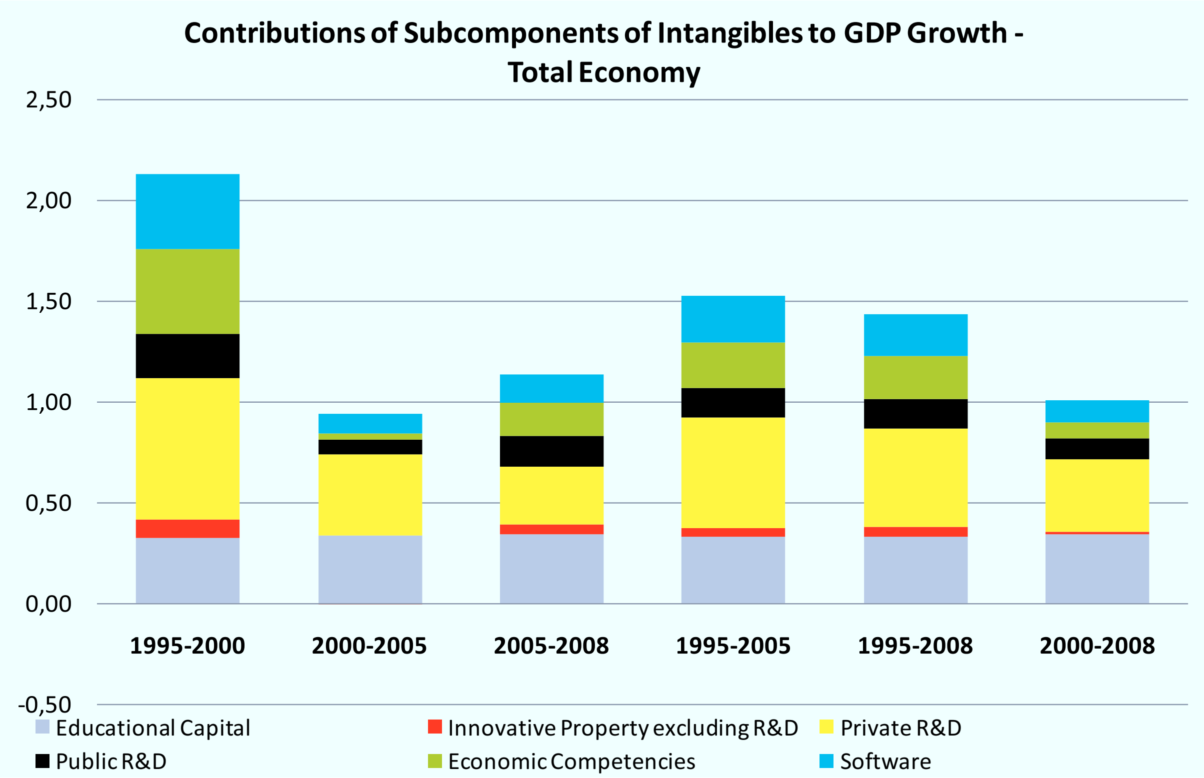
Note: GDP is conventionally measured GDP (as published from Statistics Netherlands)

Figure 4



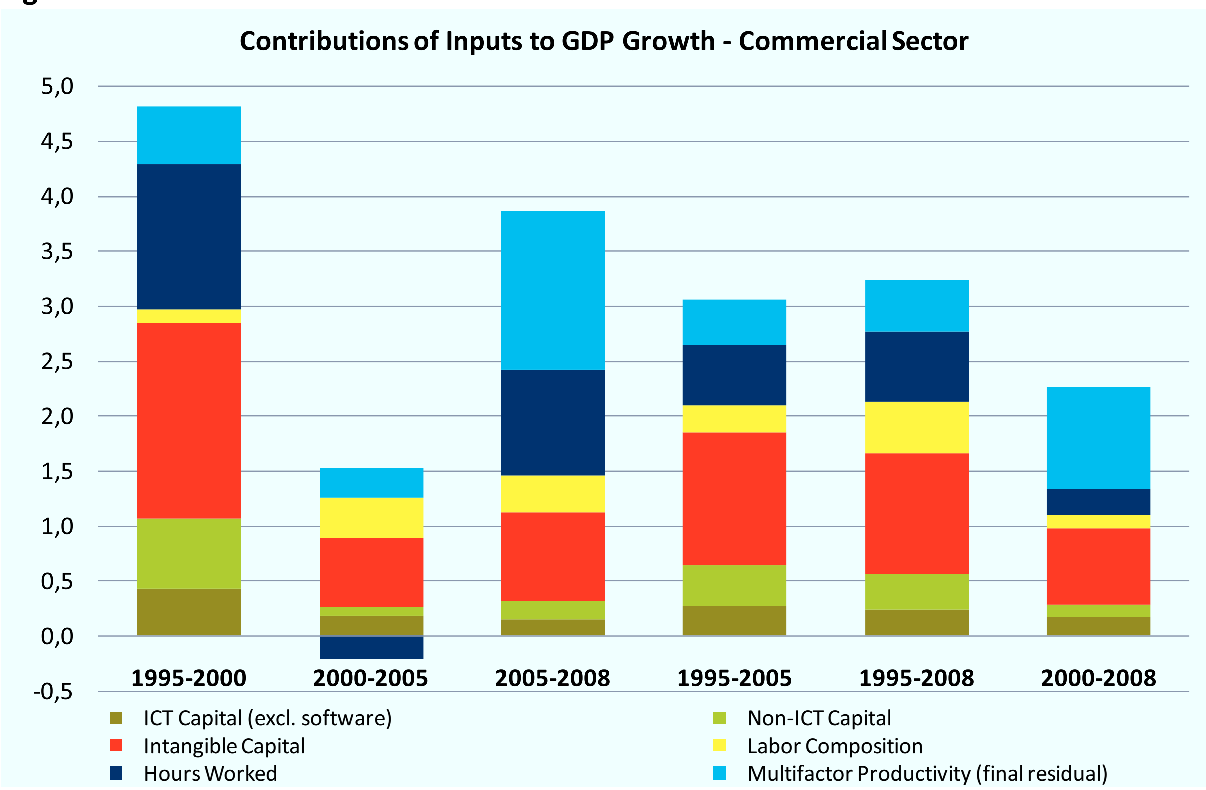
Data sources: Statistics Netherlands and EU KLEMS database, November 2009, at http://www.euklems.

Figure 5



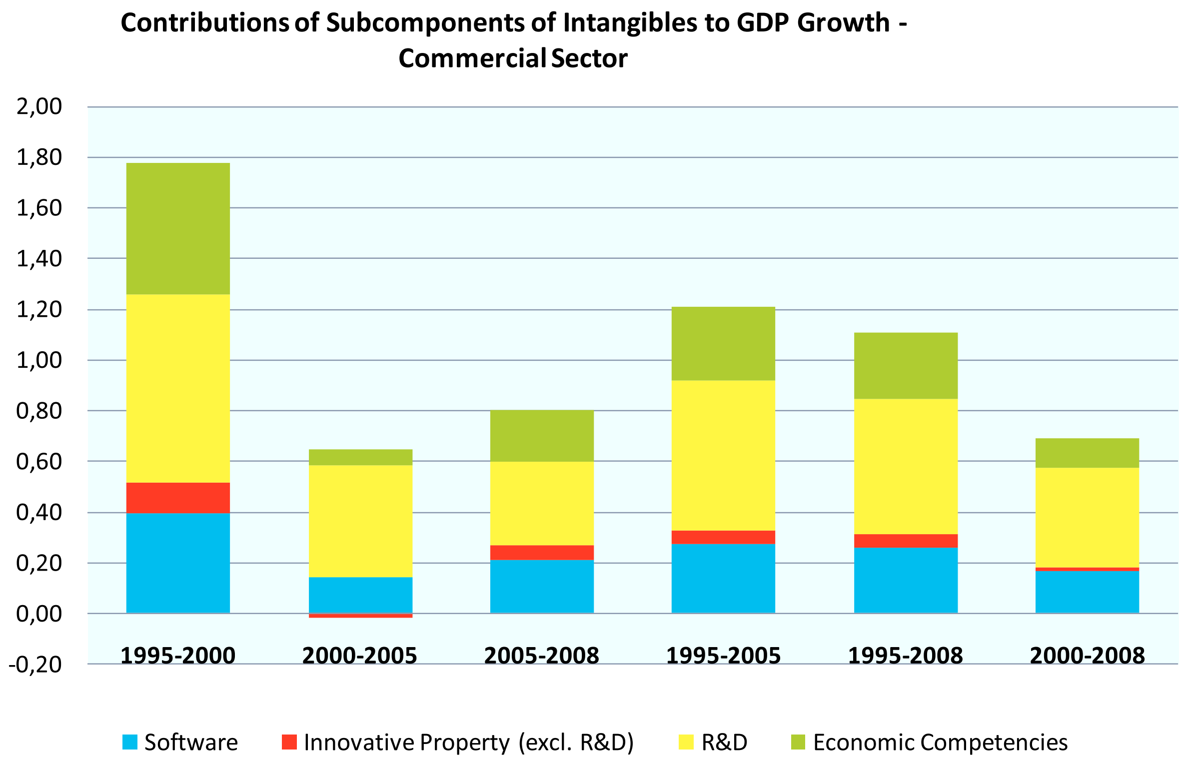
Data sources: Statistics Netherlands and EU KLEMS database, November 2009, at http://www.euklems.

Figure 6



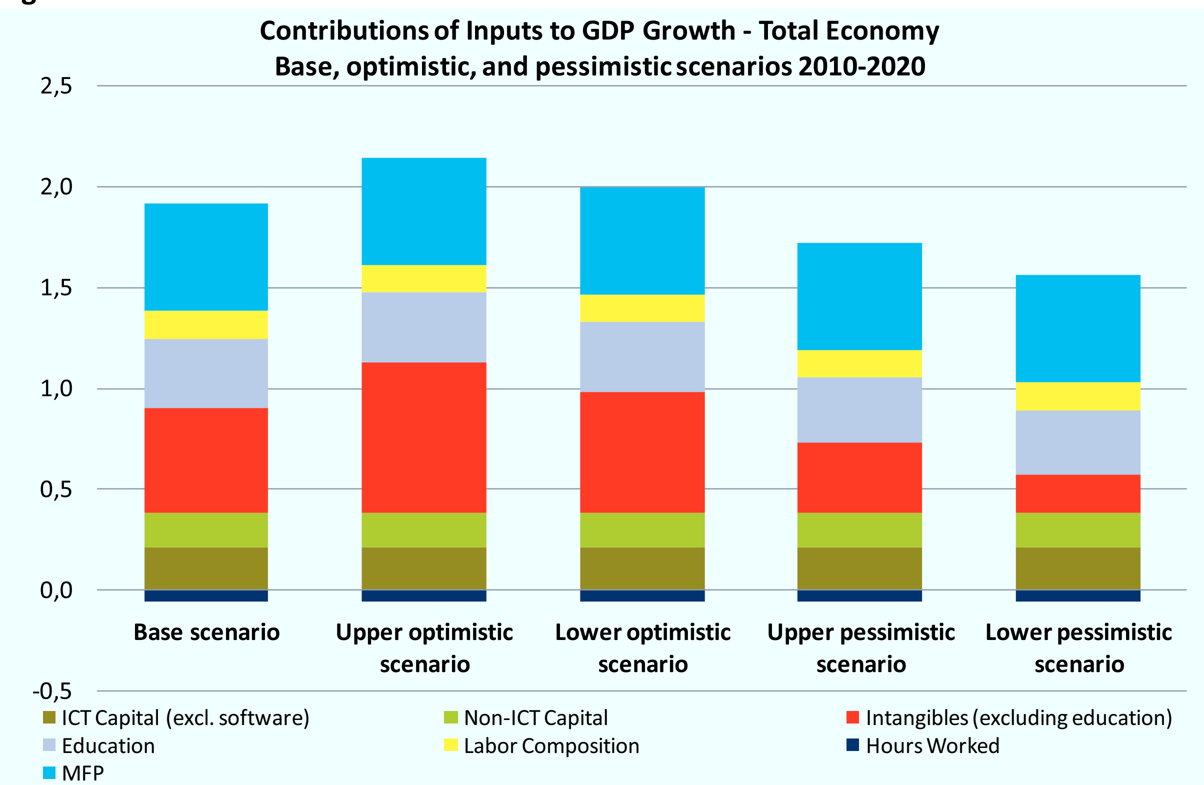
Data sources: Statistics Netherlands and EU KLEMS database, November 2009, at http://www.euklems.

Figure 7



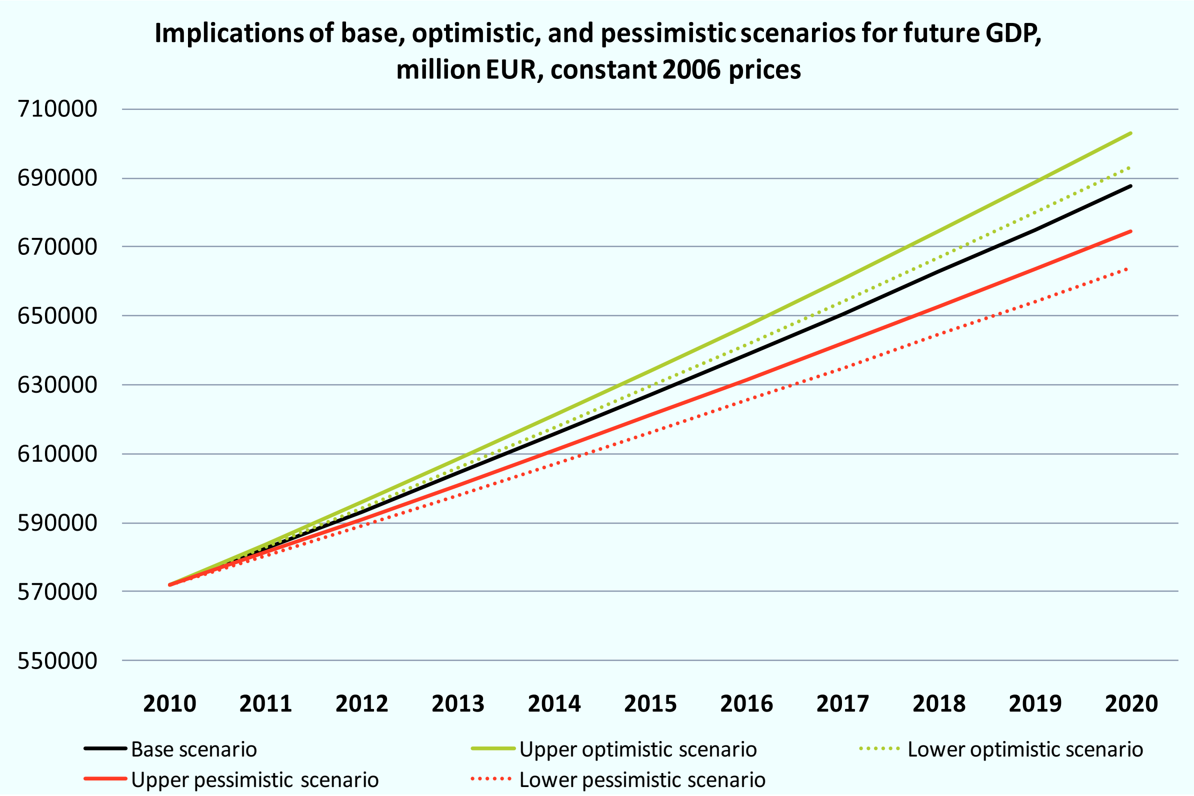
Data sources: Statistics Netherlands and EU KLEMS database, November 2009, at http://www.euklems.

Figure 8



Data sources: Statistics Netherlands and EU KLEMS database, November 2009, at http://www.euklems.

Figure 9



Data sources: Statistics Netherlands and EU KLEMS database, November 2009, at http://www.euklems.

Appendix

A.1 Sources and Methods

1. Computerized Information - Software

The data source of software investment is Statistics Netherlands (CBS). Software is already included in the national accounts as an intangible asset. CBS based their estimates on a survey of both purchases of software and own account until 2000. Private consumption of software is subtracted from domestic demand of software to calculate investment in purchased software since then. As no reliable data on own account software is available since 2001, CBS assumes that the change in levels of own account software equals the change in levels of purchases of software. Different prices indices for own account software and purchased software are used to calculate volume changes. Spending on databases cannot be distinguished from software as it is included in the software figures.

2. Innovative Property

Corrado, Hulton and Sichel (2005) state that innovative property is the expenditures that lead to a patent, copyright or license, or the acquisition of new resources. The authors measure six groups of innovative property:

- R&D in science and engineering
- Mineral explorations
- Copyright and license costs
- R&D in social science and humanities
- Development costs in financial industry
- New architectural and engineering designs

We use a slightly different grouping of innovative property following CBS, and estimate R&D including social science and humanities.

Research and Development

CBS itself obtains data on R&D capital expenditure from the Dutch satellite accounts on knowledge (also called the knowledge module). This addition to the core national accounts has been developed to measure the role of knowledge in the economy in greater detail.

Mineral Exploration and Evaluation

The estimates from CBS are based on data series regarding the amount of exploratory drilling (by type of drilling and location) and on data series on the average costs of exploratory drilling (by type of drilling and location for a benchmark year).

Copyright and license costs

To estimate development costs in the motion picture industry and in the radio and television, sound recording and book publishing industries in the Netherlands, CBS uses data series from the Dutch national accounts with regard to investment in entertainment, literary or artistic originals. These estimates are calculated using revenues from royalties and licenses. Therefore, assumptions on the age efficiency of royalties and licenses are necessary to estimate the value of new originals from the revenues mentioned above.

New architectural and engineering designs

A large part of expenditures in this category are registered as investment in the national accounts. They are included in the estimates of tangible capital investment and, more precisely, in investments in dwellings, nonresidential buildings and machinery and equipment. CBS has distinguished the intangibles parts from their tangible counterparts for their analysis and made this data available for us.

3. Economic Competencies

Brand Equity

Economic competencies are the largest category and include three subgroups: brand equity, firm-specific human capital and organizational structure.

The Dutch national accounts are used by CBS to construct advertising expenditures. The business survey data are combined with other data sources to arrive at industry expenditure by commodity. The national accounts make a distinction between eight different expenditure categories of marketing and advertisement, which feature seven types of advertisement expenditure and one type of market research:

- Advertisements in newspapers
- Advertisements in specialist journals
- Advertisements in other journals
- Advertising pamphlets / brochures
- Free local papers
- Other spending on marketing and advertisement
- Market research services
- Public relation services

As advertising is only a fraction of the total sales and marketing effort of companies, it is necessary to decide what part of advertising is related to strengthening the brand relative to advertising to capture market share. CBS defines investment in brand equity as the part of the expenditure on marketing and advertisement that has as the primary aim to increase the value of a brand name or to increase output over a period of more than one year.

CBS excludes spending by advertising agencies, as it is done on behalf of their customers and is therefore considered intermediate input of the advertising agencies. Excluded is spending on free local papers, because they do not aimed at increasing output for more than one year. Included in the advertising numbers are 50 percent of the spending on advertising pamphlets and brochures. Furthermore, 13 percent of spending on advertisement in newspapers is excluded from the investment estimates and 5 percent of the spending on advertisement in specialist journals.

CBS calculates purchases of market research and public relation services with the same method as the estimation of investment in organizational structure. As the results for these services deviate less than 10 percent from output of the market research industry and the public relation industry, the output estimate of the corresponding industry seems to be a good approximation of total investment.

Firm-specific human capital

Investment in firm-specific capital and human resources includes direct firm expenses such as tuition reimbursement or outlays on trainers and wage and salary costs of employee time. A company would not pay for firm-specific training unless it expects a return on investment - even though it mainly improves the human capital of employees. Expenditures on firm specific training also meet the criterion of an asset because the expected returns on company training will last usually for more than one year. As with the R&D data, CBS obtained the data series on firm-specific human capital from the Dutch knowledge module which are mainly based on the 'Continuing Vocational Training Survey' (CVTS).

Organizational Structure

Purchased organizational advice from consultancy firms and own account creation of organizational structure by the management together build the category organizational structures. Statistics Netherlands cannot construct these figures from the Dutch innovation survey because companies are only asked if such changes have been implemented and not about costs or the numbers of employees involved. This survey also does not distinguish between purchased and own account changes in organizational structure. Instead, CBS calculates purchased organizational structures based on national accounts data series concerning total production and purchases of economic advice as well as more detailed micro data.

The new method to estimate organizational structure on own account is described in CBS (2009). It uses the mean annual earnings (2002, 2006) and the number of employees (2002, 2006) for the Netherlands (Structure of earnings survey, SES, from the Eurostat database). It also uses national accounts data on the compensation of employees (Table 4.1 in the Dutch national accounts). CBS first determines the total compensation of employees by multiplying mean annual earnings with the number of employees, both of which are from the SES survey. They do this for ISCO1, management occupations and for ISCO total, all occupations. In the next step, they calculate ISCO1 earnings as part of total earnings. They apply this ratio on the compensation of employees from our national accounts data. Following the CHS method, CBS assumes that managers spend 20 percent of their time on improving organizational structures. In the next step, they multiply the estimates on managers' compensation by 0.20 to arrive at an estimate of investment in own account organizational structure. Time series for the years 1987–2001 are constructed with the help of compensation of employees-data from the national accounts (extrapolation). With the estimates for the years 2003–2005 they took into account the changing ratio of ISCO1/ISCO total from 2002 to 2006.

A.2 Additional tables and figures

Table A.1: Table: Intangible Investment - Million euros (Constant 2006 Prices)

	Commercial Sector				Public Sector				Total Economy			
	2000	2004	2006	2008*	2000	2004	2006	2008*	2000	2004	2006	2008*
Computerized information	**5,823**	**5,894**	**6,724**	**7,847**	**632**	**734**	**986**	**1,151**	**6,455**	**6,628**	**7,710**	**8,997**
Software and Databases	*5,823*	*5,894*	*6,724*	*7,847*	*632*	*734*	*986*	*1,151*	*6,455*	*6,628*	*7,710*	*8,997*
Innovative property	**9,072**	**8,526**	**9,503**	**9,525**	**4,172**	**4,247**	**4,620**	**4,767**	**13,244**	**12,772**	**14,123**	**14,293**
a) R&D including social science and humanities	*5,204*	*5,220*	*5,203*	*5,338*	*3,442*	*3,502*	*3,823*	*3,922*	*8,647*	*8,722*	*9,026*	*9,260*
R&D in the financial industry	443	338	407	417					443	338	407	417
b) Mineral exploration and evaluation	*237*	*201*	*250*	*196*					*237*	*201*	*250*	*196*
c) Other innovative property	*3,631*	*3,105*	*4,050*	*3,991*	*730*	*745*	*797*	*845*	*4,361*	*3,849*	*4,846*	*4,837*
Copyright and license costs	1,020	750	1,373	1,151					1,020	750	1,373	1,151
New architectural and engineering designs	2,611	2,355	2,677	2,840	730	745	797	845	3,341	3,100	3,473	3,685
Economic competencies	**27,897**	**27,658**	**27,659**	**29,154**	**3,316**	**2,923**	**3,261**	**3,545**	**31,213**	**30,581**	**30,920**	**32,698**
a) Brand equity	*11,098*	*11,599*	*11,993*	*12,326*	*121*	*145*	*154*	*160*	*11,219*	*11,744*	*12,147*	*12,486*
Advertising expenditure	9,855	10,391	10,858	11,116	61	76	88	90	9,915	10,466	10,946	11,206
Market research	1,243	1,209	1,136	1,210	61	69	66	70	1,304	1,278	1,201	1,280
b) Firm-specific human capital	*4,465*	*4,257*	*3,882*	*4,271*	*2,213*	*1,760*	*2,141*	*2,356*	*6,678*	*6,018*	*6,024*	*6,627*
Direct firm expenses	2,170	1,997	1,797	1,976	815	652	781	859	2,986	2,649	2,577	2,835
Wage and salary costs of employee time	2,295	2,260	2,086	2,295	1,397	1,109	1,361	1,497	3,692	3,368	3,447	3,792
c) Organizational structure	*12,334*	*11,801*	*11,783*	*12,557*	*982*	*1,018*	*966*	*1,029*	*13,316*	*12,819*	*12,749*	*13,586*
Purchased	6,332	6,411	7,041	7,503	308	365	407	434	6,640	6,776	7,448	7,937
Own account	6,002	5,391	4,742	5,053	674	653	559	595	6,676	6,043	5,301	5,649
Total - CHS categories	**42,791**	**42,077**	**43,886**	**46,526**	**8,121**	**7,904**	**8,867**	**9,463**	**50,912**	**49,981**	**52,752**	**55,988**
Education					**19,434**	**21,581**	**22,418**	**23,926**	**19,434**	**21,581**	**22,418**	**23,926**
Primary / Secondary					16314	18275	18984	20170	16314	18,275	18,984	20,170
Tertiary					3120	3306	3434	3756	3120	3,306	3,434	3,756
Total	**42,791**	**42,077**	**43,886**	**46,526**	**27,555**	**29,485**	**31,285**	**33,389**	**70,346**	**71,562**	**75,170**	**79,914**

Notes: * Preliminary results for 2007 and 2008, which include an approximation of the commercial and public sectors according to shares of total economy in 2006.
Commercial sector also includes other industries and health care
Data source: Statistics Netherlands.

Table A.2: Table: Annual Average Growth Rates of Intangible and Tangible Assets 2000-2008 (Base Scenario).

Growth rates 2000-2008	
Intangible assets	
Advertising expenditure	0.51
New architectural and engineering designs	2.19
Copyright and license costs	2.55
Software and Databases	3.20
Direct firm expenses	0.90
R&D in the financial industry	0.33
Market research	0.90
Organizational structure - own account	-0.95
Organizational structure - purchased	3.42
Private R&D	1.39
Public R&D	2.73
Wage and salary costs of employee time	1.89
Primary /secondary education	3.16
Tertiary education	2.81
Tangible assets	
Communications equipment	2.54
Computing equipment	2.66
Non-resident structures	2.49
Other machinery and equipment	0.22
Other assets	2.57
Transport equipment	1.61

Table A.3: Growth Accounting on Contributions to Labour Productivity Growth – Total Economy

	1995-2000	2000-2005	2005-2008	1995-2005	1995-2008	2000-2008
Excluding Intangible Capital						
GDP growth (excl. software and education)	3.79	1.39	3.31	2.59	2.75	2.11
Hours growth	2.35	-0.31	1.74	1.01	1.18	0.45
Labour Productivity growth	1.49	1.67	1.62	1.58	1.59	1.65
Contributions to Labour Productivity growth						
ICT Capital (excl. software)	0.48	0.28	0.21	0.38	0.34	0.25
Non-ICT Capital	0.05	0.29	-0.22	0.17	0.08	0.10
Labour Composition	0.12	0.38	0.32	0.25	0.07	0.12
Multifactor Productivity (excl. effects of software and education)	0.85	0.72	1.32	0.79	1.10	1.18
Including Intangible Capital						
GDP growth (incl. Intangibles)	4.28	1.35	3.59	2.80	2.98	2.18
Hours growth	2.27	-0.27	1.66	0.99	1.14	0.45
Labour Productivity growth	1.97	1.63	1.89	1.80	1.82	1.73
Contributions to Labour Productivity growth						
ICT Capital (excl. software)	0.39	0.23	0.17	0.31	0.28	0.21
Non-ICT Capital	0.05	0.21	-0.16	0.13	0.06	0.07
Intangible Capital	1.08	1.06	0.37	1.07	0.91	0.80
Software	0.31	0.10	0.10	0.21	0.18	0.10
Innovative Property	0.55	0.53	0.15	0.54	0.45	0.39
Private R&D	0.40	0.44	0.07	0.42	0.34	0.30
Internal effect	0.03	0.04	0.01	0.04	0.03	0.03
External effect	0.36	0.40	0.07	0.38	0.31	0.28
Public R&D	0.09	0.09	0.05	0.09	0.08	0.08
Internal effect	0.01	0.01	0.01	0.01	0.01	0.01
External effect	0.07	0.08	0.05	0.08	0.07	0.07
Economic Competencies	0.26	0.05	0.05	0.15	0.13	0.05
Educational Capital	-0.04	0.38	0.08	0.17	0.15	0.27
Labour Composition	0.12	0.36	0.30	0.23	0.07	0.11
Multifactor Productivity (final residual)	0.33	-0.24	1.21	0.05	0.50	0.53

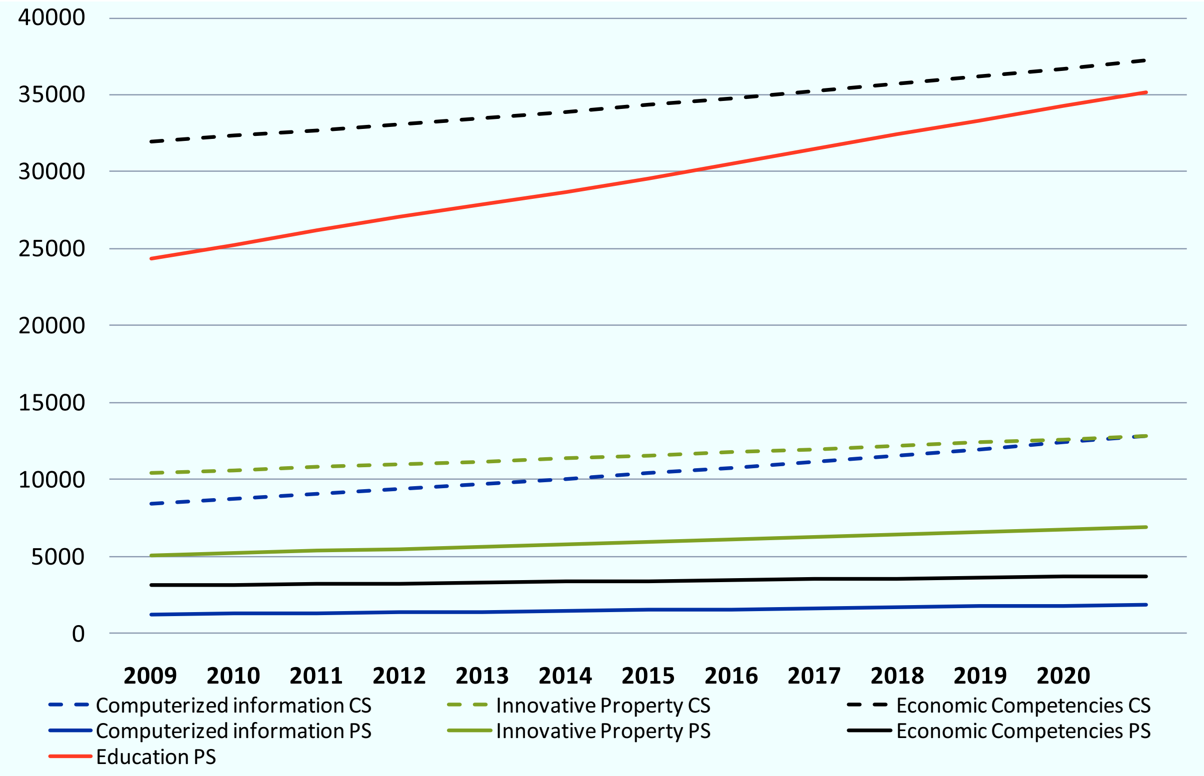
Data sources: Statistics Netherlands and EU KLEMS database, November 2009, at http://www.euklems.
Note: Items may not add up due to a rounding error. Public and private R&D do not add up to innovative property because innovative property also comprises other categories such as copyright and license costs.

Table A.4: Growth Accounting on Contributions to Labour Productivity Growth – Commercial Sector

	1995-2000	2000-2005	2005-2008	1995-2005	1995-2008	2000-2008
Excluding Intangible Capital						
GDP growth (excl. software)	4.25	1.54	3.71	2.88	3.07	2.35
Hours growth	2.59	-0.37	1.95	1.10	1.30	0.50
Labour productivity growth	1.67	1.96	1.77	1.81	1.81	1.89
Contributions to Labour Productivity growth						
ICT Capital (excl. software)	0.42	0.22	0.14	0.30	0.25	0.19
Non-ICT Capital	0.11	0.22	-0.31	0.15	0.05	0.03
Labour Composition	0.13	0.42	0.38	0.28	0.52	0.14
Multifactor Productivity (excl. effects of software)	1.01	1.10	1.57	1.08	0.99	1.53
Including Intangible Capital						
GDP growth (incl. Intangibles)	4.82	1.32	3.87	3.06	3.25	2.27
Hours growth	2.54	-0.41	1.90	1.05	1.25	0.45
Labour productivity growth	2.23	1.74	1.94	1.99	1.97	1.81
Contributions to Labour Productivity growth						
ICT Capital (excl. software)	0.37	0.19	0.11	0.26	0.22	0.16
Non-ICT Capital	0.09	0.17	-0.24	0.13	0.04	0.02
Intangible Capital	1.12	0.74	0.28	0.94	0.78	0.57
Software	0.33	0.16	0.14	0.24	0.22	0.15
Innovative Property	0.48	0.49	0.10	0.48	0.39	0.34
R&D	0.39	0.50	0.06	0.45	0.36	0.34
Internal effect	0.04	0.05	0.01	0.05	0.04	0.04
External effect	0.35	0.45	0.06	0.40	0.32	0.30
Economic Competencies	0.32	0.10	0.05	0.21	0.17	0.08
Labour Composition	0.12	0.37	0.33	0.25	0.46	0.13
Multifactor Productivity (final residual)	0.53	0.27	1.45	0.41	0.47	0.94

Data sources: Statistics Netherlands and EU KLEMS database, November 2009, at http://www.euklems.
Note: Items may not add up due to a rounding error. Public and private R&D do not add up to innovative property because innovative property also comprises other categories such as copyright and license costs.

Figure A.1 Projections of Investment in Intangibles until 2020, Base Scenario, Million euros, Constant 2006 Prices



Data sources: Statistics Netherlands and EU KLEMS database, November 2009, at http://www.euklems.