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Innovation and Aggregate Economic Performance

Paper for
the 6th BETA-WORKSHOP IN HISTORICAL ECONOMICS
'Cliometrics of Creativity: Ideas, Innovation, Patents, R&D...'

Strasbourg, 14-15 May 2010,

and

**The 12th Annual SNEE European Integration
Conference,**

Mölle, 18-21 May, 2010

Work in progress – please do not quote!

Abstract. Although the divergence over the last decades between Europe and USA has drawn much attention, the dispersion of rates of economic growth is even larger among the countries within Europe. There is reason to presume that the more successful among the European countries are those that have set more innovations into production. This paper exploits the correlation between innovation, as materialized in new products, and falling relative prices. Our analysis suggests that major European countries have a low capability for innovation and is lagging behind USA. A handful of peripheral European countries have been more successful and to some extent also extend significant innovation to services. A waiver: this is a first draft and the manuscript probably has some loose ends...

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Although the divergence over the last decades between Europe and USA has drawn much attention, the dispersion of rates of economic growth is even larger among the countries within Europe. There is reason to presume that the more successful among the European countries are those that have set more innovations into production. In want of output data of actual innovation diverse measures are used in the literature: patents, R&D, surveys such as the CIS, etc. These indicators have, however, different drawbacks and most important is that they tell more about input to innovation than actual innovations. An assumption of this paper is that there is a source that can tell a lot about the amount and importance of innovation: prices. We use the EUKLEMS price data to investigate, from a macro perspective, innovation in 14 EU countries (EU15 less Luxembourg) and the USA and Korea for comparison. Besides the problem of economic performance and innovation we also address, without going into depth with the matter, the question of the validity and reliability of available price data.

1. THEORETICAL CONSIDERATIONS

It is well known that electronic equipment such as personal computers or LCD television-sets have become much cheaper with time. The phenomenon of falling prices is, however, nothing particular for ICT goods. In general do commodities that are the outcome of innovation display falling prices, at least in relative terms but often also absolutely. Had, for example, the price of an ordinary bicycle followed the general price level as indicated by the CPI since the beginning of the twentieth century, today it would have cost more than 1200 euro. The current price of a single-g geared bicycle is about a third or even less. However, the whole of this fall in the relative price of a bicycle took place in the first three to four decades. Broadly speaking, relative prices fell in the period when the bike was a new commodity, some basic innovations or improvements such as the free-wheel were introduced, new manufacturers appeared and the industry was in its formative years.

In economic theory prices are usually connected with sellers' and buyers' behaviour in the market place. Buyers' demand drives prices up or down, and sellers supply a certain quantity due to prices. Mostly they act according to a given demand or supply function and important changes, described as outward or inward shifts in any or both of these functions, are perceived as exogenous and casual factors. Basically this is a static approach and little interest has been devoted to integrate the shift factors into the behaviour of prices. In other words, little interest has been devoted to price effects of innovation, nor their role for economic growth. A notable exception is the volume, *The Economics of New Goods*, edited by Bresnahan and Gordon (1997) which deals with prices and technological change.

However, already the economic historian Alexander Gerschenkron (1962) found that prices could indicate dynamic macro-economic change. Moreover, Gerschenkron developed an analytical method for exploring economic transformation in a study of whether industrialisation took place in early twentieth century Bulgaria. His point of departure was that an aggregate index for the volume of production may give quite different results if the weights are taken from the end of the period compared with weights from its beginning:

“Those discrepancies in measurements are known as the index-number problem and are gall and wormwood to the statistician and theoretical economist. By contrast, their existence, magnitude, and change over time are a subject of very positive interest to the economic historian who regards them as an integral part of the processes of economic change.” (Gerschenkron 1962, p. 204)

Gerschenkron discussed an index of the output of industrial production but exactly the same characteristics apply to price indices and instead of just shifting the weights between the beginning and end of the period, one could extract more information by comparing different index types. For example, a Paasche price index with annual quantity weights could be compared with a Laaspeyres price index with constant quantity weights obtained from the beginning of the period. If economic transformation takes place and new goods with falling relative prices are providing an increasing share of the

aggregate output, then the Paasche price index will show lower values than the Laspeyres price index. Goods that are becoming relatively cheaper get increasingly more weight in the Paasche index whereas the weights do not change in the Laspeyres index. Thus, to be precise, they are showing different things. While the Laspeyres price index shows how much the base year's basket changes in price over a period, does the Paasche price index show how much the price of today's basket has changed from what it would have cost in the base year. This is, as Gerschenkron noted, the annoying index problem but if we take the ratio between the Paasche and Laspeyres indices we can pretend to have another index indicating economic transformation. The more the Paasche/Laspeyres ratio declines, which has been labelled the *Gerschenkron* effect, the more is the economy transformed. In an historical study of prices for commodity production in Sweden over the period 1885-1969, it was shown that such transformation was concentrated to the two decades around the turn of the century 1900 and again during the 1940s (Ljungberg 1990; 1991).

However, the transformation can be of two sorts, positive or negative, to use the wording by Erik Dahmén (1970 [1950]). Dahmén in his seminal study of entrepreneurship and innovation in Swedish interwar manufacturing industry classified sectors at a low level of aggregation according to their economic performance in interaction with the market. Thus he had four different categories, with advancing industries either characterised by *supply-push* or *demand-pull*, and stagnating industries by either *supply-contraction* or *demand-reduction* (see also Dahmén 1980). In two of the categories, the industry itself is a key or major causal factor behind the performance. A major factor behind the supply-push was innovation, whereas conservative or defensive entrepreneurship caused supply-contraction, often as a reaction to innovations which had made the products in question obsolete. In the two other categories, demand-pull and demand-reduction, the major forces were identified as outside the firms and these only reacted to developments in the market. ¹

¹ Dahmén was, at least originally, very critical against conventional supply-demand curves since they "eliminate important instruments for the causal analysis which are useful for the tracking of the driving forces in a process" (1950, p. 50 n, translation by JL). In Leijonhufvud's translation (1970) this note is omitted and the supply-push etc have no exact match in the Swedish original where there

Dahmén did not comprehensively include prices in his analysis but this was done by Ljungberg (1990) who classified more than 35 sectors of manufacturing industry according to Dahmén's scheme on the basis of changes in relative prices and relative sales volumes. Generally, there was a negative correlation between relative prices and volumes as already indicated by the *Gerschenkron effect* or decreasing Paasche/Laspeyres price index ratio. The question is whether this was mainly the result of a supply-push, with falling prices and expanding sales, or of supply-contraction, with increasing prices and declining sales. The secular trend was more on the positive side of transformation, that is supply-push, than on the negative side with supply-contraction. And also in the periods of the more pronounced Gerschenkron effects, around the turn of the century 1900 and in the 1940s, there was more of positive supply-push than negative supply-contraction. Furthermore, when it comes to the role of innovation, new commodities or product innovation seem to have been more connected with significant cases of supply-push, whereas process innovation typically was connected with a more moderate development (Dahmén 1950 p. 124; Ljungberg 1990 p. 74). Whilst the normal case was a negative correlation between relative prices and volumes, there were also cases of a positive correlation classified as demand-pull, with increasing prices and volumes, and demand-reduction, with decline in both. However, these were more rare cases. Demand-reduction signified obsolete products and it is a natural part of the industrial development. Demand-pull, although conforming with the textbook case of demand driving up the prices, were in fact often connected with particular conditions in the market. Not seldom did this apply to sales in export markets where the producer had the advantage of technological leadership, as ball bearings produced by SKF in the interwar period. It could also apply to new consumption goods which were in high demand when, as during most of the twentieth century, personal earnings rose. However, the background could also be more institutional such as for the building materials industry which in the postwar period could benefit from an economic policy with the aim to enhance residential construction (Ljungberg 1990 p. 154, p. 215).

is no "supply", neither "demand" in these concepts but different "market" processes. Dahmén (1980) can be seen as loyal to Dahmén (1950).

The idea of this paper is to apply the described approach on the varying performance within Western Europe, for comparison including USA as the established technological leader and Korea as a recent catch-up economy. The next section deals with the data and also discusses a fundamental problem in empirical price analysis, namely whether the price series accurately take account of quality change. Section four maps the Gerschenkron effects, that is the extent of transformation, for the total economies and section five continues with Gerschenkron effects within major sectors. Section six investigates whether transformation has been of the positive or negative type, and discusses the factors behind. Here innovation and capability for innovation, as conditioned by the broader context, is the problem in focus. Section seven sums up the conclusions and discusses the research agenda of prices and innovation.

3. DATA: SOURCES AND PROBLEMS

Ideally, the construction of price indices should start from the commodity level and be weighted together to subsectors, sectors and the aggregate economy. Needless to say, that would be a very large project. A particular problem, that can only be handled at the commodity level is quality change. In principle, quality change could be accounted for under the assumption that the same price at the same point in time (and place) implies the same quality. Then continuous price series can be spliced together from various price quotations or, if there are large amounts of data, constructed by help of regression models (hedonic indices). In this paper we use, however, price indices available at a higher level of aggregation. One disadvantage is that the Gerschenkron effects which occurs within sectors will be hidden and for the present we have disregard this impact and assume that it is approximately proportional with the Gerschenkron effects between sectors. The data used are derived from the EU KLEMS Growth and Productivity Accounts data base, 2008 release. The data covers 45 industries down to a two digit ISIC level for the period 1970 to 2005 for fourteen western European countries, United States and Korea.² The EU KLEMS project is until now the most

² The industry “Coke, refined petroleum and nuclear fuel” (ISIC 23) have been dropped since there appears to be an error in the price index for Germany.

ambitious effort to assemble and harmonize input, output and price data at disaggregate levels. It is based mostly on data from national statistical agencies, which as such differ a lot as regards data collection methods, accounting standards, etc., both across countries and over time. The EU KLEMS project have transformed the national data into a consistent data set in accordance with the NACE industry classification and ESA95 standard.³

Even though the EU KLEMS research team have made a tremendous effort to harmonise the data, some problems remain unsolved in the 2008 release. One is, for example, the differences between countries and over time as regards the construction of deflators for the private and government service industries. Another problem, which is the most serious from the present perspective, is that official price indices and national accounts deflators at best only to a limited degree reflect the introduction of new products and quality changes.

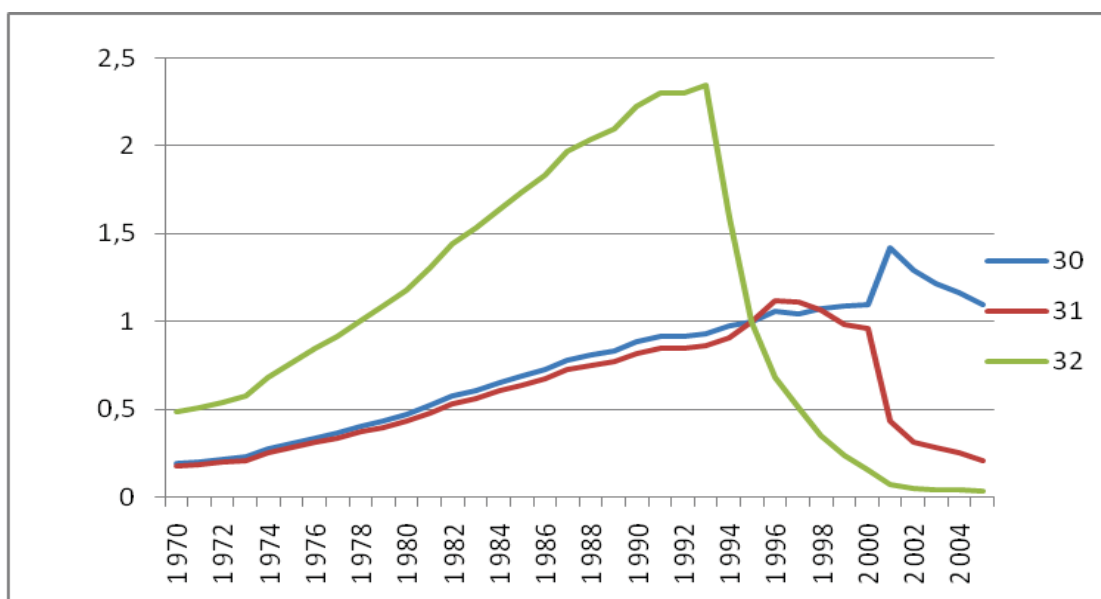
This is obvious in electrical, electronics and ICT equipment industries. The problem is aggravated by the fact that the methods and practices for the construction of price indices vary a great deal across countries. The United States, for example, have used hedonic methods to incorporate quality changes and new products in electronics and ICT industries deflators for a long time, while other countries have introduced the method at later stages, others use different methods while still others do not deal with quality differences at all. Most countries statistical agencies now follow the recommendations of ESA95 and are guided by the IMS's PPI manual and Eurostat's *Handbook on Price and Volume Measures in National Accounts*. However, the guidelines are still not applied entirely or consistently among the old EU countries. The EU KLEMS team have ambitiously attempted to harmonise both older and newer producer price indices by applying methods proposed by Schreyer (2002). Nevertheless, as also pointed out by van Ark (2002), the diversity of approaches do have a significant impact on comparisons of aggregate labour productivity. In the present context where disaggregate production and price data are compared across countries and over time the possible errors therefore may be considerable and it is still a pressing task to harmonise these between

³ For a full account see Timmer et al 2007.

countries. Furthermore, it is crucial to improve the price statistics so it to a much larger extent takes account of the introduction of new goods and quality change, in short, innovation.

This problem of quality change is highlighted by the Swedish accounts which began to incorporate quality changes and introduction of new products in

Figure 1. Price indices for electrical, electronic and ICT devices, 1970-2005: Sweden (1995=1)



Note: 30: Office, accounting and computing machinery
 31: Electrical machinery and apparatus
 32: Radio, television and communication equipment

electronics and ICT equipment in 1993. Statistics Sweden (SCB) then started to apply a variety of methods to account for quality changes, such as re-sampling and chaining and hedonic estimations were taken into use for personal computers (Deremar and Kullendorff 2006). Figure 1 clearly demonstrates the inconsistency of the resulting time series. Up to the early 1990s the price statistics took no account of the quality improvements in telecommunication devices but then comes a steep fall. To a lesser extent the same applies to other ICT sector but with the change occurring a decade later.

The consequences for the output estimates even at an aggregate level are far from negligible. The average annual growth rate of Swedish manufacturing industry, which was 1.5 per cent over the period 1970-1992, with the new ICT deflators rose to very impressive 19.1 per cent over the

period 1993-2005! A similar pattern is displayed by the American ICT prices all since 1970, in particular ISIC 30 (“Office, accounting and computing machinery”). According to this index would 12 cent in 2005 suffice to buy such machinery equivalent to 1000 dollars in 1980.⁴ Since we are not fully convinced that these figures inform about reality and, in any case, the underlying calculations are not consistent with those for most other countries and also blow up the break in the Swedish series in the early 1990s, we have made calculations both with and without the ICT sectors. For most countries the differences are negligible, for some they are significant but for USA and Sweden they are nothing but remarkable and not convincing.⁵ This is not to say that in general the problem with price statistics is its insufficient account of quality change but it is not a fortunate solution only to consider such changes for one category of products.

Another inconsistency is caused by ISIC 23, “Coke, refined petroleum and nuclear fuel”, the composition of which obviously varies a lot, and this sector has simply been excluded for all countries. Also excluded is the sector ISIC 70, “Real estate activities”, which contributes a sizeable value added in national accounts more as a result of real estate valuation than the transaction activity as such. Its growth can therefore not be seen as an outcome of innovation or the dynamism of an economy.

Notwithstanding the mentioned problems with the data, the EU KLEMS offers a unique dataset for comparative analyses and with its extension back to 1970 it encompasses the technological shift of the third industrial revolution. Despite the sectoral data represent a higher level of aggregation than we would desire, our hypothesis is that the price and volume measures will give new insights about the extent and distribution of innovation across Europe.

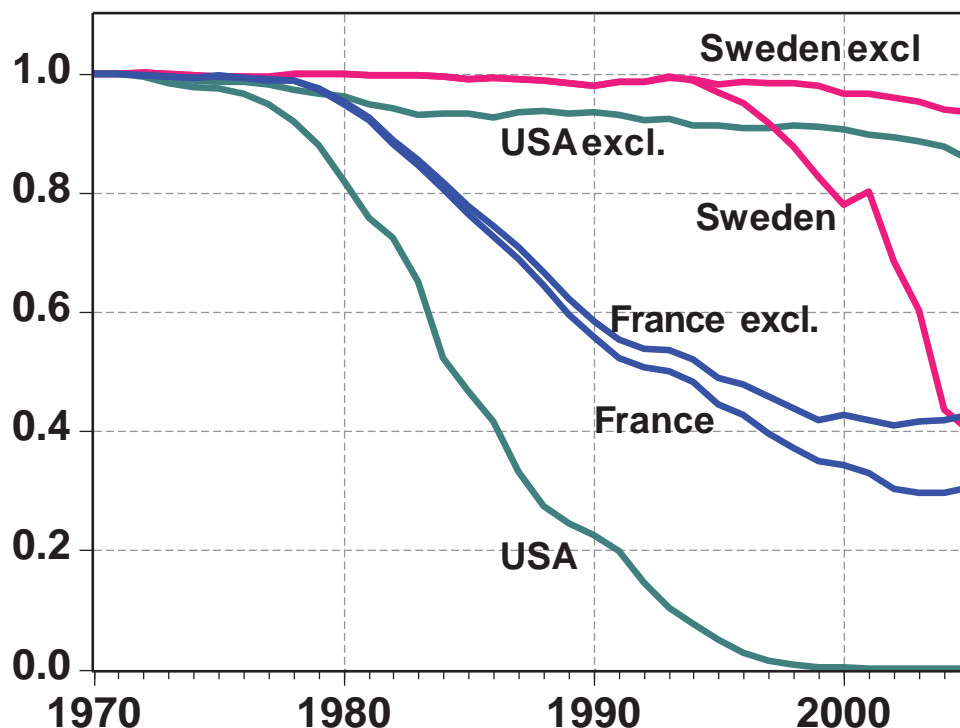
4. GERSCHENKRON EFFECTS: TOTAL ECONOMIES AND ICT

⁴ It could be observed that even when the three ICT sectors are excluded, Swedish manufacturing steamed up its growth rate from 1.5 to 4.5 per cent.

⁵ Thus output growth of US manufacturing when aggregating sectors in the EU KLEMS data was 17.6 per cent over 1970-92 and 48.9 per cent over 1993-2005! Excluding the three ICT sectors gives 1.5 and 2.1 per cent annual growth over 1970-92 and 1993-2005, respectively.

Let us recall the Gerschenkron effect in price indices: in a ratio between a given year weighted Paasche index and a start year weighted Laspeyres index (henceforth P/L ratio), economic transformation will show up as a downward sloping trend. This could be due both to expanding sectors with falling

Figure 2. Paasche/Laspeyres price ratios and ICT, 1970-2005: USA, France and Sweden (1970=1).



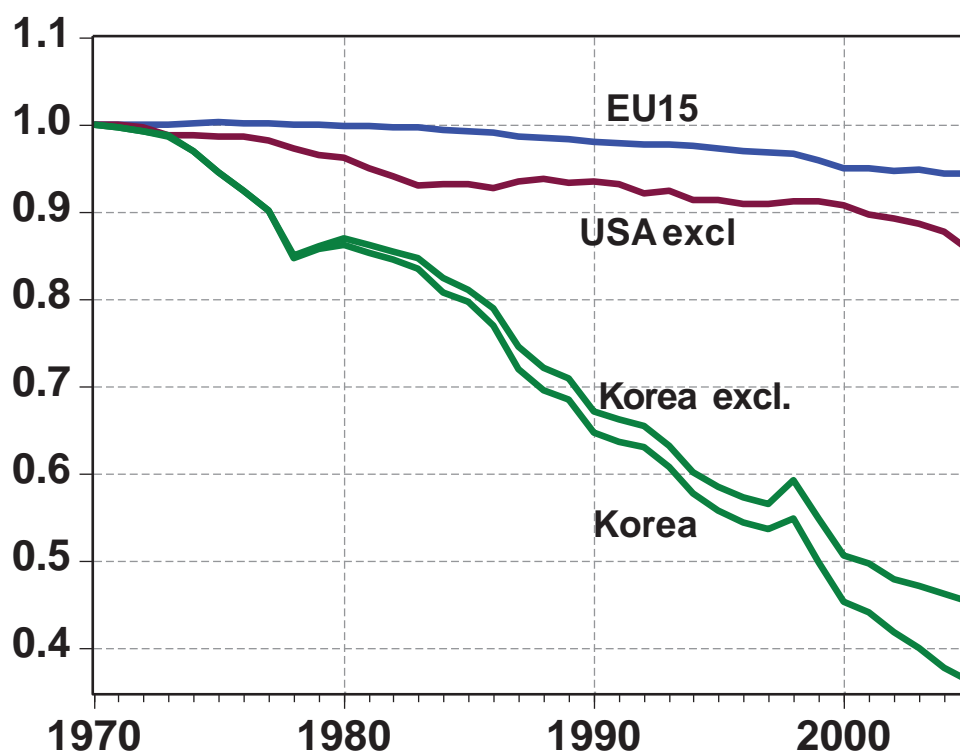
Note: Country without suffix considers total economy including primary sectors. “Excl.” consider total economies less ICT sectors.

relative prices, and to stagnating sectors with rising relative prices. As a way of demonstration we will first highlight the impact of the more advanced price indices for ICT products in some countries, before we look for Gerschenkron effects in aggregate economies and then look within the major sectors of industry and services.

Figure 2 shows P/L ratios for the entire economies of USA, France and Sweden both including the ICT sectors, and with these excluded. The declining prices of the ICT sector has an extreme impact for the American economy, with a P/L ratio close to zero from the late 1990s. By contrast,

when the ICT sectors are excluded has the American P/L ratio only a moderate slope, from 1 in 1970 to 0.86 in 2005. This suggests that the economic transformation in the main is limited to the ICT sectors – and it may be overemphasized.

Figure 3. Paasche/Laspeyres price ratios and ICT, 1970-2005: EU15, USA and Korea (1970=1)



Note: See figure 2.

Sweden is similar with the American case but the ICT impact is delayed by the lagged introduction of advanced techniques in the index calculation. Excluding the ICT sectors shows even less transformation than in the USA, with the P/L ratio declining to 0.94 in 2005. France offers a remarkable case for the opposite reason. Even when the ICT sectors are excluded France has a strong Gerschenkron effect and the P/L ratio drops to 0.43. Maybe one should rethink the picture of the traditionalist French!

Among the compared countries only Korea displays Gerschenkron effects similar to France. In figure 3 Korea can be compared with USA, with ICT sectors excluded, and EU15. For EU15 the ICT sectors have been retained

in the shown curve and excluding them only make a very marginal difference. Figure 3 conforms with the general picture of EU15 as less dynamic than the USA, and with Korea as a rapidly changing economy. Its P/L ratio, exclusive of ICT, hits 0.45 in 2005, not far above the French. In the next section we will

Table 1. P/L ratios for total economies and ICT sectors excluded, 1981, 1993, 2005 (1970=1)

| | All sectors | | | ICT excluded | | |
|----------------|-------------|-------|--------|--------------|------|------|
| | 1981 | 1993 | 2005 | 1981 | 1993 | 2005 |
| France | 0.92 | 0.50 | 0.30 | 0.93 | 0.54 | 0.43 |
| Korea | 0.85 | 0.61 | 0.36 | 0.86 | 0.63 | 0.45 |
| Denmark | 0.99 | 0.84 | 0.66 | 0.99 | 0.86 | 0.69 |
| Finland | 0.96 | 0.91 | 0.62 | 0.96 | 0.94 | 0.86 |
| USA | 0.76 | 0.104 | 0.0006 | 0.95 | 0.92 | 0.86 |
| Belgium | 0.92 | 0.90 | 0.88 | 0.92 | 0.90 | 0.87 |
| Greece | 0.96 | 0.95 | 0.89 | 0.96 | 0.95 | 0.89 |
| Netherlands | 1.00 | 0.93 | 0.89 | 1.00 | 0.93 | 0.89 |
| Ireland | 1.00 | 0.87 | 0.85 | 1.00 | 0.98 | 0.92 |
| Italy | 0.95 | 0.91 | 0.91 | 0.95 | 0.93 | 0.92 |
| Austria | 0.99 | 0.97 | 0.93 | 0.99 | 0.97 | 0.93 |
| United Kingdom | 0.98 | 0.98 | 0.92 | 0.98 | 0.98 | 0.93 |
| Sweden | 1.00 | 0.99 | 0.40 | 1.00 | 0.99 | 0.94 |
| Portugal | 0.97 | 0.98 | 0.94 | 0.97 | 0.98 | 0.95 |
| EU15 | 1.00 | 0.98 | 0.94 | 1.00 | 0.98 | 0.97 |
| Germany | 1.00 | 0.99 | 0.96 | 1.00 | 1.00 | 0.98 |
| Spain | 0.96 | 0.96 | 0.99 | 0.96 | 0.96 | 0.99 |

follow up on Korea and see whether the transformation mainly was caused by structural change from primary sectors to industry and services, or if transformation has been more pervasive.

Here we proceed with the cross-country comparison of the extent of Gerschenkron effects, both with all sectors included and with the exclusion of the ICT sectors. Since the base year is 1970, the P/L ratios all have 1 that year, and with the passing of time the ratio tend to decline. Table 1 ranks the countries due to their P/L ratio, when ICT is excluded, in 2005. The lowest

P/L ratio has France, closely followed by Korea, both with ratios under 0.5. Next comes Denmark with 0.69, and not very different with 0.66 if ICT is included. Then there is a new gap to a group of countries placed between 0.85 and 0.9. Finland is heading this group and notable is that with ICT included Finland would come before Denmark. After Finland comes USA which thus is ahead of most European countries except France, Denmark and Finland. Very small or no Gerschenkron effects are shown by Germany and Spain, and also EU15. Between the years shown in the table no country shows an increase in the P/L ratio, apart from the minor deviation of Portugal which increases from 0.97 in 1981 to 0.98 in 1993. However, what not could be seen in the table is that Belgium was different, down from 0.92 in 1981 to 0.83 in 1985 and again rising to 0.90 in 1993. Otherwise there are not much volatility in the P/L ratios but they move along a trend. If we assume that the Gerschenkron effect reflects the dynamism and ability for innovation of an economy, in order to at least approximately identify the most transformative fields one can calculate P/L ratios for major sectors.

5. GERSCHENKRON EFFECTS: MAJOR SECTORS

Table 2 shows the P/L ratios for industry and services with two variants for both. Industry comprises manufacturing, construction and utilities, and in its second variant the three ICT sectors have been excluded for reasons already discussed. Services include a wide range of activities including the public services and other non-marketed services. The latter, and also some marketed services such as financial services, are “measurement resistant” since they have no clearly defined output or prices. We will not discuss that problem here but would emphasise that accounting practices differ between countries. If we as regards ICT devices are less than convinced about the superiority of the hedonic indices in some countries, our hypothesis about services is that probably no country has gone too far but most countries still employ too conservative measurement practices. The column “Services – less public”, in table 2, should highlight the marketed or private services although some of those excluded also comprise private activities. Thus all education, all “Health and social work” as well as “Other community, social and personal services” has been excluded.

Table 2. P/L ratios for industry and services in 2005 (1970=1; rank order as in table 1)

| | Industry - all | No | Industry - less ICT | No | Services - all | No | Services -less public | No |
|-------------------|-------------------|----|------------------------|----|-------------------|----|--------------------------|----|
| 1. France | 0.14 | 2 | 0.29 | 1 | 0.47 | 2 | 0.32 | 1 |
| 2. Korea | 0.36 | 4 | 0.49 | 2 | 0.34 | 1 | 0.59 | 3 |
| 3. Denmark | 0.68 | 6 | 0.91 | 11 | 0.66 | 3 | 0.55 | 2 |
| 4. Finland | 0.44 | 5 | 0.75 | 4 | 0.83 | 5 | 0.85 | 6 |
| 5. USA | 0.0002 | 1 | 0.92 | 13 | 0.91 | 10 | 0.92 | 9 |
| 6. Belgium | 0.72 | 7 | 0.72 | 3 | 0.97 | 15 | 0.98 | 16 |
| 7. Greece | 0.90 | 13 | 0.90 | 9 | 0.82 | 4 | 0.84 | 5 |
| 8. Netherlands | 0.81 | 10 | 0.82 | 6 | 0.90 | 8 | 0.96 | 13 |
| 9. Ireland | 0.74 | 8 | 0.82 | 6 | 0.99 | 17 | 0.98 | 16 |
| 10. Italy | 0.75 | 9 | 0.78 | 5 | 0.94 | 13 | 0.93 | 11 |
| 11. Austria | 0.92 | 15 | 0.92 | 13 | 0.92 | 11 | 0.96 | 13 |
| 12. United Kingd. | 0.93 | 16 | 0.98 | 17 | 0.87 | 7 | 0.89 | 8 |
| 13. Sweden | 0.19 | 3 | 0.90 | 9 | 0.90 | 8 | 0.92 | 9 |
| 14. Portugal | 0.91 | 14 | 0.94 | 15 | 0.84 | 6 | 0.78 | 4 |
| 15. EU15 | 0.82 | 11 | 0.89 | 8 | 0.96 | 14 | 0.94 | 12 |
| 16. Germany | 0.83 | 12 | 0.91 | 11 | 0.97 | 15 | 0.96 | 13 |
| 17. Spain | 0.97 | 17 | 0.97 | 16 | 0.93 | 12 | 0.87 | 7 |

Note: for explanations, see text.

The countries appear in table 2 in the same order as in table 1, that is, from the most to the least significant Gerschenkron effect in the total economy. To the right of the P/L ratios for the sectoral divisions there is a number, denoting the rank as regards Gerschenkron effect in that sector. What is worth to notice is that the economies with a top rank for the total economy have low P/L ratios, thus impressive Gerschenkron effects, also for the services. That applies to France which has lower ratios for services than any other country has for industry with ICT excluded. Korea is even more remarkable since the services, inclusive of public services, have a lower P/L ratio even than industry inclusive of ICT sectors. The presumption that the

low overall P/L ratio for Korea would be a result of structural change out of agriculture thus finds no support. The dynamism of the economy is instead very pervasive and the Gerschenkron effect is everywhere. Denmark is also an interesting case where services, in particular when the public services are excluded, have a significantly lower P/L ratio than industry with ICT excluded. Denmark is sometimes seen as less innovative, at least in comparison with Finland and Sweden (Virén and Malkamäki 2002), however, as reflected in prices this view is arguable. It is true that Denmark has less capacity in the ICT sectors, but its services are second only to France and Korea. The fourth country in the overall ranking, Finland, correspond more to expectations: the Gerschenkron effect is most significant in industry. However, also Finnish services show a lower P/L ratio than industry in most countries.

Further below in the ranking, the pattern is more to expectations than in the Finnish case. Belgium, Italy, Ireland and the Netherlands have P/L ratios around 0.8 for industry, but mostly above 0.95 for services. In these days much haunted Greece, in the middle of the ranking, shows the opposite pattern, with services just above 0.8 and industry at 0.9. Maybe the Greek economy had a potential... Worrisome is the insignificant Gerschenkron effects in the lower half, with big economies such as the UK, Spain and worst of all, Germany. If the Gerschenkron effect is an indicator of the dynamism and occurrence of innovation in an economy, then only a small group among EU14 qualify. A large group looks rather traditional, with some Gerschenkron effects appearing only in industry and an equally large group demonstrate no effects at all. When it comes to Germany, a hypothetical explanation is that its industry faces demand-pull, as did Swedish ball-bearings in the interwar period, with export markets driving mark-ups on its products. That may create a particular economy, very dependent on foreign demand. However, we now turn to the question whether the explored Gerschenkron effects are due to positive or negative transformation.

6. RELATIVE PRICES AND SECTORAL GROWTH

Transformation showing up in falling P/L ratios can be due to both supply-push, with falling relative prices and expanding output, and supply-

contraction, with rising relative prices and stagnating output. Supply-push would then represent positive transformation whereas supply-contraction

Table 3. A typology of change in relative prices and volumes across EU14, USA and Korea, 1970-2005

| Relative prices and volumes | | Negative correlation | | Positive correlation | |
|---|----------|--|--------------------|----------------------|-------------|
| Sector | Code | Supply-push | Supply-contraction | Demand-reduction | Demand-pull |
| Forestry | 2 | | France | (Greece) | |
| Fishing | B | | | (Austria) Spain | |
| Mining and quarrying | C | | | Germany | |
| Pulp and paper | 21 | Italy | | | |
| Chemicals | 24 | Belgium Ireland Italy Korea | | | |
| Rubber and plastics | 25 | | | Portugal | |
| Basic metals | 27 | Finland France | | Spain Sweden | |
| Machinery, nec | 29 | | | | Portugal |
| Office, accounting and computing machinery | 30 | Austria Denmark Finland France Germany Ireland Netherlands UK USA Korea | | | |
| Electrical machinery and apparatus | 31 | Ireland Italy Korea | France | | |
| Radio, television and communication equipment | 32 | Denmark Finland France Ireland Italy Portugal Sweden Korea | | Netherlands | |
| Medical, precision and optical instruments | 33 | Ireland Korea | | | |
| Motor vehicles, trailers and semi-trailers | 34 | Korea | | | |
| Other transport equipment | 35 | | | Spain | |
| Manufacturing nec, recycling | 36 37 | | Germany UK | Greece | |
| Electricity, gas and water | E | Greece | | | |
| Services | | | | | |

| | | | | | |
|---|----|--|-------------|--|--------------------|
| Sale, maintenance and repair of motor vehicles and motor-cycles; retail sale of fuel | 50 | | Denmark | | |
| [Sea transport] | 61 | Denmark Germany | | | |
| Other Air transport [abroad] | 62 | Austria Finland Netherlands Spain | France | | |
| [Travel agencies] | 63 | Greece | | | |
| Post and telecomm. | 64 | Finland Greece UK <i>Korea</i> | | | |
| Financial intermediation | J | Portugal | | | |
| Renting of machinery and equipment | 71 | | France | | |
| Computer and related activities | 72 | Denmark Greece | | | Germany Austria |
| Other community, social and personal services | O | | Netherlands | | |
| Private household with employees | P | | Netherlands | | |

Note: Explanation – see the text.

implies negative transformation. As a first approximation, one could identify the more extreme cases that may particularly contribute to the Gerschenkron effects. Table 3 offer an overview of the significant cases of supply-push and supply-contraction, and for the comprehension also the significant cases demand-reduction and demand-pull which, however, should give no Gerschenkron effects. What is significant? We have simply taken those sectors which deviate at least one standard deviation from the mean of the average annual rate of change 1970-2005 for the total economy of the country in question, in prices and volumes. The appendix gives a somewhat fuller presentation with rates of change as well as standard deviations in the total economies and classification of all sectors.

We start with the two columns showing cases of supply-push and supply-contraction. The two countries with the most pronounced Gerschenkron effects, France and Korea, also stand out in table 3. Korea tops with 8 cases, all for supply-push, whereas France has 3 cases for supply-push and 4 cases for supply-contraction. The relative importance of supply-contraction, as

measured by the share in current value added, was about the same as for supply-push. The expectation that France's pronounced Gerschenkron effect would be an indication of a very dynamic economy thus received no further support. Its transformation had a good portion from the "negative side", to use Dahmén's vocabulary.

Other countries with many significant cases are Finland and Ireland, both with 5 cases for supply-push, and Denmark with 4 supply-push and 1 supply-contraction. In the group with less significant Gerschenkron effects, Italy, Greece, Netherlands and Portugal have 4 cases each. The first two only cases of supply-push while the latter two have half of supply-contraction. Notable is that there are so many cases of supply-push in services, not the least Greece with four cases.

Overall, most significant cases are for supply-push, whilst supply-contraction, demand-reduction or demand-pull show a lower number of cases. The presumption that the insignificant Gerschenkron effect for Germany might be due to counter-balancing cases of demand-pull in export industries finds no support in this typology. Actually there are only three cases of demand-pull, one for Portugal in manufacturing industry and one each for Austria and Germany, both in "Computer and related activities" which typically is oriented towards the domestic market. Germany in this comparison thus comes out as the economy with least propensity for transformation.

7. CONCLUDING REMARKS

Innovation is more than new commodities. "New combinations" is maybe its most general characteristic and with the growth of services new ways of doing or organising business are typical for dynamic regions or clusters. This is also why services figure with close to a third of the cases of supply-push, as reported in table 3. Usually it is thought that services only increase in price whereas commodities is becoming (relatively) cheaper. However, a finding of this paper is that also services can provide supply-push and make out a part of the positive side of economic transformation, with the basis in innovation.

The emphasis made here on services is due to two facts: one is that the countries with the most significant Gerschenkron effects also had a

significant contribution from services; another is precisely that innovation is not limited to manufacturing but encompasses all aspects of the working of an economy. In want of adequate measures of output of innovation, we have applied an approach based on relative prices. Since the used price data are indices at a rather aggregate level it was not possible to identify and characterise innovations but we suggest that sectors with realised innovations could be indicated.

When it comes to the debate about the divergence between USA and Europe, we found that USA has a lead over EU15 but that there is a group of countries in Europe where innovation has a larger impact, as shown by the Gerschenkron effects. In this comparison Korea comes out as the most innovative country with transformation only indicated on the positive side, as shown by supply-push, whereas the Gerschenkron effects in Europe had a significant contribution from the negative side, as shown by supply-contraction. Europe's largest economy, Germany, comes out as the least innovative and with insignificant Gerschenkron effects. France, on the other hand, demonstrates the largest Gerschenkron effects but with about equal weight for the positive and negative side. Other countries in the middle of Europe show rather insignificant Gerschenkron effects and in an old fashioned way limited to manufacturing industry. More innovative were peripheral countries like Finland, Denmark, Ireland, and Greece. The latter country, as well as Denmark, had a significant contribution from services which may indicate a potential for innovation and growth.

The displayed pattern of transformation in the European economies cannot easily be correlated with performance in economic growth. There may be a variety of reason although we stick to the hypothesis that in the long run innovation as captured by the Gerschenkron effect could predict economic growth. We have only looked at 1970-2005 as one period but since more radical innovation show up in growth with a lag, and the first decades in the actual period saw the beginning of the third industrial revolution, there are good reasons to not only scrutinize the variations across space but also over time by looking at subperiods.

For further research it is moreover important to find price data at a lower level of aggregation and data which encompasses new products and

capture, without going exorbitant, technological change. The analysis in this paper is, moreover, somewhat arbitrary with the broadly defined categories for supply-push etc, and by applying a more gradual typology more information can be extracted.

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APPENDIX

Note: 1 stands for relative price or relative volume change within plus/minus one standard deviation from the national average; 2 is more than... and 0 is more than one standard deviation below... (Following pages)

| 1970-2005 | GERMANY | | GREECE | | IRELAND | | ITALY | | NETHERLANDS | | PORTUGAL | |
|---|----------|----------|----------|----------|----------|----------|----------|----------|-------------|----------|----------|----------|
| Aggr price change | 0,027245 | 0,021956 | 0,126724 | 0,022455 | 0,069712 | 0,046084 | 0,083981 | 0,022862 | 0,028807 | 0,02595 | 0,106912 | 0,030382 |
| SD of sector price change | 0,016632 | 0,024278 | 0,014544 | 0,026718 | 0,017069 | 0,035835 | 0,017324 | 0,014146 | 0,020947 | 0,024892 | 0,017661 | 0,018955 |
| desc | Rprices | Rvolumes | Rprices | Rvolumes | Rprices | Rvolumes | Rprices | Rvolumes | Rprices | Rvolumes | Rprices | Rvolumes |
| TOTAL INDUSTRIES TOT | | | | | | | | | | | | |
| AGRICULTURE, HUNTING | | | | | | | | | | | | |
| AGRICULTURE, HUNTING A | | | | | | | | | | | | |
| Agriculture 1 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 |
| Forestry 2 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 |
| FISHING B | 1 | 0 | 2 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 0 |
| MINING AND QUARRY C | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 |
| MINING AND QUARRY 10t12 | | | | | | | | | | | | |
| Mining of coal and lign 10 | | | | | | | | | | | | |
| Extraction of crude pe 11 | | | | | | | | | | | | |
| Mining of uranium anc 12 | | | | | | | | | | | | |
| MINING AND QUARRY 13t14 | | | | | | | | | | | | |
| Mining of metal ores 13 | | | | | | | | | | | | |
| Other mining and quar 14 | | | | | | | | | | | | |
| TOTAL MANUFACTURING | | | | | | | | | | | | |
| FOOD, BEVERAGES AND TOBACCO 15t16 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 0 |
| Food and beverages 15 | | | | | | | | | | | | |
| Tobacco 16 | | | | | | | | | | | | |
| TEXTILES, TEXTILE, LEATHER, WOOD AND OF WOOD 17t18 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 2 | 1 |
| Textiles 17 | | | | | | | | | | | | |
| Wearing Apparel, Dresses 18 | | | | | | | | | | | | |
| Leather, leather and fct 19 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 2 | 1 |
| WOOD AND OF WOOD 20 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| PULP, PAPER, PAPER, PRINTING, PUBLISHING 21t22 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 2 | 1 | 1 | 1 | 1 |
| Pulp, paper and paper 21 | | | | | | | | | | | | |
| Printing, publishing an 22 | 1 | 0 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 |
| Publishing 22t | | | | | | | | | | | | |
| Printing and reproduction 22x | | | | | | | | | | | | |
| CHEMICAL, RUBBER, PLASTICS 23t25 | | | | | | | | | | | | |
| Coke, refined petroleum 23 | | | | | | | | | | | | |
| Chemicals and chemicals 24 | 0 | 1 | 1 | 1 | 0 | 2 | 0 | 2 | 1 | 1 | 1 | 1 |
| Pharmaceuticals 24x | | | | | | | | | | | | |
| Chemicals excluding plastic 24x | | | | | | | | | | | | |
| Rubber and plastics 25 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 |
| OTHER NON-METALLIC 26 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| BASIC METALS AND FABRICATED METAL 27t28 | | | | | | | | | | | | |
| Basic metals 27 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 |
| Fabricated metal 28 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 |
| MACHINERY, ELECTRICAL AND OPTICAL 29t33 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 |
| MACHINERY, NEC 29 | | | | | | | | | | | | |
| ELECTRICAL AND OPTICAL 30t33 | | | | | | | | | | | | |
| Office, accounting and 30 | 0 | 2 | 1 | 0 | 0 | 2 | 0 | 1 | 0 | 2 | 1 | 2 |
| Electrical engineering 31t32 | | | | | | | | | | | | |
| Electrical machinery and 31 | 1 | 1 | 1 | 0 | 0 | 2 | 0 | 2 | 1 | 1 | 1 | 1 |
| Insulated wire 31x | | | | | | | | | | | | |
| Other electrical machinery 31x | | | | | | | | | | | | |
| Radio, television and electronic 32 | 0 | 1 | 0 | 1 | 0 | 2 | 0 | 2 | 0 | 0 | 0 | 2 |
| Electronic valves and tubes 32t | | | | | | | | | | | | |
| Telecommunication equipment 32t | | | | | | | | | | | | |
| Radio and television receivers 32t | | | | | | | | | | | | |
| Medical, precision and scientific 33 | 1 | 1 | 1 | 0 | 0 | 2 | 0 | 1 | 1 | 1 | 1 | 1 |
| Medical, precision and 33 | | | | | | | | | | | | |
| Scientific instruments 33t13 | | | | | | | | | | | | |
| Other instruments 33t15 | | | | | | | | | | | | |
| TRANSPORT EQUIPMENT 34t35 | | | | | | | | | | | | |
| Motor vehicles, trailer 34 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 2 |
| Other transport equipment 35 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 2 | 1 |
| Building and repairing 35t | | | | | | | | | | | | |
| Aircraft and spacecraft 35t | | | | | | | | | | | | |
| Railroad equipment and 35x | | | | | | | | | | | | |
| MANUFACTURING NEC 36t37 | 2 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 2 | 1 |
| Manufacturing nec 36 | | | | | | | | | | | | |
| Recycling 37 | | | | | | | | | | | | |
| ELECTRICITY, GAS AND HEAT 40 | 1 | 1 | 0 | 2 | 1 | 1 | 2 | 1 | 1 | 1 | 2 | 1 |
| ELECTRICITY AND GAS 40 | | | | | | | | | | | | |
| Electricity supply 40x | | | | | | | | | | | | |
| Gas supply 40t | | | | | | | | | | | | |
| WATER SUPPLY 41 | | | | | | | | | | | | |
| CONSTRUCTION 41t | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 |
| WHOLESALE AND RETAIL TRADE 50t52 | | | | | | | | | | | | |
| Sale, maintenance and 50 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 |
| Wholesale trade and 51 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Retail trade, except of 52 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| HOTELS AND RESTAURANTS 53 | 2 | 1 | 1 | 1 | 2 | 1 | 2 | 1 | 1 | 1 | 2 | 1 |
| TRANSPORT AND STORAGE 60t63 | | | | | | | | | | | | |
| Other Inland transport 60 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 2 | 1 | 1 | 1 | 1 |
| Other Water transport 61 | 0 | 2 | 1 | 2 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| Other Air transport 62 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 2 | 1 | 1 |
| Other Supporting and 63 | 1 | 2 | 0 | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 2 |
| POST AND TELECOMMUNICATIONS 64 | 0 | 1 | 0 | 2 | 0 | 1 | 1 | 2 | 1 | 2 | 1 | 2 |
| FINANCE, INSURANCE, REAL ESTATE AND ACTIVITIES RELATED TO FINANCE 65t67 | | | | | | | | | | | | |
| FINANCIAL INTERMEDIATION 65 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 0 | 2 |
| Insurance and pension 66 | | | | | | | | | | | | |
| Activities related to finance 67 | | | | | | | | | | | | |
| REAL ESTATE, RENTING AND ACTIVITIES RELATED TO REAL ESTATE 70 | | | | | | | | | | | | |
| Real estate activities 70 | | | | | | | | | | | | |
| Renting of machinery and 71t74 | | | | | | | | | | | | |
| Renting of machinery 71 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 2 | 1 | 2 |
| Computer and related 72 | 2 | 2 | 0 | 2 | 2 | 1 | 1 | 2 | 1 | 2 | 2 | 2 |
| Research and development 73 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Other business activities 74 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1 |
| Legal, technical and administrative 74t14 | | | | | | | | | | | | |
| Other business activities 74t18 | | | | | | | | | | | | |
| COMMUNITY SOCIAL AND CULTURAL 75t77 | 1 | 1 | 2 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1 |
| PUBLIC ADMINISTRATION AND DEFENSE 78 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 |
| EDUCATION 79 | 1 | 1 | 2 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1 |
| HEALTH AND SOCIAL SERVICES 80 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 |
| OTHER COMMUNITY, SOCIAL AND CULTURAL 90 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 2 | 0 | 2 | 1 |
| Sewage and refuse disposal 90 | | | | | | | | | | | | |
| Activities of members of 91 | | | | | | | | | | | | |
| Recreational, cultural and 92 | | | | | | | | | | | | |
| Media activities 92t12 | | | | | | | | | | | | |
| Other recreational activities 92t17 | | | | | | | | | | | | |
| Other service activities 93 | | | | | | | | | | | | |
| PRIVATE HOUSEHOLDS 94 | 1 | 1 | 2 | 1 | 2 | 1 | 1 | 1 | 2 | 0 | 2 | 1 |
| EXTRA-TERRITORIAL ORGANIZATION 95 | | | | | | | | | | | | |
| Number of sectors =2 | 3 | 5 | 7 | 6 | 10 | 5 | 2 | 9 | 2 | 5 | 17 | 9 |
| Number of sectors =1 | 34 | 33 | 29 | 27 | 25 | 36 | 33 | 33 | 36 | 35 | 22 | 32 |
| Number of sectors =0 | 8 | 7 | 9 | 12 | 10 | 4 | 10 | 3 | 6 | 5 | 5 | 4 |
| Cases of market push (2-0) | | 2 | | 4 | | 5 | | 4 | | 2 | | 2 |
| Cases of market contraction (2-0) | | 1 | | 0 | | 0 | | 0 | | 2 | | 1 |

| 1970-2005 | GERMANY | GREECE | IRELAND | ITALY | NETHERLANDS | PORTUGAL | | | | | | | |
|---------------------------|----------|----------|----------|----------|-------------|----------|----------|----------|----------|----------|----------|----------|----------|
| Aggr price change | 0,027245 | 0,021956 | 0,126724 | 0,022455 | 0,069712 | 0,046084 | 0,083981 | 0,022862 | 0,028807 | 0,02595 | 0,106912 | 0,030382 | |
| SD of sector price change | 0,016632 | 0,024278 | 0,014544 | 0,026718 | 0,017069 | 0,035835 | 0,017324 | 0,014146 | 0,020947 | 0,024892 | 0,017661 | 0,018955 | |
| desc | code | Rprices | Rvolumes | Rprices | Rvolumes | Rprices | Rvolumes | Rprices | Rvolumes | Rprices | Rvolumes | Rprices | Rvolumes |
| TOTAL INDUSTRIES | TOT | | | | | | | | | | | | |
| AGRICULTURE, HUNTI | AtB | | | | | | | | | | | | |
| AGRICULTURE, HUNTI | A | | | | | | | | | | | | |
| Agriculture | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 |
| Forestry | 2 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 |
| FISHING | B | 1 | 0 | 2 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 0 |
| MINING AND QUARRY | C | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 |
| MINING AND QUARRY | 10t12 | | | | | | | | | | | | |
| Mining of coal and lign | 10 | | | | | | | | | | | | |
| Extraction of crude pet | 11 | | | | | | | | | | | | |
| Mining of uranium anc | 12 | | | | | | | | | | | | |
| MINING AND QUARRY | 13t14 | | | | | | | | | | | | |
| Mining of metal ores | 13 | | | | | | | | | | | | |
| Other mining and quar | 14 | | | | | | | | | | | | |
| TOTAL MANUFACTURI | D | | | | | | | | | | | | |
| FOOD , BEVERAGES AN | 15t16 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 0 | |
| Food and beverages | 15 | | | | | | | | | | | | |
| Tobacco | 16 | | | | | | | | | | | | |
| TEXTILES, TEXTILE , | LE/17t19 | | | | | | | | | | | | |
| Textiles and textile | 17t18 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 2 | 1 | |
| Textiles | 17 | | | | | | | | | | | | |
| Wearing Apparel, Dres | 18 | | | | | | | | | | | | |
| Leather, leather and fc | 19 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 2 | 1 | |
| WOOD AND OF WOOD | 20 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| PULP, PAPER, PAPER , | 21t22 | | | | | | | | | | | | |
| Pulp, paper and paper | 21 | 1 | 1 | 1 | 1 | 1 | 0 | 2 | 1 | 1 | 1 | 1 | |
| Printing, publishing an | 22 | 1 | 0 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | |
| Publishing | 22t | | | | | | | | | | | | |
| Printing and reproduct | 22x | | | | | | | | | | | | |
| CHEMICAL, RUBBER, P | 23t25 | | | | | | | | | | | | |
| Coke, refined petroleu | 23 | | | | | | | | | | | | |
| Chemicals and chemi | 24 | 0 | 1 | 1 | 1 | 0 | 2 | 0 | 2 | 1 | 1 | 1 | |
| Pharmaceuticals | 24t | | | | | | | | | | | | |
| Chemicals excluding pl | 24x | | | | | | | | | | | | |
| Rubber and plastics | 25 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | |
| OTHER NON-METALLIC | 26 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| BASIC METALS AND FA | 27t28 | | | | | | | | | | | | |
| Basic metals | 27 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | |
| Fabricated metal | 28 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | |
| MACHINERY, NEC | 29 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | |
| ELECTRICAL AND OPTI | 30t33 | | | | | | | | | | | | |
| Office, accounting and | 30 | 0 | 2 | 1 | 0 | 0 | 2 | 0 | 1 | 0 | 2 | 1 | 2 |
| Electrical engineering | 31t32 | | | | | | | | | | | | |
| Electrical machinery ar | 31 | 1 | 1 | 1 | 0 | 0 | 2 | 0 | 2 | 1 | 1 | 1 | 1 |
| Insulated wire | 31x | | | | | | | | | | | | |
| Other electrical machi | 31x | | | | | | | | | | | | |
| Radio, television and c | 32 | 0 | 1 | 0 | 1 | 0 | 2 | 0 | 2 | 0 | 0 | 2 | |
| Electronic valves and t | 32t | | | | | | | | | | | | |
| Telecommunication ec | 32t | | | | | | | | | | | | |
| Radio and television re | 32t | | | | | | | | | | | | |
| Medical, precision and | 33 | 1 | 1 | 1 | 0 | 0 | 2 | 0 | 1 | 1 | 1 | 1 | |
| Scientific instruments | 33t3 | | | | | | | | | | | | |
| Other instruments | 33t4t | | | | | | | | | | | | |
| TRANSPORT EQUIPME | 34t35 | | | | | | | | | | | | |
| Motor vehicles, trailer | 34 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 2 |
| Other transport equip | 35 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 2 | 1 |
| Building and repairing | 35t | | | | | | | | | | | | |
| Aircraft and spacecraft | 35t | | | | | | | | | | | | |
| Railroad equipment an | 35x | | | | | | | | | | | | |
| MANUFACTURING NEC | 36t37 | 2 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 2 | 1 | |
| Manufacturing nec | 36 | | | | | | | | | | | | |
| Recycling | 37 | | | | | | | | | | | | |
| ELECTRICITY, GAS AN | E | 1 | 1 | 0 | 2 | 1 | 1 | 2 | 1 | 1 | 1 | 2 | 1 |
| ELECTRICITY AND GAS | 40 | | | | | | | | | | | | |
| Electricity supply | 40x | | | | | | | | | | | | |
| Gas supply | 40t | | | | | | | | | | | | |
| WATER SUPPLY | 41 | | | | | | | | | | | | |
| CONSTRUCTION | F | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 |
| WHOLESALE AND RET/G | | | | | | | | | | | | | |
| Sale, maintenance and | 50 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | |
| Wholesale trade and c | 51 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| Retail trade, except of | 52 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| HOTELS AND RESTAURH | | 2 | 1 | 1 | 1 | 2 | 1 | 2 | 1 | 1 | 2 | 1 | |
| TRANSPORT AND STOF | I | | | | | | | | | | | | |
| TRANSPORT AND STOF | 60t63 | | | | | | | | | | | | |
| Other Inland transport | 60 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 2 | 1 | 1 | 1 | 1 |
| Other Water transport | 61 | 0 | 2 | 1 | 2 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| Other Air transport | 62 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 2 | 1 | 1 |
| Other Supporting and | 63 | 1 | 2 | 0 | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 2 |
| POST AND TELECOMM | 64 | 0 | 1 | 0 | 2 | 0 | 1 | 1 | 2 | 1 | 2 | 1 | 2 |
| FINANCE, INSURANCE, JK | | | | | | | | | | | | | |
| FINANCIAL INTERMEDIJ | | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 0 | 2 | |
| Financial intermediatic | 65 | | | | | | | | | | | | |
| Insurance and pension | 66 | | | | | | | | | | | | |
| Activities related to fin | 67 | | | | | | | | | | | | |
| REAL ESTATE, RENTINCK | | | | | | | | | | | | | |
| Real estate activities | 70 | | | | | | | | | | | | |
| Renting of m&eq and c | 71t74 | | | | | | | | | | | | |
| Renting of machinery | 71 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 2 | 1 | 2 |
| Computer and related | 72 | 2 | 2 | 0 | 2 | 2 | 1 | 1 | 2 | 1 | 2 | 2 | 2 |
| Research and develop | 73 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Other business activiti | 74 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1 |
| Legal, technical and ad | 74t4 | | | | | | | | | | | | |
| Other business activiti | 74t8 | | | | | | | | | | | | |
| COMMUNITY SOCIAL / LtQ | | 1 | 1 | 2 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1 |
| PUBLIC ADMIN AND D L | | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 |
| EDUCATION | M | 1 | 1 | 2 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1 |
| HEALTH AND SOCIAL VN | | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 |
| OTHER COMMUNITY, 'O | | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 2 | 0 | 2 | 1 |
| Sewage and refuse dis | 90 | | | | | | | | | | | | |
| Activities of members | 91 | | | | | | | | | | | | |
| Recreational, cultural | 92 | | | | | | | | | | | | |

| | SPAIN | SWEDEN | | UNITED KINGDOM | | KOREA | USA | | | | |
|---------------------------|----------|-----------------|----------|----------------|----------|----------|----------|----------|----------|----------|----------|
| Aggr price change | 0,081165 | 0,02742 | 0,057732 | 0,020516 | 0,066172 | 0,020811 | 0,084779 | 0,075968 | 0,039776 | 0,028908 | |
| SD of sector price change | 0,016736 | 0,019567 | 0,023312 | 0,026516 | 0,016287 | 0,024044 | 0,027863 | 0,051052 | 0,058817 | 0,061285 | |
| desc | code | Rprices | Rvolumes | Rprices | Rvolumes | Rprices | Rvolumes | Rprices | Rvolumes | Rprices | Rvolumes |
| TOTAL INDUSTRIES | TOT | | | | | | | | | | |
| AGRICULTURE, HUNTI | AtB | | | | | | | | | | |
| AGRICULTURE, HUNTI | A | | | | | | | | | | |
| Agriculture | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 |
| Forestry | 2 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 |
| FISHING | B | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 |
| MINING AND QUARRY | C | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 |
| MINING AND QUARRY | 10t12 | | | | | | | | | | |
| Mining of coal and lign | 10 | | | | | | | | | | |
| Extraction of crude pet | 11 | | | | | | | | | | |
| Mining of uranium anc | 12 | | | | | | | | | | |
| MINING AND QUARRY | 13t14 | | | | | | | | | | |
| Mining of metal ores | 13 | | | | | | | | | | |
| Other mining and quar | 14 | | | | | | | | | | |
| TOTAL MANUFACTURI | D | | | | | | | | | | |
| FOOD , BEVERAGES AN | 15t16 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Food and beverages | 15 | | | | | | | | | | |
| Tobacco | 16 | | | | | | | | | | |
| TEXTILES, TEXTILE , | LE/17t19 | | | | | | | | | | |
| Textiles and textile | 17t18 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 |
| Textiles | 17 | | | | | | | | | | |
| Wearing Apparel, Dres | 18 | | | | | | | | | | |
| Leather, leather and fc | 19 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 0 |
| WOOD AND OF WOOD | 20 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| PULP, PAPER, PAPER , | 21t22 | | | | | | | | | | |
| Pulp, paper and paper | 21 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 |
| Printing, publishing an | 22 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Publishing | 221 | | | | | | | | | | |
| Printing and reproduct | 22x | | | | | | | | | | |
| CHEMICAL, RUBBER, P | 23t25 | | | | | | | | | | |
| Coke, refined petroleu | 23 | | | | | | | | | | |
| Chemicals and chemica | 24 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 2 | 1 | 1 |
| Pharmaceuticals | 244 | | | | | | | | | | |
| Chemicals excluding pl | 24x | | | | | | | | | | |
| Rubber and plastics | 25 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| OTHER NON-METALLIC | 26 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| BASIC METALS AND FA | 27t28 | | | | | | | | | | |
| Basic metals | 27 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 2 | 1 | 1 |
| Fabricated metal | 28 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| MACHINERY, NEC | 29 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 2 | 1 | 1 |
| ELECTRICAL AND OPTI | 30t33 | | | | | | | | | | |
| Office, accounting and | 30 | 1 | 2 | 0 | 1 | 0 | 2 | 0 | 2 | 0 | 2 |
| Electrical engineering | 31t32 | | | | | | | | | | |
| Electrical machinery ar | 31 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 2 | 1 | 1 |
| Insulated wire | 313 | | | | | | | | | | |
| Other electrical machi | 31x | | | | | | | | | | |
| Radio, television and c | 32 | 0 | 1 | 0 | 2 | 0 | 1 | 0 | 2 | 1 | 1 |
| Electronic valves and t | 321 | | | | | | | | | | |
| Telecommunication ec | 322 | | | | | | | | | | |
| Radio and television re | 323 | | | | | | | | | | |
| Medical, precision and | 33 | 1 | 2 | 1 | 1 | 0 | 1 | 0 | 2 | 1 | 1 |
| Scientific instruments | 331t3 | | | | | | | | | | |
| Other instruments | 334t5 | | | | | | | | | | |
| TRANSPORT EQUIPME | 34t35 | | | | | | | | | | |
| Motor vehicles, trailer | 34 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 2 | 1 | 1 |
| Other transport equip | 35 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Building and repairing | 351 | | | | | | | | | | |
| Aircraft and spacecraft | 353 | | | | | | | | | | |
| Railroad equipment an | 35x | | | | | | | | | | |
| MANUFACTURING NEC | 36t37 | 1 | 1 | 0 | 1 | 2 | 0 | 2 | 1 | 1 | 1 |
| Manufacturing nec | 36 | | | | | | | | | | |
| Recycling | 37 | | | | | | | | | | |
| ELECTRICITY, GAS AN | E | 1 | 2 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 |
| ELECTRICITY AND GAS | 40 | | | | | | | | | | |
| Electricity supply | 40x | | | | | | | | | | |
| Gas supply | 402 | | | | | | | | | | |
| WATER SUPPLY | 41 | | | | | | | | | | |
| CONSTRUCTION | F | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| WHOLESALE AND RET/G | | | | | | | | | | | |
| Sale, maintenance and | 50 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Wholesale trade and c | 51 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Retail trade, except of | 52 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| HOTELS AND RESTAURH | | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1 |
| TRANSPORT AND STOF | | | | | | | | | | | |
| TRANSPORT AND STOF | 60t63 | | | | | | | | | | |
| Other Inland transport | 60 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Other Water transport | 61 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Other Air transport | 62 | 0 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Other Supporting and | 63 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 |
| POST AND TELECOMM | 64 | 1 | 2 | 0 | 1 | 0 | 2 | 0 | 2 | 1 | 1 |
| FINANCE, INSURANCE, IJK | | | | | | | | | | | |
| FINANCIAL INTERMEDIJ | | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 |
| Financial intermediatic | 65 | | | | | | | | | | |
| Insurance and pension | 66 | | | | | | | | | | |
| Activities related to fin | 67 | | | | | | | | | | |
| REAL ESTATE, RENTINCK | | | | | | | | | | | |
| Real estate activities | 70 | | | | | | | | | | |
| Renting of m&eq and c | 71t74 | | | | | | | | | | |
| Renting of machinery | 71 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 |
| Computer and related | 72 | 1 | 2 | 2 | 1 | 1 | 2 | 1 | 2 | 1 | 2 |
| Research and develop | 73 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Other business activiti | 74 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 1 | 1 |
| Legal, technical and ad | 74t4 | | | | | | | | | | |
| Other business activiti | 74t8 | | | | | | | | | | |
| COMMUNITY SOCIAL / LtQ | | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 |
| PUBLIC ADMIN AND D L | | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 |
| EDUCATION | M | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 |
| HEALTH AND SOCIAL VN | | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 |
| OTHER COMMUNITY, SO | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Sewage and refuse dis | 90 | | | | | | | | | | |
| Activities of members | 91 | | | | | | | | | | |
| Recreational, cultural | 92 | | | | | | | | | | |