# Manufacturing Productivity in Sweden: an International Perspective Since 1960

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LABOUR PRODUCTIVITY IN THE SWEDISH manufacturing industry has been a central area of research for several decades. An important example of this research is the report from the "committee on productivity" (SOU, 1991: 82), which concluded that productivity growth in the Swedish manufacturing industry was lagging behind that in other industrial countries up to 1990.

The objective of this article is to update the earlier report with an additional decade of data for manufacturing productivity. Is Swedish manufacturing productivity growth still lagging? In addition, this article also tries to shed light on productivity developments within the Swedish manufacturing industry in the 1990s by using a so-called "shift-share method" where overall productivity growth is determined by the rate of increase within industries and the change in productivity which can be attributed to changes in employment between industries.[2]

Labour productivity is defined as real value added per hour worked. The statistics on international trends in labour productivity in the manufacturing industry have been taken from the U.S. Bureau of Labor Statistics (BLS). The countries included in the study are Belgium, Canada, Denmark, France, Germany, Italy, Japan, the Netherlands, Norway, Sweden, the United Kingdom, and the United States. The period studied is 1960-2004.[3] The analysis of the Swedish manufacturing industry in the 1990s is based on statistics from Statistics Sweden (SCB). In this data set, the Swedish manufacturing industry consists of 18 sub-industries.[4] The period studied is 1980-2001.

## Swedish Manufacturing Productivity from an International Perspective

Two indexes are presented in Chart 1. One is aggregate productivity growth in the Swedish manufacturing industry between 1960 and 2004, the other is the unweighted average growth rate for output per hour in manufacturing for the other 11 countries in the BLS series. It appears from Chart 1 that productivity growth in the Swedish manufacturing industry slightly exceeded the average of the other countries until the mid 1970s. Then, for a little more than 15

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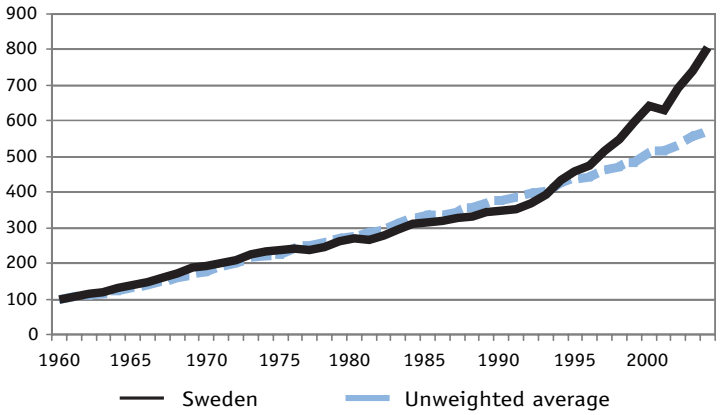
2 The method is presented in the Appendix.

3 Germany consists of West Germany until 1991 and then the unified Germany. The statistics for the Netherlands cover the period up to 2003.

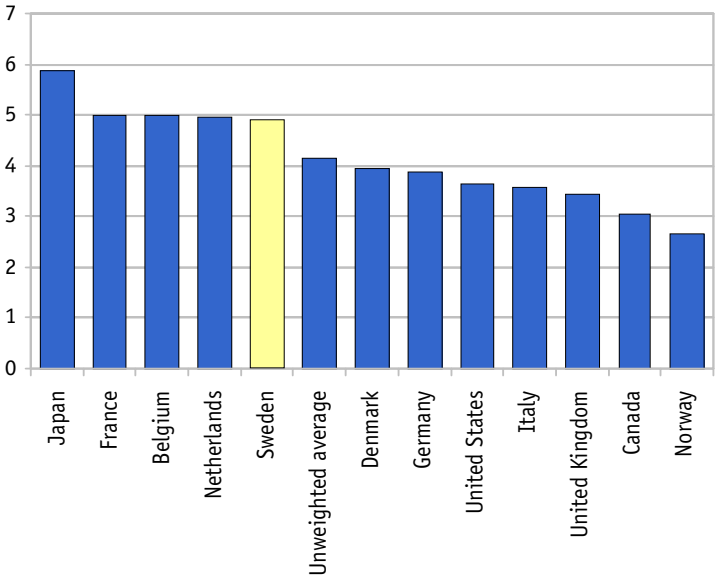
4 The BLS statistics are available at www.bls.gov. The statistics from Statistics Sweden can be obtained from the author.

**Chart 1**
**Productivity in the Swedish Manufacturing Industry and the Average for the Other Countries, 1960-2004**
Index (1960=100)




Source: BLS and author's calculations.

**Chart 2**
**Average Productivity Growth in the Manufacturing Industry, 1960-2004**
(per cent)




Source: BLS and author's calculations.

years, Sweden experienced lower productivity growth than the average of the other countries.[5]

In the 1990s, Sweden's lagging productivity performance was reversed, with the country's productivity growth above the international average. In 1993, Sweden surpassed the unweighted international average for the index of manufacturing productivity growth based in 1960. In the latter half of the 1990s and during the very first years of the 21st century, Swedish productivity growth exceeded the international average growth rate. Indeed, in 2004 the difference between Sweden and the unweighted international average has never been larger.

Chart 2 shows that at 4.9 per cent per year Swedish manufacturing exhibited higher annual productivity growth between 1960 and 2004 than the unweighted international average at 4.1 per cent. With an average of 5.9 per cent, the Japanese manufacturing industry recorded the highest productivity growth between 1960 and 2004. Following Japan, France, Belgium, the Netherlands and Sweden exhibited average annual productivity growth rates of around 5.0 per cent. At the other side of the spectrum, we find Norway (2.7 per cent) and Canada (3.1 per cent). For the remaining countries, it can be noted that the manufacturing industries of both the United States and the United Kingdom were clearly below the unweighted average, at average annual growth rate of 3.6 per cent and 3.4 per cent respectively.

Taking an average over a period of more than 40 years conceals many fluctuations which occur in productivity growth rates within the period. Accordingly, it is informative if the period 1960-2004 is divided into shorter periods. Table 1 shows that there has been a gradual fall in aver-

5 From a Swedish perspective, BLS statistics show the years 1975 to 1978 to have been particularly unfavourable for the manufacturing industry. The average productivity growth in this period amounted to only 1.1 per cent and was even negative in 1977 (-1.6 per cent). There was a structural shift for the entire group of countries in connection with the first oil crisis in the 1973-75 period. In 1973, the unweighted average growth was 7.6 per cent. The following year, it fell to 3.4 per cent and then to 1.4 per cent in 1975. The average productivity growth between 1968 and 1973 was 6.7 per cent per year, while it was 3.4 per cent in the 1974-82 period. Another particularly weak period for the international average was the 1986-93 period when the unweighted average was 2.3 per cent. Between 1985 and 1991, the Swedish average was only 1.7 per cent.

**Table 1**

**Average Productivity Growth in the Manufacturing Industry, Different Sub-periods**

(The figures in the brackets show the position of the country in each period)

| | 1960-70 | | 1970-80 | | 1980-90 | | 1990-2004 | |
|---|---|---|---|---|---|---|---|---|
| Japan | 10.6 | [1] | 5.4 | [5] | 4.1 | [3] | 4.1 | [4] |
| Netherlands | 7.5 | [2] | 6.1 | [2] | 3.7 | [5] | 3.1 | [8] |
| France | 7.0 | [3] | 4.6 | [6] | 4.4 | [1] | 4.2 | [3] |
| Sweden | 6.7 | [4] | 3.5 | [8] | 2.6 | [7] | 6.3 | [1] |
| Italy | 6.6 | [5] | 5.6 | [4] | 2.1 | [11] | 1.0 | [12] |
| Belgium | 6.3 | [6] | 7.1 | [1] | 4.0 | [4] | 3.1 | [7] |
| Denmark | 6.3 | [6] | 6.1 | [3] | 1.7 | [12] | 2.2 | [10] |
| Germany | 6.0 | [7] | 4.1 | [7] | 2.5 | [8] | 3.2 | [6] |
| Unweighted average | 6.0 | | 4.4 | | 3.1 | | 3.3 | |
| Norway | 4.7 | [8] | 2.8 | [10] | 2.4 | [10] | 1.3 | [11] |
| Canada | 3.8 | [9] | 3.0 | [9] | 2.4 | [9] | 3.0 | [9] |
| United Kingdom | 3.8 | [10] | 2.4 | [12] | 4.3 | [2] | 3.3 | [5] |
| United States | 2.6 | [11] | 2.6 | [11] | 3.3 | [6] | 5.2 | [2] |

Source: BLS and author's calculations

age productivity growth for the 12 countries in the BLS database during the 1970s and 1980s: from an unweighted average of 6.0 per cent in the 1960s to 4.4 per cent in the 1970s and 3.1 per cent in the 1980s. That trend has been (slightly) reversed during the last 15 years, with an average productivity growth of 3.3 per cent. Notwithstanding this upturn, average productivity growth has fallen by approximately 45 per cent from 1960s to the 1990-2004 period.

For Sweden, the gradual fall ceased in a remarkable way in the 1990s: productivity growth increased from an average of 2.6 per cent in the 1980s to 6.3 per cent in the 1990s.

Table 1 shows that Japan had the strongest growth in the 1960s. Sweden was in fourth place, 0.7 percentage points above the unweighted average.

In the 1970s, Belgium, at 7.1 per cent, had the highest average annual productivity growth rate. At 3.5 per cent growth Sweden fell to eighth place, 0.9 percentage points below the average. Other changes worth noting were Japan's fall from first to fifth place, Denmark's improvement from eighth to third place and the fact that United States and the United Kingdom changed places.

If we turn to the 1980s, there is a radical change in the picture. With only a slight reduction in the average between the 1970s and the 1980s, France experienced the highest average during that decade. Due to an increase from 2.4 to 4.3 per cent, the Untied Kingdom was the country showing the second highest average. Japan was third, a country which regained a top position despite an average reduced by 1.3 percentage points from the previous decade. Denmark showed the opposite trend, moving from third to twelfth and last place. The Swedish average was reduced by another 0.9 percentage points to 2.6 per cent. However, Sweden improved its relative position from eighth to seventh place.

Finally, in the most recent period Swedish manufacturing enjoyed the most rapid productivity growth among the 12 countries in the BLS database, more than double the international average and up from seventh in the 1980s and eighth in the

**Table 2**
**Average Productivity Growth in the Swedish Manufacturing Industry as the Sum of the Three Effects**

| | 1980-90 | 1990-2001 |
|---|---|---|
| Manufacturing productivity growth | 1.76 | 7.60 |
| of which | | |
| Within-effect | 2.46 | 5.53 |
| Static effect | 0.05 | 0.05 |
| Dynamic effect | -0.75 | 2.03 |

Source: Statistics Sweden and author's calculations.

1970s. In absolute terms the productivity growth rate of 6.3 per cent was close to the "golden-age" average of the 1960s. After Sweden came the United States (5.2 per cent) and France (4.2 per cent). Italy (1.0 per cent) and Norway (1.7 per cent) had the lowest growth rates.

## What Happened in the Swedish Manufacturing Industry in the 1990s?

A central task of this article is to try to understand what factors might explain the remarkable upswing in the Swedish manufacturing industry in the 1990s. The starting point of this analysis is the understanding that productivity growth is not only the result of productivity within industries — henceforth called the "within-effect" — but also of relative shifts in employment between sub-industries.[6] The structural shifts emerge in two ways. First, employment might increase/fall in industries with a higher/lower *level* of productivity than the industry average. Second, the relative shifts might take place in sub-industries with higher/lower productivity *growth* than the industry average. The former structural effect is defined as "static," the latter as "dynamic."

Table 2 shows that the average annual productivity growth in the Swedish manufacturing industry was 1.76 per cent between 1980 and 1990.[7] A total of 2.46 percentage points of this average are explained by productivity growth within the sub-industries, 0.05 percentage points by a relative shift in employment to industries with a productivity level exceeding the average in the manufacturing industry and — finally — a negative contribution of 0.75 percentage points via a relative increase in employment in sub-industries with low productivity growth. This means that employment shifts between sub-industries, on average, made a negative contribution to productivity growth in the manufacturing industry in the 1980s and that the entire increase can therefore be attributed to improved efficiency within the sub-industries.

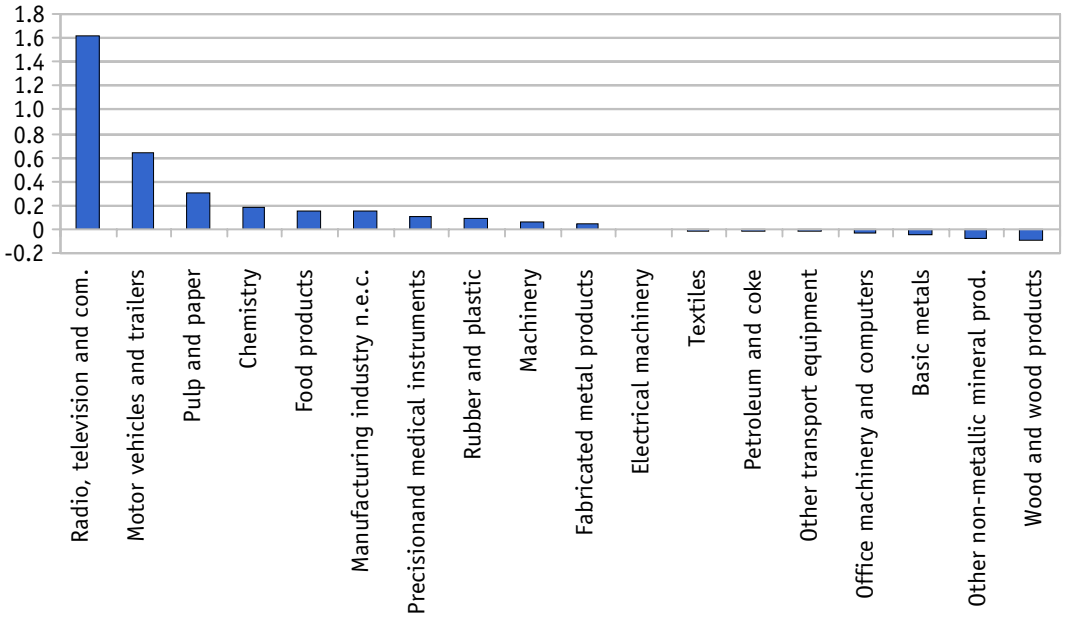
Turning to the 1990s, or more specifically the 1990-2001 period, Table 2 shows that average productivity growth was 7.6 per cent, an increase of 5.84 percentage points compared to the 1980s. This change is first explained by an increase in the average contribution of the within-effect from 2.46 to 5.53 percentage points. On the other hand, the static effect remained unchanged in the 1990s compared to the previous decade. Finally, there was the dynamic effect, which changed from a negative contribution of 0.75 percentage points to a positive contribution of 2.03 percentage points — an improvement by 2.78 percentage points.

Altogether, productivity growth within the sub-industries and relative shifts in employment to industries with high productivity growth explain the increased productivity growth in the manufacturing industry between the 1980s and

6 This means that even if productivity growth had remained unchanged in all sub-industries, changes in the employment structure can affect the aggregate productivity growth.

7 Note that different data sources and methods of calculation mean that the productivity growth rates for Swedish manufacturing in this section do not correspond to those in Table 1.

**Chart 3**
**Changes in the Average Within-effects of the Sub-industries Between 1980-90 and 1990-2001**
(percentage points)




Source: Statistics Sweden and author's calculations.

the 1990s. The latter explanation means that the Swedish manufacturing industry has undergone a period of positive structural change in terms of allocation of labour.[8]

## The Within-effect

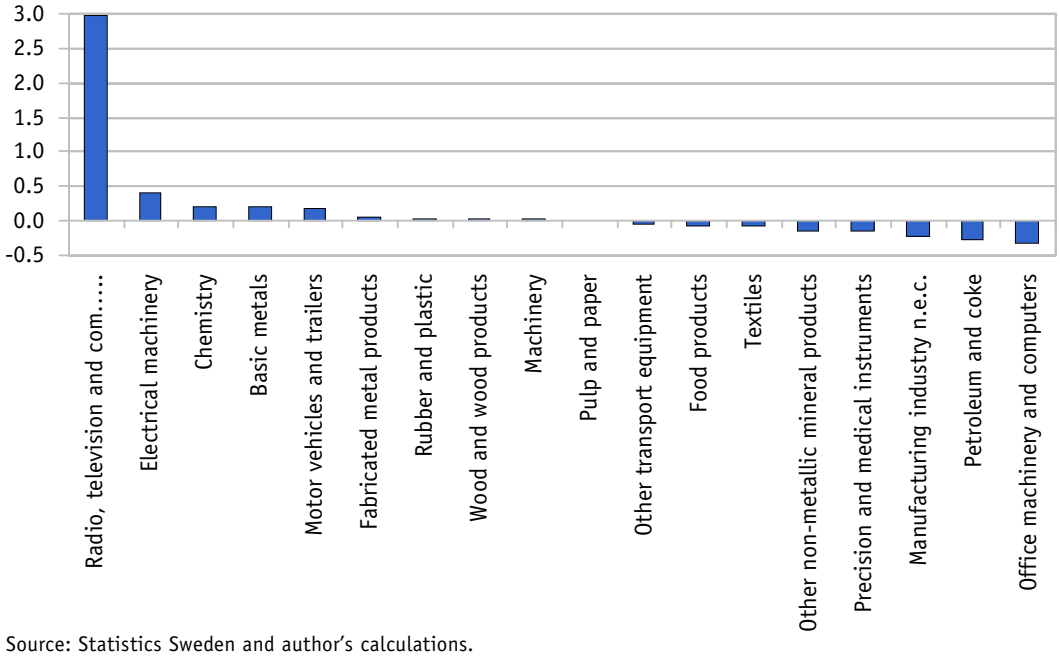
As stated in the above section, the average within-effect increased by 3.07 percentage points between the 1980s and the 1990s. A central issue in this context must be which sub-industries have contributed to this considerable increase? Chart 3 shows that 1.62 percentage points of the within-effect can be attributed to the radio, television and communication equipment and apparatus industry. This corresponded to slightly more than 50 per cent of the total increase in the within-effect. Then came the motor vehicles and trailers industry, where the within-effect increased by 0.65 percentage points. The pulp and paper, chemicals, chemical products and man-made fibres industry then followed. At the other end of the spectrum, we find wood and wood products (-0.09), other non-metallic mineral products (-0.08) and basic metals (-0.05). Around 20 per cent of the hours worked in the manufacturing industry in the 1990s were carried out in those sub-industries where the contribution fell between the two decades.

## The Dynamic Effect

The next question to be discussed is which sub-industries can explain the considerable improvement in the dynamic effect between the 1980s and the 1990s? Chart 4 shows that the

8 This is in line with the theory of industrial development which stipulates that over time, industrial production is allocated to industries characterized by a high and sophisticated use of capital. This is usually connected with a higher level and growth of productivity. See, for example, Syrquin (1988).

**Chart 4**
**Changes in the Average Dynamic Effect of the Sub-industries Between 1980-1990 and 1990-2001**
(percentage points per year)




Source: Statistics Sweden and author's calculations.

radio, television and communication equipment and apparatus industry was once more outstanding and increased its contribution by 2.98 percentage points between the 1980s and the 1990s. The electrical machinery industry increased its contribution by 0.4 percentage points. After these two followed three sub-industries — chemicals, basic metals and motor vehicles and trailers — which increased their respective contributions by about 0.2 percentage points. Among those manufacturing industries with decreased contributions were office machinery and computers (-0.32), petroleum and coke (-0.27) and manufacturing industries not elsewhere classified (-0.23). The industries with increased contributions in the 1990s constituted 45 per cent of the hours worked in the manufacturing industry.

In a comparison between the changes in the contribution to the within-effect, the increase in the dynamic effect was found to be more concentrated in a small number of manufacturing industries and a smaller share of the hours worked. Furthermore, the radio, television and communication equipment and apparatus industry becomes even more prominent.

## The Contribution of the Sub-industries to the Productivity Growth in the Manufacturing Industry

The change in the within- and dynamic effects of the sub-industries says nothing about their absolute contribution to the productivity growth in the manufacturing industry. Table 3 shows that all sub-industries exhibited a positive within-effect in the 1980s and 1990s. In the 1990s a small number of industries contributed the lion's share of the within-effect in the manufacturing industry. Among these sub-industries are radio, televi-

**Table 3**
**The Contribution of the Sub-industries to the Manufacturing Productivity Growth, 1980-90 and 1990-2001**
(percentage points per year)

| | 1980-1990 | 1990-2001 | 1980-1990 | 1990-2001 | 1980-1990 | 1990-2001 | 1980-1990 | 1990-2001 |
|---|---|---|---|---|---|---|---|---|
| **Industry** | **Within-effect** | | **Static effect** | | **Dynamic effect** | | **Total contribution[1]** | |
| Food products | 0.09 | 0.24 | 0.00 | -0.01 | -0.02 | -0.10 | 0.07 | 0.13 |
| Textiles | 0.08 | 0.07 | -0.05 | -0.06 | -0.07 | -0.15 | -0.04 | -0.14 |
| Wood and wood products | 0.22 | 0.13 | -0.03 | 0.00 | -0.03 | -0.01 | 0.16 | 0.12 |
| Pulp and paper | 0.12 | 0.43 | 0.03 | -0.04 | 0.01 | 0.01 | 0.16 | 0.39 |
| Petroleum and coke | 0.04 | 0.02 | -0.01 | 0.04 | 0.06 | -0.20 | 0.09 | -0.14 |
| Chemicals | 0.09 | 0.28 | 0.02 | 0.13 | -0.07 | 0.14 | 0.05 | 0.55 |
| Rubber and plastic products | 0.01 | 0.10 | 0.01 | 0.02 | -0.01 | 0.02 | 0.01 | 0.14 |
| Non-metallic mineral products | 0.09 | 0.01 | -0.02 | -0.04 | -0.04 | -0.18 | 0.02 | -0.21 |
| Basic metals | 0.30 | 0.26 | -0.06 | -0.04 | -0.25 | -0.04 | 0.00 | 0.18 |
| Fabricated metal products | 0.18 | 0.22 | 0.03 | 0.03 | 0.00 | 0.05 | 0.20 | 0.30 |
| Machinery | 0.33 | 0.39 | 0.01 | -0.01 | 0.00 | 0.02 | 0.34 | 0.40 |
| Office machinery and computers | 0.03 | 0.00 | 0.03 | -0.18 | -0.01 | -0.33 | 0.05 | -0.52 |
| Electrical machinery | 0.10 | 0.10 | -0.02 | 0.03 | -0.19 | 0.21 | -0.12 | 0.34 |
| Radio, television and communication equipment and apparatus | 0.33 | 1.94 | 0.00 | 0.14 | -0.16 | 2.82 | 0.17 | 4.90 |
| Precision and medical instruments | 0.04 | 0.14 | 0.09 | 0.03 | 0.15 | 0.00 | 0.28 | 0.17 |
| Motor vehicles and trailers | 0.12 | 0.76 | 0.02 | 0.05 | -0.10 | 0.08 | 0.03 | 0.89 |
| Other transport equipment | 0.02 | 0.00 | 0.01 | -0.02 | 0.00 | -0.04 | 0.03 | -0.06 |
| Manufacturing industry n.e.c. | 0.29 | 0.44 | 0.00 | -0.02 | -0.01 | -0.24 | 0.27 | 0.17 |
| Total effects[2] | 2.46 | 5.53 | 0.05 | 0.05 | -0.75 | 2.03 | 1.76 | 7.60 |

Source: Statistics Sweden and author's calculations.

1 These two columns constitute the sum of the three effects.

2 These effects are the ones presented in Table 2.

sion and communication equipment and apparatus (1.94), motor vehicles and trailers (0.76), manufacturing industry not elsewhere classified (0.44), pulp and paper (0.43) and machinery (0.39). Altogether, these sub-industries contributed approximately 70 per cent of the within-effect of the manufacturing industry in the 1990s, while somewhat less than 50 per cent of the hours worked were carried out in these industries. The radio, television and communication equipment and apparatus industry on its own contributed more than one third of the within-effect of the manufacturing industry.

Table 3 shows that the static effect contribution can be mostly attributed to the radio, television and communication equipment and apparatus industry (0.14) and the chemicals, chemical products and man-made fibres industry (0.13); no other sub-industry made a positive contribution exceeding 0.05 percentage points in the 1990s. Unambiguously, the largest negative contributor was the office machinery and computers industry (-0.18).

The dynamic effect of the radio, television and communication equipment and apparatus industry was annual average of 2.82 percentage points in the 1990s. The second largest contribution can be attributed to the chemicals, chemical products and man-made fibres industry (0.14). The largest negative contributors were

the office machinery and computers (-0.33) and manufacturing industry not elsewhere classsified (-0.24) sub-industries. In the 1980s 60 per cent of the hours worked in the manufacturing industry constituted a negative contribution to the dynamic effect. In the 1990s, this share fell to about one third.

Finally, we have the sum of the three effects — the total contribution to productivity growth in the manufacturing industry. Table 3 shows that both textiles and electrical machinery made a total negative contribution in the 1980s. On average, these two sub-industries constituted about eight per cent of the hours worked between 1981 and 1990. From the final column, it appears that five sub-industries showed a total negative contribution to productivity growth in the manufacturing industry in the 1990s. These sub-industries constituted about 10 per cent of the total number of hours worked. This means that the number of hours worked contributing positively to the productivity growth decreased somewhat in the 1990s, as compared to the 1980s.

A total of 4.9 percentage points — or 65 per cent — of the average manufacturing productivity growth in the 1990s can be attributed to the radio, television and communication equipment and apparatus industry. After this industry came motor vehicles and trailers (0.89), chemicals (0.55), machinery (0.4) and pulp and paper (0.39). The sub-industries with the largest negative contributions were office machinery and computers (-0.52) and other non-metallic products (-0.21).

Considering the size of the sub-industries, the results are even more remarkable. Studying the ratio between the total contribution and the sub-industries' share of total hours worked, the contribution of the radio, television and communication equipment and apparatus industry amounted to 0.95 percentage points in the 1990s. This means that one per cent of hours worked accounted for 13 per cent of manufacturing productivity growth. The closest industries — chemicals, electrical machinery and motor vehicles and trailers — amounted to 0.11, 0.10 and 0.10 percentage points respectively. Considering the size of the sub-industries, it was therefore the chemicals, chemical products and man-made fibres industry that contributed second most to the manufacturing productivity growth in the 1990s. The sub-industries with the largest negative contributions were, if considered in the same way, office machinery and computers (-0.76) and petroleum and coke (-0.37).

## Concluding Remarks

Productivity growth in the Swedish manufacturing industry performed very well in the 1990s, the best among the 12 countries in the BLS international manufacturing productivity database.

There is, however, a more sombre reality behind these pink clouds. The reason for this is, as we have seen, that a very large part of the recovery of the Swedish manufacturing industry is due to the radio, television and communication equipment and apparatus industry. Almost solely, this industry consists of the company Ericsson. In this way Sweden is very similar to Finland when it comes to productivity developments during the 1990s — increased manufacturing productivity growth driven by one high-tech company. In Finland, the company with capital C is Nokia, and according to some measures its contribution to the labour productivity growth even exceeded that of Ericsson.[9]

In fact, about 80 per cent of the increase between the 1980s and the 1990s in the Swedish manufacturing productivity growth would disappear if the telecom industry had made the same contribution as in the 1980s. To this it

9 See, for example, Daveri and Silva (2004) for a discussion on Finland, the high-tech industry and Nokia.

must also be added that the positive view in terms of structural changes becomes considerably darker if this industry is excluded; the remaining part of the manufacturing industry underwent unfavourable changes in relative employment in the 1990s.

Such negative structural changes might have considerable effects on the potential growth rate of Sweden. Adding together the effects of a smaller Ericsson[10] and a growing service economy — which, on average, has lower productivity growth than the manufacturing industry — there is a risk that future productivity growth will not reach the rates of the 1990s.

On the other hand, this challenge may be compensated for by Sweden's other historically successful manufacturing sub-industries, such as raw materials, chemicals, motor vehicles, pharmaceuticals, and machinery. If we also take into account that many services once performed within the manufacturing industry are now outsourced to companies that belong to the service industry, manufacturing's share of the total economy — both in terms of production and employment — has stayed roughly the same over the last 30 years. Official hours estimates, which do not take account of the increased interaction between producers of goods and producers of services, show that manufacturing's share of total hours worked in the economy is constantly declining. Nevertheless, a higher national employment rate, in many ways, hinges on a competitive manufacturing industry.

Whatever the future will bring, the question of the supply of labour should be included in the discussion of the future Swedish growth rate. We know that elderly people will comprise a larger share of the population when those born in the 1940s retire. In addition, approximately 20 per cent — around 1 million people — of the population aged 20-64 do not contribute to the total number of hours worked. This group mainly consists of people who have taken early retirement, are disabled, unemployed, or on social assistance.

A considerable increase in labour supply is desirable to avoid a reduction in the future potential growth rate. If the government succeeds in reducing ill-health by 50 per cent by the year 2008, this might be a contribution, but a much broader economic-political perspective is a condition for being able to maintain the potential growth rate of the last few decades. Two important areas in this context are a higher employment rate among immigrants and an older generation that remains employed longer.

If today's labour reserve does not succeed in compensating for the demography, only weekly working hours and holidays remain to be discussed. Such a scenario would probably lead to an increase in conflicts of goals between how much we want to work and how much we want the pie to grow. We are not yet there, but we should think about Ericsson's employees who, almost on their own, made the 1990s a golden decade for the Swedish manufacturing industry — as Churchill said: "So much owed by so many to so few."

## Appendix

### The Shift-share Method

The starting point of this method (OECD, 2001) is that productivity growth in the manufacturing industry can be expressed as the sum of contributions of each sub-industry $(i)$, weighted by the number of hours worked $(L_i / L = S_i)$:

$$P = \frac{Y}{L} = \sum_{i=1}^{n} \left(\frac{Y_i}{L_i}\right)\left(\frac{L_i}{L}\right) = \sum_{i=1}^{n} (P_i S_i) \ .$$

10 In 2000, Ericsson´s net sales amounted 273 billion Swedish krona (approximately $29 billion US, at the exchange rate prevailing on December 31, 2000). In 2004, net sales had fallen to 132 billion krona (approximately $20 billion US at the exchange rate prevailing on December 31, 2004).

If differentiated, the equation can be written as:

$$\Delta P(t) = \sum_{i=1}^{n} \Delta P_{i(t)} * S_{i(t-1)} + \sum_{i=1}^{n} (P_{i(t-1)} * \Delta S_{i(t)}) + \sum_{i=1}^{n} (\Delta P_{i(t)} * \Delta S_{(t)}) \ .$$

The first term on the right-hand side is a so-called "within-effect", which defines the contribution of productivity from the sub-industry (*i*) to the aggregate manufacturing productivity growth. The number of hours worked in the previous year is used as a weight. The second and third term together constitute the contribution that can be attributed to labour moving between industries. The second term, defined as the "static effect," weights the change in the number of hours worked by the level of productivity in the sub-industry from the previous year. An increase in the number of hours worked in industries with a high level of productivity generates a positive static effect. The third term, usually defined as the "dynamic effect", weights the change in the number of hours worked by the growth rate in labour productivity. An increase in the number of hours in sub-industries with a productivity growth above the average gives a positive dynamic effect — and the other way round.

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