Convergence in Structure and Productivity in European Manufacturing?*

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Abstract

We find fast convergence in productivity for 99 3-digit European industries over the 1985-1998 period. Half of any productivity gap is closed on average in about 10-15 years. We explicitly formulate the steady state assumptions for structural convergence to hold. Convergence in industrial structure is much slower than productivity catch up with a half-life of around fifty years, a stylized fact which cannot easily be explained by the existing models of trade and growth.

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1 Introduction

The literature on "technological gaps" (Nelson, Wright, 1992, Abramovitz, 1986) and on catching up (see e.g. Fagerberg, 1994, 1995) mainly restricts itself to the macro level. Recently, there has been increasing interest in the question whether the experiences of individual industries confirm the observed pattern of catching up at the macro level. Many studies focus on convergence in productivity, but systematic evidence on the determinants of industry growth rates, and thus on the direction and speed of structural adjustment is not yet available. This is particularly worrying since most of the EU policies are designed to increase output and employment growth by speeding up structural change. The present paper sets up a conceptual framework for structural convergence and provides new evidence on convergence in productivity and in industry structure of European Countries for the 1990s.

There are several reasons to expect convergence in structure. First, factor endowments may be converging. Aiginger et al. (1999) find that factor endowments of European Countries indeed became more similar during the 1980s and 1990s, especially with respect to R&D-capital. Besides faster factor accumulation of lagging countries, convergence in endowments may also be induced by factor mobility. Higher returns on capital, for example, motivate flows into countries which are not well endowed with capital. Additionally, multinational firms are expected to contribute to structural convergence by investing directly in those countries where marginal returns on capital are high. Second, knowledge spillovers lead to convergence in productivity and a leveling off of comparative (Ricardian) advantages. The result is that both productivity and structure converge.

There are, however, also reasons to expect that structural convergence never takes place or only very slowly, while productivity converges. Markusen (1983) shows that factor mobility which is motivated by differences in productivity adds an additional factor endowment basis to trade, and thus induces production structures to *di*verge. In an endogenous growth model, Helpman, Grossman (1992) demonstrate that in case of perfect spillovers there exists a steady state where countries share a common stock of knowledge and grow at the same rate. Yet, their production structure remains different, and in the steady state a stable trade pattern based on endowment differences as in the Heckscher-Ohlin model emerges. To the extent that knowledge is a local public good, prior experience in developing new products influences the allocation of research activities. In the extreme case of no spillovers across countries, typically one country inherits the lead and history determines the output pattern. Convergence in structure then never takes place. Hence, path dependency is a major source of slow or absent structural convergence.[1]

It remains an empirical question which forces dominate, and this paper provides new evidence on this issue. We explicitly formulate the steady state assumptions for structural convergence to hold and estimate convergence equa-

[1] Models of economic geography likewise emphasize path dependency as an important determinant of persistent structural differences.

tions for value added and employment shares as well as productivity. Our estimates are based on a comprehensive panel of 99 3-digit industries for 14 EU countries, covering the period 1985-1998. Our main results indicate that convergence in productivity was quite rapid and about three to five times faster than convergence in structure (value added and employment shares) during the period under investigation. Productivity catch up seems to take place in all countries, and in most of the industries across the board without changing the specialization pattern of European countries substantially.

The paper is structured as follows: the next section discusses the econometric specification, Section 3 briefly describes our database and presents the main results, Section 4 puts our results into perspective. The last section provides tentative explanations for the finding of rapid productivity convergence combined with much slower convergence in industrial structure.

2 The econometric specification

To measure the speed of structural convergence, we propose a simple econometric set-up, which is based on the standard specification of β-convergence. For a typical industry i in country c, convergence requires that the deviation of a country's industry growth rate from its long run value is negative proportional to the deviation of industry size from the long run value (Barro, Sala-i-Martin, 1995). Formally, the log linearization around the steady state is given by:

$$\frac{d\left(\ln y_{ict} - \ln y^*_{ict}\right)}{dt} = -b\left(\ln y_{ict} - \ln y^*_{ict}\right) \tag{1}$$

where y_{ict} denotes the level of value added or employment at time t, y^*_{ict} the corresponding steady state value at time t, and $b > 0$ the factor of proportionality. Solving this differential equation results in the growth rate over a period of length T:

$$\ln y_{icT} - \ln y_{ic0} = \left(\ln y^*_{icT} - \ln y^*_{ic0}\right) - \left(1 - e^{-bT}\right)\left(\ln y_{ic0} - \ln y^*_{ic0}\right) \tag{2}$$

We assume that the steady state is defined as $y^*_{ict} = B_{ic}e^{gt}$, with g denoting the long run (steady state) growth rate and $B_{ic} > 0$ the exogenously given steady state industry size at time 0. Dividing (2) by T gives the average growth rate over a period of length T:

$$\frac{1}{T}\left(\ln y_{icT} - \ln y_{ic0}\right) = g - \frac{1}{T}\left(1 - e^{-bT}\right)\left(\ln y_{ic0} - \ln B_{ic}\right) \tag{3}$$

For each industry/country observation, equation (3) decomposes the average growth rate into two components: (i) the long run steady state growth rate g, and (ii) a factor proportional to the initial deviation of industry size from its steady state size. The gap (ii) vanishes when T grows large and has no effect on the growth rate in the long run. We postulate the same equation (2) for the

European manufacturing industries and denote the corresponding EU-aggregate variable by a dot (i.e. $y_{i.t} = \sum_{c=1}^{C} y_{ict}$ and $B_{i.} = \sum_{c=1}^{C} B_{ic}$).[2]

$$\frac{1}{T}\left(\ln y_{i.T} - \ln y_{i.0}\right) = g - \frac{1}{T}\left(1 - e^{-bT}\right)\left(\ln y_{i.0} - \ln B_{i.}\right) \tag{4}$$

Subtracting (4) from (3) leads to the equation of β-convergence in industry shares for each country (with $s_{ict} = y_{ict}/y_{i.t}$):

$$\frac{1}{T}\left(\ln s_{icT} - \ln s_{ic0}\right) = -\frac{1}{T}\left(1 - e^{-bT}\right)\left(\ln s_{ic0} - \ln \frac{B_{ic}}{B_{i.}}\right) \tag{5}$$

In (5), g drops out, since in the steady state all industries in all countries grow at the same rate g in order to hold the industry structure, i.e. the share of each industry held by each country, constant. This implies unconditional convergence. If there is conditional convergence with some industries growing faster than others in the steady state, structure does not stay constant over time and we may even observe structural *di*vergence. Convergence in industry structure is intuitive: If the share of a particular industry i of country c in the aggregate output of the EU in that industry is smaller (larger) than the corresponding overall steady state country share $B_{ic}/B_{i.}$, we should observe this share growing (falling).

In order to derive a valid econometric specification, one has to be more explicit about the assumed steady state country share. In the steady state all countries exhibit an identical industry structure in the sense that a country's share in a particular industry is the same in all industries and equal to its share in total EU-manufacturing, whatever the size of the corresponding aggregate EU-industry. This implies that for all industries i the steady state share of country c in industry i, $B_{ic}/B_{i.}$, stays constant and is equal to the initial steady state country share in total EU-manufacturing, which we denote by s^*_{c0}. Therefore, $B_{ic} = B_{i.}s^*_{c0}$ has to hold, which is only possible, if the steady state industry sizes can be multiplicatively decomposed into "independent" country and industry components, $B_{ic} = B^I_i B^C_c$. It follows then that $B_{i.} = B^I_i \sum_{c=1}^{C} B^C_c$ and $s^*_{c0} = (B^I_i B^C_c)/(B^I_i \sum_{c=1}^{C} B^C_c) = B^C_c / \sum_{c=1}^{C} B^C_c$.

Put differently, for industrial structure to remain unchanged and non-degenerate in the steady state, a particular aggregate EU-industry being larger than another *must not* affect a country's steady state share in that industry.[3] The relative initial share on the right hand side of (5) is essentially Balassa's (1965)

[2] For simplicity we ignore adding-up restrictions. So the predicted shares do not necessarily add up to one and provide only an approximation of the empirical distribution. The inconsistency mainly comes from using logs (which is important when estimating the model) and looking at the geometric mean when aggregating accross countries.

[3] For example, the European food industry has a larger steady state share in European manufacturing (9%) than the fabricated metal products industry (7%). For a steady state as defined above to exist, this *must not* affect the steady state country shares in these two industries. That is, e.g. Germany with a 23.9% share in total EU-manufacturing *holds the same steady state share in both industries*, namely its 23.9%. The same is true for Austria with a 2.4% share in total EU-manufatcuring .

RCA-index of specialization. In the empirical estimation, we assume s^*_{c0} can be approximated by the observed initial country share $s_{.c0}$.

The most comprehensive model to be estimated can be specified as follows:

$$\begin{aligned}\frac{1}{T}\left(\ln s_{icT}-\ln s_{ic0}\right) \quad = \quad & \beta_1 \ln\left(s_{ic0}-s_{.c0}\right)+\beta_2 \ln\left(s_{ic0}-s_{.c0}\right) * D_{ABOVE}+ \\ & \sum_{k=2}^{4}\beta_{3k}\ln\left(s_{ic0}-s_{.c0}\right) D_k+\sum_{c=2}^{C}\beta_{4c}\ln\left(s_{ic0}-s_{.c0}\right) D_c+ \\ & \mu_{kc}+\varepsilon_{icT} \qquad (6)\end{aligned}$$

with $\varepsilon_{icT} \sim iid(0, \sigma_\varepsilon)$. The speed of convergence can be calculated from the regression coefficients on the initial relative share. For example, for the base case, it is given by $b_1 = -\left(\ln\left[1+T\beta_1\right]\right)/T$ and the half live is given by $ln2/b$.

We allow the speed of convergence to differ in several dimensions. First, we test whether convergence occurs at the same rate for industries starting above and below their steady state shares. Thus, we interact the initial relative share with a dummy variable, D_{ABOVE}, taking on the value one if the industry started out with a larger share than the corresponding country share (or with a productivity lead relative to the corresponding EU industry, see below). Secondly, we investigate whether the speed of convergence differs by the following four industry types: (1) neither skill nor capital intensive, (2) skill but not capital intensive, (3) capital intensive but not skill intensive, and (4) neither skill nor capital intensive (D_k, $k = 1, ..., 4$). We do this classification on the basis of whether the skill and/or the capital intensity of an industry is above or below the median value. Skill intensity is defined as the share of white-collar high-skilled workers in the industry, whereby these include legislators, senior officials, managers, professionals, technicians and associate professionals (see OECD, 1998). Following Carree et al. (2000), we use labor productivity as a proxy for the capital intensity of an industry, on the grounds that industries with high levels of labor productivity use, on average, technologies with a higher capital intensity than industries with a low level of labor productivity. If skill and/or capital intensive industries are characterized by higher knowledge barriers or needs of "absorptive capacity" than other industries, one would expect structural convergence to be slower in these industries. On the other hand, if factor mobility - such as the migration of high-skilled workers - is higher in skill intensive industries or if European integration increased capital mobility, one would expect faster convergence in skill and capital intensive industries. Finally, we test whether the speed of convergence differs by country (D_c). In order to avoid multicollinearity, we perform the latter two tests separately. μ_{kc} denote industry type*country dummy interaction terms.[4]

In the steady state, when industry structure per definition remains constant, growth rates have to be equal in all industries and countries. Nevertheless, in

[4] Since we control for fixed country, industry type and country*industry type interaction effects, a further relaxation of the assumptions on the error structure (e.g. assuming that the error terms are correlated within countries but uncorrelated across countries) did not alter our results.

the data we find growth differentials even for prolonged periods. We prefer to interpret these differentials as the impact of transitory shocks showing up in the 13-year averages over the estimation period and not as long run growth differentials, which would rule out convergence in structure by definition. Specifically, as no reliable deflators are at hand and we have to use nominal values, these dummies pick up changes in the macroeconomic environments like devaluations in course of the break down of the EMS in the beginning of the 1990s and/or industry type specific shocks.

Convergence in labor productivity (which is denoted by p_{ict}) can be analyzed in the traditional manner. We likewise look at the relative figures:

$$\frac{1}{T}\left(\ln\frac{p_{icT}}{p_{ic0}}-\ln\frac{p_{i.T}}{p_{i.0}}\right)=-\frac{1}{T}\left(1-e^{-bT}\right)\ln\frac{p_{ic0}}{p_{i.0}} \tag{7}$$

We assume the growth rate of labor productivity of the respective aggregate EU-industry as the steady state growth rate, which implies that $\ln\frac{p^*_{iT}}{p^*_{i0}}=\ln\frac{p_{i.T}}{p_{i.0}}$.Note, that the steady state growth rate of labor productivity is industry-specific, but country-invariant. For ease of comparison, we specify the same regression as in (6) to measure the speed of convergence in labor productivity.

β-convergence is a necessary but not sufficient condition for convergence (Barro, Sala-i-Martin, 1995). Therefore, we additionally look at σ-convergence and investigate for each industry, whether the standard deviation of the country shares (corrected for the estimated steady state country share) as well as that of relative productivity decreased over time. We denote σ_0^2 as the variance for a particular industry in 1985, and σ_T^2 as that in 1998, and test for the hypothesis $\sigma_T^2=\sigma_0^2$ using the T_2- and the T_3-statistics derived in Carree and Klomp (1997).[5]

3 Data and estimation results

Eurostat provides data on nominal value added and employment for manufacturing industries at the 3-digit level for the member countries of the European Union (EU) covering the period 1985-1998. In some countries values are not provided for all industries (mostly for reasons of confidence and problems which have evolved from the reclassification of NACE codes). The Austrian Institute of Economic Research (WIFO) interpolated or estimated missing data, constructing a full and comprehensive database (for detailed variable definitions see Appendix I).

[5] Formally, we test whether the regression $y_{icT}=\pi y_{ic0}+\upsilon_{icT}$ (y is either $\ln s_{ict}-\ln s_{.ct}$ or $\ln p_{ict}-\ln p_{i.t}$) implies constant variance. If the starting value $y_{ic0}\sim N\left(0,\sigma_0^2\right)$ and $\upsilon_{icT}\sim iid.$ $N\left(0,\sigma_\upsilon^2\right)$, this is the case if $\pi^2=1-\frac{\sigma_\upsilon^2}{\sigma_0^2}$. In contrast, there is σ-convergence if $\pi^2<1-\frac{\sigma_\upsilon^2}{\sigma_0^2}$. Carree, Klomp (1997) provide a likelihood-ratio test which performs well even in small samples. There is additionally the T_3-statistic, which has often higher power, when the simulated significance level is close to the theoretical one (see ibid., p. 686).

We use nominal value added in ECUs, since deflators at the three-digit level are of poor quality, and methods of measurement differ across the EU-member countries. Productivity is defined as nominal value added per employee.[6]

Table 1 provides summary statistics. Initially, Portugal exhibited the lowest productivity level and Sweden the highest. In 1998, Austria had higher than EU average productivity levels, Sweden and Finland lost their productivity lead. Belgium remained a high productivity country throughout the period. The median rate of nominal growth in a typical 3-digit industry amounted to 3.5% p.a. during the thirteen-year period 1985-1998, median productivity increased by 4.4 %, and employment shrank by 1.0 %.

The Portuguese manufacturing industries performed best, growing by 8.0% per annum in nominal terms, this high median growth rate is also confirmed by the real figures. At the bottom end of the scale, Sweden and Finland experienced a period of deep recession during the nineties.

Table 1

Panel A of Table 2 presents our results for uniform convergence, i.e. the only explanatory variable is the initial relative share. We also provide estimates for the speeds of adjustment and the implied half-lives of adjustment (for definitions, please see the notes to Table 2). There was significant β-convergence at the 3-digit industry level in nominal value added shares, employment shares, and productivity during the period 1985 to 1998 in the member countries of the European Union. However, with estimated speed of adjustment coefficients of 0.013 for value added and employment shares, and expected half-lives of adjustment of more than fifty years, structural convergence has been very slow or even non-existent.

In contrast, convergence of relative labor productivity is quite rapid and highly significant, with an estimated β-coefficient of -0.033 and a t-value of around ten. This implies that we predict that industries which, in 1985, lagged behind in labor productivity relative to the EU average would close half of a given gap in around sixteen years, which is approximately three times faster than convergence in structure. Below we will see, that convergence is much faster for some types of industries.

Panel B of Table 2 presents the results including interaction terms of the initial relative share and industry types. We classify 23.5% of the industries as neither skill nor capital intensive, 26.5% as skill but not capital intensive, 31.2% as capital intensive but not skill intensive, and 18.8% as skill and capital

[6] Several arguments defend our approach. First, we include fixed country effects to capture transitory country specific differences in inflation and exchange rate movements, etc. Second, we test for the robustness of our estimation results for productivity by matching data from the OECD-STAN database, which provides information on real and nominal value added, mainly at the two-digit level. We calculate the implicit deflators and impute them at the three-digit level. The correlation between growth in nominal and real value added across countries and industries is 0.83. Our estimation results do not vary substantially (see Appendix II) confirming our view that relying on nominal value added does not distort our conclusions.

intensive. Further, convergence should occur from initial positions above and below the steady state. In the table the neither skill nor capital intensive industries are the base. The coefficient β-ABOVE tests whether convergence from "above" and "below" takes place at the same speed.

Table 2

Structural convergence speeds are a bit lower if the industry starts out with a larger share. This may be due to rigidities in labor markets which prevent faster adjustment to the steady state from above, in particular as this implies laying off people. Interestingly, it appears that productivity leads are faster eroded as productivity laggards catch up.

Turning now to our skill/capital intensity industry classification, the following conclusions emerge. We measure the fastest speed of productivity convergence for neither skill nor capital intensive industries with a half-live of adjustment of less than 13 years. This is intuitive, since high skill or capital requirements may errect barriers to knowledge transfer or proxy for high "absorptive capacity" needs. However, β-coefficients are not significantly different from each other for productivity convergence, implying that productivity catch-up takes place in all types of industries in Europe. In contrast, there is no structural convergence in purely capital intensive industries, although there is convergence in structures in skill *and* capital intensive industries. One explanation is that factor mobility, e.g. via migration of high-skilled workers, is higher in skill intensive industries, and this induces industrial structures to convergence. In contrast to productivity, convergence speeds for industrial structure differ significantly across industry types. This underlines our claim that productivity convergence occurs across the board without the necessity that industrial structures convergence.

Table 3 presents the results allowing for industry-type differential convergence as well as for unobserved fixed industry-type and country heterogeneity.

Table 3

All our results are robust to this heterogeneity. We estimate that half of any productivity gap is closed in nine to sixteen years depending on the type of the industry. Nearly fifty percent of the total variation in productivity growth is explained by this simple regression. Fixed country as well as country*industry-type interaction effects are highly significant in all three equations. As already discussed, we interpret the fixed country effects as capturing transitory differences in business cycles, but also - since we use nominal variables - as controlling for the cross country variation in exchange rate movements and inflation rates. Thus, we do not view the significant fixed country effects as implying different long run steady state growth rates, since the economies involved are characterized by a high degree of economic integration.

Our database permits the analysis of differential country convergence (Table 4). On average, convergence is fairly uniform for both nominal value added and employment shares, although the F-test rejects the hypothesis of equal speeds of convergence for value added shares at the 10 percent level. There is one country with no convergence in value added structure (Sweden). Thus, while there are signs of increased integration via structural convergence in most EU countries, the tendency to converge to a common EU industry structure is rather slow and in some countries non-existent. Idiosyncratic country characteristics and/or policies remain important.

Table 4

While we measure significantly (at the 5 percent level) different convergence speeds for labor productivity, *all* country-wise $\beta-$coefficients are negative and significant for nominal labor productivity. Thus, productivity convergence takes place in all countries of the European Union.

The interpretation of a negative β-coefficient as evidence for convergence has been criticized in the literature (see Quah, 1993; Friedman, 1992). The criticism argues that a negative sign of the initial-condition coefficient does not indicate a collapsing cross-sectional distribution, but simply the Galtonian fallacy of a regression towards the mean. We respond to this criticism by additionally analyzing σ-convergence.

Consistent with our results for β-convergence, Table 5 shows that there is σ-convergence only for productivity. In more than 70 % of the 99 industries, the cross country standard deviation declines; in 43.4 % of the industries this decline is significant at the 10% level according to the T_3-statistic of Carree and Klomp (1997). σ-convergence for industrial structure is much weaker. Only around one third of the industries exhibit structural convergence, significantly so only 2-11% depending on the statistic chosen.

Table 5

4 Discussion

Our estimates for labor productivity convergence are much higher than those previously obtained in the literature. For example, Bernard and Jones (1996a, 1996b) obtain an only marginally significant β-coefficient of -0.026 (t-value = 1.78) for total manufacturing labor productivity (real value added per worker) for 14 OECD countries over the 1970-1987 period. Carree et al. (2000) estimate a β-coefficient of -0.195 (t-value = 1.79) for the 21 year period 1972-1992, implying a yearly value of around -0.01.From Table 2, we obtain a much larger β-coefficient in absolute terms (i.e. unconditional convergence) of -0.033 with a t-value of around ten. For conditional convergence from Table 3 (i.e. including country fixed effects), we also obtain much larger values of between -0.032 (skill and capital intensive industries) and -0.075 (neither skill nor capital intensive industries). This implies that either (1) convergence accelerated during the last decade, and/or (2) convergence was much faster intra-EU than when countries outside of the EU are included (e.g. Bernard and Jones (1996a, b) and Carree et al. (2000) include Australia, the US, Canada, and Japan), and/or (3) the level of disaggregation (i.e. the unit of analysis) should really be at or beyond the 3-digit level in order to accurately assess industrial convergence.[7]

The results about productivity convergence conform to Dollar and Wolff (1988, 1994). They find convergence in nearly every individual industry and conclude that convergence in productivity within industries is the main cause of convergence in aggregate labor productivity. In contrast, Bernard and Jones (1996a, b) claim that while aggregate productivity was converging for a group of 14 industrialized countries over the 1970 to 1987 period, individual sectors show quite disparate behavior. In particular, convergence in the manufacturing sector was only marginally significant, while convergence in the service sector was significant at standard levels. Carree et al. (2000) find large inter-industry differences in convergence, part of which can be explained by knowledge and capital barriers. The above studies do not, however, analyze convergence in structure.

Studies also looking at convergence in structure are those by Pugel (1992), Beelen and Verspagen (1994), and Dalum et al. (1996). Pugel (1992) finds that the growth rates of manufacturing industries within Europe (EU-12), the US, and Japan vary widely, indicating substantial structural change. Dalum et al. (1996) find slow but significant de-specialization in exports of the OECD-countries. Beelen,Verspagen (1994) compare convergence in productivity and in trade specialization for a sample of mainly OECD countries at the two digit industry level over the period 1963 to 1988. Their estimates of speeds of convergence of productivity and trade patterns are comparable to ours for the 1990s, although theirs differ across sectors while ours differ across countries and industry types.

5 Conclusions

This paper unearthed an apparent puzzling result. We find very fast convergence in productivity for 99 3-digit European industries over the 1985-1998 period. The speed of convergence is much higher than obtained previously in the literature. Convergence in productivity, however, is not accompanied by convergence in industrial structure (measured by nominal value added and employment shares) which is much slower or in most industries even non-existent. The type of the industry, i.e. whether it is skill and/or capital intensive, is much more important for structural convergence than for productivity convergence.

No single trade or growth model can convincingly explain rapid productivity convergence combined with much slower convergence in structure. Explanations for the higher persistence of industry structure as compared to productivity differences come from the endogenous growth theory, the theories of geography and trade as well as from evolutionary approaches. Assuming perfect spillovers

[7] Carree et al. (2000) compare the 2nd digit level (28 industries) with the 1st digit level (ISIC 3, total manufacturing), and also find that the average rate of convergence at the lower level of aggregation is likely to be higher than that at the higher level of aggregation.

between countries, Helpman, Grossman (1992) obtain persistent differences in production structure while productivity grows at an equal steady state rate. Forces of agglomeration may preserve industry structure for some time despite convergence in productivity and/or labor costs (Fujita et al., 1999). Evolutionary models emphasize the cumulative and path dependent character of technological change (Fagerberg, 1994) as an explanation for persistent structures.

Our results entail important policy implications. If it is the case that productivity catch up is quite rapid despite relatively modest structural convergence, European integration and the accession of new member countries to the EU may proceed at a relatively fast pace, since productivity converges irrespective of existing (and probably persisting) differences in structure. Nevertheless, to arrive at a fuller picture what determines growth and structure, one certainly should find additional observables at the country and detailed industry level to *explain* productivity catch up despite persistence in structure.

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Appendix I: The database

Our database comprises information at the 3-digit level for manufacturing from NACE 15 to 36 for the period 1985-1998 and 14 EU- countries (Belgium and Luxembourg are treated as one country). Nominal value added and employment are from the SBS-database (Structural Business Statistics), provided by EUROSTAT. Real and nominal value added (STAN-database, OECD) are used to calculate implicit deflators (1990=100), which are imputed at the 3-digit NACE level. The data are converted from ISIC Rev.2 to NACE Rev.1. The real values are calculated in 1990 ECUs. For Ireland and the Netherlands and also for some industries, these data are missing.

There are missing values because (i) some values are confidential, (ii) some countries did not report at the three-digit level in 1985, and (iii) there is no 1:1 concordance between the old NACE-classification an the new NACE-Rev. 1 classification, which has been introduced in 1996. The Austrian Institute of Economic Research (WIFO) estimated the missing values using information on the corresponding 2-digit figures, information from outside (e.g. STAN-OECD) or using interpolation procedures. See Aiginger et al. (1999) for more details. Overall, in 1998 24% of the values are estimated and for 1985 this figure amounts to 48%. The latter figure is much higher because Austria, Finland, Portugal and Sweden did not report 3-digit figures at that time. See Table A1 for a breakdown of estimated values by country and year.

Table A1

Skill intensity is defined as the share of white-collar high-skilled workers in the industry in 1990, whereby these include legislators, senior officials, managers, professionals, technicians and associate professionals (see OECD, 1998). The occupational data are based on the International Standard Classification of Occupations of the International Labour Office, ISCO 88. The mean value is 22% (range 10% to 57%). This variable does not vary across countries. We use productivity as a proxy for the capital intensity of an industry. Industries with high levels of labor productivity use, on average, technologies with a higher capital intensity than industries with a low level of labor productivity.

Appendix II: Estimation results for real productivity

Table A2 shows that the results for real productivity convergence do not change our conclusions; on the contrary, the speed of real productivity convergence is higher than for the nominal variable.

Table A2