Chapter 2

Why has productivity growth declined?

Labour productivity decelerated markedly over the 1990s and into the current decade. One reason is the slowdown in capital deepening related to the trend increase in employment. Greater inclusion in the labour market of workers with lower-than-average productivity may also have contributed. However, these factors do not account for the observed reduction in total factor productivity (TFP) growth. The TFP slowdown is puzzling in light of Denmark's comparatively productivity-friendly policies and institutions. The financial crisis is likely to hold back productivity growth over the medium run, through the pace of capital deepening and, possibly, through lower investment in R&D and innovation. This chapter analyses the slowdown in productivity growth and reviews the policies that could help boost it in the future.

Labour productivity growth in Denmark has been on a declining trend for almost a decade and a half. Over this period, labour utilisation has trended up, reflecting rising employment and, to a lesser extent, longer working hours by those employed. A common view is that the slowdown in labour productivity is due to the inclusion of workers from the fringes of the labour market. Additional labour supply may have weighed on productivity growth for two reasons. First, it takes time for the capital stock to adjust to the higher level of labour supply. While capital deepening has been a major contributor to labour productivity growth, additional capital may be required to complement the extra labour in use. Second, the additional workers brought into employment may have lower-than-average productivity.

Even taking these factors into account, it is difficult to explain the extent of the slowdown in labour productivity, especially since the basic framework conditions that are considered to be conducive to productivity growth are generally sound in Denmark. Indeed, R&D investment amounts to 2½ per cent of GDP – in the top third of OECD countries. Product market regulation is relatively liberal. Corporate taxes are relatively low. There is a high rate of firm turnover, suggesting strong "creative destruction", and foreign direct investment is high.

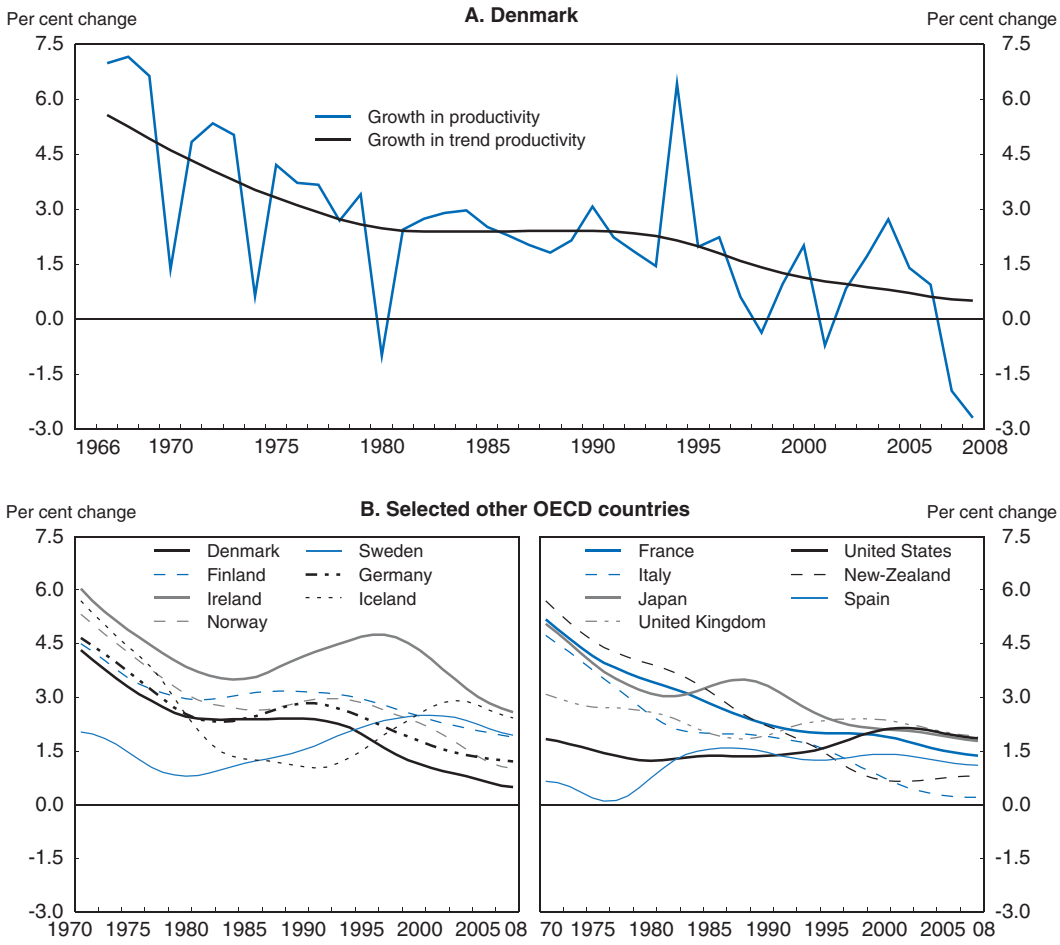
The financial crisis is likely to have medium-term implications for Danish productivity growth. An increase in risk aversion might dampen capital deepening, compounding the slowdown of the past decade. Furthermore, the recession might also reduce the resources devoted to R&D investment and innovation. While general framework conditions for productivity growth are good, there is a need to consider what further measures would boost productivity growth and thereby national income gains in the medium term.

Trends in labour productivity

Growth in labour productivity (gross domestic product – GDP or gross value added – GVA per hour worked) has trended down since the early 1990s, after strong performance in the 1970s and 1980s.[1] Aggregate labour productivity growth averaged about three-quarters of a percentage point less over 1993-2006 than over 1981-92. Several OECD countries have had a similar experience (*e.g.* Japan, New Zealand and Spain), but Denmark's labour productivity growth has fallen well below that in many other OECD countries (Figure 2.1). Accordingly, the level of labour productivity, converted into US dollars using purchasing power parities, has begun to fall below the leading countries. Improving terms of trade have worked in the opposite direction to productivity growth, providing a boost to national income. This contrasts with countries like Sweden and Finland, which have experienced declining terms of trade due to the large share of ICT products in their exports. Statistical issues may also affect cross-country comparisons of productivity performance, although it is difficult to say how much (Box 2.1).

Growth accounting suggests that the slowdown in labour productivity between 1981-92 and 1993-2005 is driven by a reduction in the contribution to growth in both TFP and capital deepening (Table 2.1, Annex 2.A1). Total economy labour productivity growth

Figure 2.1. **Labour productivity growth in Denmark has slowed to well below that in other OECD countries**[1]



1. The growth of GDP per hour worked has been smoothed using a HP filter (lambda=100) and the series shown are the annual growth rates of the smoothed series.

Source: Statistics Denmark National Accounts, Tables NAT02 and NAT18 and *OECD Productivity Database*.

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Box 2.1. **Statistical issues in productivity measurement**

Cross-country comparisons of labour productivity performance are made difficult by measurement issues. In general, while most countries' national accounts data conform to the System of National Accounts, differences arise between countries due to interpretation or structural factors. Data on hours worked are sourced from national accounts and sometimes labour force surveys. Labour force surveys generally over-report hours worked compared to time-use surveys while employer-survey-based measures do not account for unpaid overtime and so may under-report hours worked (OECD, 2008d). This box discusses several issues related to Danish data that may affect international comparisons of productivity performance.

Box 2.1. **Statistical issues in productivity measurement** *(cont.)*

The dwellings sector, which captures rent paid for rental dwellings as well as imputed rent from owner-occupied dwellings, has been stable in real terms and fallen as a share of GVA over the past decade. Owner-occupied rent is calculated by using the rents paid in the private rental market. This market is heavily regulated and rents do not necessarily change much with changes in demand. Prices of owner-occupied housing have increased sharply in recent years. To the extent that this reflects a rise in the quality of the housing stock, it should be captured in the stratification methods used for national accounts. Price increases which don't reflect quality improvement should not affect the volume measure of value added in the national accounts. However, since the rental rate used in the national accounts is linked to rents that do not necessarily mirror house prices, the implied rental yield may be unrealistically low, which may bias recorded GVA (and productivity) downwards.

Difficulties in measuring service-sector productivity growth could affect international comparisons. Labour productivity growth in the public sector has historically often been set at zero with output assumed to equal inputs. For countries with large public sectors, this could mechanically reduce aggregate productivity growth relative to a country with similar growth in productivity in the market sector but a smaller public sector. In some other services sectors, where direct price measurement is difficult, value added is deflated using wages. This effectively removes labour productivity growth from volume measures and so could lead to some understatement of productivity growth.

National accounts volume measures are constructed using deflators which should control for the rapid rise in quality of computer products. Price indices for ICT products, based on hedonic methods, have fallen considerably faster than traditional price deflators (Pilat *et al.*, 2002). If the output produced using computer inputs is not deflated with hedonic indices, or deflated with different hedonic indices showing smaller price falls, importing computer equipment and using it as an input to produce non-ICT goods could lead to a rise in the volume of intermediate inputs, making volume value added appear weaker (Schreyer, 2002). In Danish national accounts statistics, hedonic price deflators are used for imports, gross fixed capital formation and private consumption of computers. Denmark has a small ICT-producing sector and there is no significant production of computers. Imports of office machines and automatic-data-processing equipment are equal to about 1% of total GVA. Input-output tables show that imports from the sector "manufacture of office machinery or computers" are used predominantly for consumption or investment. Given the small amount of imported computer equipment and its predominant use in consumption and investment, it is unlikely that hedonic deflation of these goods could significantly reduce reported GVA and labour productivity growth.

Finally, the measurement of investment in intangible assets may affect cross-country comparisons of productivity. Some intangible assets, such as computer software, are currently captured in gross value added and capital services measures. However, other intangibles, such as computerized information, firm-specific human capital, and organisational capital, are not currently captured in output or capital measures. To the extent that investment in these "other intangibles" is growing faster than in other types of capital, capital services growth may be under-estimated. Similarly, treating expenditure on these items as investment rather than intermediate inputs would increase value added and existing measures of value added growth may be under-reported if growth in other intangibles is higher than growth in other outputs. Thus, incorporating other intangibles may affect overall labour productivity growth, as well as the breakdown between capital deepening and TFP. Calculations for a number of countries indicate that including other intangibles tends to raise overall labour productivity growth and capital deepening and reduces TFP growth (Barnes and McClure, 2009). Given the data requirements and time limitations, no attempt has been made to assess whether these factors have played a part in the Danish labour productivity slowdown since the early 1990s.

Table 2.1. **Labour productivity growth accounting**
Average annual % change

.		1981-92	1993-2005	Change
Panel A. OECD Secretariat calculations				
Total economy	GDP per hour worked	2.4	1.6	–0.8
Contribution to total economy GDP per hour worked from				
	Capital deepening	1.1	1.0	–0.1
	Labour quality	0.4	0.3	–0.1
	Total factor productivity	0.9	0.3	–0.6
Panel B. Statistics Denmark calculations				
Total market activity	Value added per hour worked	2.9	1.5	–1.5
Contribution to market activity value added per hour worked from				
	IT-capital deepening	0.7	0.5	–0.2
	Non IT-capital deepening	0.9	0.2	–0.7
	Labour quality	0.2	0.1	–0.1
	Total factor productivity	1.2	0.7	–0.5

Note: The total economy growth accounting has been calculated using OECD capital services data and EU-KLEMs data on educational attainment of the labour force. Labour quality captures the effect on labour productivity of a shift towards higher educational attainment in the workforce. See Annex 2.A1 for a description of the methodology.
Source: OECD Analytical Database; EU-KLEMS labour input files; Statistics Denmark, Tables NAT02, NAT18 and NAT25; OECD calculations.

(Panel A of Table 2.1) has slowed by around three-quarters of a percentage point. In the market sector (Panel B of Table 2.1), the slowdown has been even more pronounced – almost 1½ percentage points. There has also been a trend shift in the share of hours worked away from low-skilled and towards higher-skilled workers, which contributes to productivity growth via a so-called "labour quality" effect. This positive contribution has declined but this accounts only marginally for the overall productivity deceleration.

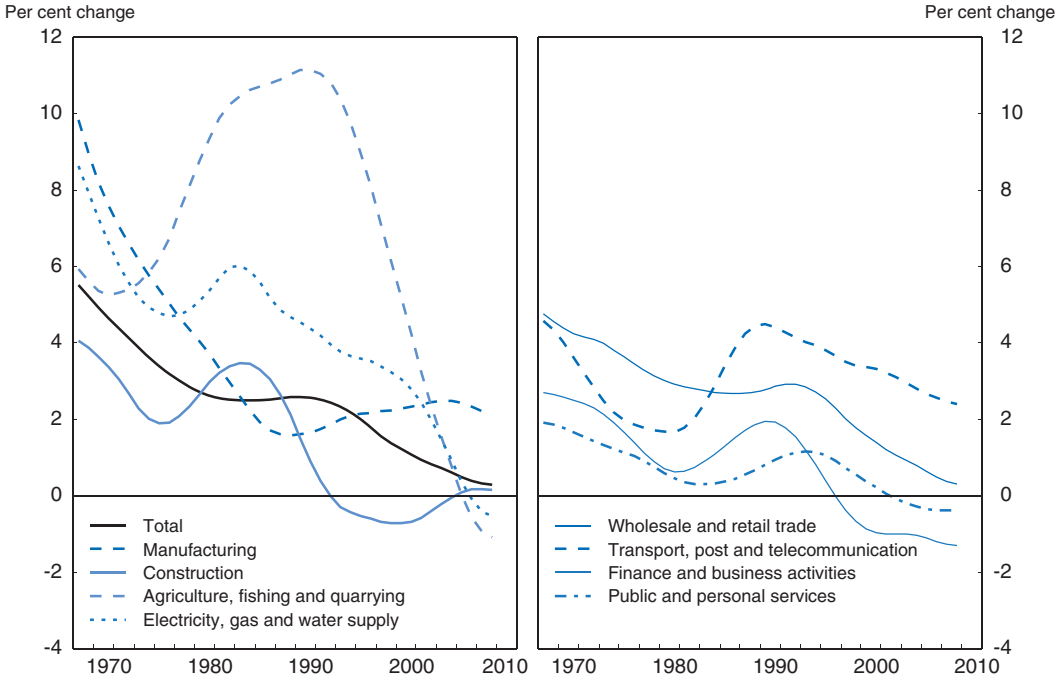
Sectoral productivity performance

The slowdown in economy-wide labour productivity has not been uniform across sectors. In agriculture, fishing and quarrying, productivity has trended down since the late 1980s.[2] It has declined in finance and business activities since about the mid-1990s. Two sectors stand out as bucking the overall trend: productivity in manufacturing has tended to accelerate since the mid-1990s; and productivity in the construction sector fell in the early 1990s but has picked up since (Figure 2.2).

Taking into account both the size and the growth rate of each sector, the sectors contributing most to the slowdown in aggregate productivity since the early 1980s were construction, agriculture, mining and quarrying, and business activities (see Annex 2.A1 for the underlying methodology). Manufacturing has recorded accelerating productivity but has declined as a share of the total economy. The opposite is true of wholesale and retail trade (Table 2.2). In construction and business activities, the productivity deceleration was mainly driven by slower TFP growth, but weaker capital deepening also played a role. In mining, weaker TFP and capital deepening were almost equally important. In agriculture, the slowdown in capital deepening was the main contributor (Figure 2.3).

A key focus of the analysis of productivity growth in recent decades has been the role of ICT (Pilat *et al.*, 2002). In Denmark, the share of the ICT-producing sectors is fairly small and their contribution to productivity growth has been modest but stable since the 1980s. The productivity slowdown is most evident in the non-ICT sectors, although it was also marked in ICT-using services (Figure 2.4).

Figure 2.2. **Productivity growth has been trending down in many sectors**[1]



1. GVA per hour worked has been smoothed using a HP filter (lambda = 100) and the series shown are the annual growth rates of the smoothed series. The sector "business activities" includes computer and related activities, research and development , and consultancy and cleaning activities.

Source: Statistics Denmark National Accounts, Tables NAT07 and NAT18.

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Table 2.2. **Value added shares and contributions to growth in labour productivity**

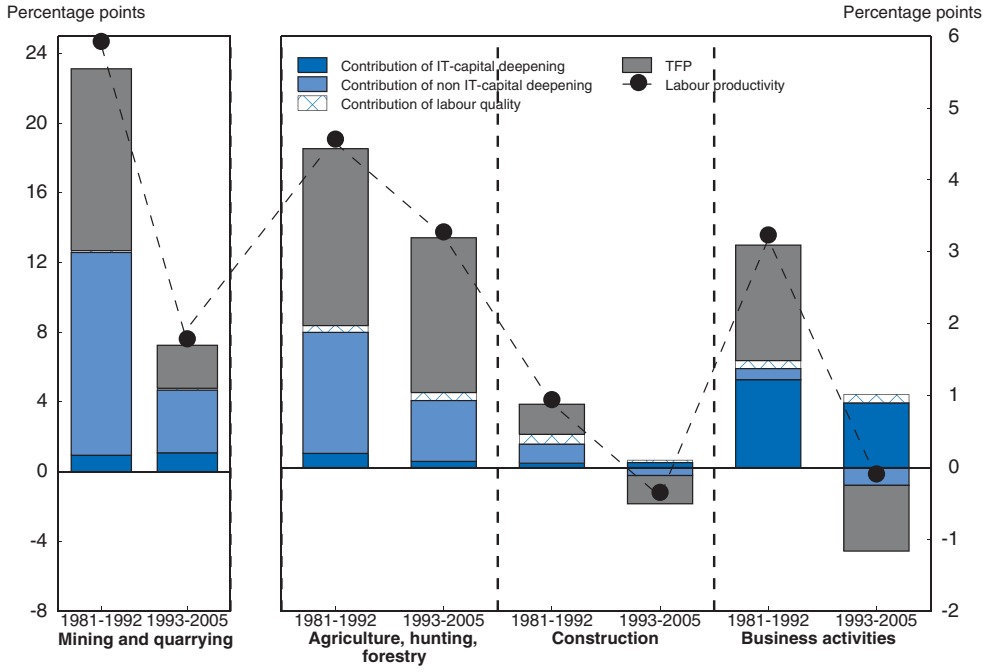
	Nominal value added share %			Contributions to growth in labour productivity (percentage point)		
	1981	1992	2006	1981-92	1993-2006	Change
Manufacturing	18.1	17.2	14.6	0.31	0.46	0.15
Letting and sale of real estate	10.1	10.6	10.4	–0.02	0.06	0.08
Post and telecommunications	1.5	2.3	2.0	0.09	0.14	0.05
Public administration	8.5	7.3	6.2	0.03	0.06	0.02
Fishing	0.7	0.3	0.2	0.00	0.01	0.00
Health care activities	4.9	4.5	4.5	0.01	0.01	0.00
Social institutions, etc.	5.3	5.5	6.0	0.00	0.00	0.00
Transport	5.1	5.4	5.8	0.16	0.13	–0.03
Education	6.1	5.5	5.5	0.06	0.02	–0.04
Hotel and restaurants	1.5	1.5	1.5	0.00	–0.08	–0.07
Finance and insurance	4.6	4.9	5.3	0.32	0.24	–0.08
Associations, culture and refuse disposal	3.8	4.4	4.3	0.04	–0.06	–0.10
Wholesale and retail trade	13.5	13.1	11.9	0.45	0.33	–0.12
Electricity, gas and water supply	1.6	2.3	2.0	0.14	0.02	–0.12
Construction	5.5	4.8	5.9	0.14	–0.02	–0.16
Agriculture, horticulture and forestry	4.6	3.1	1.3	0.36	0.20	–0.16
Mining and quarrying	0.5	1.0	4.1	0.21	0.05	–0.17
Business activities	4.3	6.2	8.5	0.21	–0.10	–0.31
Memorandum item: Total economy growth in GVA per hour worked				2.5	1.5	–1.1

Note: Industry-level contributions to productivity growth are calculated as outlined in Annex 2.A1. Industries are sorted by largest increase in the contribution to growth in labour productivity between 1981-92 and 1993-2006. The sector "business activities" includes computer and related activities, research and development, and consultancy and cleaning activities. "Associations, culture and refuse disposal" includes sewerage and refuse disposal services; activities of membership organisations; recreational, cultural and sporting activities; and other service activities.

Source: Statistics Denmark National Accounts, Tables NAT07 and NAT18, OECD calculations.

Figure 2.3. **Weaker capital deepening and TFP growth are the main factors behind slower productivity growth**

Contributions to growth in labour productivity



Source: Statistics Denmark Table NAT25.

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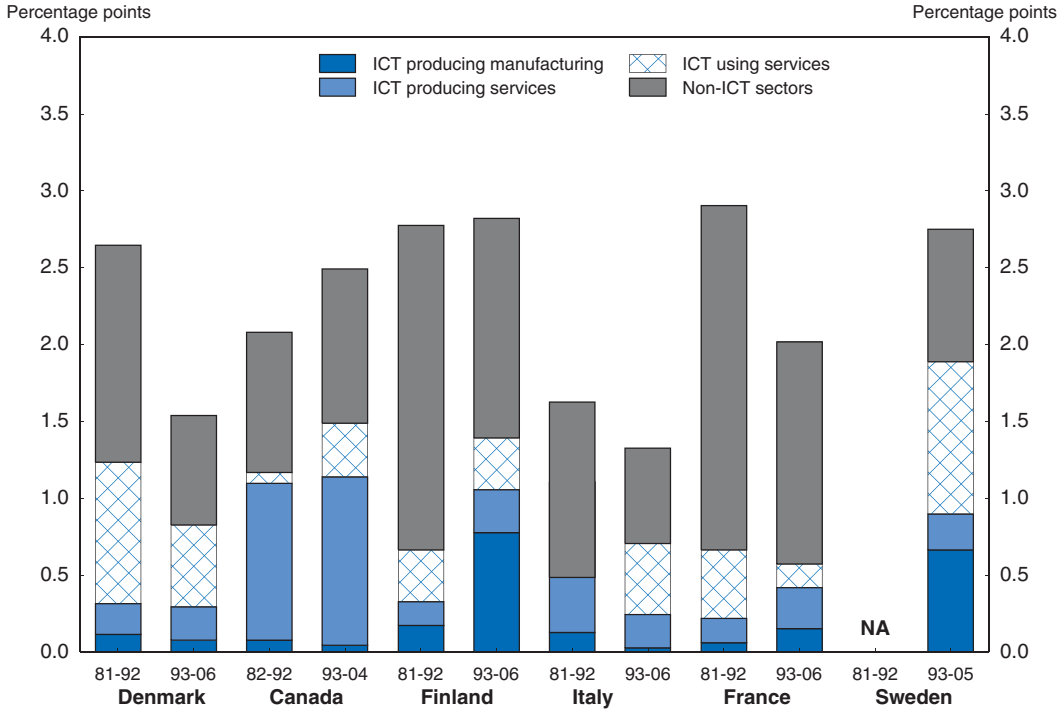
Figure 2.4. **Productivity growth has slowed mainly in non-ICT sectors**



Source: *OECD STAN08 Database* and OECD Secretariat calculations.

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The large Danish public sector may lead to understating productivity growth relative to other countries, since in the Danish national accounts labour productivity growth in this sector is effectively zero (Box 2.1).[3] It has been estimated that moving from an input to an output-based approach to calculating value added in the public sector would add 0.1 percentage point to the average growth in total economy labour productivity over 2000-05 (Deveci *et al.*, 2008).[4] Looking at the market sector in isolation, however, the slowdown in Danish labour productivity is even starker (Table 2.3). Table 2.3 also shows that some countries record a contribution from the market sector well below total productivity growth, hence have recorded positive public sector productivity growth.

Table 2.3. **Total economy and market-sector labour productivity growth**
Period average of annual growth rates, %

		Total economy	Market sector	Contribution to total economy growth from market sector
Denmark	**1981-1992**	**2.2**	**3.1**	**2.1**
	1993-2005	**1.4**	**1.9**	**1.3**
Finland	1981-1992	2.7	3.2	2.5
	1993-2005	2.6	3.8	2.7
France	1981-1992	2.7	3.0	2.2
	1993-2005	1.8	2.2	1.4
Germany	1981-1992	2.5	2.6	1.9
	1993-2005	1.8	1.6	1.2
Ireland	1981-1992	2.8	3.2	2.5
	1993-2005	3.7	4.4	3.5
Italy	1981-1992	1.6	1.6	1.2
	1993-2005	1.0	1.1	0.7
Japan	1981-1992	4.2	4.7	3.7
	1993-2005	2.4	2.5	2.0
Sweden	1981-1992	1.6	2.1	1.5
	1993-2005	2.6	3.7	2.5
UK	1981-1992	2.4	2.9	2.3
	1993-2005	2.1	2.8	2.1
USA	1981-1992	1.3	1.8	1.1
	1993-2005	2.0	2.5	1.6

Notes: Labour productivity is measured as GVA per hour worked. For the United States, the data is drawn from the SIC-based tables in the EU-KLEMS database. The contribution to growth from the market sector rests on the same methodology, outlined in Annex 2.A1.
Source: EU-KLEMS March 2008 release additional tables.

Recent developments in labour productivity

Labour productivity fell in 2007 and 2008 by 2% and 2.7% respectively. As discussed in Chapter 1, GDP growth weakened in 2007 and GDP contracted in 2008. The labour market had been very tight, with unemployment falling to record lows. Hence, businesses may have been unusually reluctant to lay off staff that they had fought hard to recruit. However, by end-2008, the labour market turned around sharply and unemployment began to rise rapidly. With a steep fall in GDP likely, productivity may fall again in 2009 but seems likely to recover strongly in 2010 as production picks up ahead of employment.

It is often argued that one positive impact from a recession is that it spurs structural adjustment. The downturn may be used to reallocate less productive workers, so productivity could accelerate as the recovery sets in. However, the exceptionally severe financial crisis may work against this. Indeed, heightened uncertainty has likely increased

the value of waiting for new information rather than pushing ahead with new investment plans. To the extent that this uncertainty persists, it will dampen the investment rebound, so that the contribution to productivity growth from capital deepening may be reduced in the near term. There is also some risk of an impact on productivity if the crisis leads to a significant cutback in R&D and innovative activity.

The contribution of labour composition and capital to productivity

Labour productivity growth can be decomposed into contributions from changes in the skill composition of the workforce, from capital deepening and from TFP. This section focuses on the contribution of labour composition and capital deepening in order to more closely examine the impact of the trend rise in labour supply in Denmark over the past decade and a half.

The labour market and human capital

It has been argued that wider inclusion in the labour market is one factor behind slower labour productivity growth since the early 1990s (Danish Government, 2008a; Iversen and Riishoj, 2007). There has been a trend increase in the employment to working-age population ratio and in average hours worked. As a result, total hours worked have risen by about 0.6% per year from the early 1990s to the mid-2000s. This compares to a fall of about 0.4% per year from the early 1980s to the early 1990s (Figure 2.5). Even so, average hours worked in Denmark remain amongst the lowest in the OECD.

Figure 2.5. **Labour utilisation has grown**

Source: OECD Analytical Statistics Database.

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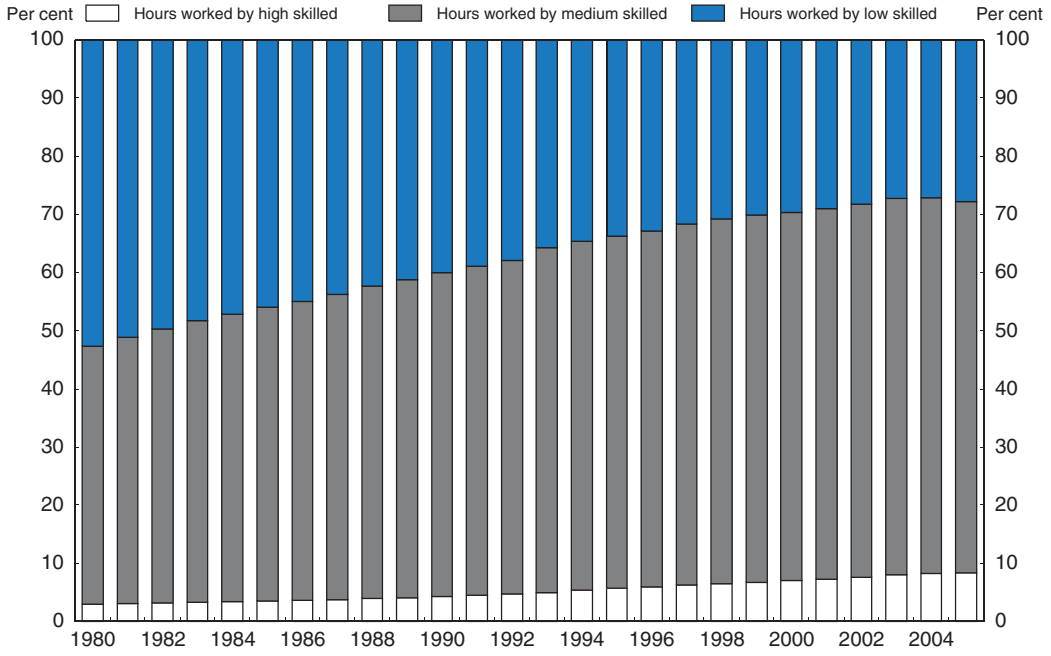
There is likely to be some trade-off between employment and productivity, even over the longer term. In the short term, weaker productivity performance can result from both lags in adopting new capital to complement additional labour and the effect of new workers having lower levels of productivity than the existing workforce. In the long term, the trade-off flattens out as additional capital is added but the heterogeneity effect can remain even if capital fully adjusts (Turner and Boulhol, 2009). Higher employment resulting from increased labour supply can lead to an expansion of labour-intensive activities. To the extent that these have lower average productivity, this could depress aggregate productivity (OECD, 2007b). However, an increasing trend in average hours worked is less likely to have a negative effect on labour productivity, apart from the short-term impact through lagged adjustment of the capital stock, insofar as already employed workers do not have the same learning phase as new workers. There seems to be a negative relationship between working hours and productivity, but it is much smaller than the one between employment participation and productivity (Mc Guckin and van Ark, 2005). Additional hours worked might be associated with lower productivity if hours worked are already high, for example due to fatigue. However, the low level of average hours worked suggests that this is unlikely to be a general issue in Denmark.

As in many countries, the general skill level of the Danish workforce is rising but this trend appears to be slowing down. The share of hours worked by workers with medium and high skill levels seems to have risen at a slower pace over the past decade (Figure 2.6). The slowdown in the trend is driven mainly by a slowing in the rate of increase in the share of the total hours worked by medium-skilled workers aged 30 to 49. Comparing the

Figure 2.6. **The skill level of the workforce is rising more slowly**

Total hours worked by skill level[1]



1. High-skilled is long-cycle higher education, medium-skilled is medium and short-cycle higher education plus. vocational education and training, low-skilled is basic school.

Source: EU-KLEMS March 2008 release.

StatLink http://dx.doi.org/10.1787/734812704610

averages for the period 1981-92 and 1993-2005, the rate of growth in hours worked by medium-skilled workers has declined – the growth rate for hours worked by high-skilled workers has increased and hours worked by low-skilled workers, which have been trending down, fell less rapidly in the latter period. This suggests that there may have been an impact on labour productivity from wider inclusion of low-skilled workers, consistent with the growth accounting analysis in Table 2.1. The total economy analysis, based on EU-KLEMS data for educational attainment, indicate a larger contribution to productivity growth from labour quality than the Statistics Denmark data for the market sector only. However, both analyses indicate that the slowdown in growth of educational attainment contributed only around 0.1 percentage point to the overall slowdown in labour productivity.

The growth accounting figures discussed above account only for educational attainment in differentiating labour inputs when, in fact, new entrants to the workforce might have lower productivity even if they have average or above-average educational attainment. It seems reasonable to expect that newly-hired persons who have been out of the labour market for some time might have lower-than-average productivity levels when first rejoining the workforce, as they acquire workplace-specific skills and re-adjust to working life. Some simple calculations have been made to test the effect of assuming that new workers in the labour market have lower levels of productivity than existing workers.[5] Under some fairly extreme assumptions about the productivity levels of new workers, aggregate labour productivity growth could have been about 0.2-0.3 percentage points lower on average over 1993-2006 due to the addition of new low-productivity workers. Somewhat more plausible assumptions give an effect of about 0.1 percentage point (Annex 2.A1). Accordingly, while the expansion of the labour supply may have contributed to the slowdown in labour productivity, the effect was probably small. Hence, the growth rate of the productivity of the existing labour likely declined.

The increase in hours worked might have been concentrated in the public sector, where productivity growth is set to zero. However, between 1993 and 2006, total hours worked increased by 12.3%, while hours worked in the general government sector rose by 7.3%. Over the same period, the general government sector share of total employment shrank by 1.1 percentage points. Average hours worked in the public sector (based on total employment excluding people on leave) rose about 0.8% in total between 1993 and 2006, while in the private sector it rose by 2.3%. Hence, concentration of the rise in hours worked in the public sector does not seem to explain the productivity slowdown.

Capital deepening

A key driver of labour productivity growth is capital deepening – increasing the amount of capital per unit of labour increases the amount of output that can be produced with that unit of labour. Capital services, which capture the stream of productive services created by the stock of capital, are estimated to have grown on average by 3.4% per year between 1981 and 1992 and 3.7% between 1993 and 2005. Growth in the capital stock instead has slowed markedly. A key element of the difference between growth in the capital stock and capital services is accelerating ICT capital formation.[6] However, ICT capital investment might not generate productivity gains in the short term. This could be due to the benefits of ICT capital investment, such as customisation and differentiation, not being captured in output measurement and considerable time lags in implementing new technologies or adjusting work practices to facilitate their use (Pilat *et al.*, 2002).

One potential explanation for a slowdown in labour productivity is that there has not been enough capital deepening since the early-to-mid-1990s to keep pace with the increase in labour supply. A slowdown in labour productivity within skill-level cohorts of the labour force could result from a reduction in capital deepening. Growth in the capital/labour ratio has slowed, as has the contribution to growth in labour productivity from capital deepening (Table 2.1).[7] If the growth in the capital/labour ratio had remained unchanged at its 1981-92 average, labour productivity growth could have been about one-quarter of a percentage point higher on average per year than actually recorded over 1993-2005 (Annex 2.A1).

The slower rise in the capital/labour ratio appears to be an economy-wide phenomenon rather than a result of a shift in production towards more labour-intensive industries. Overall capital intensity, measured as the share of national income going to capital, has declined by around 1.6 percentage points (Table 2.4). Shift-share analysis suggests that changes in capital intensity within each sector, assuming constant sectoral value added shares at their 1993 level, pushed capital intensity down by about 2.9 percentage points, while reallocation of production between sectors pushed it up by 1 percentage point (the difference being account for by the so-called "cross term").

Table 2.4. **Value added share and capital intensity**

	1993	2006	1993	2006
	Capital intensity		Value added share	
Total	38.4	36.8	100.0	100.0
Agriculture, fishing and quarrying	77.6	87.4	4.2	5.5
Manufacturing	28.2	32.1	16.7	14.6
Electricity, gas and water supply	76.9	82.0	2.4	2.0
Construction	17.1	26.8	4.5	5.9
Wholesale and retail trade	35.6	25.9	14.2	13.4
Transport, post and telecommunication	41.0	45.7	7.6	7.8
Finance and business activities	64.6	53.6	22.6	24.2
Public and personal services	18.4	14.8	27.9	26.5

Note: Capital intensity is calculated as the capital share of income (measured by one minus compensation of employees divided by GVA less other taxes less subsidies on production). Value added share is based on current price data.
Source: Statistics Denmark National Accounts, Tables NAT07 and NAT09.

Conclusion on capital and labour inputs

Aggregate labour productivity growth averaged about three-quarters of a percentage point less in 1993-2006 than in 1980-92. Less than half of this slowdown might be explained by "capital thinning" and the composition of labour supply – slightly more under some relatively strong assumptions about the productivity of new workforce entrants. Slower capital deepening might reflect a relatively sluggish adjustment of the capital stock to a structural increase in labour supply. If this adjustment takes place in coming years, labour productivity growth could be expected to accelerate. However, as mentioned above, the severe economic downturn may work against this insofar as it durably heightened risk aversion. At the same time, the expected adjustment in the capital/labour ratio could come about via reduced employment, due to a rise in structural unemployment, rather than through additional capital.

Structural and policy factors affecting productivity

Even after allowing for slower capital deepening, the addition of low-productivity workers and changes in skill levels, there remains a significant unexplained slowdown in labour productivity growth, attributed by definition to weaker TFP growth. A broad range of potential factors are likely to affect TFP. The following sections discuss the links between structural and policy factors and productivity growth, focusing on TFP, and assess Denmark's performance in these areas relative to other OECD countries. The macroeconomic policy framework, general economic environment, and operation of financial markets, which can also influence labour productivity performance, are discussed in Chapter 1.

Infrastructure

There is cross-country evidence that infrastructure investment boosts economic growth beyond its direct impact on the capital stock. This can come about through facilitating the division of labour, competition in markets, diffusion of technology, adoption of new organisational practices, or through providing access to new markets, resources or intermediate inputs. However, the benefits probably decrease as the infrastructure capital stock rises (Sutherland *et al*., 2009).

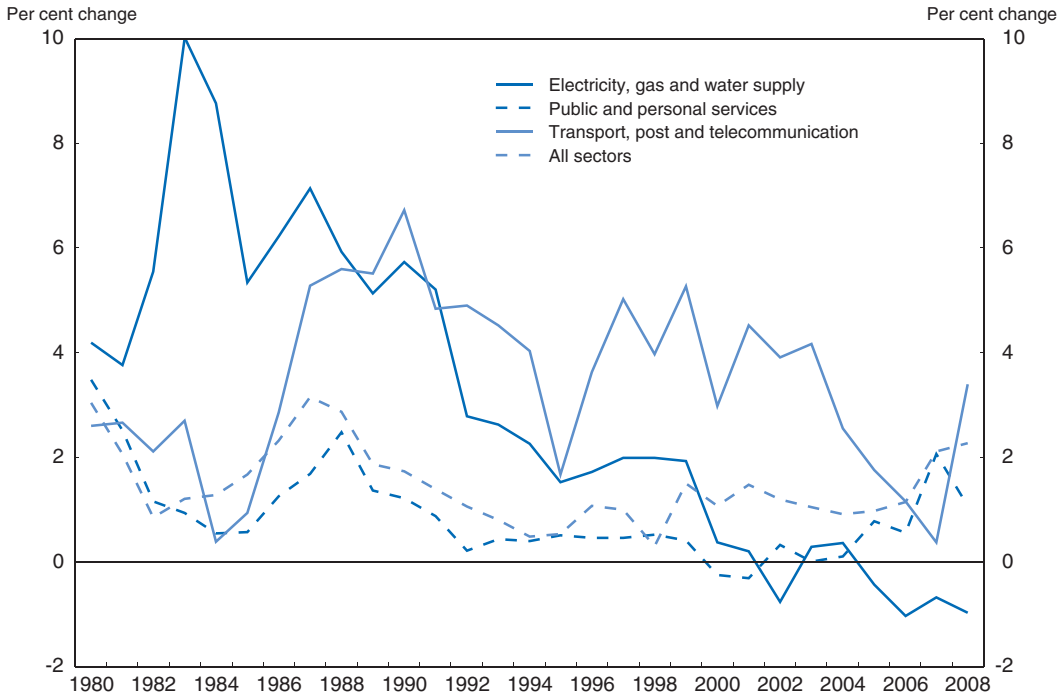
It is difficult to get a clear picture of the development of Danish infrastructure capital from the capital services data discussed above, since infrastructure can be found in a range of sectors. However, the contribution to growth in capital services from non-residential construction and, to a lesser extent, from communication equipment has tended to decline. Turning to capital stock data, it is notable that there has also been a marked slowdown in the growth of the net capital stock in the electricity, gas and water supply industry (Figure 2.7). While the World Economic Forum *Global Competitiveness Report* ranks Denmark 12th out of 133 countries for its overall infrastructure, it points to weaknesses as regards the quality of railway infrastructure, airline passenger capacity and telephone lines (World Economic Forum, 2009).

The government has acknowledged that a significant infrastructure backlog has built up over recent decades, and appointed a Commission in 2006 to analyse the long-term challenges of future public spending on infrastructure. The Commission found that central parts of the road and rail network had been experiencing growing capacity and congestion problems during the past decade, especially during gradually widening peak hours (Danish Infrastructure Commission, 2008). It recommended prioritising investments on the basis of the highest socio-economic returns, ensuring the necessary maintenance of infrastructure, greater private sector involvement in the organisation and management of construction projects, and better coordination of physical planning, including urban and commercial development, as well as infrastructure planning. Following the publication of the Commission's report, the government created a DKK 90 billion fund to finance infrastructure projects over 2009-20, including in environment and public transport. An additional DKK 60 billion will be assigned to several specific infrastructure projects.

The government has also announced the frontloading of infrastructure spending in the Green Growth initiative in 2010 and additional funding for municipal government investment as part of the 2010 budget negotiations. These measures are timely, given the relative effectiveness of infrastructure spending as a counter-cyclical measure in a longer-

Figure 2.7. **Growth in the capital stock in key infrastructure sectors has declined**

Annual percentage change in the real net capital stock



Source: Statistics Denmark National Accounts, Tables NAT08 and NAT09.

StatLink http://dx.doi.org/10.1787/734826210877

than-usual recession, the slowdown in capital deepening and also the medium-term implications for potential output of the decline in private investment over 2008-10.

Taxation

High tax rates can affect TFP growth through a number of channels, as documented in the recent OECD *Tax and Economic Growth* study (Johansson *et al.*, 2008, Vartia, 2008):

- Personal income taxes have a bearing on entrepreneurship and labour mobility incentives. High marginal tax rates affect both successful entrepreneurs and the skilled people who make crucial contributions in supporting positions. Taxation also influences the international mobility of skilled labour. Being able to attract workers with strong skills is important for firms' capacity to adapt and implement new technologies and processes. Furthermore, high personal income taxes can also affect labour productivity via the incentives to invest in human capital formation (OECD, 2008c).
- Corporate income taxes affect the rate of investment and capital deepening, including in the form of foreign direct investment (FDI). By changing relative factor prices, corporate taxes might also affect TFP by forcing firms to adopt a sub-optimal combination of labour and capital. TFP can also be negatively affected to the extent that corporate taxes reduce incentives to invest in innovation.
- Social security contributions can influence TFP through their effect on relative factor prices. They may lead firms to use sub-optimal combinations of inputs, especially in countries where collective agreements with widespread coverage reduce the ability of firms to pass the incidence of the tax on to labour.

Taxes could be a significant factor affecting productivity in Denmark, since the Danish overall tax burden is the second-highest in the OECD. While the Danish corporate income tax rate is relatively low at 25%, the top marginal personal income tax rate is amongst the highest in the OECD and sets in at incomes only modestly above average earnings.[8] However, the statutory corporate income tax rate has been reduced significantly and marginal tax wedges have trended down in Denmark since the 1980s (OECD, 2008c). Therefore, the slowdown in productivity cannot be ascribed to taxation.

The tax reform package agreed in early 2009 between the government and the Danish People's Party, following on from the recommendations of the Tax Commission, moves Danish tax policy strongly in the direction recommended in the *Tax and Economic Growth* study (Box 1.4 in Chapter 1). While the top marginal tax rate is being reduced by the elimination of the middle tax and the reduction in the rate of the bottom tax (the bottom, middle and top taxes add up to the marginal tax rate as income rises), further reductions in the top tax rate would yield additional benefits. The concomitant increase in the threshold for the top tax rate reduces the tax burden, but further increases in the threshold would be needed in future to avoid bracket creep. Also, reducing the top marginal tax rate by lowering the bottom rate is a very expensive way to reduce the burden for higher income earners compared with cutting the top rate. While further cuts to taxes on above-average incomes might meet with concerns about the impact on equity, lower taxes would lead to changes in skill supply, for example by raising the incentive to take further education, which would probably increase the wages for lower-skilled workers (OECD, 2008c).

Entrepreneurship

Entrepreneurship is an important driver of productivity through the creative destruction process of new, more efficient firms replacing older and less efficient ones. Studies of firm dynamics generally find a significant role of entry and exit for productivity growth in all countries and a stronger role of entry in dynamic industries where new firms may better harness new technologies (Arnold *et al.*, 2008).

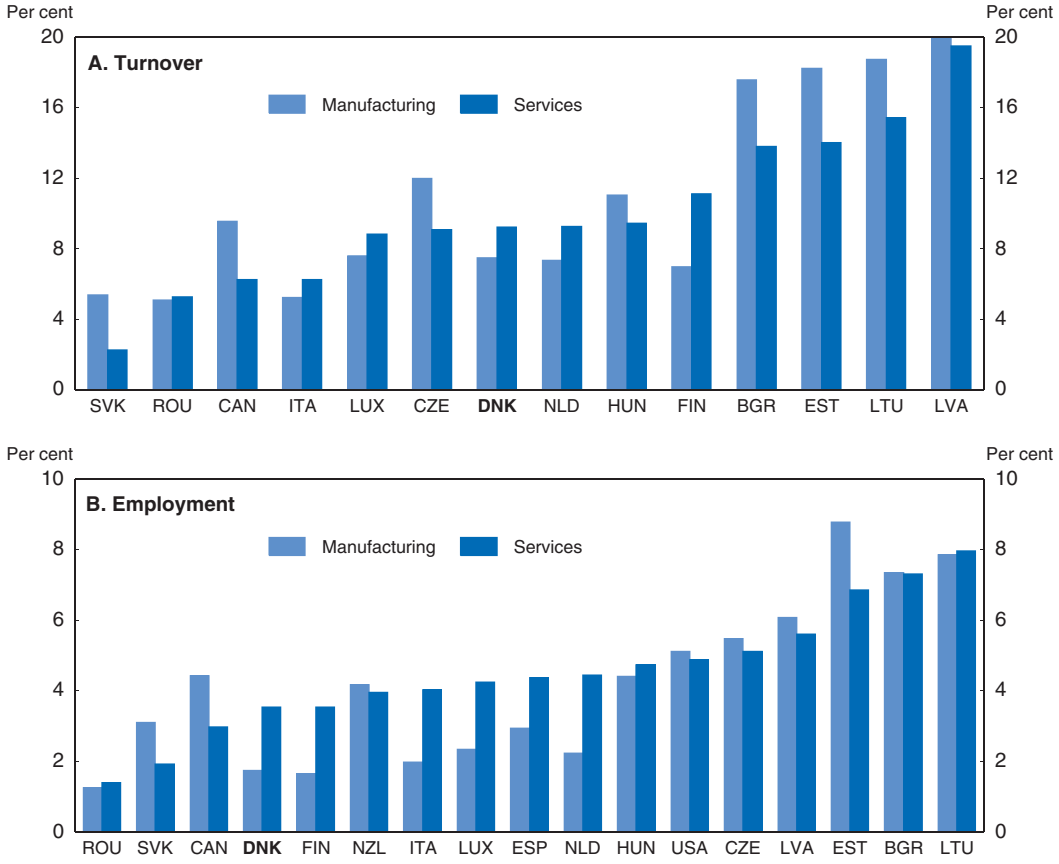
The overall conditions for entrepreneurship in Denmark are generally sound. The World Bank ranks Denmark fifth of 181 countries, and third OECD-wide, on the "ease of doing business" index (World Bank, 2008). The general macroeconomic policy settings are sound, with a strong fiscal framework and a highly credible fixed-exchange-rate monetary policy regime.

The Danish start-up rate has trended up since the early 1990s, despite a marked downturn in 2000-03, and reached 13% in 2005 – amongst the highest in Europe. The percentage of start-ups surviving for three years has also been rising gradually (OECD, 2008a). Overall, one fifth of all Danish private companies either enter the market or close within a year. However, evidence from Denmark suggests that only about 16% of annual productivity growth between 1997 and 2002 can be attributed to replacement of companies via firm turnover, a somewhat lower share than reported in some other countries (Danish Competition Authority, 2009a). Denmark has a lower share of high-growth, recently-established firms than many other OECD countries (Figure 2.8). The share of high-growth enterprises with more than 10 employees has risen when measured in terms of turnover but has been relatively stable in terms of employment (OECD, 2008a).

The government's globalisation strategy set targets for Denmark to become one of the OECD countries with the highest share of high-growth start-ups (Danish

Figure 2.8. **Denmark has a relatively low share of growth enterprises**

Share of growth enterprises, 2005[1]



1. Growth enterprises are all enterprises with average annualised growth in employees (or in turnover) greater than 20% a year, over a three-year period, and with ten or more employees at the beginning of the observation period. The share of high-growth enterprises is compiled as the number of high-growth enterprises as a percentage of the population of enterprises with ten or more employees.

Source: OECD (2008e).

StatLink http://dx.doi.org/10.1787/734836103707

Government, 2006). Accordingly the funds and infrastructure available to support young enterprises with high growth potential have increased substantially. However, the focus on high-growth start-ups in the globalisation strategy might be problematic insofar as recent research suggests that high-potential firms are not necessarily young (OECD, 2008a).

Entrepreneurship education

Greater focus on entrepreneurship in the Danish education system is warranted, along with better evidence to measure the effects of new educational initiatives. The EU Entrepreneurship Survey shows that in Denmark the most important barriers to entrepreneurship are in supply of skills and entrepreneurial capabilities: 28% of respondents indicate this as the main obstacle to entrepreneurship – the highest proportion EU-wide. In the Survey questions about whether schools promote the role of entrepreneurship, Denmark scored much lower than other EU countries (European Commission, 2007). It is estimated that approximately 3 to 5% of all students at Danish universities attend an entrepreneurship course during their studies, compared with 10-20% in leading international universities (OECD, 2008a).

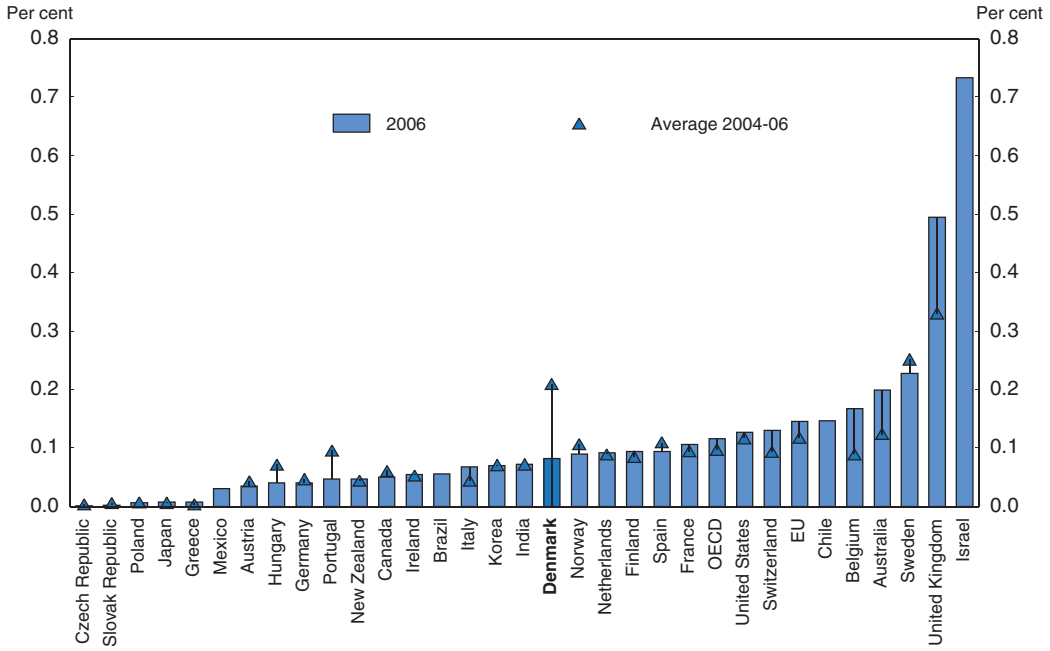
The government's aim to provide access to entrepreneurship courses to all students in tertiary education is commendable. In many countries, entrepreneurship courses tend to be offered only in business and economics schools, whereas innovative and viable business ideas are more likely to arise from technical, scientific and creative studies (European Commission, 2008). At the same time, careful consideration needs to be given to education programme design. There is some evidence that, to be successful, entrepreneurs also need work experience as an employee to complement formal education (Iversen *et al.*, 2008). This suggests that entrepreneurship training programmes should include such employment experience rather than focusing solely on developing the students' own business ideas.

Venture capital

Entrepreneurship may be held back by the small size of the venture capital market. The overall venture capital market is less than 0.1% of GDP, below the OECD average (Figure 2.9). Public funding plays an important role in venture capital through the government-owned venture capital fund *Vaekstfonden* (about 12% of total venture capital investment) and budget funding of the Innovation Incubators programme. The dominant role of public money in venture capital is especially clear in the market for seed finance, where the public investments through *Vaekstfonden* and the innovation incubators account for more than 61% of investment. Venture capital may also be held back on the demand side – that is, too few businesses seeking funding. However, a recent report suggests that over 2005-08 firms funded via venture capital experienced faster growth in employment, sales and exports (Vaekstfonden, 2009).

Figure 2.9. **The Danish venture capital market is relatively small**

Venture capital as a percentage of GDP, 2004-06[1]



1. Venture capital includes the seed, start-up, early development and expansion stages. Later stages and buyouts are excluded except for Mexico, Chile and Brazil. Total OECD excludes Luxembourg, Turkey and Iceland.

Source: OECD (2008a).

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OMX First North in Denmark was launched in December 2005 to provide an alternative investment market for smaller growth companies. Among other things, the intention was to improve the possibility for entrepreneurs and venture capital investors to sell their business, but it has not been particularly successful in this regard due to a lack of share liquidity, limited investments from institutional investors and insufficient monitoring of listed companies.

Expansion of venture capital financing could come through greater involvement of Danish pension funds in the Danish venture capital market. Most pension funds have historically allocated only a very small proportion of their assets to venture capital. In 2005, the government and the pension funds agreed that the latter would aim to double the share of investments in venture capital by 2010. However, the financial crisis is likely to dent pension funds' risk appetite and so attaining the 2010 goal may now be unrealistic.

Other entrepreneurship policies

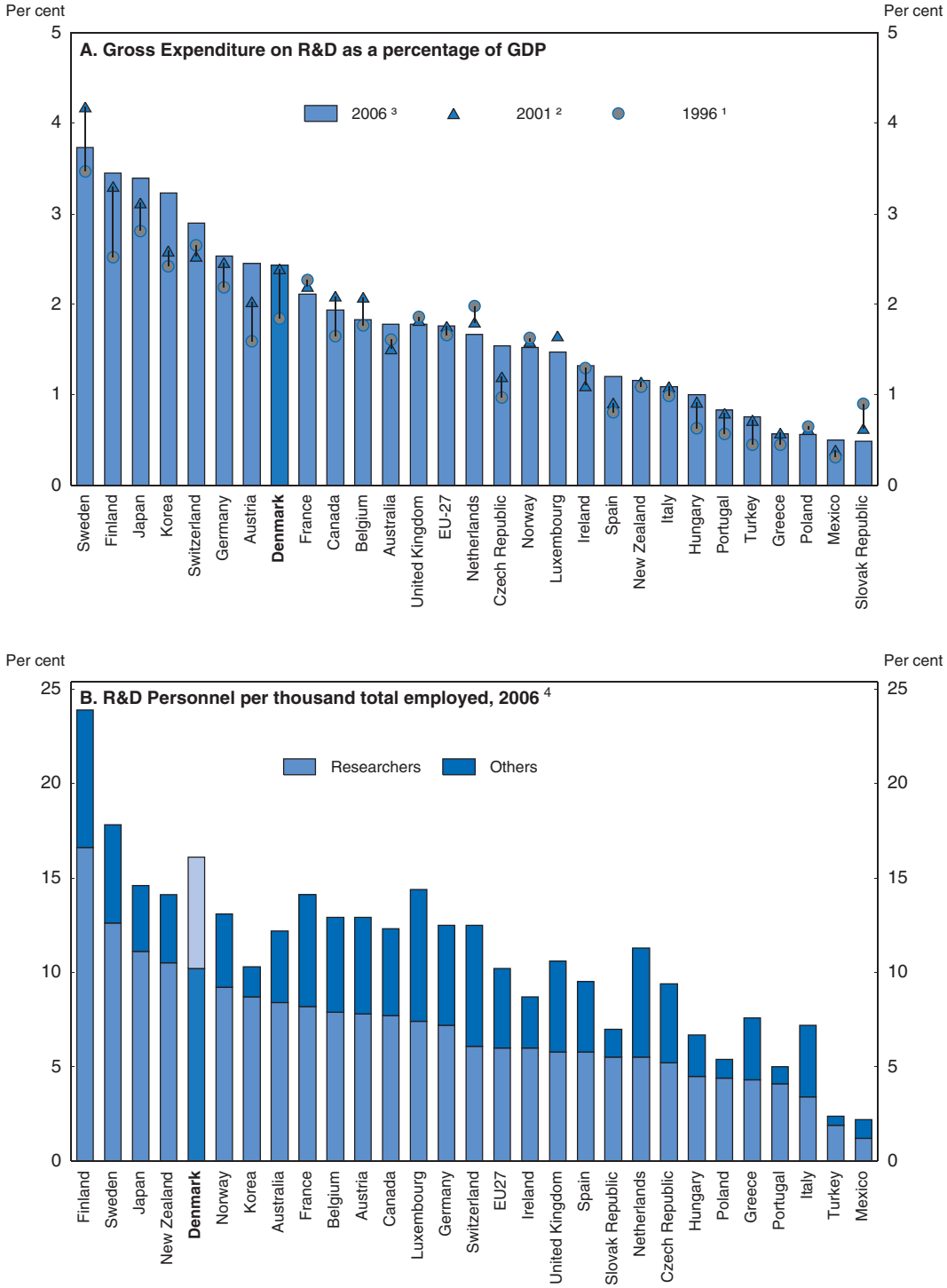
Greater opportunities for foreign high-skilled workers and potential entrepreneurs to move to Denmark could boost entrepreneurship. Denmark has a low share of professional or technically-skilled migrants in total such staff compared with other OECD countries. High marginal tax rates as well as cumbersome administrative arrangements and procedures for visas are obstacles in this area. For example, in September 2009, average regional state administration and Immigration Service processing time for work entry was 2.8 weeks for immigrants from EU member states, just below the target of 3 weeks, and 74 days for immigrants from non EU member states. For the latter type of immigrants, the target of having 90% of all applications processed within a targeted period, which varies between one and two months depending on the application scheme, was not met for half of the schemes in 2009. In a study of attitudes of expatriates in Denmark, work and residence permits and taxation were named as the two areas creating the most problems for foreign knowledge workers (Oxford Research, 2007). The Labour Market Commission's recommendations (Box 1.6) include a number of measures to attract foreign workers, including reducing the income floor in the "Pay Limit Scheme" and expanding the "Positive List", but entrepreneurship might also be served by expanding the "Green Card" scheme, where an existing job offer is not required.

Coordinating the various elements of entrepreneurship policy remains a challenge. The globalisation strategy acknowledged the mutual interdependence of areas like education, entrepreneurship and innovation. The government is currently working on a plan to create more cohesion between different publicly-funded initiatives. It will aim at a "no-wrong-door" approach, where firms regardless of where they enter the system will be guided to the right place.

Research and development and innovation

R&D investment was on a rising trend in Denmark between the early 1980s and the early 2000s, suggesting that the productivity slowdown is not related to a lack thereof. Gross domestic expenditure on R&D in Denmark, at about 2.5% of GDP, is slightly above the OECD average and well above the EU average (Figure 2.10, Panel A). This share rose progressively from 1.75% in the early 1990s to 2.5% in the early 2000s and has been stable since. The percentage of R&D financed by industry is slightly below the OECD average but has risen over the past decade, the share financed by government has fallen and is slightly below the OECD average and the share of R&D financed from abroad is higher than the

Figure 2.10. **R&D spending is relatively high and R&D activities are labour-intensive**



1. 1997 instead of 1996 for Greece, Iceland, New Zealand, Norway and Sweden.
2. 2000 instead of 2001 for Australia, Luxembourg and Switzerland.
3. 2004 instead of 2006 for Australia and Switzerland; 2005 for Iceland, Italy, Mexico and New Zealand.
4. 2005 instead of 2006 for France, Italy, Mexico, New Zealand, Norway and Portugal. 2004 for Australia, Canada and Switzerland.

Source: OECD (2008b).

StatLink http://dx.doi.org/10.1787/735041283020

OECD average but has been fairly stable. Business R&D is largest in pharmaceuticals, followed by computer and related activities. The number of researchers per thousand employed (full-time equivalent) is amongst the highest OECD-wide and total R&D personnel is the third-highest in the OECD (Figure 2.10, Panel B). The number of firms reporting product or process innovations as a share of the total number of firms is slightly below the average reported in other countries (Danish Competition Authority, 2009a) and the share of turnover from new product innovations is amongst the smallest for OECD countries where data is available (OECD, 2008b).

The link between R&D, innovation and productivity

There is evidence that R&D investment boosts productivity at the firm level in Denmark. R&D-active firms account for close to half of total value added in the private sector, but only for 17% of the total number of firms, reflecting the fact that larger firms are more likely to be R&D-active. R&D-active firms have 40% larger value added per employee than the others, and R&D-active firms have a higher level of value added per employee in all firm size categories, although the difference between R&D-active and inactive firms increases with firm size. Estimates based on a production function approach with R&D capital identified separately suggest that the rate of return to all firms from R&D capital is 11% and that amongst R&D-active firms it is 34% (Graversen and Mark, 2008). The figure for R&D-active firms is significantly higher than found in previous research on Danish data, which indicated a return on R&D capital of 9 to 12% (Smith *et al.*, 2004). In an analysis of OECD countries, a model estimating the impact of sales of new products on firms' labour productivity (sales per employee) finds a strong statistical connection in almost all countries (OECD, 2008b). The magnitude of the coefficient in the model for Denmark is at the lower end of the range of countries, suggesting that innovation has a smaller impact on firm productivity than in some other countries. For Denmark, the overall result appears to be driven by a link between innovation and productivity in manufacturing: no such link being found for services. It may be the case that Danish companies invest a lot in the early stages of R&D activities, for example in pharmaceuticals, which could lead to greater increases production abroad than in Denmark.

Public incentives for R&D

There is Danish evidence that public funding increases business R&D activities, with estimates that a 1% increase in public funding boosts business R&D by between 0.062 and 0.11% (Bloch and Graversen, 2008; Sørensen *et al.*, 2003).[9] Cross-country research supports the view that fiscal incentives for R&D are effective, but their effect is small. Business R&D is more positively affected by a strong non-business R&D sector and strong links between the business sector and non-business R&D. In addition, general framework conditions are important, particularly access to the stock of foreign R&D knowledge and liberal product market regulations (Jaumotte and Pain, 2005). However, there is evidence from cross-country analysis that the link between firms' spending on innovation and receipt of public support for innovation is strong in Denmark relative to other countries (OECD, 2008b).

As discussed in Chapter 1, there is a risk that the financial and economic crisis may have adverse medium-term implications for economic growth, in part because spending on R&D and innovation may be curtailed. In recent years, public-financed R&D expenditure has increased to around 1% of GDP as foreseen in the Globalisation Strategy, with business sector R&D reaching at least 2% of GDP (Box 2.2). The government announced investments

Box 2.2. **Danish R&D policies**

Danish R&D policies are focused on direct financing and linking R&D activities with business. The Ministry of Science, Technology and Innovation allocates research funding both directly and through a number of research funding councils. The Council for Independent Research is the umbrella organisation for five research councils and provides support based on researchers' initiatives. It carries out open competitions based on independent assessment. The Council for Strategic Research supports research based on politically-defined programmes, and gives advice on research and technical subjects and focuses on increased co-operation between public and private research. The Ministry for Economics and Business Affairs, operating through the Danish Enterprise and Construction Authority, looks at entrepreneurship, public-private co-operation, user-driven innovation, regional innovation, design, standards and trade regulations. *Vækstfonden,* the government-owned venture capital fund, invests in early-stage ventures mainly in life sciences, medical technology and high-tech firms. The Danish National Research Foundation is an independent fund which finances larger research activities based on researchers' own ideas and contributes to the development of centres of excellence. A Foundation for High Tech Development funds strategic high-tech projects which involve interaction between public knowledge institutions and companies.

The OECD 2006 *Going for Growth* study on innovation policies made specific recommendations to boost innovation in Denmark. These included strengthening the capacity for cross-border research, thereby complementing recent policy efforts to improve technology transfers, and increasing the share of public research grants allocated on a competitive basis while allowing private and semi-private entities to bid (OECD, 2006). Since then, the government has stepped up efforts to strengthen international collaboration. The Danish research and innovation councils are now allowed to hand over parts of their funds to international bodies or programmes, and thus they are better capable of actively engaging in international R&D collaboration. New Danish innovation centres have been established in Silicon Valley, Shanghai and Munich in order to enhance R&D collaboration and technology transfers. Bilateral science and technology agreements have been signed with China, India and Israel in order to strengthen collaboration with these countries. Since 2006, the Danish government has been working towards increasing the share of public research grants allocated on a competitive basis, with a goal that at least 50% of the funds should be subject to open competition. A new model for competition between universities has been implemented in 2008, with each university's management bidding for large-scale, long-term research projects. A special competitive grant pool has been created in the State Budget for the purpose of financing investments in cross-cutting research infrastructures that are so large that they will be difficult for universities to finance out of their ordinary budget.

of an additional € 1.5 billion in R&D over 2007-10 (Danish Government, 2006). Coincidentally, given the economic situation, the planned increase in R&D funding is well timed.

Consideration could be given to whether tax incentives might be more effective than direct financing of private R&D.[10] In recent years, there has been a shift in OECD countries towards indirect rather than direct public funding. In 2008, 21 OECD countries offered tax relief for business R&D, up from 12 in 1995. Tax credits are appealing because they do not discriminate in terms of fields of research and technology or industry. However, R&D tax incentives may be motivated by tax competition and so need careful evaluation of their

effectiveness (OECD, 2008b). Empirical research has found modest positive effects of R&D tax incentives on raising productivity, and the effect is larger for industries with more R&D. Tax incentives have been found to have generally more effect than direct funding (Johansson *et al.*, 2008; Jaumotte and Pain, 2005). At the same time, deadweight losses may be larger for tax incentives, and the incentives are generally only available for formal R&D, thus having little effect on productivity in sectors where R&D activity is informal (Box, 2009).

Competition and regulation

Countries that have reduced barriers to trade and competition appear to have experienced higher levels and growth rates of productivity. Market-friendly regulations tend to ease the reallocation of resources towards the highly-dynamic firms that tend to drive productivity growth. Regulations that shelter them from competition and increase adjustment costs curb the incentive to exploit their potential. Countries with less restrictive regulatory environments tend to invest more in ICT capital. In ICT-using sectors, inappropriate regulations restrain productivity growth of the best-performing firms – that is, those that are catching up and that are closest to the productivity frontier. In these sectors, firms with relatively better productivity performance are the ones with the potential to further advance the technological frontier (Arnold *et al.*, 2008; Conway *et al.*, 2006; Nicoletti and Scarpetta, 2005).

The Danish Competition Authority's 2009 *Competition Report* indicates that the number of sectors "with substantial competitive problems" has fallen in recent years, accounting for approximately 12% of GVA, as against more than 20% four years ago (Danish Competition Authority, 2009b). This substantial reduction should boost productivity in the long run. However, the connection between this indicator and aggregate productivity growth is not straightforward. The reduction in the number of sectors with competition problems simply represents the number of sectors with competition indicators above a certain threshold level. The indicator does not capture improvements in competition in sectors that are already below the threshold. Conversely, competition issues may not arise in the entire sector but rather in some sub-sectors. The report also calls for the need for regulatory reform in relation to the pharmacy and taxi industries, as well as further changes to the Competition Act to raise fines and improve merger control (Danish Competition Authority, 2009b).

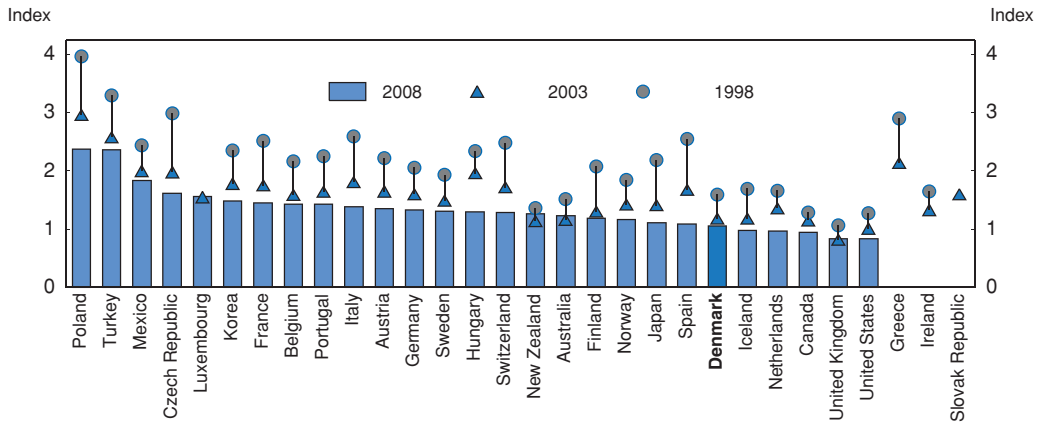
OECD product market regulation (PMR) indicators show Denmark to be a relatively lightly-regulated economy. The extent of regulation has fallen less since 1998 than in many other OECD countries, but this may reflect the fact that Denmark started from a relatively low position (Figure 2.11).

Even with relatively light regulation, there may be additional gains to productivity in the long run from continuing with reforms. The restrictiveness of regulation in Denmark exceeds the OECD average in four areas: license and permit systems, anti-trust exemptions, barriers to entry in services and regulatory barriers to trade and investment (Figure 2.12).

- The above-average value of the indicator for licenses and permit systems stems from the absence in Denmark of a "silence is consent" rule (where licenses are issued automatically if the licensing office has not acted by the end of the statutory response period).

Figure 2.11. **Product market regulation is relatively liberal**

Index of overall product market regulation



Source: OECD Product Market Regulation Database.

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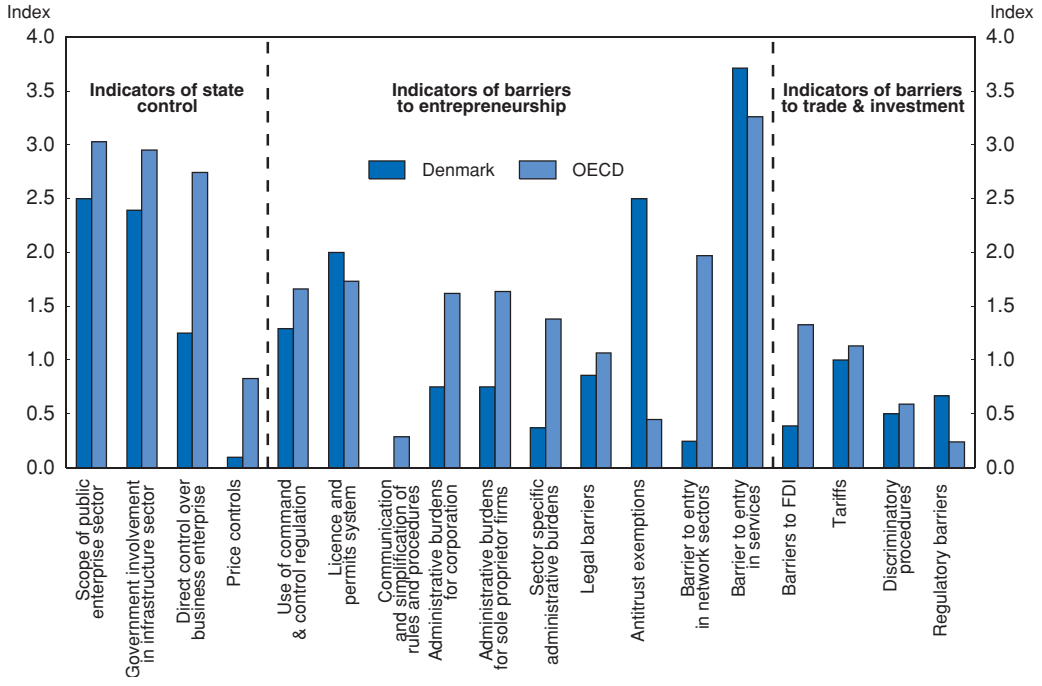
- The relatively high value of the indicator of anti-trust exemptions for public enterprises or state-mandated actions reflects a clause in the Danish Competition Act which provides for exemptions from the law when an anti-competitive practice is a direct consequence of public regulation. One-third of the OECD countries that responded to the relevant questions of the PMR indicator survey have such exemptions.

Figure 2.12. **Regulation could be lower still in a few areas**

PMR low-level indicators in 2008[1]



1. For Greece, Ireland and the Slovak Republic, the indicator values for 2003 are used since 2008 data was not available at the time of writing.

Source: OECD Product Market Regulation Database.

StatLink http://dx.doi.org/10.1787/735167537340

- The high value of the PMR indicator for barriers to entry in services is primarily due to the legal services profession having exclusive rights to provide an array of services. Also, in retail distribution, Denmark is amongst the one third of OECD countries in which professional bodies or representatives of trade and commercial interests are involved in licensing decisions. In addition, Denmark has a relatively low threshold for the surface area above which regulation of large retail outlets applies. Indeed, the Planning Act puts strict limits on the size and placement of new shops, impeding entry in the retail market. Furthermore, approval decisions are made partly based on discretionary assessments of market need by local or regional authorities (Jørgensen, 2005).
- The above-average value of the PMR indicator for regulatory barriers to trade and investment comes about because Denmark is one of a handful of OECD countries that does not have specific provisions which require or encourage regulatory administrative procedures to avoid unnecessary trade restrictiveness.

Greater competition could also be achieved in a number of areas where Denmark's PMR is below the OECD average. For example, there is still relatively widespread public ownership. Government commissions are currently considering liberalisation of the railway sector and the national postal service. Also, there is a relatively high level of government involvement in infrastructure sectors. There is scope for liberalising retail opening hours (which may not have any direct beneficial impact on productivity but would improve consumer choice) and reducing the regulation of the legal sector.

Enhancing competition in the public sector could boost economy-wide productivity by improving the efficiency of services delivered to the private sector.[11] Reducing red tape affecting businesses would work in the same direction. In March 2009, the government unveiled a new package of reforms to that effect, including providing better conditions for starting and operating businesses. It will facilitate access to the authorities, make it easier to file accounts and is meant to allow a new company to be established within seven to eight hours. The government estimates that these measures will save businesses up to DKK 4 billion per year in administrative expenses (Danish Ministry of Economic and Business Affairs, 2009). Efforts to improve the overall quality of regulation could be helped by an overall vision for regulatory reform, covering regulation impact assessment, quality control, public consultation processes and processes to review the stock of regulation in addition to assessment of new regulations (OECD, 2009).

Foreign direct investment

There is a theoretical connection between inward FDI and productivity, through imitation, technology transfer, labour mobility and investment in training of locally-engaged staff, increased competition and expanding market size by creating export spillovers (Görg and Greenaway, 2004; Lesher and Miroudot, 2008). The evidence of these effects is mixed, although this could be because studies have tended to focus on within-industry effects, whereas the benefits might be more likely to accrue to other, related industries such as suppliers and distributors (Kugler, 2005).[12] It could also be the case that spillovers are stronger in services while many studies have focused on manufacturing. There is evidence of strong productivity effects of FDI in services, particularly through linkages with downstream customers and linkages between trade openness and the productivity benefits of FDI (Lesher and Miroudot, 2008). The most recent official Danish study on the connection between inward FDI and productivity provides weak evidence that

sectors with high inflow of FDI tend to have higher productivity (Danish Ministry of Economic and Business Affairs, 2003).

To the extent that there are links between FDI and productivity, Danish conditions suggest that FDI should be supporting productivity performance. The stock of inward FDI in Denmark was 45% of GDP in 2005, as against some 21% for the OECD as a whole (reflecting low inward FDI stocks in large OECD countries like the United States and Japan). Manufacturing accounts for a modest share of the aggregate stock of inward FDI, the bulk of which is concentrated in services, business activities (such as legal, accounting, book-keeping and auditing activities; tax consultancy; market research and public opinion polling; business and management consulting). Denmark ranks below the OECD average in the restrictiveness of regulations towards FDI and the ranking would be lower if it had fewer restrictions in legal services, accounting and air transport (OECD, 2007a).

To increase potential for spillovers between FDI and productivity, the focus should remain on policies that promote openness to trade, a generally sound business environment and nurture the capacity of domestic firms and workers to learn new techniques from foreign producers. In this regard, and alongside the policies related to entrepreneurship and competition discussed above, the Danish government has focused on improving labour supply through reductions in income taxes and efforts to step up international recruitment.

Labour market policies and human capital

Labour market policies can affect productivity growth through various channels. Overly strict statutory employment protection legislation appears to dampen productivity growth, by restricting labour mobility into higher-productivity firms. Higher minimum wages appear to be associated with higher productivity levels but it is not clear whether this results from improved incentives to invest in training or substitution of skilled for unskilled workers. Reforms that reduce the generosity of unemployment benefits could depress productivity by reducing the time and resources available to workers to find well-matched jobs, but activation policies could replicate the positive effects of generous unemployment benefits by improving the quality of matches. Parental leave is also estimated to have a positive impact on productivity (OECD, 2007b). Denmark has relatively liberal employment protection legislation (apart from protection for collective dismissals, which is above the OECD average), no statutory minimum wages and relatively generous parental leave arrangements. However, unemployment benefit duration is amongst the longest in the OECD, at four years, but active labour market programmes are extensive.

General increases in the skill level of the population lift productivity insofar as higher-skilled workers have higher productivity. A higher-skilled workforce can create the impetus for restructuring of production towards higher-value-added activities. Human capital is also important in relation to entrepreneurship since a combination of formal training and work experience contributes to the emergence of successful entrepreneurs. Human capital is important for R&D and the spillover effects of FDI since the benefits are greater when employees have the skills to adapt to new technologies, techniques, and processes. Businesses need to have highly-qualified staff who have sufficient knowledge to deal with specialists in academia and translate their insights for operational purposes in the firm (Graversen and Mark, 2008). Recent research, which attempts to explain TFP growth in the Nordic countries, documents that human capital (measured by tertiary educational enrolment) has been a strong contributor to TFP growth in Denmark, but that the

contribution has declined since 1996. Simulations suggest that if Denmark raised its tertiary educational enrolment to the US level by 2015, the contribution to TFP growth from human capital development could be significantly higher in 2006-15 than in 1996-2005 (Skaarup and Blomquist, 2009). Given the important role of human capital in productivity improvement, the following chapter reviews Danish human capital and education policies in detail.

Box 2.3. **Main recommendations on productivity**

A robust macroeconomic policy framework, openness to trade and investment and a sound general business environment are all conducive to productivity growth. Further specific measures to boost productivity in the long run are listed below.

- The government's tax reforms can be expected to promote entrepreneurship and human capital formation. Further reductions in income taxes on higher-income earners would magnify this effect.
- Entrepreneurship policies should not focus too narrowly on young high-growth firms since there is evidence that not all high-growth firms are young.
- Entrepreneurship education programmes need to be designed in a way that incorporates practical work experience as an employee in order to improve students' understanding of running a business.
- Further efforts are needed to streamline immigration processing to ensure that high-skilled workers can quickly and easily migrate to Denmark.
- Consideration needs to be given to whether tax incentives could be used as well as, or instead of, direct expenditure as a tool to promote investment in R&D.
- A "silence-is-consent" rule, whereby licenses are issued automatically if the licensing office has not acted by the end of the statutory response period, needs to be introduced.
- The "market need" discretion in approval of retail outlets in the Planning Act ought to be removed and size and placement restrictions reviewed.
- The regulatory framework for legal services needs to be reviewed to identify unnecessary restrictions on competition.

Notes

1. Productivity is measured as GDP per hour worked, rather than per worker, to capture the effect of changes in working hours. Industry-level analysis measures productivity as gross value added per hour worked.
2. This aggregate masks a strong growth in productivity in the mining sector during the 1990s, due to oil discoveries in the North Sea, which has recently reversed as production has declined.
3. Denmark currently has an exemption until 2012 from European Commission guidelines to move towards an output-based approach to measuring the public sector in the national accounts.
4. The high tax burden and potentially greater regulation associated with a large government sector might indirectly affect labour productivity. However, other countries with large public sectors such as Sweden and Finland have not experienced the same weak productivity performance. Also, the Danish public sector has not expanded since the 1980s.
5. In this simulation, labour heterogeneity is only in the form of existing and new workers, no account being taken of skill heterogeneity.
6. The capital services approach weights the growth in the capital stock for each asset by the user cost of that asset, rather than purchase prices. This allows for a greater impact on the capital

services series if there is an increase in investment in assets with high marginal products. ICT assets are generally thought to have higher user costs and high marginal products, so a shift in the capital stock towards ICT assets would be associated with increased growth in capital services. The implication for productivity analysis is a higher contribution from capital deepening and a lower contribution from TFP growth. Conceptually, this approach embodies improvements in the productivity of capital into capital deepening rather than into TFP. See Schreyer (2002) for further details.

7. The slowdown in growth of the capital/labour ratio is by no means unique to Denmark. Several other OECD countries, including Belgium, Canada, Finland, France, Japan, New Zealand, and Spain, have recorded sharper reductions in the growth of the capital labour ratio than Denmark, when comparing the periods 1981-92 and 1993-2006. All of these countries, with the exception of Canada, have experienced a slowdown in labour productivity growth over the same period. In the case of Spain, New Zealand and Japan, the slowdown in labour productivity growth was more pronounced than in Denmark; for Belgium, France and the Netherlands, the slowdown was about the same as in Denmark and for Finland the slowdown was significantly milder.

8. The *Taxation and Economic Growth* study highlights the link between taxes and entrepreneurship, noting that the effect of taxes is likely to be stronger in industries with high rates of enterprise creation and in countries with highly regulated product markets. While the latter is not the case in Denmark, there is a high rate of firm creation (OECD, 2008a). Furthermore, the enterprise creation rate is relatively evenly distributed across industries, with enterprise creation rates well below average only in agriculture, fishing and quarrying and electricity, gas and water supply.

9. The latter study found that public innovation support has an indirect positive effect on productivity, but the estimate is insignificant and the bulk of the variation in productivity is related to domestic productivity shocks and spillovers from foreign R&D capital.

10. In OECD (2008b), Figure 2.3 indicates that the tax treatment of R&D in Denmark is close to the average for OECD countries. However, this overstates the true extent of the tax incentive since the result is largely driven by an R&D tax concession available to firms that collaborate with universities. In the calculations underlying Figure 2.3, this incentive is treated as if it applied to all firms. Without the collaborative tax concession, Denmark would record a small negative value for the overall tax subsidy to R&D.

11. Outsourcing or private provision of publicly-funded services could boost the level of measured productivity to the extent that it results in activities being carried out in the market sector where productivity is measured separately rather than the public sector where outputs are assumed to be broadly equal to inputs.

12. Multinational companies that undertake FDI in a country might seek to protect their firm-specific technical knowledge from domestic competitors in the same industry in order to protect their market share.

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ANNEX 2.A1

Background technical analysis

Growth accounting and simulated impact of increased capital deepening

Growth accounting estimates presented in Table 2.1 were calculated according to the methodology outlined in Timmer *et al.* (2007). In this production-function framework:

$$GDP_t = A_t L_t^{\alpha} K_t^{(1-\alpha)}$$

where A is total factor productivity, *L* quality-adjusted hours worked and *K* capital services. This expression is rearranged to measure labour productivity growth as follows, where *H* is total hours worked:

$$\Delta \ln\left(\frac{GDP_t}{H_t}\right) = \Delta \ln(A_t) + \alpha_t \Delta \ln\left(\frac{L_t}{H_t}\right) + (1-\alpha_t)\Delta \ln\left(\frac{K_t}{H_t}\right)$$

where α = *compensation of employees/(GDP – indirect taxes + subsidies)*. In growth terms, *L* captures the effect of a shift the composition of the workforce towards workers with relatively higher skills, as measured by level of educational attainment. *L* is constructed as an index using the following relationships:

$$\Delta \ln L_t = \sum_j \bar{v}_{jt} \Delta \ln H_{jt}$$

and $$\bar{v}_{jt} = \frac{1}{2}\left(\frac{w_{jt}H_{jt}}{\sum_j w_{jt}H_{jt}} + \frac{w_{jt-1}H_{jt-1}}{\sum_j w_{jt-1}H_{jt-1}}\right)$$

The *j*'s in these expressions represent categories of employees grouped by age (15-29, 30-49 and 50+), sex (male and female) and skill level (low, medium and high). The skill levels are based on educational attainment with high-skilled being employees who have completed a long cycle higher education, medium-skilled employees who have completed a medium or short cycle higher education or a vocational education and training programme, and low-skilled employees who have only basic schooling. The *w*'s represent the wage level per hour worked for each of these groups. The data used for these variables was taken from the EU-KLEMS database.

The expression for labour productivity growth is solved for A. The contributions to growth in labour productivity are then calculated according to the three terms on the right, for TFP, labour quality and capital deepening respectively.

This production function was then used to simulate the impact on labour productivity of higher growth in capital services. Given the observed total hours worked, the capital

services series was adjusted to ensure an annual increase in the capital/labour ratio of 3.8% (*i.e.* the average for 1981-92) between 1993 and 2005. This artificial capital series was then used, along with the originally estimated TFP series and the observed total hours to recalculate GDP and labour productivity growth. Under these assumptions, growth in GDP per hour worked was boosted by about one-quarter of a percentage point per year on average between 1993 and 2005.

Industry-level contributions to labour productivity growth

Aggregate labour productivity growth can be approximated by the following relation:

$$LP\ growth_t = VA\ growth_t - hours\ growth_t$$

where VA is value added. This approximation can then be decomposed as the sum of the contributions to aggregate VA growth in each sector i and the contribution to growth in labour input for each sector i (OECD, 2001):

$$LP\ growth_t = \Sigma_i[(nominal\ VA_{it-1}/nominal\ VA_{t-1}{}^{*}VA\ growth_{it}) - (hours_{it-1}/hours_{t-1}{}^{*}hours\ growth_{it})]$$

A sector can make a positive contribution to growth in aggregate labour productivity even if it experiences negative productivity growth, for example, if it has a large share of aggregate value added but a small share of aggregate hours – that is, a high productivity level. This is the case with the letting and sale of real estate sector, which recorded negative productivity growth on average over 1993-2006. Since its level of labour productivity was five times the economy-wide level, the contribution to growth in labour productivity from growth in value added outweighed the subtraction from growth in labour productivity due to growth in hours worked.

Stylised illustration of the effect of labour composition on productivity

Some simple calculations have been conducted to assess how productivity performance is affected if new workers entering the labour market are initially less productive than existing workers. They rest on the assumption that labour heterogeneity only takes the form of existing *versus* new workers, no account being taken of skill heterogeneity. The productivity of the existing stock of hours worked is assumed to grow by 2.4% per annum, *i.e.* growth remains constant at the average observed during the 1980s. The calculations examine the increase in employment since 1993, assuming average hours worked per worker is constant from 1993. This adjustment is made since it is assumed that an additional hour worked by someone already employed is as productive as the hours he or she already worked, but that additional employees may have lower productivity levels than existing employees.

As the stock of hours worked grows, the extra hours are assumed to have 50% of the level of productivity of the existing stock in the first year and 75% in the second year. By the third year, the additional hours worked are assumed to have caught up to the original stock of hours in terms of productivity levels. From that point on, the new hours worked record the same productivity growth rate as the initial stock of workers. Under these assumptions, the observed trend increase in employment leads to a reduction in aggregate productivity growth of around 0.09 percentage points on average between 1993 and 2006.

The calculations were conducted again with the same assumptions about the initial level of labour productivity and the rate of catch-up, but assuming that the added hours record productivity growth of only 1% per year, while the existing stock records productivity growth of 2.4%. This reduces aggregate labour productivity by around

0.13 percentage points per year on average between 1993 and 2006. Assuming that the new workers had half of the original stock's labour productivity level but that it grew at twice the rate, implying a slow rate of catch-up to the productivity level of the existing stock, aggregate labour productivity growth would slow by about 0.25 percentage points. Assuming that the new hours had 50% productivity and the same growth as the existing stock (that is, no catch-up), aggregate labour productivity growth would be reduced by about 0.3 percentage points (Table 2.A1.1).

Table 2.A1.1. **Scenarios on the possible impact of new workers having lower productivity than existing workers, 1993-2006**

Productivity level of new workers relative to existing stock (%)		Productivity growth rate after transition period (%)	Change in average productivity growth relative to baseline of 2.4% (%)
First year	Second year		
90	95	2.4	–0.02
80	90	2.4	–0.04
60	80	2.4	–0.07
50	75	2.4	–0.09
50	75	1	–0.13
50		4.8	–0.25
50		2.4	–0.29
50		1.2	–0.31

Source: OECD calculations based on data from *OECD Analytical Database*.

Shift-share analysis of capital intensity

Capital intensity is calculated as the share of national income going to capital. This is measured as:

KI = 1 – (compensation of employees/GVA – other taxes less subsidies on production)

This can be decomposed by industry:

$$KI_t = K_t / VA_t = \frac{\sum_i K_{it}}{VA_t} = \sum_i (K_{it} / VA_{it} * VA_{it} / VA_t)$$

with VA_i representing value added in industry i.

Defining $VAshare_{it}$ as VA_{it}/VA_t, the percentage change in capital intensity (*KI*) can be decomposed as follows:

$$\Delta KI_t / KI_{t-1} = \frac{\sum_i (\Delta KI_{it} * VAshare_{it-1})}{\sum_i (KI_{it-1} * VAshare_{it-1})} + \frac{\sum_i (KI_{it-1} * \Delta VAshare_{it})}{\sum_i (KI_{it-1} * VAshare_{it-1})} + \frac{\sum_i (\Delta KI_{it} * \Delta VAshare_{it})}{\sum_i (KI_{it-1} * VAshare_{it-1})}$$

Where deltas refer to the change between 1993 and 2006 and all other variables refer to the level in 1993. The first term on the right is the effect on the aggregate percentage change in capital intensity of changes in capital intensity within each industry (within effect). The second term measures the impact of changes in the share of value added assuming the original capital intensities within each sector (between effect). The third term measures the combined effect of changing capital intensity and value added shares in each industry (cross term). The analysis was carried out using eight sectors (agriculture, fishing and quarrying; manufacturing; electricity, gas and water supply; construction; wholesale and retail trade; transport, post and telecommunication; finance and business activities; public and personal services).