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Speed of Change and Growth of Manufacturing

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Chapter 4 of the Study
Structural Change and Economic Growth;
Reconsidering the Austrian "Old-Structures/High-Performance" Paradox

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The complete study (either the english long version or the german short version) is available at the Austrian Institute of Economic Research (WIFO) Tel. +43 1 798 26 01 – 282.

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Summary

This paper investigates the interrelation between economic dynamics and the structural change of production. We survey theoretical arguments why growth depends on structural change and how growth induces structural change. We then investigate whether the speed of structural change in manufacturing is empirically related to growth of manufacturing in the member countries of the European Union, and in the partners in the triad. This underlines the sectoral composition and its importance for economic growth, thus complementing the other projects organised within the OECD Growth Project. The empirical data support the idea that growth and speed of change are related. Most of the indicators of structural change are significantly related to growth. The correlations seem to increase over time; the fit is much closer for the most recent years than for the total period. Changing export structures are at least as closely connected with growth as changes in value added, indicating that changing structures may be specifically important for external competitiveness and for open economies. If we want to determine the direction of causality, we find evidence that growth depends on past structural change more closely than the other way round.

1. Introduction

This paper investigates the interrelation between economic dynamics and the structural change of production. The importance of structural change, flexibility, and a quick reaction to new challenges facing growth, welfare and competitiveness seems to be a foregone conclusion explicitly or implicitly present in the statements of politicians, managers and experts and often, of such organisations as the OECD, the European Commission, the World Economic Forum, Lehman Brothers, etc. Economics presents several arguments explaining not only why growth will be easier to achieve if structures do change, but also why structures have to change if incomes change. This two-way causality prevents the falsification (and of course also the scientific support) of the hypothesis, since tests for significance become very difficult under these circumstances. The result is that the relation between structural change and growth seems to be under-researched relative to its alleged importance. One indication of this is that from the large number of studies conducted for the OECD Growth Project, very few relate to structural changes and their impact on growth.

This paper summarises theoretical hypotheses about the relation between structural dynamics and growth (Section 2), provides a very short overview about the empirical work in these fields (Section 3) and provides references to related fields, such as the dynamics of specialisation and regional concentration. We present the data, and choose indicators for growth and for structural change in Section 4. We investigate in the next section the closeness of the correlation between the speed of change of industry structure within manufacturing and the growth of manufacturing in 14 EU countries, in the USA and in Japan. We report which countries are the driving force in the existing positive relation and which countries do not follow the trend, how the speed of change evolved over time, and which differences between Europe, the USA and Japan are evident. We then investigate in Section 6, whether the direction of change into high/low growing sectors, high/low productivity sectors is important. Next we try to find tentative evidence of which way the causality is stronger: from growth to change or from change to growth. Finally, we run a regression and a panel estimate to show at least partially how growth is related to change and to the specialisation of countries at the beginning of the observation period (1985). The ultimate objective of the chapter is not to prove or falsify a specific hypothesis, but to learn more about the speed and direction of change, about country differences and their relation to growth.

2. Theoretical considerations regarding structural change and growth

That there is a connection between structural change and growth has been common knowledge in economics for a very long time. The channels, which relate the two phenomena, are diverse, and the direction of causality (whether growth promotes change or whether change is necessary for growth) is an open question.

The three sector hypothesis

The empirical regularity according to which growth in per capita income fosters structural change is one of the messages of the Three-Sector Hypothesis (Fourastier, 1954, Clark 1957). It reads that the share of the primary sector decreases with rising income, that the secondary sector (manufacturing, construction and utilities in today's language) first wins, but then in later stages of development loses shares in total production and demand, and that the service sector continuously grows and finally takes the lion's share of production. The hypothesis was extended towards a fourth sector – which, as early as the seventies, was labeled the information sector (Bell, Schmoranz: empirical studies aggregated teachers, administrations, postal services etc.). Today, we would relate the information sector primarily to the use of computers, electronic devices and telecom and define an information and communication technology sector (ICT). A large and rising share of these sectors is said to increase productivity and growth, and is one of the constituent features of the "New Economy Paradigm".

Income elasticities change the shares of individual industries

The hypotheses that rising per capita income drives changes in production and demand was transferred to changes w i t h i n the manufacturing sector. The structural changes within manufacturing stem from differences in the income elasticities of product groups: it is widely accepted as an empirical fact that demand e.g. for food, lodging, and textiles increases under-proportionally relative to total income, while demand for durable consumer goods, electronic goods, and leisure related luxury goods increases faster than total income.

Capital deepening, product innovation and the ability to shift demand

Complementarily to demand induced change, supply forces may lead to systematic changes in production structures. The substitution of labour by capital in production (capital deepening) leads to increasing shares of capital goods. First the share of machinery increases, then that of electrical machinery and finally electronic equipment and computers (OECD, 2000). Furthermore, due to capital deepening and technical progress, material inputs and natural resources can be implemented with greater efficiency, thus leading to decreasing shares of basic and resource related goods, like ores and steel, non ferrous metals, basic chemicals etc. Capital intensive homogenous inputs therefore lose shares as incomes rise, while industries which constantly increase demand specificity, such as special purpose machinery, electronic equipment, or innovative consumer products, increase their shares.

Older theories would call this product innovation, modern industrial organisation stresses that there are industries in which market size is exogenously defined, while other industries can shift demand curves by means of product innovation, product differentiation and advertising. The latter industries are labeled endogenous sunk cost industries, since there is no technically fixed capital input defined by capacity needs, but rather, the amount of intangible investment is derived from optimisation. See Sutton (1991) for the main theoretical contribution, the European Commission (1998, 1999) and Peneder (2001) for the implementation of this idea into taxonomy.

Summing up, this implies that technical progress and active strategies of firms can change structures even for a given income. The first channel was already stressed by Fourastier: the higher potential for productivity growth in manufacturing decreased the share of manufacturing at the expense of the service sector at least when sector shares were measured in nominal terms: even if manufacturing goods and service goods were constant in real demand, the share of manufacturing would decline if prices decrease; the share of employment in manufacturing could decrease due to higher productivity growth. Higher productivity would however – via declining prices – boost demand for a given income, a feature intensively studied in computer technology. A constant race between lower prices and the addition of new features and characteristics makes it difficult to measure sector shares. The second channel means that there are some industries, which face a demand curve depending on income and endowments, while other industries can use innovation and

marketing to shift the demand curve. It is likely that the second group will win shares over time, and this is consistent with empirical findings.

A positive theory of structure

A specific slant of the hypothesis that structure is influenced by rising income is given if we switch from the analytic level to the normative. If each income level implies a specific industry structure, we can calculate a hypothetical income dependent "norm structure" (Görgens, 1975). The expectation is that countries, which exhibit this norm structure, may grow faster, while countries whose structures deviate from the norm will grow more slowly. The policy implication is that impediments to structural change are detrimental to growth. This simple "single variable norm structure" hypotheses was then extended insofar as the norm was defined more elaborately: country specific material resources were allowed to be used as additional determinants of the "optimal" structure; skills and research potential were included.

Links to trade theories

An extended "norm theory" provides a bridge between the norm structure and an endowment based explanation of structure. If all endowments are taken into account, and if the technological position is considered, this becomes a dynamic corollary of trade theories. Of course, extended norm theories have a normative notion and relate to growth explanations, while Ricardo, Heckscher-Ohlin or technology oriented trade theory focus on trade patterns in a general equilibrium framework. However, there is some literature in trade theory, which is less formal and assumes a link between certain types of specialisation and growth. Kaldor (1981), Thirwall (1979), Fagerberg (1988), and Amable (1993, 2000) argue that some patterns of international specialisation, associated with high-income elasticities for exports, are more favourable for growth. Sometimes, a second stream of consequences is added, if higher demand then induces technological change and productivity improvements, which in turn foster growth through a mechanism of cumulative causation (Amable, 2000, p .413).

The upshot of this is that structures change and probably should change with rising income and changing endowments (analytical version); and that countries with optimal structures – defined by resources and income – may attain the "highest possible growth" (normative

version). Countries lacking in adjustment would suffer a growth penalty, as would countries with too rapid change (premature change, senility effects).

The other direction: rigidities may impede growth

The three sector hypothesis and the norm structure hypothesis specifically, and in general all hypotheses which stress changes in demand and in endowments relative to income per capita, imply that the causality runs from growth to changing structures. During periods of slow growth, the idea emerges that structures changed too slowly. This was the case in Germany, as growth decelerated during the sixties, following the extraordinary post war growth; in the United Kingdom, as it deplored its industrial decline; and in the USA, as it complained that it was losing competitiveness with respect to the Japanese during the late eighties. This diagnosis returned in the nineties, as Europe also experienced a period of slow growth compared to its performance over the past decades, as well as compared to the USA. It was believed that political or institutional factors prevented adequate change; specifically, it was said that the labour market was not flexible enough; product market distortions were added (OECD Job Markets Study, OECD indicators on labour and product market regulation).

The diagnosis of inadequate speed of structural change leads to two different strands of policy conclusions. One strand has to do with increasing government interference, for example by defining the industrial sectors in which investment and research should be concentrated. Variants of this were the French sectoral planning system, the German "Strukturpolitik", the English "Industrial Policy", the Japanese "structural targeting" or other systems of picking the winners. This strand dominated – with variations according to the country involved – in the late sixties and early seventies. The opposite strategy was followed during the eighties, namely one of eliminating rigidities and blockades to structural change, through liberalisation, privatisation and abandoning wage and job rigidities. Strategies designed to increase flexibility and liberalisation support structural change by decreasing government interference.

The burden of change

There is, however, also a strand of literature, which stresses that changes can be too fast. It stresses the burden of change on infrastructure, firms and people. On the one hand, it has to do with sociology or political science, which stress the social costs to specific groups. But it also is related to the integration literature and economic geography. It was expected that the

Single Market would lead to fundamental changes in industry structure, which could imply drastic changes, combined with high costs of adjustment and the fear that regions on the periphery might de-industrialise. This gloomy forecast was extended to a globalising world, in which large differences in wages were thought to endanger many low cost industries in developed countries. This implies high costs of adjustment specifically to less qualified and less mobile workers in the developed countries and probably lower wages. Some studies stress that the necessity to change from one industry to another (inter industry change) infers larger adjustment costs, than intra industry change. The latter was intensively measured by indicators of intra industry trade. Structural and regional programs initiated by the EU were designed on the one hand to decrease the burden of sudden change on less developed regions; and secondly, to provide infrastructure and skills, enabling the necessary specialisation into products for which these regions had comparative advantages. But the upgrading of infrastructure and of skills takes time, so that the speed of change is sometimes too fast.

Restructuring and cycles

Schumpeter (1934, 1942) links the performance of countries to the degree that the industry structure uses scarce resources most effectively, opening the debate on how industrial economics defines the optimal structure. Part of the literature stresses optimal size structure, with the one extreme being that progressive industries are dominated by economies of scale and that monopoly rents are necessary for stimulating research and innovation. The other extreme view is that any deviation from marginal cost pricing constitutes inefficiency and social loss. The literature on size and innovation represents one outcome, the discussion on the efficiency and profitability of mergers, on the emergence of multinationals and product differentiation is another.

An antithesis to the hypothesis that growth fosters change, is the hypothesis that crises are necessary for fundamental changes. This hypothesis was previously the general presumption of standard business cycle hypotheses (the virtue of crisis), but is also present in many case studies of the turnarounds of firms and technological breakthroughs. Examples of such economic policy are available for the Netherlands, which developed a consensual tri-party model for decision making (government, trade unions, and industrialists), favouring low costs and flexible labour, following a crisis in international competitiveness (Polder model); or

Finland and Sweden, which managed the switch from resource based structures to telecom in the midst of a severe budget and currency crisis during the nineties.

Shift and share analysis

A pragmatic strand of literature relating structural change to growth is the exercise, which decomposes growth into "shift and share" components. Constant Market Shares Analyses (CMA) decompose export growth into market growth, the impact of structure and of structural change, and increases in the market shares of a country or firm (within industry performance). Other studies decompose productivity increases into increases of the "within" and "between" types. One recent variant is to calculate the impact of the information and communication technologies on growth and productivity.

Higher specialisation and growth

Another question deals with the relation between specialisation and growth. Most economists will agree that specialisation is the basis for high-income levels and productivity. And probably most will translate this idea in principle to the country level and to dynamics. This would imply that countries which are more specialised will grow faster. However, in general, there are advantages as well as disadvantages to specialisation. They can be grouped into an efficiency effect, a risk effect and a dynamic effect. At the firm level, a specialised firm is supposed to be able to exploit economies of scale, to reap the effects of learning, and to use specialised inputs etc. (efficiency increases). On the other hand, risks increase for less diversified firms (risk effect) and thirdly, specialisation can be disadvantageous, if the firm is locked in a mature, declining industry. Both effects translate to the regional and national levels. Countries with more specialised industries can enjoy higher productivity if the specialisation occurs in dynamic markets; countries specialised in low wage industries, in mature industries or in industries with a low potential for product differentiation will not be able to grow fast (dynamic effect). Countries enjoy benefits from increasing specialisation, if they have specific endowments, which can be exploited, and if their primary industries produce under the condition of significant economies of scale. The geographic concentration of industries increases competitiveness if significant spillovers exist, or if there is cost savings through the supply of industry specific inputs or a complementary service sector.

The risk effect at the macro level has become a major policy issue as Europe is turning into a Monetary Union. This issue is discussed in the literature dealing with the optimal regional extension of areas with a common currency. If the member countries of a Monetary Union are too highly specialised in narrow product markets, then external shocks will lead to asymmetries in demand, which can no longer be dampened by changes in the external value of currencies. The flexibility of the labour market must be increased, in order to prevent persistent differences in demand. If countries are specialised in different industries, it is advantageous for the specialisation to be in unrelated industries (diversified production).

3. Empirical work so far

There is surprisingly little recent empirical work available on the relation between speed of change and the structure of manufacturing and growth. Most of the empirical studies date from the sixties. Recent studies related to the topic investigate the specialisation of countries and the regional concentration of industries. If these studies focus on the dynamics of specialisation, they implicitly analyse changes in the structure. Relating "changes in specialisation" to manufacturing growth then more closely approaches our question. Another related field has to do with studies of the entries and exits of firms, labour churning, growth and mobility. These studies are usually performed at the firm level.

Structural change and growth

Dorner (1964) investigates the relation between structural change and growth for ten countries and nine industrial sectors and finds a weak statistical relation. Görgens (1985) uses more disaggregated data and reports a statistically significant influence of inter-industry change on manufacturing growth, as well as on the economy as a whole.

Bombach (1959) and Mertens (1964) investigate the influence of changes in industry structure on productivity. In these studies, the effect of shifts from agriculture to manufacturing and then from manufacturing to services is investigated. For a survey of other studies examining the sectoral composition of production and productivity see Görgens (1985). In trade analysis, "shift and share analyses" are applied to estimate the influence of structure on the dynamics of exports (CMS-analyses; for an overview see Breuss, 1986). Similarly, investigations are made in regional studies, explaining growth differences according to either structure, structural

change or "within dynamics". Austria is revealed to be specialised in slow growing regional and product markets, and in industries for which prices define the competitive edge; however it is able to increase its overall market share by increasing market shares and upgrading quality within given industries (Aiginger, 1999, 2000).

The role of dynamics and specialisation

Another group of studies investigates specialisation in industries which are considered to be important for future growth, specifically in high tech industries (OECD, 2000), in technology and marketing driven industries (Peneder, 2000), or in information and communication technology (Amable, 2000). In general, the empirical studies prove that a high share of "promising industries" supports growth, but the contribution of structure to growth remains weak. Many intervening variables exist and the problem of two-way causality is also present in this relation. If we switch to the question whether growth is related to the degree of specialisation, the null hypothesis is that higher specialisation should imply higher productivity. Aiginger (1999, p. 119) finds no general support for the growth of manufacturing, neither exports nor employment depend on the degrees of specialisation.

However, we do have the following stylised facts:

- At the industry level, growth in extra trade relates significantly positively to specialisation, a weak indication that a strong base is needed for global expansion, or that a minimum scale is necessary to defend export capacity in a toughening environment. The correlation is much weaker for intra trade and for total trade, and there is no relation between change in the degree of specialisation and export growth. The results are replicated weakly at the sectoral level.

- The second significant result is that more highly specialised countries have smaller productivity gaps compared to the USA. This result can be attributed to the high productivity and high specialisation in Ireland, and to the combination of low specialisation and large productivity gaps (relative to the USA) for Italy, Spain, Portugal and the United Kingdom. The results are significant at the sectoral and industrial levels.

- Thirdly, the increase in specialisation is negatively correlated with employment growth, implying that restructuring and repositioning decrease employment at least over the short

run. This is well in line with evidence that firms, which are merging and/or restructuring, streamline production and reduce employment first, thus becoming more competitive.

These results, and the many correlations, which did not show any significant relations, indicate the importance, as well as the complexity, of the link between structural changes and competitiveness. The data underline the fact that adapting to new conditions and rapidly making use of new opportunities and challenges increase the growth potential. Exploiting new opportunities always requires changes, which sometimes lead in the direction of specialisation and concentration, and sometimes make use of a firm's own capabilities to extend operations into other countries. This is consistent with the stylised fact that growth and speed of structural change correlate more closely than growth and specialisation. The lower productivity gap of more specialised countries relative to the USA, and the correlation between extra-export growth and specialisation, are consistent with larger economies of scale for exports into distant countries and with the role of multinational firms in technology transfers. Laursen (2000) emphasises that specialisation does indeed matter with respect to economic growth, showing that sectoral growth rates depend on intra sectoral specialisation patterns of international trade.

Reallocation, microevidence

Haltiwanger's (2000) summary of the recent empirical literature exploring micro datasets for a look at questions of aggregate growth, is "that reallocation does contribute significantly to aggregate productivity growth. For the US manufacturing sector, roughly half of total productivity growth can be accounted for by the reallocation of input and output away from less productive to more productive businesses". He warns, however, that it would also be wrong to always claim that a faster pace of reallocation has to be a signal of greater efficiency or that one would predict a monotonic relationship between the pace of reallocation and growth. Caballero and Hammour (2000) claim that the magnitude and timing of reallocation may be inefficient. Thus, while the evidence suggests that reallocation does contribute positively to growth, there can also be too many micro changes, and there can be inefficiencies in the pace and timing of reallocation.

4. The design of the empirical evidence

For the empirical implementation, we have to decide how we will measure growth and the speed of structural change, and whether we want to test a specific theory or primarily look for stylised facts.

Growth indicators

We focus on the growth of manufacturing, since the data permit us to disaggregate for 23 sectors (2-digit NACE) and 99 industries (3-digit NACE). We calculate growth for three variables: nominal and real value added, and employment. Of these variables, the growth of nominal value added is our favourite indicator, firstly since it includes quality changes, and secondly, because the calculation of nominal data is not flawed by differences in adjustment methods for inflation. In general, the measurement of inflation is different for a sector with continuously changing products, and this problem grows with the degree of disaggregation. Quality changes are treated differently in different countries and in different industries. Thirdly, value added (as compared to employment) is preferred, since it is an output indicator reflecting demand and productivity. However, nominal growth has disadvantages too: growth may be high, if inflation is large; and nominal growth may be low, if a country experiences a devaluation. This disadvantage becomes smaller, the more highly disaggregated the data are, and a common trend of inflation is canceling out in shares.

The robustness of the estimates calculated by using nominal value added is checked according to the other indicators. In one experiment, we construct a superindicator of growth, which combines information on nominal and real growth and the dynamics of employment.

Indicator of the speed of change

As an indicator of the speed of change, we choose the absolute sum of all changes in value added shares for a specific country. That means - since we have data from 1985 to 1998 - that the indicator of the speed of change is the sum of all available changes in industry shares between the first year (1985) and the last year (1998); each difference in shares is counted, whether or not it is positive or negative. The advantages and disadvantages of this indicator are summarised in Box 1. It is heavily used in the literature, and is sometimes called the Michaeli index. An intuitive reaction – although it is not done here – is to divide it into 2; in

this case, it could be interpreted as an "average share of changes". In our case, the index lies between zero and 200.

Having chosen nominal value added as a favourite growth variable, we measure the speed of change consequently by adding up the changes in the structure of nominal value added. This can be done at the 2-digit level (adding changes in the shares of sectors only) or at the 3-digit level (adding changes in the shares of industries). In tests of robustness, the speed of change is, however, also calculated for total exports, intra exports, extra exports and employment. Five indicators of change, plus two levels of aggregation, result in 10 correlations as a first indication of the concordance of these variables. Furthermore, we calculate a superindicator of growth, by calculating an unweighted average of the growth indicators and of the speed of change indicators. This has disadvantages from the standpoint of economic interpretation, but helps to cancel out measurement problems connected with the individual indicators.

Measuring the speed of change

As is usual for complex processes, the speed of change of an economy is difficult to measure by simple indicators.

We calculate the indicator for the speed of change in two steps: first, we calculate differences between the share of an industry i in total manufacturing over a time period starting in year (t-n) and ending in the final year (t). Then we sum over the industries. Each change for an industry share contributes to this indicator, independent of its direction (plus or minus) and independent of whether it originates from mature or dynamic industries. The variable used is nominal value added, the shares are calculated as part of a sector (2 digit) or industry (3 digit) from total manufacturing.
The shortcomings of this indicator should be kept in mind. Several problems relate to statistical issues, others to the economic content or to its interpretation.

Speed of Change = $\Sigma i \mid a\ i\ ,\ t - a\ i,\ t\text{-}n \mid$, where a i, t , a i, t-n shares in final year, starting year for industry i

Statistical caveats:

- Adding up absolute changes in shares without regard to the size of the sectors, and the degree of disaggregation. It is recommended to compare countries only for identically classified sectors, and to limit the comparison if the sectors have extremely different structures in the beginning (e.g. highly concentrated versus highly dispersed structures). It recommends not focusing too much on the contribution of a large vs. a small industry to total change.
- Stochastic elements and errors in the variables further contribute to a potential bias. Large countries will exhibit a lower value for this indicator than smaller countries, since for larger countries, a stochastic influence such as the entry or exit of a firm of given size will result in a smaller change in shares. Growing countries will tend to have stochastically somewhat larger changes than countries of stagnating size.
- Economic caveats

- Changes in the shares of an industry can originate for different reasons and are of varying importance to long run competitiveness. Changes due to the loss of a firm's competitiveness in a mature industry will have a different impact, than changes, which evolve when firms switch into dynamic, innovative industries. We therefore distinguish in Section 6 between positive and negative, or active and passive changes, for example by looking at whether the shares of a country increase in industries with high growth (high productivity, strong productivity growth) or in less attractive industries.
- Adaptability is a complex process, in which the speed of change of shares can highlight only one aspect. A more comprehensive picture would need an investigation of the entry and exit process, and of the financing of small, risky, fast-growing firms. Ideally even the nature of the change in the environment – to which adaptation seems desirable – and its causes should be investigated.

Finally, any proof or hint that speed of change and competitiveness or growth are interrelated – be it suggested by graphs or by correlations and regressions – involves many complications. The main problem is that of causality, since we expect that growth needs adaptability, but measured speed of change is also higher if growth accelerates (two way causality). With all these reservations in mind, we can use this as an indicator of an important economic characteristic.

Character of evidence searched for

Having screened the literature, we see no challenging operational hypothesis, which predicts a stable uni-directional impact of growth and structural change. Growth induces changes in structure, for example via income elasticities, but on the other hand, a change in the production structure is a precondition or at least an accelerator for growth. We therefore try to find stylised facts, which confirm the closeness of the relation, differences in the speed of change across countries, and the direction of change. We then show that of the two streams of causality – whether growth depends on past change or whether growth promotes future changes – the first tends to be stronger. Technically, this allows us to include more than one variable into a regression of growth on speed of change and opens the possibility of panel analyses.

5. Evidence of the concordance and its country and time patterns

The overall result

Table 1 shows the correlation between six indicators of growth and five measures of the speed of change in structure (plus one summary relation). The overall result is that all correlations are positive and all but 9 of 31 in Table 1 are significant at least at the 90 % level. If we start with the nominal value added we see that it has the closest relation to speed of change in exports, and to both of its components - intra and extra exports. The correlation is rather close, with speed of change in employment at the 3-digit level. Nominal growth and the speed of change of value added are positively related but not significant. There is no definite hierarchy depicting whether real or nominal growth is more closely related to change, nor whether 2- or 3-digit indicators of change are more closely related to growth.

Table 1: Correlation between growth and speed of change

Growth		Speed of change: Nominal value added	Employment	Total exports	Extra exports	Intra exports	Super-indicator
Nominal value added							
	2 digit	0.3924	0.4057	0.5212**	0.5393**	0.5680**	
	3 digit	0.2873	0.4190*	0.4721*	0.6130**	0.5588**	
Real value added							
	2 digit	0.4007	0.7209**	0.6696**	0.6886**	0.7056**	
	3 digit	0.2787	0.4836**	0.6420***	0.5918**	0.7005**	
Employment							
		0.7314	0.5130	0.2452			
	2 digit	0.0741	0.3465	0.4722*	0.4885*	0.5888**	
	3 digit	0.0480	0.3242	0.4445*	0.4539*	0.5825**	
Superindicator							0.5336**

*, **, *** denote significance at 90%, 95%, 99%.

Source: EUROSTAT (NEW CRONOS), COMEXT, WIFO calculations.

Country pattern behind

The correlations are partly driven by Ireland and Portugal. Both countries share high growth and rapid structural change according to all indicators. On the other hand, there are large countries like the United Kingdom, France, and to a much lesser extent Italy and Germany, which combine slower growth with less structural change. Both these groups contribute to a close relation.

The country, which reduces the closeness of the fit, is Greece. Its manufacturing sector stagnates, but structural change is considerable, according to production and exports. Structural change is moderate, if measured by employment. This combination of rapid change in output and exports with a rather constant pattern of employment hints at rigidities, which prevent growth. Belgium, the Netherlands and Spain are better placed in growth than in structural change. Sweden and Finland exhibit considerable structural change, but growth (specifically in nominal figures) is low. In both countries, real growth is above average, specifically if we consider the period after 1993. The explanation is that both countries suffered severe crises and devaluation in the early nineties and that the full impact of changes towards the telecom sectors was evident only in the second half of the nineties. Sweden and

Finland decrease the overall closeness of the fit between nominal value added and speed of change.

If we compare structural change in Europe with that of Japan and the USA, we see that structural change is somewhat slower in Europe than in the USA, but the difference is not large. Both the USA and Japan have higher levels of growth than Europe over the 14-year period.

Noise elimination by superindicators

If we summarise growth indicators into a "superindicator" of growth, and the speed of change indicators into a "superindicator" of the speed of change, this "noise decreasing" procedure enables us to attain a very close fit between growth and speed of change:

- Of the 14 countries, six have an identical rank for growth and for speed of change or only one rank difference (Belgium, France, Ireland, the Netherlands, Portugal, and the United Kingdom). One country differs by 2 ranks (Austria is 3rd in growth, 5th in speed of change).

- Three countries have a difference of three ranks, two differ by 6 ranks. Denmark and Germany experience higher growth (5th and 10th) despite a rather low speed of change (8th, 13th). Spain (number 4 in growth, but 10th in speed of change) and Italy (9th in growth, 14th in speed of change) perform in the same direction, but with wider differences.

- Greece is the outlier with the slowest growth and second highest speed of change. This development will be analysed below. The statistical impact of this is that the rank correlation among European countries is R = 0.53 (significant at the 5 % level), including Greece, and increases to R = 0.75 (significant at the 1 % level) if we exclude Greece.

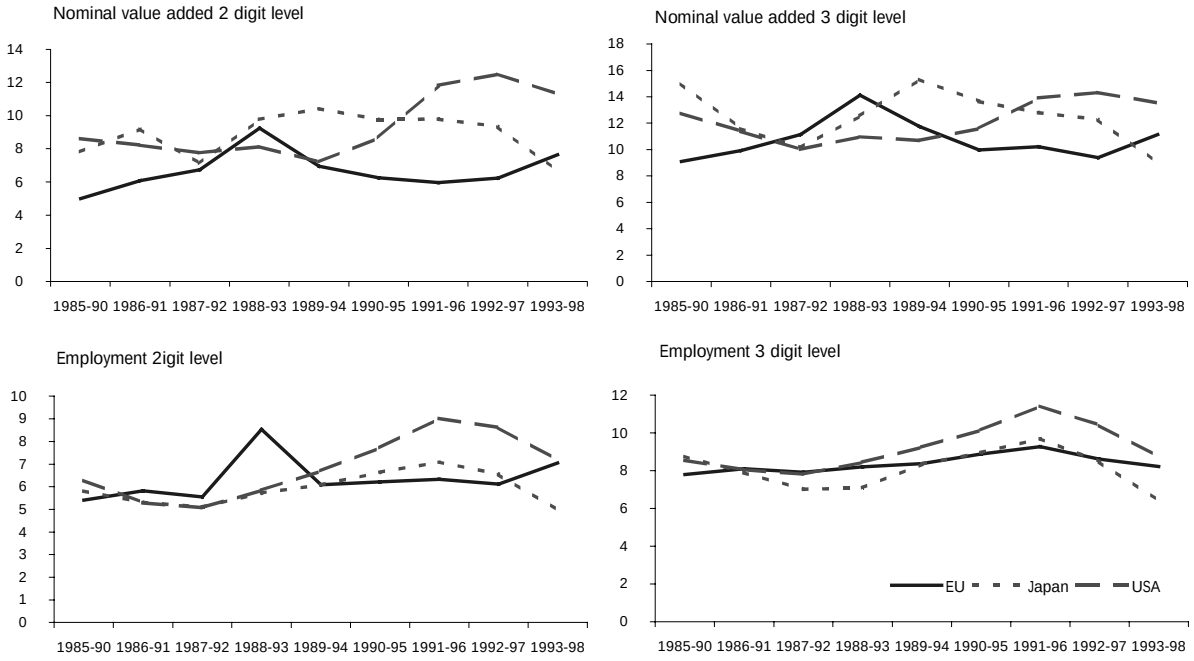
Table 2: Indicators on growth and on structural change 1985-1998

	Growth of nominal value added		Growth of real value added		Growth of employment		SPOCH of value added		SPOCH of exports		SPOCH of employment		SPOCH of value added		SPOCH of exports		SPOCH of employment		Superindicator growth[1])		Superindicator SPOCH[2])	
	3 digit		3 digit		3 digit		3 digit		3 digit		3 digit		2 digit		2 digit		2 digit					
	1985-1998	Rank	1985-1998	Rank	1985-1998	Rank	1985-1998	Rank	1988-1998	Rank	1985-1998	Rank	1985-1998	Rank	1988-1998	Rank	1985-1998	Rank		Rank		Rank
Belgium	3.95	7	2.49	6	-1.26	10	28.11	10	27.28	10	33.76	4	19.35	10	21.26	9	21.75	6	1.73	8	25.25	9
Denmark	4.79	4	2.28	7	0.39	2	36.40	6	28.42	9	32.83	5	20.24	7	19.60	11	19.48	8	2.49	5	26.16	8
Germany	3.87	8	1.74	11	-1.21	9	24.50	12	19.63	14	25.27	10	12.28	14	12.18	13	18.43	10	1.47	10	18.71	13
Greece	2.38	13	0.25	14	-2.12	14	58.27	1	45.88	2	26.17	8	45.84	1	37.76	3	20.03	7	0.17	14	38.99	2
Spain	4.64	6	2.57	5	0.26	4	29.68	9	32.07	8	25.51	9	19.83	8	22.01	8	16.11	12	2.49	4	24.20	10
France	2.87	12	1.41	13	-0.90	7	25.60	11	23.41	12	22.49	13	17.54	11	17.20	12	16.70	11	1.13	11	20.49	11
Ireland	7.86	1	10.18	1	2.18	1	46.62	3	66.85	1	37.61	2	39.39	2	63.79	1	33.13	1	6.74	1	47.90	1
Italy	3.61	9	1.76	10	-0.58	6	23.80	14	21.16	13	22.90	12	14.54	12	12.07	14	11.99	14	1.60	9	17.74	14
The Netherlands	4.71	5	1.85	9	0.36	3	31.82	8	42.61	4	24.94	11	19.57	9	37.37	4	19.29	9	2.31	6	29.27	7
Austria	5.34	3	3.93	2	-1.45	12	43.27	4	35.29	6	27.71	7	32.04	5	23.68	7	22.00	5	2.61	3	30.67	5
Portugal	7.75	2	2.21	8	-0.08	5	49.57	2	44.48	3	40.46	1	32.18	4	38.61	2	22.49	3	3.29	2	37.96	3
Finland	3.17	10	3.76	3	-1.33	11	42.78	5	40.99	5	33.98	3	33.66	3	35.28	5	26.62	2	1.87	7	35.55	4
Sweden	1.07	14	3.23	4	-1.01	8	34.59	7	34.43	7	32.68	6	23.95	6	27.70	6	22.33	4	1.10	12	29.28	6
United Kingdom	3.05	11	1.69	12	-1.68	13	24.12	13	26.01	11	18.34	14	13.73	13	20.30	10	15.11	13	1.02	13	19.60	12
EU	3.67		2.04		-0.89		19.27		21.33		17.48		11.47		16.01		12.58		1.61		16.36	
Japan[2])	4.53		1.38		-0.72		22.13		20.91		16.75		12.17		9.63		12.99		1.73		15.76	
USA[2])	4.42		3.19		-0.03		20.50		17.03		18.61		14.40		13.29		12.45		2.53		16.05	

Remark: Correlation between superindicators R = 0.5336 (R without Greece = 0.7460)
rank correlation between superindicator R = 0.3934 (R without Greece = 0.6796)
SPOCH for extra EU exports (better for comparising with Japan and the USA) = 23.24.

[1]) Superindicator on growth = average of growth of nominal value added, real value added and employment 19985 to 1998. - [2]) Superindicator on speed of change = average of speed of change of nominal value added, exports, employment (3-digit level and 2-digit level).

Figure 1: Speed of change over time in EU, Japan and the USA

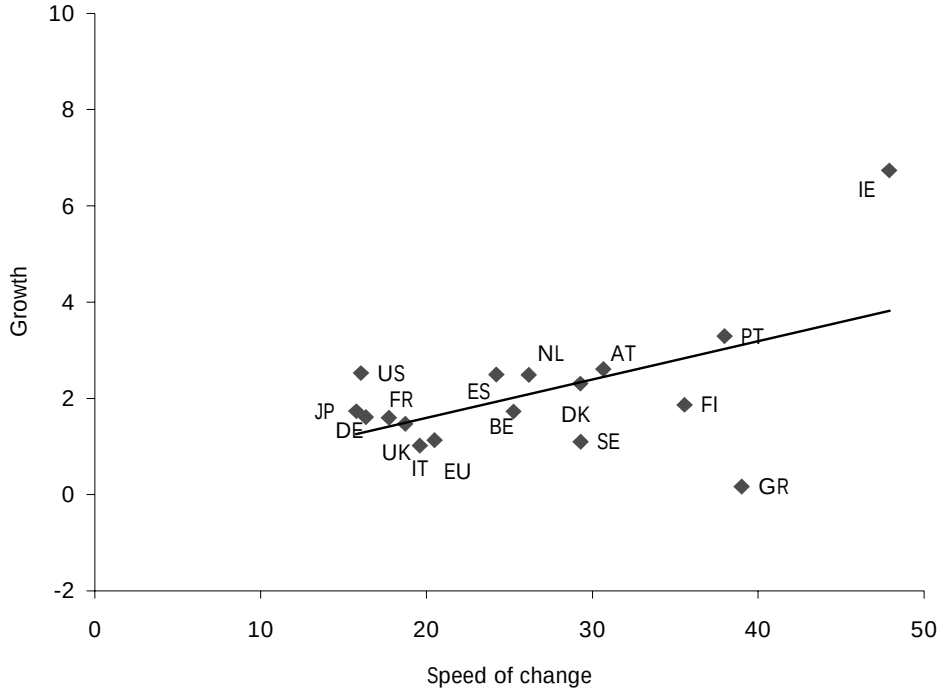


Source: EUROSTAT (NEW CRONOS), WIFO calculations.

Differences according to time periods

The correlations are positive for all subperiods. However, the closeness of the fit increases over time and the correlation is closest for the last period (1993-1998). One of the significant changes of this period is that Sweden and Finland also join the top countries with respect to growth. The data indicate an increase in the speed of change, taking place about 1990. Using a five-year moving average, most indicators indicate a maximum in 1988-1993. For employment at the industry level, the maximum is in 1990-1995 (see Figure 1). Greece is an outlier in the correlation in all subperiods, however speed of change (which was moving in an unfavourable direction) slowed down in the nineties. Italy and Germany exhibited a slow speed of change in all periods, but their growth position was more favourable in the late eighties. Both these trends support the correlations between growth and speed of change (see Figures 2 and 3).

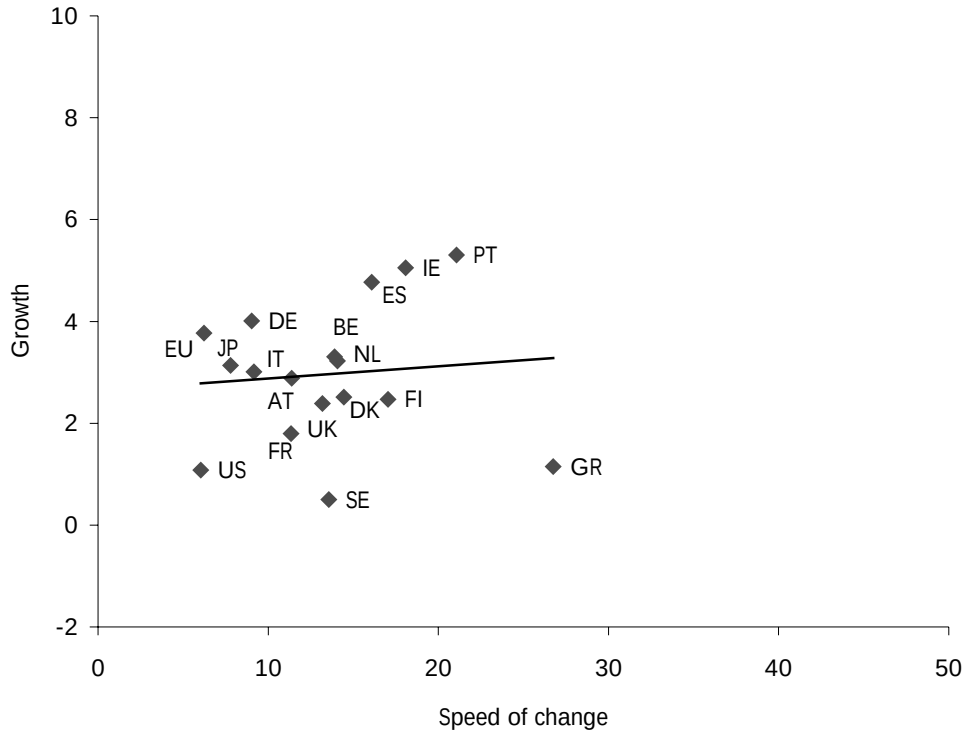
Figure 2a: Country pattern for growth and speed of change 1985-1998 (Superindicator)



Remark: Growth=average of nominal, real growth of value added and employment.
Speed of change= average of speed of change in value added and employment (2 digit and 3 digit)

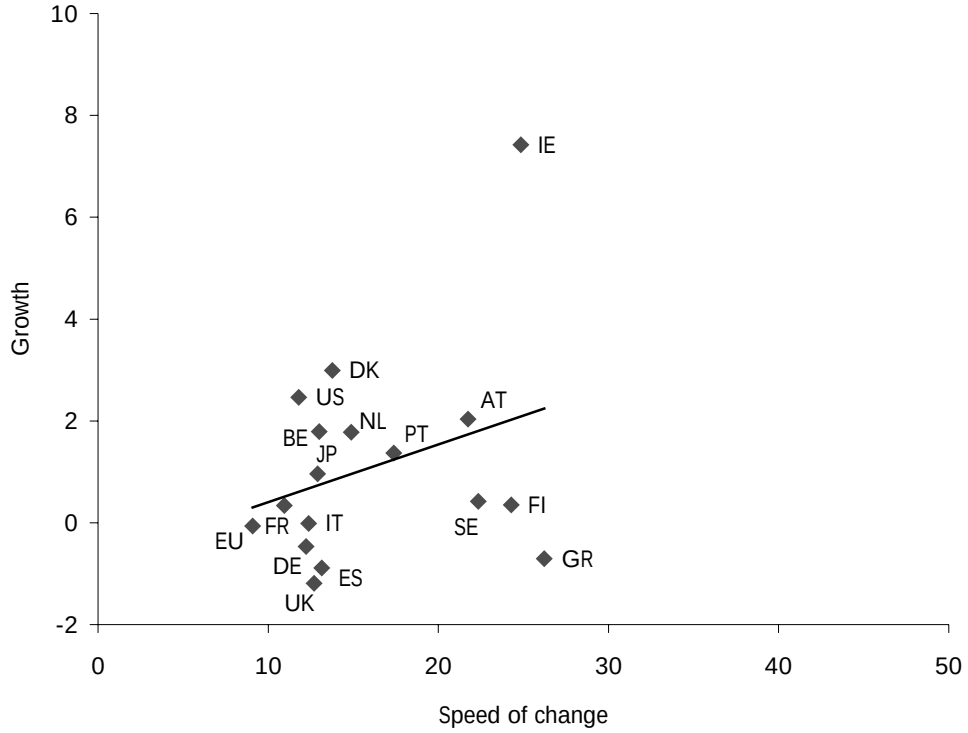
Source: EUROSTAT (NEW CRONOS), WIFO calculations.

Figure 2b: Country pattern for growth and speed of change 1985-1990 (Superindicator)



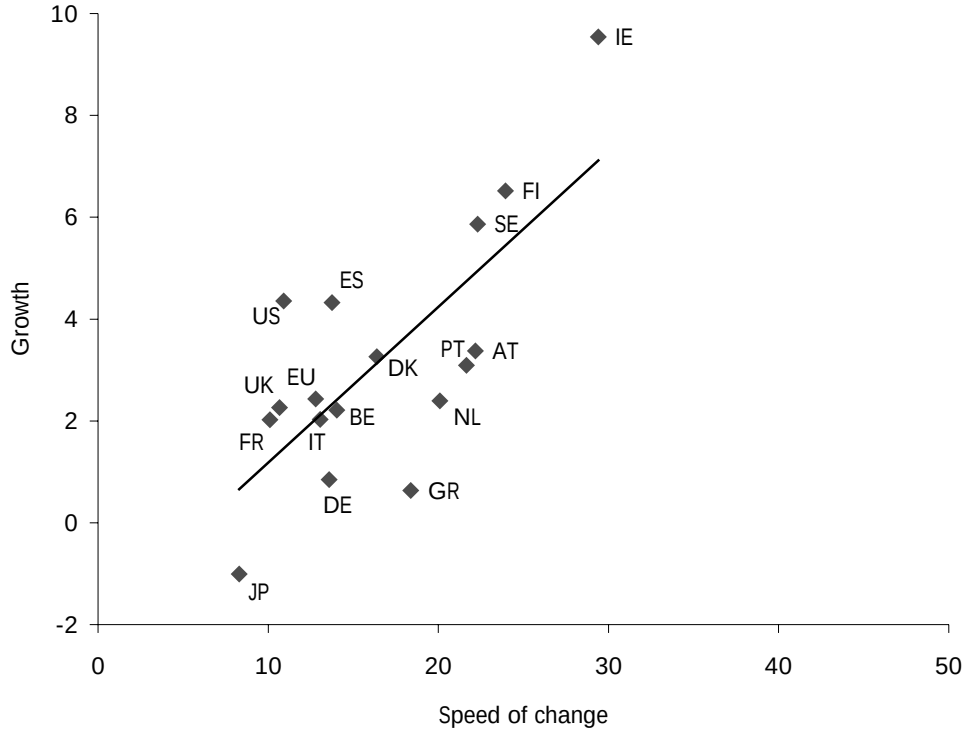
Source: EUROSTAT (NEW CRONOS), WIFO calculations.

Figure 2c: Country pattern for growth and speed of change 1990-1995 (Superindicator)



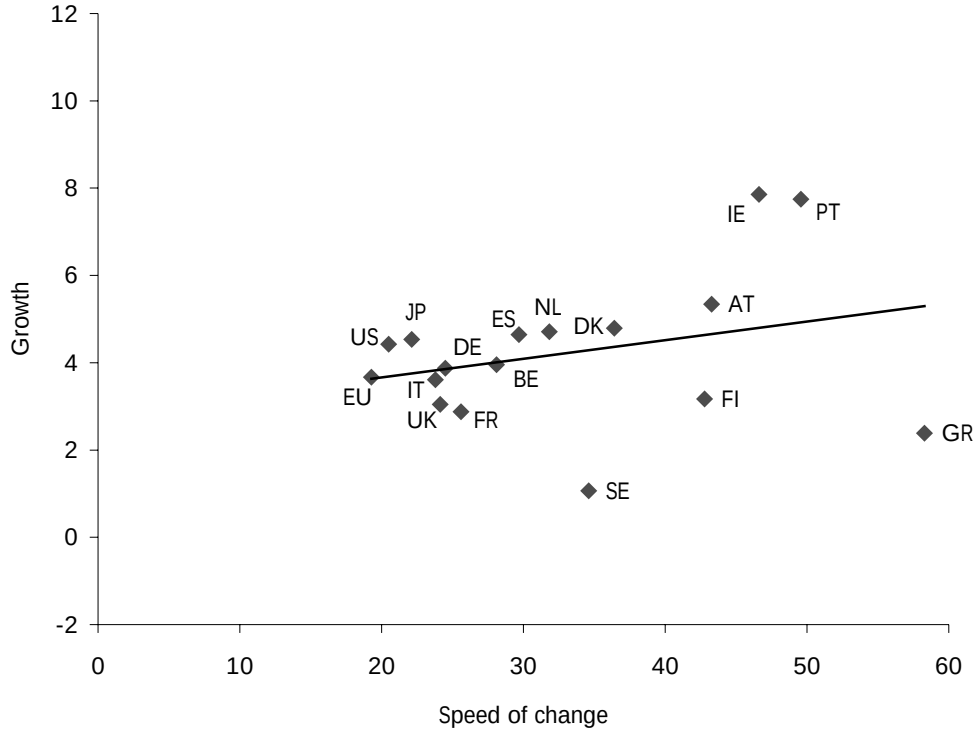
Source: EUROSTAT (NEW CRONOS), WIFO calculations.

Figure 2d: Country pattern for growth and speed of change 1993-1998 (Superindicator)



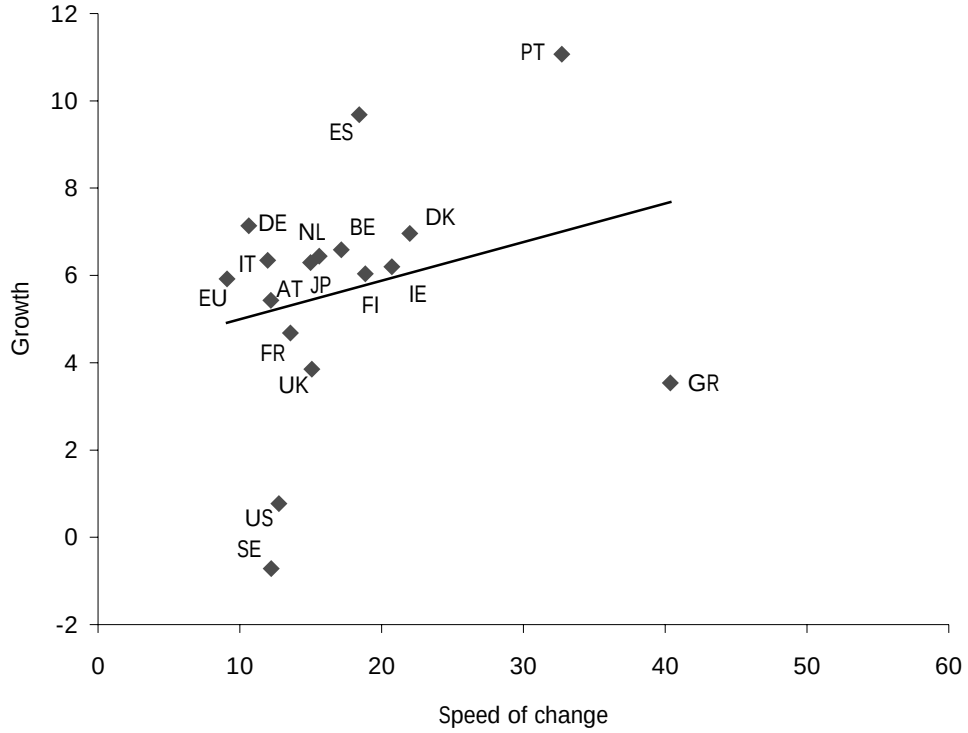
Source: EUROSTAT (NEW CRONOS), WIFO calculations.

Figure 3a: Growth and speed of change of value added 3-digit level 1985-1998



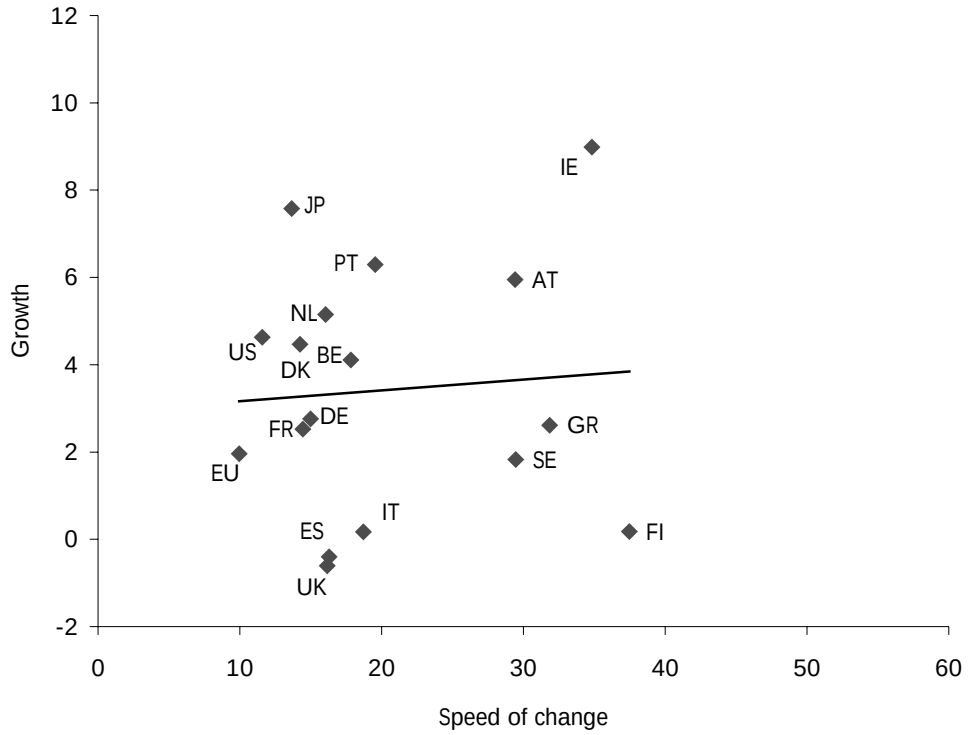
Source: EUROSTAT (NEW CRONOS), WIFO calculations.

Figure 3b: Growth and speed of change of value added 3-digit level 1985-1990



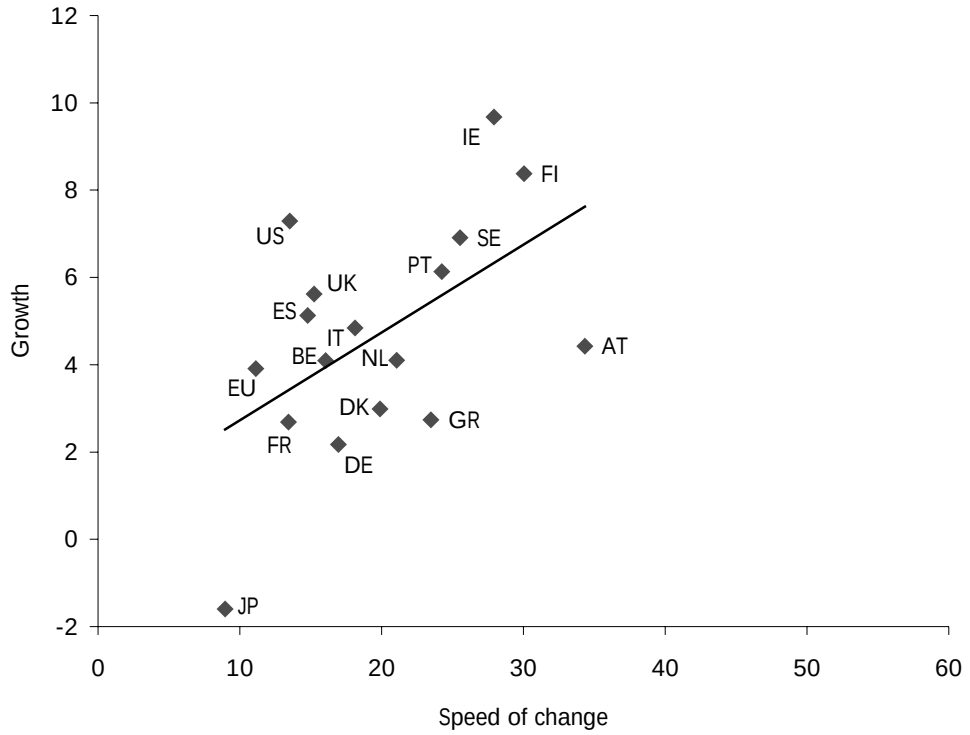
Source: EUROSTAT (NEW CRONOS), WIFO calculations.

Figure 3c: Growth and speed of change of value added 3-digit level 1990-1995



Source: EUROSTAT (NEW CRONOS), WIFO calculations.

Figure 3d: Growth and speed of change of value added 3-digit level 1993-1998



Source: EUROSTAT (NEW CRONOS), WIFO calculations.

6. Towards explanations of the connection

Active versus passive change

Theory predicts that rising incomes will change demand structures, and that countries will specialise according to their endowments. If incomes (domestic and worldwide) change, and if the endowments and relative advantages of countries change over time, countries which actively and quickly adjust production according to changing demand and endowments will perform better than those passively hit by external shocks. This suggests that we differentiate between active changes in structure and those changes, which will happen sooner or later, due to losses of competitiveness or shrinking demand. It is not possible to distinguish easily between these two types of "positive" or "active" or "voluntary" change on the one hand, and

"negative", "passive" or "involuntary" change on the other hand. But, we can suggest that active strategies could be indicated by increases in the share of

- fast growing industries (measured first at the European level with respect to value added and production)
- high productivity industries
- industries with comparative advantages at the beginning (measured in relative productivity)
- industries with first mover advantages (measured in above-average shares at the beginning)
- industries with high productivity growth
- industries requiring high skill levels

Increases in these industries, and decreases in opposite categories (increases in slowly growing industries) were labeled “active change”; while increases in slowly growing industries and decreases in fast growing industries may reflect passive, involuntary change. The net balance of active change minus passive change is later used in regressions as the "positive speed of change".

Taking long term growth of value added in the EU as a first criterion, an average of the EU countries reveals that 8.7 points of the "speed of change" can be attributed to increasing shares in sectors in which growth is above average, and 8.8 points can be attributed to decreasing shares in sectors with low growth. This amounts to 17.5 points, implying that more than two thirds of the "total speed of change" is active change (in the sense of either shifting into high growth or leaving stagnating sectors; shares of change go into sectors with higher growth rates). About 3.5 points are derived from increases and decreases "against the tide"; meaning growth of sectors in specific countries, despite moderate overall growth and declining shares in growth industries. Greece is the only country in which the structural change "against the tide" dominates. This is due to the fact that the textile industry is increasing its share, but also to the slow growth of oil and basic metals and the large decline in the metal products industry.

Table 3a: Speed of change in subperiods and in directions of change

	Speed of change in value added (2 digit)				Share of "active" change (total period) according to . . .				
					High/low growth of value added	High/low productivity	High/low productivity growth	1985 comparative advantage[1])	1985 specialisation[2])
	1985-1998	1985-1990	1990-1995	1993-1998	In percent				
Belgium	19.4	9.9	11.4	12.4	70.8	78.3	61.6	26.6	24.6
Denmark	20.2	10.3	7.5	13.9	89.5	54.0	35.9	57.9	46.1
Germany	12.3	6.9	10.1	9.9	90.5	37.9	39.2	65.0	58.8
Greece	45.8	28.7	28.6	20.3	19.3	59.2	12.4	10.1	30.0
Spain	19.8	14.5	11.2	12.1	91.2	57.4	35.8	11.8	22.1
France	17.5	10.8	9.7	7.8	88.4	57.2	60.6	5.8	29.3
Ireland	39.4	10.8	31.4	24.9	70.8	77.4	48.5	63.7	51.7
Italy	14.5	7.0	13.3	14.7	92.6	43.6	66.5	38.9	32.3
The Netherlands	19.6	9.6	9.7	17.2	66.7	44.8	24.2	35.0	29.7
Austria	32.0	9.9	18.1	28.6	81.5	57.9	51.7	21.7	26.4
Portugal	32.2	21.2	12.0	13.2	68.3	58.4	55.8	30.3	31.8
Finland	33.7	13.0	29.4	24.1	73.5	78.9	51.8	63.4	32.5
Sweden	24.0	12.9	23.1	18.4	89.5	69.2	40.8	36.3	64.7
United Kingdom	13.7	8.4	10.7	8.4	82.4	62.4	50.6	45.7	75.8
Average over EU countries	24.6	12.4	16.1	16.1	76.8	59.8	45.4	36.6	39.7
EU	11.5	5.0	6.3	7.6	-[3])	55.0	48.7	50.0[4])	50.0[4])
Japan[5])	12.2	7.8	9.8	6.7	78.4	51.5	38.5	42.5	29.9
USA[5])	14.4	8.6	8.7	11.3	85.6	85.5	28.5	50.0	58.5

[1]) Relative productivity of industry in country i versus EU. - [2]) Relative share of industry in country i versus EU. - [3]) By definition 100 percent. - [4]) By definition 50 percent. - [5]) Last year 1997.

Source: EUROSTAT (NEW CRONOS), COMEXT, WIFO calculations.

Table 3b: Speed of change in subperiods and in directions of change

	Speed of change in value added (3 digit)				Share of "active" change (total period) according to . . .					
	1985-1998	1985-1990	1990-1995	1993-1998	High/low growth of value added	High/low productivity	High/low productivity growth	1985 comparative advantage[1])	1985 specialisa-tion[2])	High skill industries
Belgium	28.1	18.9	17.8	16.0	72.5	44.6	50.9	29.6	19.7	46.3
Denmark	36.4	22.0	14.3	19.9	84.7	52.8	69.2	46.4	46.8	53.1
Germany	24.5	10.6	15.0	16.9	94.5	46.4	60.2	44.5	46.2	51.1
Greece	58.3	40.4	31.9	23.5	57.0	59.6	70.4	15.4	35.3	50.3
Spain	29.7	18.4	16.3	14.8	86.3	45.4	52.6	25.4	33.1	54.5
France	25.6	13.6	14.4	13.4	89.7	45.5	64.5	32.2	28.0	45.0
Ireland	46.6	20.7	34.8	27.9	68.0	52.2	57.9	53.8	53.2	60.1
Italy	23.8	12.0	18.7	18.1	83.7	38.0	58.5	57.3	32.2	51.0
The Netherlands	31.8	15.6	16.1	21.1	86.9	54.1	53.8	30.2	30.2	57.9
Austria	43.3	12.2	29.4	34.3	78.9	35.8	53.0	35.0	28.2	55.2
Portugal	49.6	32.7	19.6	24.3	76.9	58.7	64.4	29.7	21.5	55.5
Finland	42.8	17.2	37.5	30.0	63.8	72.8	74.5	51.5	52.8	53.0
Sweden	34.6	12.2	29.5	25.5	69.7	64.7	62.4	41.3	51.6	56.1
United Kingdom	24.1	15.1	16.2	15.2	85.7	51.0	60.0	38.7	51.4	54.9
Average over EU countries	35.7	18.7	22.2	21.5	78.5	51.5	60.9	37.9	37.9	53.1
EU	19.3	9.1	10.0	11.1	-3)	46.2	63.9	50.0[4])	50.0[4])	52.7
Japan[5])	22.1	15.0	13.6	9.0	79.8	52.3	54.6	31.8	42.3	50.1
USA[5])	20.5	12.8	11.6	13.5	69.7	68.5	70.1	44.4	49.1	39.4

[1]) Relative productivity of industry in country i versus EU. - [2]) Relative share of industry in country i versus EU. - [3]) By definition 100 percent. - [4]) By definition 50 percent. - [5]) Last year 1997.

Source: EUROSTAT (NEW CRONOS), COMEXT, WIFO calculations.

Ireland, on the other hand, had the largest "positive" component, increasing its share of chemicals, and decreasing its food share. Sweden, Finland and Portugal follow. Portugal, successful in catching up (with rapid growth and speed of change), achieved this position by increasing its share of motor vehicles and by decreasing its share of all textile related industries. Italy and Germany excelled, having only a 1-point share of change in the wrong direction (i.e. out of growth sectors plus entry into slow growth sectors). A substantial part of the shifts against the tide is evident in the two countries with fastest overall change (Ireland and Portugal), but also in Finland, Belgium and the Netherlands.

If we look for changes driven by productivity, the results are as follows: On average, changes are driven by the productivity level, i.e. the share of high productivity industries increases. However, this trend is not as strong as the shift into high growth industries. And structural change does not move into industries with high productivity growth.

- Starting with the level of productivity: on average (across countries), 15 % of the changes in sector shares follows absolute productivity (implying increasing shares in high productivity industries and decreasing shares in low productivity industries), but 9.3 % move in a different direction. In Italy and in the Netherlands, movements against the tide dominate; in Greece, Spain, France and Portugal, the "positive" change is only slightly larger than the negative. The large share of negative effects can be attributed mainly to capital intensive basic goods industries (basic metals, oil), as well as to tobacco, which have above average labour productivity, but declining shares in value added. However, smaller countries are also specialising in office machinery and telecom, driving shares away from others (larger countries, as well as the Netherlands), which would otherwise contribute to this trend.

- Productivity growth is not really driving sectoral changes. On average, the “against the tide” effect dominates slightly (10.7 : 13.9); strong counter effects are evident in Greece and in the Netherlands; effects which are somewhat less negative are revealed for Denmark, Spain and Sweden. Strong switches into industries with above average growth are shown for Belgium, France, Italy and Portugal. It is interesting that in Ireland and Austria (two fast growing countries), neither effect dominates.

Two indicators show the declining influence of specialisation according to comparative advantages: First, specialisation according to relative productivity (Ricardian comparative

advantage) and then specialisation according to revealed strongholds in 1985. According to both indicators, countries moved production out of former strongholds. On average across countries, 4.7 % of the changes in structure were in the direction of sectors in which the countries had higher (relative) productivity and 4.1 % of the changes were away from sectors with relatively low productivity, for a total of 8.8 % which were intensifying original comparative advantage. On the other hand, 15.2 % were changes away from the original specialisation, either by shifting into sectors with relatively low productivity or by abandoning positions with higher productivity levels. However, there are four countries which moved their structures into sectors with higher productivity: Ireland and Finland, and to a lesser degree Germany and Denmark. Quite similar trends become evident if we define strongholds according to revealed comparative advantages (above average shares of sectors in 1985), rather than relative productivity: 9 % are intensifying specialisation and 15 % are downgrading past specialisation. Four countries create an exception: again, they are Germany and Ireland, joined this time by Sweden and the United Kingdom.

Robustness and the influence of high skills

The results were reported for the average of countries, and then for individual countries and for the 2-digit level. The results are also the same for the EU as an aggregate (changes follow growth, somewhat less for productivity, but not for productivity growth, and they run contra to past specialisation). All these trends are replicated for the USA and Japan.

At the 3-digit level, the results are replicated as far as changes, which follow growth differences, are concerned, and run counter to past specialisation. The unique character of Greece is underlined, as it specialises counter to the overall growth trends. The excellent positions of Germany and Italy (with nearly no specialisation against the tide) is replicated; Belgium, France, the United Kingdom and Austria are the countries with less than a 3 % change against growing sectors. Portugal has the second highest share of shifts against the tide, for 3 digits, as well. Ireland and Finland have much less, implying that the structure shifted into high growing 3-digit industries, within lower-growth 2 digits.

For productivity, results change for 3 digits, as compared to broader sectors. The speed of change into industries with productivity levels above and below average is about the same; however, countries change into industries with above average productivity growth. This implies that data on disaggregated industries are highly necessary for structural analysis.

Specialisation is not lead by absolute productivity (which depends on capital intensity), but by productivity growth, which may be fostered less by capital deepening than by upgrading skills and quality. Data on the share of skilled workers show that specialisation follows skill levels.

About the direction of causality

To attain information about the direction of causality, we look at the time shape of the correlation. If growth is connected to past, as well as to concurrent speed of change, this indicates that the speed of change influences later growth and is the independent variable. If, on the other hand, speed of change is more closely related to past growth, this indicates that growth leads to changes. This test was popular in business cycle analyses, where long datasets with high periodicity are available. Even then it was questioned whether, under all circumstances, "post hoc" also implies "proper hoc". Here, we have only three time periods. Therefore, we test the time pattern for several variables to get at least a hint.

Table 4: The time structure of the relationship

	SPOCH 2 digit			SPOCH 3 digit		
	t	t-1	t-2	t	t-1	t-2
Growth						
Value added nominal	0.5026**	0.4724***	0.0269	0.5370**	0.5238**	0.0205
Value added real	0.6542*	0.6434*	-0.0534	0.5826**	0.6319*	-0.0975
Employment	0.6916*	0.2169	0.5236**	0.6087*	0.3315	0.4209***
Average	0.6161	0.4442	0.1657	0.5761	0.4957	0.1146
		Growth[1])			Growth[2])	
Speed of change						
Value added nominal	0.5026**	0.2350	0.0260	0.5370**	0.1876	0.0014
Value added real	0.6542*	0.5855**	0.1877	0.5826**	0.4692***	0.1867
Employment	0.6916*	0.0514	-0.1676	0.6087*	0.0312	-0.1971
Average	0.6161	0.2906	0.0154	0.5761	0.2293	-0.0030

Remark: The same specification is calculated for upper part and lower part of the table.
Upper part: Yt/Xt, Yt/Xt-1, Yt/Xt-2
Lower part: Xt/Yt, Xt/Yt-1, Xt/Yt-2

[1]) Correlation is calculated between growth variable and speed of change on the 2-digit level. - [2]) Correlation is calculated between growth variable and speed of change on the 3-digit level.

Source: EUROSTAT (NEW CRONOS), COMEXT, WIFO calculations.

In general, the growth of value added is related approximately as well to past speed of change as to concurrent; the results remain significant for all four correlations in the upper half of

Table 4 (real, nominal growth which is related to the speed of change at the 2- and 3-digit levels). For real growth and speed of change measured at the industry level, the correlation coefficient is even slightly higher, if the latter is lagged. For two lags, the correlation collapses. For employment, there is a drop if the speed of change lags by one period and then an increase if it lags by two periods (this is not easy to explain).

If, on the other hand, we correlate speed of change to past growth, the correlation coefficients drop faster, becoming insignificant for nominal growth and decreasing by 0.7 resp. 11 points for real growth. The relation to the speed of change in employment is practically zero, if growth lags by one period.

These results indicate that the causality between speed of change and growth might be more important than the other one. We maintain, however, that both streams will be present, as proposed by the theoretical considerations.

7. Econometric evidence assuming growth as the independent variable

The correlations between speed of change and growth are all positive; due to the data noise and the small number of data points (14 countries) they are sometimes not significant (9 of 31 cases in Table 1). The closeness of the fit is excellent, if we eliminate some of the "noise" by averaging indicators (see results for the "superindicator" above). It also improves, if we relate growth to the "active" speed of change, defined as structural change in a country in the direction of growing industries (measured at the EU level). As an indicator, we take the share of change following demand, minus the share against the tide.

The result is that the speed of change follows demand, but runs counter to past specialisation and it suggests that we incorporate these two variables into the regression. Explaining production growth according to the dissimilarity at the start, and following the speed of change into fast growing industries, provides the expected results. Growth is higher, the more industry changes there are, and the more different it was in the beginning; this result is significant for nominal value added (see BB in Table 5).

The results are supported in a panel in which the total period is subdivided into three subperiods. Now, each variable corresponds to three time data points and 14 countries. Both variables are significant in a model without fixed effects. In models with fixed country

effects, the contribution of the positive speed of change remains to be seen, while significance is given for real value added. However, part of the explanatory value of the variable is now hidden by fixed country effects.

Table 5: OLS and panel explanations of growth by speed of change and dissimilarity

Value added on 3-digit level

		Speed of change		Positive speed of change		Dissimilarity		
Growth		T	R^2 if single	T	R^2 if single	T	R^2 if single	R^2 if double
A: Single equation 1985-1998								
Value added nominal		1.21	0.1095	2.41**	0.3262	2.15*	0.2777	
Value added real		0.96	0.0710	-0.04	0.0001	1.69	0.1929	
B: Multiple equation OLS 1985-1998								
Value added nominal	A	-1.66				2.44**		0.4218
	B			3.34***		3.11***		0.6410
Value added real	A	-1.36				1.94*		0.3084
	B			0.06		1.62		0.1931
C: Panel, 1 variable								
Value added nominal		0.32	0.0042	2.45**	0.0364	2.80***	0.3182	
Value added real		0.35	0.0000	1.47	0.0348	2.15**	0.0859	
D: Panel, 1 variable with fixed country effects								
Value added nominal		-0.42	0.0042	1.25	0.0364	3.55***	0.3182	
Value added real		-0.01	0.0000	1.22	0.0348	1.59	0.0859	
E: Panel, 2 variables								
Value added nominal	A	-0.81				2.69***		0.0825
	B			3.69***		3.03***		0.2011
Value added real	A	0.73				1.60		0.0922
	B			3.26***		2.29**		0.2198
F: Panel, 2 variables with fixed country effects								
Value added nominal	A	-0.02				3.48***		0.3183
	B			1.65		3.09***		0.3830
Value added real	A	0.91				1.54		0.1140
	B			2.23*		1.05		0.2326

A . . . Speed of change value added + Dissimilarity. B . . . Positive speed of change value added + Dissimilarity

Source: EUROSTAT (NEW CRONOS), COMEXT, WIFO calculations.

Table 6: Favourite panel - growth as a function of positive speed of change and dissimilarity

Fixed-effects (within) regression	Number of obs	=	42			
Group variable (i) : co1	Number of groups	=	14			
R-sq: within = 0.2326	Obs per group: min	=	3			
between = 0.3115	avg	=	3.00			
overall = 0.2683	max	=	3			
	F(2,26)		3,94			
corr(u_i, Xb) = -0.4996	Prob > F		0,0320			
grr3va	Coef.		Std. Err.	t	P>t	[95% Conf. Interval]
sp3ava	0.1750428		0.0784993	2.23	0.035	0.013685 0.3364004
dis3va	0.1312898		0.1251026	1.05	0.304	-0.1258622 0.3884419
_cons	-5.20084		6.315986	-0.82	0.418	-18.18354 7.781855
sigma_u	2.4487147					
sigma_e	1.9356521					
rho	0.61544009		(fraction of variance due to u_i)			
F test that all u_i=0:	F(13, 26) =		2.83			Prob > F = 0.0115

. predict fixed, u
(14 missing values generated)

. table co1, c(m fixed)row

co1	mean(fixed)
Belgium	0.3575212
Denmark	-1.677391
Germany	0.949039
Greece	-5.956641
Spain	1.974682
France	1.331256
Ireland	1.88364
Italy	1.421728
Netherlands	-1.353771
Austria	0.2766223
Portugal	-3.851935
Finland	0.0519358
Sweden	2.505619
United Kingdom	2.087696
Total	-5.32E-09

Source: EUROSTAT (NEW CRONOS), COMEXT, WIFO calculations.

8. Caveats and conclusions

Speed of change and dynamics are two economic features, which support each other. Any change in income and activity implies changes in structure, since some industries grow less than total production, for example when there is an opportunity to economise on inputs, or when more and more basic needs have been fulfilled. Other inputs are used increasingly, particularly when they add new features to products and/or when demand increases overproportionately with rising incomes. Therefore, rising income levels make changes in the structure of an industry necessary. If these changes are feasible, production will follow demand closely and allow growth, partly by winning market shares at the expense of economies with less flexibility. This two-way causality between growth and structural change imposes difficulties in the use of usual statistical techniques like regressions, which basically need a one way causality.

The empirical data support the idea that growth and speed of change are related. Most of the indicators of structural change are significantly related to growth, specifically if we eliminate noise by combining information contained in different data sets (each flawed by measurement errors) or by eliminating fixed industry or country effects). The correlations seem to increase over time; the fit is much closer for the most recent years than for the total period. Changing export structures are at least as closely connected with growth as changes in value added, indicating that changing structures may be specifically important for external competitiveness and for open economies. If we want to determine the direction of causality (whether growth makes structural change necessary, or whether change is the precondition of growth), we find evidence that growth depends on past structural change more closely than the other way round. In principle, however, the data are too limited and too noisy to prove this; above all, theory suggests an intrinsic two-way relationship.

The country hierarchies are similar in growth and speed of change, but there are some notable exceptions. Industrial structures have been changing fast, but growth is inadequate in Greece. In using production growth at the European level to discriminate between high and low growth industries, we see that Greece is specialising in low growth industries, while the vast majority of other countries is changing into high growth sectors. Countries with better positions in growth, but with inadequate structural change, are Italy and Spain, and to a lesser extent Germany and Denmark. Sweden and Finland are experiencing rapid structural change,

but were only able to transfer this into higher growth during the latest subperiod. In the nineties, however, they successfully reaped the benefits of their excellent position in the telecom sector. For a long time, Austria had slow structural change specifically relative to growth, but in the nineties, structural changes were achieved specifically by shedding employees in formerly nationalised industries.

All countries abandoned, at least in part, positions in which they were specialised during the eighties. This is the consequence of a re-shaping of specialisation, which originally was based on larger endowment differences, but which now is primarily linked to intra industry specialisation. Panel analysis confirms that growth is highest if it follows restructuring away from past strongholds and towards fast growing industries.

Comparing the EU and the USA, the speed of change is larger in the USA and in Japan than in Europe. The extent is not dramatic, but is evident for all indicators. The time shape indicates an increase in changes in Europe, with a maximum during the 5-year period 1988 – 1993; while in Japan, the maximum occurred later; and in the USA, not until the very last period. During the period 1992 – 1997, the speed of change was 50 % to 100 % higher in the USA than in Europe.

In general, Austria fits into the picture, insofar as growth and speed of change is larger than for most other countries. Austria was lacking in speed of change in the eighties, but experienced fast changes in the nineties. Change moves in the direction of high growth industries, not in the direction of industries with high levels and growth of labour productivity. The nevertheless strong productivity performance seems to be the consequence of productivity growth and supplying quality within industries.

The upshot of the study is that despite all the problems of how to define aggregate dynamics and structural change, and how to assess the direction of causality, there is a link between structural change and growth. European countries with high growth also have rapidly changing structures. Structural change is increasingly supportive, if the change is in the direction of faster growing industries and if the change upgrades quality and product differentiation (intra industry specialisation; abandoning old strongholds). And European change, as well as growth, seems to have been insufficient in the nineties, at least when compared to the impressive acceleration of productivity growth in US manufacturing.

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