NBER WORKING PAPER SERIES

IS POLAND THE NEXT SPAIN?

Francesco Caselli
Silvana Tenreyro

Working Paper 11045
http://www.nber.org/papers/w11045

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
January 2005

We would like to thank Richard Clarida, Juan Dolado, Jeff Frankel and participants at the 2004 ESOM conference in Iceland for helpful comments and suggestions. All errors are our own. The views expressed in this paper do not necessarily reflect those of the Federal Reserve Bank of Boston nor the Federal Reserve System. The views expressed herein are those of the author(s) and do not necessarily reflect the views of the National Bureau of Economic Research.

Is Poland the Next Spain?
Francesco Caselli and Silvana Tenreyro
NBER Working Paper No. 11045
January 2005
JEL No. F15, F43, N10, O11, O14, O47

ABSTRACT

We revisit Western Europe's record with labor-productivity convergence, and tentatively extrapolate its implications for the future path of Eastern Europe. The poorer Western European countries caught up with the richer ones through both higher rates of physical capital accumulation and greater total factor productivity gains. These (relatively) high rates of capital accumulation and TFP growth reflect convergence along two margins. One margin (between industry) is a massive reallocation of labor from agriculture to manufacturing and services, which have higher capital intensity and use resources more efficiently. The other margin (within industry) reflects capital deepening and technology catch-up at the industry level. In Eastern Europe the employment share of agriculture is typically quite large, and agriculture is particularly unproductive. Hence, there are potential gains from sectoral reallocation. However, quantitatively the between-industry component of the East's income gap is quite small. Hence, the East seems to have only one real margin to exploit: the within-industry one. Coupled with the fact that within-industry productivity gaps are enormous, this suggests that convergence will take a long time. On the positive side, however, Eastern Europe already has levels of human capital similar to those of Western Europe. This is good news because human capital gaps have proved very persistent in Western Europe's experience. Hence, Eastern Europe does start out without the handicap that is harder to overcome.

Francesco Caselli
Harvard University
Department of Economics
Littauer Building
Cambridge, MA 02138
and NBER
caselli@harvard.edu

Silvana Tenreyro
Federal Reserve Bank of Boston
silvana.tenreyro@bos.frb.org

1 Introduction

Western Europe is the quintessential convergence club. In 1950, real labor productivity in some of its richest countries was more than three times that of some of its poorest. By the end of the century, all Western European labor-productivity ratios were well below two. One aspect of this decline in cross-country European inequality is, of course, the catch-up by the Southerners: Italy first, then Spain, Greece, Portugal, and eventually Ireland (a Southerner in spirit) all had their spurts of above-average productivity growth. Spain's experience is emblematic and inspiring: In less than 15 years between the late 1950s and the early 1970s, its labor productivity relative to France's (our benchmark for the "average" European experience) went from roughly 65 percent to over 90 percent.

On May 1, 2004, the European Union (EU) admitted 10 new members, primarily from Eastern Europe. To varying degrees, the Easterners' current relative labor productivities are similar to the relative labor productivities of the Southerners before their convergence spurts. For example, Hungary today is almost exactly as productive relative to France as Greece was in 1950, while Poland is roughly as productive – always relative to France – as Portugal was then. This widely noted analogy has naturally given rise to hopes that the Easterners will be the new Southerners, and Poland, the new Spain. Indeed, this hope is one of the very reasons why these countries have wanted to join (and several others hope to join) the club.

Given that so many people are pinning so many hopes on the continued ability of the European club to generate convergence among its members, this seems a useful time to re-visit the data on the relative growth performance of European countries in the second half of the 20th century. Our main aim is to look behind the aggregate labor productivity numbers and present a couple of different approaches to "decompose" the overall convergence experience into more disaggregated processes. We make no claim of methodological or conceptual innovation: Our goal is to organize all the data "under one roof" and take stock.

We organize the discussion around four views or hypotheses potentially explaining the convergence process. The first view is grounded in the Solovian-neoclassical hypothesis, according to which initially capital-poor countries have higher marginal productivity of capital, and hence faster growth. The second hypothesis, motivated in part by endogenous growth models, explains the convergence process as the result of technological catch-up. Backward countries converge to the technological leaders mainly through a process of imitation (which is presumably cheaper than innovation). The third hypothesis interprets the convergence process as driven mainly by gains from trade from European integration, which may have been disproportionately larger for the poor economies (as a proportion of GDP) both because of their initially more autarchic status and because of their relatively smaller size. The fourth and final hypothesis views the convergence process as a by-product of the

structural transformation, which is partially a process of reallocation of resources from low-productivity to high-productivity sectors. If initially poorer countries had a longer way to go in this transformation, this process may itself have been a source of convergence.

With respect to the relative contributions of capital deepening and technological change to the reduction of European inequality we find that physical capital accumulation and total factor productivity (TFP) growth were roughly equally important. However, somewhat surprisingly, we also find virtually no role for human capital accumulation: Differences in human capital per worker – at least, as measured by years of schooling – are both substantial and persistent. Another somewhat surprising result is that TFP was not always initially lower in poor countries, a fact that is hard to reconcile with catch-up theories of technological diffusion.

As an explanation for regional convergence the trade view runs into some problems. For example, countries with a comparative disadvantage (or no advantage) in agriculture invariably show larger shares of agriculture, while countries with a comparative advantage in agriculture tend to show systematically lower shares. The structural-transformation approach fares better. For example, we find that Southerners converged to the rest mainly through a faster rate of reallocation of the labor force from low-productivity agriculture into high-productivity manufacturing and services. However, in other cases within-industry productivity catch-up was also quite important.

When we turn our attention to 13 (mostly) Eastern European countries that have either recently joined the EU, or are in line to join, we tend to find very large labor productivity gaps vis-à-vis Western Europe. In accounting for these gaps, we find substantial roles for physical capital and TFP gaps, but no role whatsoever for human capital gaps. This is in a sense good news for the Easterners, because the Western European experience suggests that human capital gaps are the hardest to bridge.

Like Portugal, Spain, Italy, and Greece 50 years ago, the new and forthcoming EU members exhibit substantially larger shares of workers employed in agriculture, which tends to be the least productive sector. Manufacturing and services are also less productive in the East than in Western Europe, though the gaps are not as large as in agriculture. There is, therefore, some scope for large productivity gains through both labor reallocation out of agriculture and within-industry catch-up. However, quantitatively, in Eastern Europe the distribution of employment among sectors is much less important as a source of income gaps vis-à-vis the rest of Europe than it was in Southern Europe in 1960. Hence, in a way, the Easterners have only one margin to exploit in their quest for convergence – the within-industry productivity gap. In contrast, the South was also able to exploit the between-industry margin.

There are, of course, several other authors who have looked at Western European con-

vergence from various angles. These include Barro and Sala-i-Martin (1991), Quah (1996), and Boldrin and Canova (2001). There are also several excellent studies of individual countries' convergence experiences, such as Honohan and Walsh (2002) and Oltheten, Pinteris, and Sougiannis (2003). Finally, the idea of using the experience of other countries/regions to speculate on the convergence prospects of Eastern Europe is also not new: see, among others, Fisher, Sahay, and Vegh (1998a, 1998b) and Boldrin and Canova (2003). Our contribution, however, looks at the data from a different perspective and is thus complementary to the existing ones.

The remainder of this paper is organized as follows. In Section 2, we review the European experience with labor-productivity convergence in the second half of the 20th century. In Section 3, we discuss various possible views one can advance to explain the convergence process. In Sections 4 and 5, we take a look at more disaggregated data to try to shed light on the explanatory power of the various approaches. In Section 6, we introduce the Easterners, and compare their characteristics with those of the Southerners before their catch-up. We summarize and conclude in Section 7.

2 European Convergence 1950-2000

The point of this section is to refresh our memories on the basic fact of European convergence. This is done in Figure 2.1, where we plot, for each of 14 Western European countries, per worker GDP in purchasing power parity (PPP) relative to France. We choose France as a benchmark because its growth experience between 1950 and 2000 is virtually identical to that of the average European country. In fact, the ratio of per-worker GDP (in PPP) of France relative to the European (population-weighted) average is practically 1 throughout the whole period. The 14 countries are the other members of the European Union (pre-May 1), less Luxembourg plus Norway.[1] The data for Figure 2.1 come directly from the Penn World Table, Version 6.1 (PWT) and measure GDP per worker [via the variable GDPWOK. See Heston, Summers, and Aten (2002)].[2]

In order to highlight the convergence outcomes we draw horizontal lines in each graph through 0.9 and 1.1. Note that 13 of the 14 countries start out outside this range, and 10 out of 14 end up inside (or right at the threshold). Furthermore, in three of the four cases in which relative GDP is still outside our "convergence band," the distance from the band has nevertheless declined considerably. The overall reduction in inequality is dramatic. To cap it

[1] Hence, other than city-states, we are missing only Iceland and Switzerland, for which there were too many gaps in some of the data we use later in the paper.

[2] For Germany we actually use the series on Western Germany from Version 5.6 of PWT up to 1990 and the series on Germany from Version 6.1 thereafter.

all, the only case in which the absolute distance from France has increased rather than fallen is not so much a case of failed convergence but one of, so to speak, "excessive convergence": Ireland started out poor, converged from below, and then forgot to stop – ending up the most productive in Europe. It is now well above the upper bound of the convergence band.

The geographical patterns are also well known but nonetheless striking. Note that the country graphs are arranged in increasing order of latitude (using the countries' capitals as the reference points). The Southerners (Greece, Portugal, Spain, Italy, and Austria) all start out poorer and experience various degrees of catching up. Spain, Italy, and Austria fully make it; Greece has virtually made it by 1975, but then slips and loses some (but by no means all) of the gains between 1975 and 1995; Portugal's progress is slower, but it seems on track to reach the lower edge of the band in the not-too-distant future. Then there are most of the "Northerners" (Belgium, the United Kingdom, the Netherlands, Denmark, Sweden, and Norway), which start out richer than France and converge "from above" to within 90 percent and 110 percent of France's labor productivity -- with the minor exception of Belgium, which ends up slightly above the upper boundary. Germany is the geographical and economic "in-betweener," starting and ending within the 90 to 110 band. The only two serious deviations from the geographical-economic pattern are Finland, which converges from below instead of from above like the other high-latitude countries; and Ireland, which is exceptional both because it converges from below instead of from above, and because – as we have already seen – it fails to stop after converging.

Of course, convergence from above by the Northerners really means that France has caught up with them. Hence, what Figure 2.1 truly tells us is that there has been a generalized catching up from South to North or that the growth rate has been, on average, decreasing with latitude fairly smoothly.

As mentioned in the Introduction, the rest of this paper explores a couple of ways of peering into the black box of the convergence processes depicted in Figure 2.1 in the hope of shedding some light on some of its mechanics.

Before proceeding, we quickly dispose of a secondary issue having to do with entering into formal membership in the EU. Figure 2.2 is identical to Figure 2.1, except that it adds a vertical line for the date at which each country joined the European Community. Visual inspection suggests that it is extremely hard to argue for an important role for formal EC (later, EU) membership *per se* in facilitating convergence. Italy, Spain, Greece, and Austria all had their convergence spurts before formally joining European institutions, and the Northerners lost ground whether or not they were in the EC/EU. One can squint at the behavior of the relative income series around the dates of accession, but no systematic "kink" up or down seems to be associated with that date. What seems to matter for convergence is

not so much entry into formal membership in European institutions, but rather – if anything – participation in a generalized trend towards greater economic integration at the European level. This integration would probably have occurred with or without the EC.[3]

3 Four Ways to Converge

Depending on one's background and tastes, there are at least four possible reactions to the graphs in Figure 2.1 and to the convergence processes they describe. In this section we briefly outline these four possible responses, and in the rest of the paper we query the available data for the corresponding supporting evidence. We stress at the outset that the four views are not mutually exclusive.

1) Solovian convergence. If you are steeped in neoclassical growth theory [Ramsey (1928), Solow (1956), and subsequent developments] you will be strongly tempted to interpret Figure 2.1 in terms of capital deepening. The idea, of course, is that initially capital-poor countries have higher marginal productivities of capital. This leads them to grow faster than initially capital-rich countries. This argument still works if you take a broader view of capital, to include human capital [Mankiw, Romer, and Weil (1992)]. It is also independent of whether one thinks the capital is generated by domestic savings or flows in from abroad – though that may affect the speed of convergence [Barro, Mankiw, and Sala-i-Martin (1995)]. This Solovian interpretation of convergence processes motivates much of the growth-regression literature of the 1990s [Barro (1991), Barro and Sala-i-Martin (1992), and all the rest]. It also finds strong support in growth accounting exercises for East-Asian miracle economies [Young (1995)].

2) Technological catch-up. If instead you have been captivated by so-called "endogenous-growth" models [Romer (1990), Grossman and Helpman (1991), Aghion and Howitt (1992)], you may tend to read in the graphs of Figure 2.1 the effects of technological catch-up by initially backward countries. In particular, you will have in mind models where imitation is less costly than innovation, so that countries initially behind the world technology frontier experience faster improvements in technology than the leaders [for example, Nelson and Phelps (1966), Krugman (1979), Barro and Sala-i-Martin (1997), Howitt (2000)]. Empirical work on cross-country TFP growth is generally motivated by this view [for example, Coe and Helpman (1995), Coe, Helpman, and Hoffmaister (1997)]. Evidence that cross-country income differences are largely due to differences in TFP is also consistent with this view [for example, Klenow and Rodriguez-Clare (1997), Hall and Jones (1999)].

[3]Some authors use growth regression techniques to estimate the coefficient of an "EC-dummy." Results are mixed. Even if it were more strongly in favor of a positive EC-effect, however, this type of evidence does not bear directly on the issue of the sources of convergence. A positive coefficient on the EC-membership dummy means that EC members grow faster than non-EC members, not that they should converge to one another.

3) Gains from trade. If you are a trade theorist your instinct may be to interpret the graphs in terms of gains from trade. In particular, suppose (realistically) that initially the richer European countries were more integrated among themselves and with the rest of the world than the poorer ones. Suppose further (and also realistically) that over the second half of the century the poorer countries gradually became more integrated with the rest. Then not only should they have experienced gains from trade but also – due to their initially more autarchic status – their gains from trade should have been larger as a proportion of GDP than those of the richer economies: Hence, the convergence. The fact that poorer countries have tended to be smaller is another reason to expect disproportionate gains by these countries and ultimately convergence.

It is customary to object to trade-based interpretations of rapid growth that the theory predicts higher income levels, not higher growth rates. But looking again at Figure 2.1, one cannot reject outright the hypothesis that convergence was the result of one-off, discrete jumps in income levels. Consider again the fewer than 15 years it took Spain to recover from a 25-percent productivity handicap, or the 10 years or so it took Greece to bridge an even larger gap. Furthermore, it is actually possible – exploiting the idea of a "ladder of comparative advantage" – to turn the static gains-from-trade theory into a dynamic one [Jones (1974), Findlay (1973), Kruger (1977), and Ventura (1997)].[4]

4) Structural transformation. If you are an old-fashioned macro-development economist, you are used to thinking about the growth process as inextricably linked with structural transformation: vast reallocation of resources from one industry to another. The early classics include Clark (1940), Nurske (1953), and Lewis (1954), among others. There is more systematic recent work by Imbs and Wacziarg (2003) and Koren and Tenreyro (2004). If resources are reallocated from low-productivity to high-productivity sectors, this structural transformation is itself a source of growth. If Southern countries – as is likely – underwent a more radical structural transformation than Northern countries during the 1950 to 2000 period, then this is also a source of convergence.

This reasoning is best illustrated by recent work on another South-to-North convergence, that of the southern United States to the rest of the United States over the 20th century [Caselli and Coleman (2001)]. At the beginning of the century, the South was overwhelmingly agricultural, while the rest of the United States was predominantly specialized in manufacturing and services. Since agriculture had much lower output per worker, the South

[4]Not all trade theorists will look at Figure 2.1 with comparative advantage in mind. Readers of Helpman and Krugman (1989) may view increased integration as allowing for increasing returns in the presence of intra-industry trade. We do not attempt to assess this view in the present draft (except for a brief remark in footnote 16), but perhaps in the future we can explore this by seeing whether there have been particular gains in labor productivity in sectors experiencing the biggest increases in trade.

also had much lower aggregate labor productivity. Over the decades, the U.S.-wide cost of migrating from the agricultural sector to the non-agricultural ones declined sharply, mainly as a result of improved access to schooling for rural children. In turn, the lower cost of migration to the more productive sectors led to overall aggregate productivity gains. However, these productivity gains were disproportionately concentrated in the South, which had the largest share of workers initially trapped in agriculture. Perhaps the Southern Europeans also had their labor force initially disproportionately concentrated in low-productivity industries?

We should stress that the mapping between the accounting exercise that follows and the four convergence hypotheses we study is not perfect. The accounting analysis is aimed at providing guidance as to the main forces behind convergence, and hence the results should be taken as suggestive indications rather than as conclusive verdicts.

4 Solovian Convergence and Technological Catch-Up

In this section we tackle the first two of the possible views of convergence we listed in the previous section: the capital deepening explanation associated with the Solow and other neoclassical models of growth, and the technology-diffusion explanation, which would be emphasized by endogenous growth theories.

Our approach will be to decompose the convergence series plotted in Figure 2.1 into three components: convergence in physical capital, convergence in human capital, and convergence in Total Factor Productivity. The sum of the first two may be seen as the contribution of Solovian convergence, while the third may capture the contribution of technology catch-up. Plainly, this approach is a hybrid of *growth accounting*, which decomposes growth rates into capital growth and TFP growth, and *development accounting*, which decomposes cross-country differences in income *levels* into capital and TFP. Here, since we decompose *relative* growth rates, we have both the time and the cross-country dimension. Hence, we may term the exercise we perform *convergence accounting*.

More specifically, we will use the following familiar-looking expression:

$$\Delta \log y_{it}^R = \alpha \Delta \log k_{it}^R + (1-\alpha)\Delta \log h_{it}^R + \Delta \log A_{it}^R, \tag{1}$$

where α is the capital share in output, and Δ is a first-difference operator. The only slightly unusual aspect is that output, inputs, and total factor productivity are measured relative to those of France. Hence, y_{it}^R is aggregate labor productivity in country i relative to aggregate labor productivity in France, k_{it}^R and h_{it}^R are relative physical and human capital, and A_{it}^R is relative TFP.[5]

[5]Of course, equation (1) can be interpreted as an approximation for the growth rate of relative labor productivity when the production function (per worker) is $y = Ak^{\alpha}h^{1-\alpha}$.

Data on y_{it}^R are of course the data we plotted in Figure 2.1. For k_{it}^R and h_{it}^R we need to construct time series for each country's physical and human capital stocks. We construct physical capital stocks from the Penn World Tables (PWT) series on real investment. Investment data start in 1950. To initialize the capital stock we assume that the growth rate of investment up to 1950 has been the same as the observed growth rate of investment between 1950 and 1955.[6] In order to minimize the bias arising from this arbitrary choice of initial value of the capital stock we begin our convergence decomposition in 1960. Little is lost by this curtailing of the time series as most of the important convergence spurts (with the exception of Italy) begin right around, or after, this date.

To construct data on h_{it}^R we mostly use the De La Fuente and Domenech (2002) data set on average years of schooling in the OECD. However, De La Fuente and Domenech data stop in 1990 or 1995, depending on the country. To extend the series to 2000 we use the growth rates (over the relevant periods) of the corresponding series in the Barro and Lee (2001) data set – in combination with the latest level reported by De La Fuente and Domenech.[7] With these data at hand, we follow the development-accounting literature and estimate each country's human capital as $h_{it} = \exp(\beta s_{it})$, where s_{it} is the average years of schooling in the labor force, and β is the Mincerian rate of return to one extra year of schooling. We set $\beta = 0.10$, which reflects a broad consensus on the average returns to schooling around the world. Finally, following yet again the development-accounting literature, we set $\alpha = 0.33$. We report later on how results change when using country-specific capital shares.[8]

Before proceeding to the formal results, we spend a minute looking at the time series in Figure 4.1, where we plot the time paths of k^R, h^R, and A^R for all countries. For physical capital we see patterns of convergence that broadly resemble those in Figure 2.1: Poor countries started out with lower physical capital levels than France and accumulated faster over time, while rich countries started out with more capital and accumulated more slowly than France. This is very Solovian. The only exceptions are Italy, which by 1960 already had a level of capital intensity very close to France's (and kept it that way thereafter), and the

[6]Hence, $K_{1950} = I_{1950}/(g + \delta)$, where g is the investment growth rate between 1950 and 1955, and δ is the depreciation rate. Young (1995) follows a similar approach. Following the development-accounting literature we set $\delta = 0.06$.

[7]An alternative would have been to use Barro and Lee throughout, but the De La Fuente and Domenench data are supposed to constitute an improvement over Barro and Lee for this set of countries. In the Appendix we compare the average years of schooling variable from the two data sets (Figure A.1). It does appear that the Barro and Lee numbers contain some surprising jumps in their series. The country rankings of attainment are also more consistent with our priors. In footnote 10 we report on the results of the convergence-accounting exercise when using the Barro and Lee data.

[8]For a survey of development-accounting methods see Caselli (2003). We will not bore the reader with the obvious list of caveats and disclaimers about the very rough and tentative nature of the exercise just described.

U.K., which in 1960 had lower capital intensity than France – despite being richer. Relative human capital in 1960 was also generally lower in poor countries and higher – or about the same as in France – in rich countries. However, unlike what we see for physical capital, relative human capital levels are extremely persistent, so that relatively human-capital-poor countries remain that way throughout the period. This is not very "augmented-Solovian" at all, and it implies that human capital accumulation cannot have contributed much to aggregate convergence. Two exceptions are perhaps Denmark and Norway, which have lost some of their human-capital advantage relative to the rest.

Initial relative TFP levels were lower in Greece, Portugal, and Austria, but rose after 1960, so technology catch-up contributed to these countries' convergence. In Spain and Italy, however, TFP was already at the same level as in France, or higher, in 1960. Still, after that date these two countries continued to outpace France in efficiency gains, so that technological change did contribute to their overall convergence. Basically, these countries used faster technological change (and Spain also faster capital deepening) to bridge the gap caused by their persistently lower human capital. For the initially rich countries, the expected pattern of initially higher and subsequently falling relative TFP is observed in the U.K., the Netherlands, and Sweden. However, Denmark's TFP is roughly at France's level throughout the period, so that its relative loss is entirely due to slower rates of physical and human capital accumulation. Norway actually starts out with lower TFP and converges to France from below, so that France's convergence to Norway occurs despite technological catch-up from Norway to France. One objection to the use of years of schooling as a measure of human capital is, of course, that it does not take into account the differences in the quality of education across countries. Caselli (2003) performs a development accounting exercise using quality-adjusted measures of human capital based on international tests and schooling inputs (pupil/teacher ratios and education spending) and finds that these differences are relatively immaterial. While level comparisons might be different from growth comparisons, Caselli's findings are somewhat reassuring.

The casual observations described before are made more precise in Table 4.1, which reports the formal results of the decomposition in equation (1). The first panel shows changes over the entire 1960 to 2000 period. Formally, this means that the Δ operator in equation (1) represents the 40-year difference. The first column reports the value of $\Delta \log y_{it}^R$ for each country. This is basically the same information already reported in Figure 2.1. Hence, for example, Greece's productivity relative to that of France increased by almost one-fourth, or roughly equivalently; over these 40 years Greece's average annual growth rate exceeded France's by little more than one-half percentage point. The biggest gain, of course, was posted by Ireland, whose productivity grew by 60 percentage points more than France's, followed

by Portugal. Italy's gain looks slightly more modest than those of the other Southerners because most of its convergence spurt took place in the 1950s. The biggest comparative losses were experienced by Sweden and the Netherlands, against which France gained about 30 percentage points of relative income.

The remaining three columns show how relative physical and human capital accumulation and TFP growth contributed to these changes in relative income. These numbers are illustrated in Figure 4.2, where the bars show the contribution of the three terms. (The sum of the bars corresponds to the total convergence to France.) The clearest indication to emerge from the table (as from the figure) is that in nearly all cases – despite substantial differences in levels, and aside from the already-noted two exceptions – convergence in human capital played a nearly insignificant role in driving aggregate productivity convergence.

This leaves it to physical capital and total factor productivity to share the role of proximate sources of convergence. Broadly speaking, in most cases relative TFP growth appears to have contributed slightly more to convergence than capital deepening, but the orders of magnitude of the two contributions are similar.[9] In view of the noisy nature of the data, it seems warranted to conclude that – as a general rule – Western European convergence is attributable in roughly equal parts to faster capital accumulation and technological improvement by the poorer countries. The only clear exceptions are Italy and Ireland, both of which converged overwhelmingly through relative efficiency gains, and Denmark, whose slowdown relative to France we have already noted to be entirely due to slower human and physical capital accumulation.

In sum, the glass is half full both for neoclassical and endogenous growth theorists: Poorer countries experienced faster physical capital deepening, and this explains about 50 percent of their relative gains; and they experienced faster TFP growth, accounting for the remaining 50 percent. But the glass is also half empty for both. Neoclassical growth theorists may be puzzled by the lack of convergence in human capital. And endogenous growth theorists may be disoriented by the fact that not all initially poorer countries lagged the rest technologically, so that their continued faster TFP growth does not square well with the technology catch-up story that these theorists would probably favor.

Inspection of Figure 2.1 reveals in many cases what may loosely be termed a "structural break" around 1975 (that fateful year!). Indeed, 1975 looks like the year of accomplished convergence for several countries. After that year, relative incomes tend to look much more stable. In the case of Greece there is actually a convergence reversal around 1975. For these reasons, it seems useful to present additional decomposition results for the 1960 to 1975 pe-

[9]This may seem puzzling given the apparently bigger swings of physical capital shown in Figure 4.1, but recall that k^R in equation (1) gets weighted by 0.33.

riod. This is done in Table 4.2, which is otherwise an exact replica of Table 4.1. Notable in this table are the truly exceptional relative performances of Greece and Spain during this sub-period, driven in equal parts by physical capital accumulation and TFP growth in the former and about two-fifths by capital and three-fifths by TFP in the latter. For completeness, in Table 4.3 we also show the convergence decomposition for the 1975 to 2000 period. Here we see with dismay the reversal of much of Greece's gains of the previous sub-period, driven once again in equal parts by a slowdown in capital accumulation and a (relative) technological falling-back; the solid gains that Portugal keeps posting, again attributable to both physical capital and TFP growth; and the TFP-driven explosion of Ireland.[10]

As a robustness check on our conclusions we repeated the capital-TFP convergence decomposition using country-specific capital shares instead of the common value of 0.33. Country-specific capital shares have recently been estimated by Gollin (2002) and by Bernanke and Gurkaynak (2001). Using figures from the latter paper, we found our main conclusion – that human-capital convergence played a very small role in cross-country productivity convergence – to be very robust. More specifically, the numbers for the contribution of human capital to convergence change very little. However, for some countries the relative contributions of physical capital accumulation and technology catch-up do change. In particular, for Greece in 1960 to 2000, convergence becomes overwhelmingly a matter of TFP convergence, while for Spain most of the action becomes concentrated on physical capital. Most of France's catch-up to the Netherlands becomes technological, while its physical-capital catch-up to Denmark and Norway becomes more pronounced (so that, correspondingly, these countries no longer vastly outpace it in TFP growth). The detailed results using country-specific capital shares are presented in Tables 4.4 to 4.7.

5 Trade and Structural Transformation

In this section we turn to interpretations (3) and (4) of the European convergence experience. According to explanation (3), gains from trade following European economic integration disproportionately benefited the (initially less integrated) poor economies. Explanation (4)

[10]There are some important differences in results when using the Barro and Lee (2001) data on years of schooling instead of those of De La Fuente and Domenech (2002). In particular, convergence in human capital becomes an important source of overall convergence for Greece and Spain. In the former, convergence in human capital almost entirely displaces convergence in TFP as a source of overall convergence, while in the latter it grabs half of TFP's contribution. (Of course, the contribution of physical capital is insensitive to measurement of human capital.) There are also several changes in the results for the Northerners. In particular, according to the Barro and Lee data, the Netherlands, Sweden, and Norway greatly outpace France in human capital accumulation, so that their convergence from above takes place despite strong divergence in human capital. Also, Finland's convergence from below becomes primarily a matter of human capital accumulation.

is that the initially poorer countries had the productive structure most distorted towards low-productivity sectors and that they therefore benefited proportionately the most from the gradual removal of barriers to inter-sectoral mobility.

It is easy to see why these two views can be assessed jointly: They have broadly opposite predictions on the patterns of structural change we should see across countries. In particular, by emphasizing specialization according to comparative advantage, the traditional trade view implies that productivity convergence should be associated with structural *divergence.* On the other hand, by envisioning a world in which all countries gradually shift resources to the greatest value-added sectors, the structural-transformation view predicts that productivity convergence should be accompanied by convergence in industrial composition as well.

In order to investigate these two convergence hypotheses we have put together a data set on the evolution of the industrial composition of output and employment in our 15 countries. Specifically, we have data on the value-added and number of workers employed in the following six sectors: (1) agriculture, hunting, and fishing (henceforth agriculture); (2) manufacturing, mining, and quarrying (henceforth manufacturing); (3) utilities; (4) construction; (5) transportation; and (6) everything else (henceforth, services). We would, of course, have preferred to work with more finely disaggregated data, but this is the best we have been able to do. We observe these data at five-year intervals, starting for most countries in 1955 (but in some cases in 1950 and in some others in 1960). We have assembled these data through a laborious process of parsing from many different sources, both international and national. We give details in the appendix.[11]

We begin the exploration of these data by looking at a series of graphs. Figure 5.1 shows for each country the evolution over time of the employment shares of agriculture, manufacturing, and services. (The other three industries together invariably account for a very small proportion of overall employment.) The textbook pattern of declining employment share of agriculture, increasing employment share of services, and inverted-U-shaped employment share of manufacturing is clearly visible in the graphs for most countries.[12] This is little more than a check on the basic reasonableness of our data. Still, it is useful to be reminded of the sheer magnitude of the differences in industrial composition among Western European countries in the 1950s. For example, all of the Southerners have employment shares of agriculture between 40 and 60 percent (roughly the level of the United States in 1880), while the Northerners have agricultural shares well below 30 percent – and in a few cases well below 10 percent. Fittingly, our "middle-of-the-road" benchmark, France, is in between,

[11]Given the paucity of organized information on this subject, especially for the early (and more interesting) period, the creation of this data set may well be the most important contribution of the present paper.

[12]See Ngai and Pissarides (2004) for a recent model that matches these empirical regularities.

with 35 percent. For completeness, Figure 5.2 shows the shares of the three "small" sectors. They jointly account, on average, for less than 15 percent of total employment.

That all of the club members have been steadily moving out of agriculture and (eventually) into services is neither surprising nor conclusive with respect to which interpretation of European convergence has more explanatory power. The more important question is whether the various countries are converging towards similar industrial structures – as predicted by a theory in which all countries shift resources towards the highest value-added sectors – or towards permanently different ones – as would be more consistent with a comparative-advantage explanation for convergence. To try to get a handle on this question, we plot in Figure 5.3 the sectoral employment shares in Figure 5.1 minus the corresponding shares in France. We also plot a horizontal line at 0 to better gauge whether the general movement is towards convergence in employment shares.[13]

The data show a general tendency towards structural convergence. The Southerners, together with Ireland and Finland, all start out with higher-than-average agricultural labor shares, but experience a substantial decline in these shares relative to France. Greece, Portugal, and Austria, though, have not yet closed the gap. The Northerners, in contrast, experience a significant increase in agricultural shares relative to France. Manufacturing shares also show remarkable convergence, with some overshooting in the cases of Portugal, Ireland, and Italy. The share of labor in services converges quickly for the Northerners, but less so for the Southerners.

Obviously, if we had all the sectors in the economy, the sum of all the lines would be zero. The persisting differences between the services shares in Greece and Austria and the services share in France are the mirror image of the persisting differences between the corresponding agricultural shares. For Italy, the services gap is made up by a symmetric gap in manufacturing. For Portugal, Ireland, and Finland, the services difference is partly compensated for by the overshooting in manufacturing, partly by a persistent gap in agricultural shares, and partly by an increase in these countries' shares of construction relative to France's, which is shown in Figure 5.4, together with the shares of the remaining (small) sectors relative to the corresponding ones in France.

In sum, at least judging by the coarse evidence of Figure 5.3, the conclusion seems to be that Western European countries did grow closer in industrial structure over the second half of the 20th century – as in the "structural-transformation" view of convergence – but there remain some potentially permanent differences in industrial composition – as in the "comparative advantage" view.

[13]The analytics in the next sub-section justify using employment-share differences instead of employment share ratios.

Another way to think about trade is to look at the relative labor productivities in the various sectors. In particular, under a comparative-advantage interpretation we would expect non-convergence to occur in those sectors in which labor productivity relative to the "average country" is relatively higher. For this reason, and also because it is interesting in and of itself, we plot in Figure 5.5 each sector's output per worker as a ratio of France's output per worker in the same sector. (We continue to choose France as a plausible stand-in for the average country).

We draw two lessons from these graphs. First, over time there has been significant convergence in the labor productivities of the various sectors towards French sectoral labor productivity levels. We will return to this important *within-industry* productivity convergence process shortly. Second, and more directly relevant to the discussion at hand, it actually does not look as if the remaining differences in industrial structure that seem to emerge from Figure 5.3 are dictated by comparative advantage. For example, looking at recent years, Italy seems to have a comparative advantage in services and a comparative disadvantage in manufacturing. Yet, as we have seen, its pattern of specialization has tilted towards manufacturing. Greece, which specializes in agriculture, has a comparative advantage in everything but.[14,15] An alternative way to look at this is through the plot of differences in sectoral shares with France against relative productivity.

Clearly, this reading of the data relies on all sectors being tradable. One may object, however, that services are very likely less tradable than both manufacturing and agriculture. Restricting the analysis to these two sectors, Greece does not exhibit any clear pattern of comparative advantage vis-à-vis France. Austria and Portugal seem to have a comparative advantage in manufacturing. But then it is certainly difficult for the comparative-advantage view to explain why Greece, Austria, and Portugal have larger shares of agriculture than France. Ignoring services, Italy and Spain exhibit a comparative advantage in agriculture with respect to France until 1970, when the comparative advantage shifts in favor of manufacturing. A similar pattern emerges for Ireland, although the shift occurs more than two decades later. Throughout most of the period, and again at odds with the comparative-advantage view, the shares of agriculture in Spain, Italy, and Ireland, although declining, have been systematically larger than that in France.

[14]Comparative advantage should be judged against all trading partners and not only France. So, for example, if other trading partners had significantly higher productivity in all sectors relative to agriculture when compared with Greece, we could rationalize the fact that Greece specializes in agriculture. However, looking at the figures we see that this criterion would imply that all other EU members (except for Austria, Germany, and perhaps Norway) should also specialize in agriculture! Note also that Austria, which should not, according to this view, specialize in agriculture, has a relatively large agricultural labor force.

[15]For completeness, Figure 5.6 shows the sectoral labor productivities of the three small sectors.

We now turn the focus to the structuralist interpretation of the data. Let us recapitulate that story. First, there are some sectors that are intrinsically more productive than others. Second, there are labor-market distortions that prevent the flow of resources to the more productive sectors, with the result that even in equilibrium one observes differences in value-added per worker. Third, these imperfections notwithstanding, resources do gradually flow toward the more productive sectors, leading to catch-up by the countries whose industrial structure was initially most distorted.

As a first step to evaluating this view, we plot, for each country, the levels of sectoral labor productivity relative to agricultural productivity. These plots are displayed in Figure 5.7. It is clear from this figure that, for all countries, and throughout the entire period, agriculture is the least productive sector. The (weak) exceptions are the U.K. before 1975, for which the productivity levels of the three sectors are very close, the Netherlands before 1970, and Sweden between 1975 and 1990, for which the productivity gap of services over agriculture is nil. To the extent that poorer countries experience flows of labor away from agriculture larger than the Northerners, these productivity gaps should be a source of overall productivity convergence. As we saw above, this has indeed been the case: Greece, Portugal, Spain, Ireland, and Italy have experienced substantial declines in their shares of agriculture relative to France, whereas the Northerners, having started out with relatively small shares of agriculture, experienced a relative increase in agricultural shares (always with respect to France).

While the inter-sectoral productivity gaps are generally large, there are few clear general trends in their behavior over time. In several countries the gap between the high-productivity sectors (services and manufacturing) and the low-productivity sectors (agriculture) has been slowly closing over the period. This is the case for Greece, Spain, Italy, Germany, Denmark, Sweden, Finland, and our reference country, France. However, in all these cases, the inter-sectoral productivity gaps remain well above 50 percent. For Portugal, the productivity gap in favor of manufacturing declines until 1980, stabilizes during the eighties, and then shoots up decisively, together with the productivity advantage of the services sector, which shows no trend in the earlier period. In the U.K., the Netherlands, and Norway, we see a sizeable increase in the productivity premium of manufacturing starting in the mid seventies. Ireland shows a similar pattern, although the increase starts in 1980. Austria exhibits significant increases in the productivity advantage of both services and manufacturing relative to agriculture in the sixties. Belgium's experience is an attenuated and more gradual version of Austria's.

For the sake of completeness, Figure 5.8 shows the labor productivity of the remaining (small) sectors relative to agriculture. Again there are no uniform trends across countries.

What strikes the eye is that the utilities sector is substantially more productive than the two other sectors and agriculture, although this is neither very surprising (given that the utility sector is not labor-intensive), nor very relevant (as utilities account on average for less than 2 percent of the labor force). Far below utilities, the next sector in this B-league ranking is transportation and the third and last is construction (although in some countries – such as Greece – and in some sporadic years, the ranking between these two is reversed).[16]

This discussion so far suggests the following tentative conclusion. Initially poorer Western European countries converged to France because: (*i*) The productivity of the sectors in which they specialized converged to the productivity of the same sectors in France – this is the *within industry productivity convergence* documented in Figure 5.5; (*ii*) They moved a larger share of their workforce towards the higher productivity sectors – this is the pattern of *convergence in sectoral composition* of the labor force documented in Figure 5.3; and (*iii*) (For some of these countries) there was a generalized convergence of the productivity of the sectors in which they had a disproportionate share of the labor force to the productivity of the sectors in which France was specialized – when and where this *inter-sectoral productivity convergence* occurred can be seen in Figure 5.7. We turn now to a quantitative assessment of these three channels.

5.1 Convergence Decomposition: Analytics

Let us call y^i_{jt} the per worker value added in country i, sector j, at time t. Denote by a^i_{jt} the share of employment in country i, sector j, at time t. Total value added per worker in country i at time t, y^i_t, can then be expressed as the weighted sum of sectoral labor productivities,

$$y^i_t = \sum_{j=1}^{J} a^i_{jt} y^i_{jt}. \tag{2}$$

[16] As we mentioned, new trade theories not grounded on comparative advantage are harder to differentiate from the structural-transformation view in that they do not necessarily predict that integration leads to structural *divergence*. We observe, however, that if trade-induced scale economies had been an important source of catch-up for the Southerners we should see their tradable sectors (agriculture and/or manufacturing) systematicaly outpace their non-tradable sectors (services, utilities, construction, and electricity) in productivity gains. It is hard to discern any such systematic pattern in Figures 5.7 and 5.8.

As always, we use France, $i = F$, as the numeraire for our convergence analysis. We thus measure overall productivity convergence to France by the quantity[17]

$$\Delta \frac{y_t^i - y_t^F}{y_t^F} = \frac{y_t^i - y_t^F}{y_t^F} - \frac{y_{t-1}^i - y_{t-1}^F}{y_{t-1}^F}.$$

This measure of convergence is convenient because it can be *exactly* decomposed into the three channels mentioned in our previous discussion: *i*) within-industry convergence, *ii*) convergence due to labor reallocation, and *iii*) inter-sectoral, or between-industry convergence. To see this, add and subtract the term $\sum_{j=1}^{J} a_{jt}^i y_{jt}^F$ to equation (2):

$$y_t^i = \sum_{j=1}^{J} a_{jt}^i (y_{jt}^i - y_{jt}^F) + \sum_{j=1}^{J} a_{jt}^i y_{jt}^F.$$

Then:

$$\begin{aligned} y_t^i - y_t^F &= \sum_{j=1}^{J} a_{jt}^i (y_{jt}^i - y_{jt}^F) + \sum_{j=1}^{J} (a_{jt}^i - a_{jt}^F) y_{jt}^F \\ \frac{y_t^i - y_t^F}{y_t^F} &= \sum_{j=1}^{J} a_{jt}^i \left(\frac{y_{jt}^i - y_{jt}^F}{y_t^F} \right) + \sum_{j=1}^{J} (a_{jt}^i - a_{jt}^F) \frac{y_{jt}^F}{y_t^F}. \end{aligned}$$

Taking first differences, and grouping terms conveniently, we obtain:

$$\begin{aligned} \Delta \frac{y_t^i - y_t^F}{y_t^F} &= \sum_{j=1}^{J} \bar{a}_{jt}^i \Delta \left(\frac{y_{jt}^i - y_{jt}^F}{y_t^F} \right) + \\ &+ \sum_{j=1}^{J} \overline{\left(\frac{y_{jt}^i}{y_t^F} \right)} \Delta a_{jt}^i - \sum_{j=1}^{J} \overline{\left(\frac{y_{jt}^F}{y_t^F} \right)} \Delta a_{jt}^F \\ &+ \sum_{j=1}^{J} \left(\bar{a}_{jt}^i - \bar{a}_{jt}^F \right) \Delta \left(\frac{y_{jt}^F}{y_t^F} \right) \end{aligned} \tag{3}$$

where $\Delta x_{jt} = x_{jt} - x_{jt-1}$ and $\bar{x}_{jt}^i = \frac{x_{jt}^i + x_{jt-1}^i}{2}$.

In the tables that follow, we call "Total convergence" the quantity on the left-hand side in equation (3). "Within-industry convergence" is the quantity on the first line of the right-hand side; this captures the productivity catch-up of each sector with the corresponding one in France, weighted by the average labor share in that sector. "Labor reallocation" is

[17] Note that the two expressions we study in our convergence decomposition exercises are, to a first-order approximation, equivalent; that is, $\frac{y_t^i - y_t^F}{y_t^F} \approx \ln y_t^i - \ln y_t^F$. To see this, notice that log-linearizing $\frac{y_t^i - y_t^F}{y_t^F} = \frac{y_t^i}{y_t^F} - 1$ around $\frac{y_t^i}{y_t^F} = 1$ leads to $\ln \frac{y_t^i}{y_t^F} (= \ln y_t^i - \ln y_t^F)$. Or, alternatively, $\frac{y_t^i - y_t^F}{y_t^F}$ can be seen as the first-order Taylor approximation of $\ln \frac{y_t^i}{y_t^F}$ around $\frac{y_t^i}{y_t^F} = 1$.

the quantity in the second line that quantifies the part of convergence due to inter-sectoral workforce movements; it is appropriately weighted by the relative productivity of the sector. In particular, in the special case where there are no within-industry labor productivity gaps ($y^i_{jt} = y^F_{jt}$), labor reallocation contributes to convergence if and only if country i transfers a larger share of the labor force than does France towards the high-productivity industries. If there are within-industry productivity gaps, this effect may be attenuated. Specifically, if sector j is much more productive in France than in country i, labor reallocation may lead to divergence even if France is moving fewer workers towards this sector. Finally, "between-industry convergence" is the quantity in the third line; it measures the contribution to convergence of inter-sectoral productivity convergence. In particular, if the productivity of the sectors in which a country had a disproportionate share of the labor force converges to the overall productivity of France, we will see convergence.

We perform this decomposition for the whole period, 1960 through 2000, for which sectoral data are available in all countries (except for Ireland, which has data beginning in 1970). The results are summarized in Table 5.1. Panel A shows the convergence decomposition in absolute terms. The first column shows the total productivity convergence to France from 1960 through 2000 (for Ireland, we report the figures for 1970 to 2000). These are the same numbers underlying the plots in Figure 2.1, and the first column of Table 4.1 to a first-order approximation ($\frac{y^i_t - y^F_t}{y^F_t} \approx \ln y^i_t - \ln y^F_t$, as noted before). As we already know, six countries experienced substantial convergence from below: Ireland, Spain, Portugal, Austria, Italy, and Greece. The other countries converged from above or remained at roughly the same level as France.

The three following columns in Panel A show the quantitative magnitudes of the three sources of convergence. The corresponding columns in Panel B show the contribution of each source as a percent of total convergence. These numbers are illustrated in Figure 5.10, which shows graphically the contribution to convergence of the different components. Interestingly, the true Southerners – Greece, Italy, Spain, and Portugal – achieved convergence mainly by reallocation of the labor force from low- to high-productivity sectors (at a faster rate than France, as always). Labor reallocation accounts for about 60 percent of total convergence in Spain and Portugal, 100 percent in Italy, and more than 100 percent in Greece (other elements played against convergence in this country). Hence, for the true Southerners, we find a lot of support for what we called the "structuralist" view of convergence. Labor reallocation is also quite important for the convergence of France to the U.K., as it accounts for about 50 percent of it. (An important part of the story here is that agricultural shares declined much more slowly in the U.K. than in France.)

Austria and Ireland, instead, converged mainly through within-industry productivity

catch-up. The within-industry mechanism is also behind the convergence of the Northerners, accounting in all cases for more than 60 percent of the total convergence. Within-industry productivity convergence is not well accounted for by either the trade view or the structural-transformation view. Rather, it probably has more to do with the capital deepening and technology catch-up processes highlighted in the previous section.

Given the qualitative evidence from Figure 5.7 it is not surprising that the third component of the sectoral decomposition of convergence, between-industry productivity convergence, is never the most important factor. Indeed, in most cases it is the least important source of convergence – and in some cases it even operates in the direction of divergence. Nevertheless, in the case of Greece, inter-sectoral productivity convergence has been fairly important. In particular, Greece benefited from the productivity gains of agriculture, given its large share in this sector. Portugal and Spain also gained some ground thanks to this between-industry catch-up, although the quantitative contribution of this source has not been as substantial.

Before concluding and summarizing this section we take a brief look at the role of sectoral developments in shaping convergence dynamics in different sub-periods. Hence, we decompose each of the terms in (3) into the two sub-periods 1960 through 1975 (60-75) and 1975 through 2000 (75-00). We now introduce sub-indices to indicate the period to which the difference operator Δ applies. So, within-industry convergence 1960-2000 is decomposed as:

$$
\begin{aligned}
\textit{Within-industry convergence} &= \sum_{j=1}^{J} \bar{a}^i_{j00} \Delta_{60-00} \left(\frac{y^i_{j00} - y^F_{j00}}{y^F_{00}} \right) \\
&= \sum_{j=1}^{J} \bar{a}^i_{j00} \left(\frac{y^i_{j00} - y^F_{j00}}{y^F_{00}} - \frac{y^i_{j60} - y^F_{j60}}{y^F_{60}} \right) \\
&= \sum_{j=1}^{J} \bar{a}^i_{j00} \left(\underbrace{\frac{y^i_{j00} - y^F_{j00}}{y^F_{00}} - \frac{y^i_{j75} - y^F_{j75}}{y^F_{75}}}_{\Delta_{75-00} \left(\frac{y^i_{jt} - y^F_{jt}}{y^F_t} \right)} + \underbrace{\frac{y^i_{j75} - y^F_{j75}}{y^F_{75}} - \frac{y^i_{j60} - y^F_{j60}}{y^F_{60}}}_{\Delta_{60-75} \left(\frac{y^i_{jt} - y^F_{jt}}{y^F_t} \right)} \right) \\
&= \underbrace{\sum_{j=1}^{J} \bar{a}^i_{j00} \Delta_{75-00} \left(\frac{y^i_{jt} - y^F_{jt}}{y^F_t} \right)}_{\text{within-industry conv. 75-00}} + \underbrace{\sum_{j=1}^{J} \bar{a}^i_{j00} \Delta_{60-75} \left(\frac{y^i_{jt} - y^F_{jt}}{y^F_t} \right)}_{\text{within-industry conv. 60-75}},
\end{aligned}
$$

where $\bar{a}^i_{j00} = \frac{a^i_{j00} + a^i_{j60}}{2}$.

Similarly, labor reallocation is decomposed as

$$
\begin{aligned}
\textit{Labor reallocation convergence} &= \sum_{j=1}^{J}\left[\left(\overline{\frac{y^i_{j00}}{y^F_{00}}}\right)\Delta_{60-00}a^i_{00} - \left(\overline{\frac{y^F_{j00}}{y^F_{00}}}\right)\Delta_{60-00}a^F_{j00}\right] \\
&= \sum_{j=1}^{J}\left[\left(\overline{\frac{y^i_{j00}}{y^F_{00}}}\right)(a^i_{j00}-a^i_{j60}) - \left(\overline{\frac{y^F_{j00}}{y^F_{00}}}\right)(a^F_{j00}-a^F_{j60})\right] \\
&= \sum_{j=1}^{J}\left[\left(\overline{\frac{y^i_{j00}}{y^F_{00}}}\right)(a^i_{j00}-a^i_{j75}+a^i_{j75}-a^i_{j60}) - \left(\overline{\frac{y^F_{j00}}{y^F_{00}}}\right)(a^F_{j00}-a^F_{j75}+a^F_{j75}-a^F_{j60})\right] \\
&= \sum_{j=1}^{J}\left[\left(\overline{\frac{y^i_{j00}}{y^F_{00}}}\right)(\Delta_{75-00}a^i_{j00}+\Delta_{60-75}a^i_{j75}) - \left(\overline{\frac{y^F_{j00}}{y^F_{00}}}\right)(\Delta_{75-00}a^F_{j00}+\Delta_{60-75}a^F_{j75})\right] \\
&= \underbrace{\sum_{j=1}^{J}\left[\left(\overline{\frac{y^i_{j00}}{y^F_{00}}}\right)\Delta_{75-00}a^i_{j00} - \left(\overline{\frac{y^F_{j00}}{y^F_{00}}}\right)\Delta_{75-00}a^F_{j00}\right]}_{\text{labor reallocation 75-00}} + \\
&\quad \underbrace{+\sum_{j=1}^{J}\left[\left(\overline{\frac{y^i_{j00}}{y^F_{00}}}\right)\Delta_{60-75}a^i_{j75} - \left(\overline{\frac{y^F_{j00}}{y^F_{00}}}\right)\Delta_{60-75}a^F_{j75}\right]}_{\text{labor reallocation 60-75}}
\end{aligned}
$$

where $\overline{\frac{y^i_{j00}}{y^F_{00}}} = \frac{1}{2}\left(\frac{y^i_{j00}}{y^F_{00}} + \frac{y^i_{j60}}{y^F_{60}}\right)$.

Finally, between-industry convergence is decomposed by sub-periods as:

$$
\begin{aligned}
\textit{Between-industry convergence} &= \sum_{j=1}^{J}\left(\bar{a}^i_{j00}-\bar{a}^F_{j00}\right)\Delta_{60-00}\left(\frac{y^F_{jt}}{y^F_t}\right) \\
&= \sum_{j=1}^{J}\left(\bar{a}^i_{j00}-\bar{a}^F_{j00}\right)\left(\frac{y^F_{j00}}{y^F_{00}} - \frac{y^F_{j60}}{y^F_{60}}\right) \\
&= \sum_{j=1}^{J}\left(\bar{a}^i_{j00}-\bar{a}^F_{j00}\right)\left(\frac{y^F_{j00}}{y^F_{00}} - \frac{y^F_{j75}}{y^F_{75}} + \frac{y^F_{j75}}{y^F_{75}} - \frac{y^F_{j60}}{y^F_{60}}\right) \\
&= \sum_{j=1}^{J}\left(\bar{a}^i_{j00}-\bar{a}^F_{j00}\right)\left[\Delta_{75-00}\left(\frac{y^F_{j00}}{y^F_{00}}\right) + \Delta_{60-75}\left(\frac{y^F_{j75}}{y^F_{75}}\right)\right] \\
&= \underbrace{\sum_{j=1}^{J}\left(\bar{a}^i_{j00}-\bar{a}^F_{j00}\right)\Delta_{75-00}\left(\frac{y^F_{j00}}{y^F_{00}}\right)}_{\text{Between-industry conv. 75-00}} + \underbrace{\sum_{j=1}^{J}\left(\bar{a}^i_{j00}-\bar{a}^F_{j00}\right)\Delta_{60-75}\left(\frac{y^F_{j75}}{y^F_{75}}\right)}_{\text{Between-industry conv. 60-75}}
\end{aligned}
$$

Table 5.2 looks at the within-industry convergence in the two sub-periods 1960 through 1975 and 1975 through 2000. As mentioned before, Austria and Ireland converged mainly through within-industry catch-up. However, in the case of Austria, this catching up took

place very early: More than 90 percent of the within-industry productivity gain took place in the first sub-period, whereas in the case of Ireland, more than 90 percent of the catch-up took place in the second sub-period. As for the Northerners, typically more than two thirds of the within-industry convergence took place in the first sub-period. The only exception is Germany, which exhibits significant convergence in the second sub-period, clearly due to the addition of East Germany. An interesting case is Greece, which lost significant ground in terms of within-industry productivity in the second period. This source of divergence is behind the reversal in relative overall productivity noted in Figure 2.1.

Table 5.3 shows the part of the convergence due to labor reallocation in each of the sub-periods. About 50 percent of the labor-reallocation-induced convergence experienced by the Southerners took place in the first 15 years. This fraction is even larger for Greece in this sub-period (65 percent), so we can conclude that Greece converged through labor reallocation in the 1960s and early 1970s and subsequently diverged by losing within-industry relative productivity. For the Northerners, more than 50 percent of the convergence due to labor reallocation appears to have taken place in the first sub-period, except for Norway, where the contribution of the early period's reallocation was 20 percent. All in all, then, these 15 years witness substantial convergence induced by labor reallocation. As discussed early on, this is primarily driven by the relatively faster decline in agricultural shares experienced by the deep Southerners. Recall that Austria, in contrast with the deep Southerners, started with a relatively low share of agriculture, and hence there was little action on this margin. Ireland started out with a somewhat higher agricultural share than Austria, but a share still well below the corresponding ones of the true Southerners.[18]

Summing up to here, the deep Southerners – Greece, Portugal, Spain, and Italy – converged mainly through labor reallocation, with about half of it taking place between 1960 and 1975. In the case of Greece, this effect was counterbalanced in 1975 by significant losses in within-industry productivity. The other (real or honorary) Southerners, Austria and Ireland, converged mainly through within-industry productivity gains, most of which occurred in the first 15 years for Austria and in the second sub-period for Ireland. France converged to the Northerners mainly through the within-industry channel, although in the U.K. labor reallocation also played an important role.

Our tentative overall conclusion on the Western European convergence experience is as follows. First, at least by the admittedly coarse standards we have applied, sectoral specialization according to comparative advantage has not been a critical source of catching up by the initially poorer countries. Instead, disproportionately large labor reallocation towards

[18]For completeness Table 5.4 shows the between-industry catch-up in the two sub-periods. We do not linger on this table because we saw in Table 5.1 that this mechanism did not play a prominent role for most countries.

more productive sectors has contributed substantially to the convergence of Portugal, Spain, Greece, and Italy towards average Western European levels of labor productivity. Second, we also see substantial within-industry labor productivity convergence, and this was especially important in the catching up of Austria and Ireland. This within-industry labor productivity convergence is probably best understood in the light of the substantial relative gains in physical capital per worker and total factor productivity by poorer countries documented in the previous section. It is probably not linked to human-capital deepening.[19]

6 The Easterners

Enough with latitude: Let's turn to longitude. As mentioned in the Introduction, relative to France, labor productivity in Eastern Europe is roughly where it was in Southern Europe before the South staged its catch-up. Given what we have learned about some of the mechanics of this catch-up, we can try to speculate about the Easterners' prospects. In particular, we can ask two sets of questions. The first set of questions is based on the analysis of Section 4. How much do gaps in physical capital per worker, human capital, and TFP account for the overall productivity gap of the Easterners relative to France? How do these three gaps compare with the corresponding gaps prevailing in Southern Europe in 1960? The second set of questions is linked to the analysis in Section 5. How does the industrial structure of the Easterners differ from France's? How do these differences compare to the corresponding differences in Southern Europe before the catch-up?

We begin, however, by briefly reviewing the aggregate picture. Figure 6.1 plots current levels of labor productivity relative to France in 13 "Eastern-European" countries: the 10 admitted into the EU in May 2004, plus three candidates, Bulgaria, Romania, and Turkey. For comparison, we also plot the corresponding relative productivities in the five Southerners in 1960. (For these aggregate GDP comparisons we could have plotted the 1950 values for the Southerners, but – for reasons already discussed above – the earliest available date for the disaggregated comparisons we present later is typically 1960. Hence, we chose to write this section with 1960 as the benchmark). To continue with the geographic theme, these relative productivities are plotted in increasing order of longitude. As before, these productivity data come from PWT.

The Easterners are very unproductive relative to France. In fact, their real produc-

[19] Needless to say, intersectoral reallocation of labor also contributes to overall capital deepening and TFP gains if labor flows towards more capital-intensive and efficient sectors. It would indeed be very interesting to be able to decompose the capital and TFP convergence of the previous section into a within-industry relative capital deepening and TFP growth component and a component linked to sectoral reallocation. At the moment we do not have the data to do this.

tivity gap with France is on average substantially larger than the Southerners' productivity gap in 1960. The exceptions are Malta (which is where Austria was then), Cyprus (between Spain and Austria), Slovenia (similar to Spain in 1960), and Hungary, the Czech Republic, and Slovakia (at about Portugal's level back then). Some of the other countries are far below these levels and indeed considerably poorer (in relative terms) than the Southerners were even in 1950. Romania's relative productivity, 15 percent, is especially low.

What are the sources of these large productivity gaps? One way to answer this question is presented in Figure 6.2, which shows physical capital gaps, that is, levels of physical capital per worker relative to France (first panel); human capital gaps (second panel); TFP gaps (third panel); and investment gaps (fourth panel). The physical capital stocks and TFPs of the Easterners are constructed in the same way as the corresponding variables for Western European countries in Section 4. Unfortunately, we have long time series on real investment rates for only five of the Easterners, which explains the thinner data clouds in the first and third panels. The human capital stocks are also constructed as in Section 4, except that now we must use the Barro and Lee (2001) data as the De La Fuente and Domenech (2002) data set does not cover these countries. Relative capital stocks and relative TFPs are plotted against relative labor productivities. The solid line in each graph is the 45-degree line.

Once again, the most striking feature of this decomposition seems to pertain to human capital: Most of the Easterners have current levels of human capital *above* those of France. Only Slovenia, Malta, and Turkey have fewer average years of schooling than France, and only the last one substantially so. Hence, one conclusion is that among the Easterners, Turkey is the only country whose productivity gap with France is partially explained by a human-capital gap. This was not generally true for the Southerners in 1960: Portugal, Greece, Spain, and Italy all had significantly lower human capital than France. Since human capital gaps seem to be very persistent (see Section 4), this may be viewed as very good news for the Easterners: The handicap that is toughest to overcome is one they do not have.

For the countries with available long investment series, physical capital gaps are large. Indeed, by checking relative physical capital levels against the 45-degree line, we can see that in most cases physical capital gaps are even larger (though not by much) than real productivity gaps. The same was true in 1960 of Portugal, Greece, and Spain. Not surprisingly, for the same countries we also see TFP gaps that are large, but not as large as the labor productivity gaps. The Southerners had smaller TFP gaps, even controlling for the level of relative income. (This makes up for their lower relative human capital.) In sum, it would appear that for the Easterners to converge, what is required is a combination of capital deepening faster than that of the West and technological catch-up. This is exactly what the

Southerners did. However, the Southerners' initial disadvantage was not as large, so it may be presumed that the Easterners' convergence will take somewhat longer.

One way to see whether the Easterners appear to be on the path to catch up in physical capital levels is to look at investment shares of GDP. These are shown in the fourth panel of Figure 6.2. (Examining these shares is a way of extending the assessment of the physical capital position of a larger number of Eastern European countries.) Judging from the position of relative investment vis-à-vis the 45-degree line, in 1960 the Southerners had investment shares relative to France somewhat higher than their labor productivities relative to France. The same seems to be broadly true today of the Easterners. This is reassuring.

We now turn to industrial structure. The discussion that follows is based on the data reported in Table 6.1 or shown in its graphical equivalent, Figure 6.3, which plots against total productivity (i) the difference in sectoral shares (resh) of each country with respect to France, (ii) the relative sectoral productivity (rely) of each country with respect to France, and (iii) the relative productivity of manufacturing and services vis-à-vis agriculture for each country (secty). Table 6.1 begins by reporting differences in employment shares of the three main sectors vis-à-vis France – in 1960 for the Southerners and in 2000 for the Easterners. Once again, sectoral data construction is described in the Appendix.

There is significant variance in the relative shares of agriculture both within the group of Southerners and within the group of Easterners. Romania and Turkey exhibit the highest agricultural share relative to France. The agricultural share in Romania is 40 percentage points higher than that in France; in Turkey it is 30 percentage points higher. The closest parallel in 1960 is Greece, with roughly a 35-percentage-point difference over France. Poland and Bulgaria are closer to Spain, with a difference in shares vis-à-vis France of about 20 percentage points. Latvia and Lithuania resemble Italy in 1960. If the historical experience of their Southern counterparts is any guide, there seems to be a substantial margin for convergence through labor reallocation for all these countries. In Hungary, Estonia, the Slovak Republic, and Slovenia, differences in labor shares in agriculture with respect to France are lower (somewhere between the corresponding share differentials in Austria and Italy in 1960), while Malta, Cyprus, and the Czech Republic have agricultural labor shares that are very close to those in France (as was the case for Austria in 1960).

Labor shares in manufacturing are larger than France's for all Easterners, except Cyprus, which exhibits approximately the same share as France. On these dimensions, then, the situation is quite different from the Southerners' in 1960, when manufacturing shares were systematically below those in France (except for Austria, whose share was very close to France's).

Services, broadly speaking, take up the slack between these sectors. Romania, Turkey,

Poland, the Czech Republic, the Slovak Republic, and Bulgaria have services shares that are well below the corresponding shares in France in 2000, and the differences are remarkably higher (in absolute terms) than those exhibited by the Southerners in 1960. Continuing with the parallel between the two years, Hungary looks like Greece, Slovenia like Portugal, Lithuania like Spain, and Estonia and Latvia like Italy.

Turning to sectoral productivity (fourth to seventh columns of Table 6.1, second row of Figure 6.3), the Easterners in 1960 are on average significantly less productive vis-à-vis France than the Southerners were in 1960. In particular, with three exceptions, agricultural productivity relative to France is lower for all Easterners than it was for Greece – the country with the lowest relative agricultural productivity in 1960. The exceptions are the Czech Republic, whose relative agricultural productivity is comparable to that in Portugal in 1960; Cyprus, with relative productivity comparable to Spain's; and a big outlier, Malta, whose agricultural productivity is well above France's in 2000.

There are also big contrasts in manufacturing productivity. The Easterners' productivity is remarkably lower than that in France, and the productivity gap is again higher than that exhibited by the Southerners in 1960. Ten out of the 13 Easterners show productivity levels well below 50 percent of France's. The relative productivities for these 10 countries range from 19 percent in Romania to 43 percent in Hungary. In 1960, even Greece, the least productive country in manufacturing, was in a better position, with a productivity equal to 53 percent of France's. This is quite remarkable, given that – as we just mentioned – the industrial production of the Easterners is tilted towards manufacturing. The productivity gaps for Slovenia, Cyprus, and Malta find some counterparts in the Southerners in 1960. Slovenia's relative productivity is similar to that of Portugal. Cyprus's relative productivity falls between that in Spain and Italy, and Malta's compares with Austria's.

A similar picture emerges in services. With the three small exceptions – Cyprus, Malta, and Slovenia – the Easterners' productivity in services is much lower than France's, and productivity gaps are larger than those shown by the Southerners in 1960. Labor productivity relative to France's ranges from 32 percent to 57 percent for the Easterners—without counting the three exceptions—whereas the lowest value for the Southerners in 1960 was 70 percent (in Portugal). Slovenia's relative productivity (77 percent) falls between those of Portugal and Austria, while Cyprus's and Malta's productivities fall between the corresponding ones in Austria and Spain

The last two columns of Table 6.1 (and the last row of Figure 6.3) take up intersectoral productivity differentials. For the Southerners in 1960 manufacturing was between two to three times as productive as agriculture. The corresponding range for services was about two to five. In the East we find more variation. At one extreme, Malta's agriculture

is (slightly) more productive than are the other sectors. At the other, Polish manufacturing is eight times as productive as agriculture, and services ten times! Romania also has an extraordinarily unproductive agriculture, vis-à-vis the other sectors. On balance, and weighted by population, we can conclude that inter-sectoral productivity differentials in the East are at least as large as they were in the South in 1960.

In sum, there are some broad qualitative similarities between the Easterners today and the Southerners in 1960. First, both groups have large shares of their workforce in their least productive sectors. Poland's large share of agriculture illustrates this massive failure of comparative advantage particularly strikingly. But Malta and Estonia also appear to have manufacturing shares that are too big.[20] Second, there is a component of the productivity gap that is not due to sectoral structure but to within-industry productivity differentials. We briefly turn now to a quantitative assessment of these similarities.

Simple algebra along the lines of the previous section allows us to write

$$\frac{y_t^F - y_t^i}{y_t^i} = \sum_{j=1}^{J} a_{jt}^i \left(\frac{y_{jt}^F - y_{jt}^i}{y_t^i} \right) + \sum_{j=1}^{J} (a_{jt}^F - a_{jt}^i) \frac{y_{jt}^i}{y_t^i} + \sum_{j=1}^{J} (a_{jt}^F - a_{jt}^i) \left(\frac{y_{jt}^F - y_{jt}^i}{y_t^i} \right). \qquad (4)$$

The left-hand side is the aggregate productivity gap between France and country i, as a percentage of country i's income. The right-hand side decomposes this gap into three components. The first term is the "within-industry" component. Holding constant country i's sectoral employment shares, it answers the question by how much would country i's income increase if its sectoral labor productivities converged to the productivities of the corresponding sectors in France? The second term is the "between-industry component." Holding constant country i's sectoral labor productivities, it asks by how much would country i's output per worker increase if its employment shares were the same as France's. The third component is a "covariance" term.

The results of this decomposition are reported in Table 6.2. The first column is the productivity gap on the left-hand side of equation (4), while columns 2 to 4 report the three pieces on the right-hand side. The top panel, reserved to the Southerners in 1960, shows that broadly speaking within-industry productivity gaps and sectoral composition were both important determinants of the productivity gaps of these countries. The between component was larger than the within component for Italy and Greece, while the within component dominated for Austria, Spain, and Portugal.

The bottom panel reports decomposition results for the Easterners. Consistent with our previous discussion, we find enormous within-industry productivity differences. For some

[20] This failure of comparative advantage has been noted more broadly. For example, developing countries have huge employment shares of agriculture and much lower relative labor productivity in this sector than in the rest of the economy. For example, Gollin, Parente, and Rogerson (2001).

of the poorest countries, within-industry productivity convergence (holding constant employment shares) would lead to a four-fold increase in aggregate labor productivity. Also, as expected, the within-industry component of the income gap with France is much larger than was the case for the Southerners in 1960.

What is new and somewhat unexpected in Table 6.2 is the relatively limited role of the between-industry component. Despite their large employment shares in the relatively unproductive industries, for 8 out of the 18 Eastern European countries the income gap due to the structure of employment is less than 10 percent (that is, moving to French employment shares holding constant labor productivities would increase output by less than 10 percent). As a result, the between component explains a relatively modest fraction of the overall productivity gap with France. In comparison, except for Austria, the Southerners had substantially larger between components, both in absolute terms and as a percent of the overall income gap. The smaller role of the between component is particularly evident if one compares South and North at similar levels of the income gap with France.

Nevertheless, for some of the largest and poorest countries, labor reallocation towards the more productive sectors would make a substantial difference. In the case of Poland it would raise income by 27 percent – hardly enough to bridge the gap with France, but certainly important in absolute terms. Similarly, attaining French sectoral employment shares would increase income per worker by 32 percent in Turkey, 19 percent in Bulgaria, and 68 percent in Romania.

To summarize, then, we could say the following. In the South, structural imbalances towards the low-productivity sectors were important determinants of their initial income gaps vis-à-vis France, and a big part of their convergence experience is associated with the reallocation of resources towards greater value-added industries. These structural distortions are also present today in the East. Indeed, some of the poorest and largest countries can look forward to meaningful labor productivity gains from inter-sectoral labor reallocation. However, in contrast with the story in the South, these potential gains constitute a relatively small share of their overall income gap. Hence, to the extent that productivity gains through structural reshuffling are a relatively low-hanging fruit, one comes away from this evidence somewhat less bullish about the prospects of fast convergence by the Easterners.

Nevertheless, the news is not all bad. The South also had sizable within-industry productivity gaps – as well as between-industry ones – and was able to bridge most of these gaps through physical capital accumulation and TFP growth. One can only presume that the East will be able to replicate this experience. Furthermore, whatever gaps remain in the South are due to a failure to catch up in human capital. If anything, then, the Easterners should do even better in the long run, as they face no permanent handicap arising from human

capital differentials. But the fact that the within-industry gaps are much larger, coupled with having to rely exclusively on the "within" margin (and not also on the "between" margin), suggests that the long run may take a long time to arrive.

7 Conclusions

In 1950, the average Spanish worker generated goods and services worth little more than 60 percent of the goods and services generated by the average French worker. By 1970, the ratio was 90 percent. How did this happen? The data suggest that a critical mechanism for Spain's explosive catch-up has been a vast redeployment of labor out of agriculture and towards higher value-added sectors. This redeployment was going on in France as well, but because Spain started out with a much larger agricultural sector, it benefited disproportionately. The sectors receiving these labor flows are presumably more productive because they are characterized by higher capital intensity and higher total factor productivity. Consistent with this conjecture, we see Spain's overall capital-labor ratio and TFP catching up strongly with France's. However, a secondary but not trivial part of Spain's convergence to France is the catch-up of labor productivity within sectors: For example, Spanish manufacturing was 60 percent as productive as French manufacturing in 1960, but by 1970 this ratio had increased to 87 percent. Hence, presumably, not all of the overall convergence in physical capital and TFP is linked to the structural transformation: Some of it is driven by relative productivity trends within industries. Despite substantial convergence in sectoral structure, physical capital per worker, and TFP, Spanish average labor productivity has hovered at around 90 percent of French average labor productivity since the mid-1970s . Our data indicate that this persistent remaining gap is due mostly to an equally persistent gap in human capital per worker.

In 2000, the average Polish worker generated goods and services worth 41 percent of those produced by the average French worker. Various elements contribute to this low productivity. As was true for Spain in 1960, a substantially large fraction of workers in Poland is employed in agriculture. The difference between the labor shares of Poland and France is above 22 percentage points. As was true for Spain then, this disproportionate share of agriculture flies in the face of economic efficiency. The average worker in agriculture in Poland produces less than 9 percent of what his counterpart produces in France, while the relative productivities of manufacturing and services are, respectively 40 percent and 56 percent. There is, therefore, substantial scope for efficient labor reallocation in the country. However, these numbers also imply that – once again – as was true for Spain in 1960, there is also a big margin for within-industry productivity catch-up. Indeed, quantitatively, the case of Poland is quite different from the case of Spain, as most of the aggregate productivity gap

with France is attributable to these within-industry productivity gaps. Hence, for Poland, the road to convergence passes through physical-capital deepening and TFP gains at the industry level. This means that convergence may take quite a bit longer. On the other hand, unlike Spain, Poland could actually look forward to a complete catch-up, as it is not hobbled by a human-capital handicap.

REFERENCES (incomplete)

Aghion, Philippe, and Peter Howitt (1992): "A Model of Growth through Creative Destruction," Econometrica, 60, 2 (March), 323-351.

Barro, Robert J (1991): "Economic growth in a Cross-Section of Countries," Quarterly Journal of Economics, 106, 2 (May), 407-443.

Barro, Robert J., and Jong-Wha Lee (2001): "International Data on Educational Attainment: Updates and Implications," Oxford economic Papers. 53 (3, July). 541-63.

Barro, Robert J; Mankiw, N Gregory; Sala-i-Martin, Xavier. Capital Mobility in Neoclassical Models of Growth. American Economic Review. Vol. 85 (1). p 103-15. March 1995.

Barro, Robert J. and Xavier Sala-i-Martin (2001): "Convergence across states and regions,", *Brookings Papers on Economic Activity* 1.

Barro, Robert J; Sala-i-Martin, Xavier. Convergence. Journal of Political Economy. Vol. 100 (2). p 223-51. April 1992.

Barro and Sala-i-Martin (1997): "Technological Diffusion, Convergence, and Growth," *Journal of Economic Growth*, 2, 1-26.

Bernanke, B.S., and R.S. Gurkaynak (2001), "Is Growth Exogenous? Taking Mankiw, Romer, and Weil Seriously", in: B.S. Bernanke, and Kenneth Rogoff, eds, NBER Macroeconomics Annual 2001 (MIT Press, Cambridge).

Boldrin, M. and F. Canova (2001): "Europe's regions: Income Disparities and regional pplicies," *Economic Policy*, April, 207-253.

Boldrin, M. and F. Canova (2003): "Regional Policies and EU Enlargement," CEPR Discussion Paper 3744.

Caselli, Francesco (2003): "The Missing Input: Accounting for Cross-Country Income Differences," unpublished, Harvard University.

Caselli, Francesco and John Coleman (2001): "The U.S. Structural Transformation and Regional Convergence: A Reinterpretation", Journal of Political Economy, 109 (3), 584-616.

Clark, C. (1940), "The Morphology of Economic Growth", in: C. Clark (ed.): The Conditions of Economic Progress (Macmillan, London) 337-373.

Coe, David T. and Elhanan Helpman (1995): "International R&D Spillovers," *European Economic Review* 39,859-887.

Coe, David T., Elhanan Helpman, and Alexander W. Hoffmaister (1997), "North-South R&D Spillovers," *Economic Journal*, 107, 134-149.

de la Fuente, A., and R. Doménech (2002), "Human Capital in Growth Regressions: How Much Difference Does Data Quality Make? An Update and Further Results", CEPR

Discussion Papers No. 3587.

Findlay (1973): *International Trade and Development Theory.* Columbia University Press.

Fisher, S., Sahay, R., and C. A. Vegh (1998b): "From Transition to Market: Evidence and Growth Prospects" IMF Working Paper 98/52.

Fisher, S., Sahay, R., and C. A. Vegh (1998a): "How Far is Eastern Europe from Brussels?" IMF Working Paper 98/53.

Gollin, D. (2002), "Getting Income Shares Right", Journal of Political Economy 110(2):458-474.

Gollin, D., S.L. Parente, and R. Rogerson (2001), "Structural Transformation and Cross-Country Income Differences", Working Paper (University of California in Los Angeles).

Grossman, Gene M., and Elhanan Helpman (1991): Innovation and Growth in the Global Economy,"MIT Press.

Hall and Jones: "Why do Some Countries Produce so Much More Output per Worker than Others?" *Quarterly Journal of Economics,* 1999, 83-116.

Helpman, Elhanan; Krugman, Paul R. Trade policy and market structure. Cambridge, Mass. and London: MIT Press. p xii, 191. 1989.

Alan Heston, Robert Summers and Bettina Aten, Penn World Table Version 6.1, Center for International Comparisons at the University of Pennsylvania (CICUP), October 2002.

Honohan, P., and B. Walsh (2002): "Catching Up with the Leaders: The Irish Hare," *Brookings Papers on Economic Activity*, 1, 1-77.

Howitt, P. (1999): "Endogenous growth and cross-country income differences," *AER,* September 2000.

Imbs, Jean; Wacziarg, Romain. Stages of Diversification. American Economic Review. Vol. 93 (1). p 63-86. March 2003.

Jones (1974): "The Small Country in a Multi-Commodity World," *Australian Economic Papers*, 13, 225-36.

Klenow and Rodriguez-Clare: "The Neoclassical Revival in Growth Economics: Has it Gone Too Far?" NBER macro annual 1997, 73-114.

Koren, Miklos, and Silvana Tenreyro (2004): "Diversification and Development," unpublished, Federal Reserve Bank of Boston.

Krueger, A. O. (1977): "Growth, Distortions, and Patterns of Trade among Many Countries," *Princeton Studies in International Finance*, 40.

Krugman, P. (1979): "A Model of Innovation, Technology Transfer, and the World Distribution of Income," *Journal of Political Economy*, 87, 253-66.

Lewis, W.A. (1954), "Economic Development with Unlimited Supplies of Labor", Manchester School of Economics and Social Studies 22:139-151.

Mankiw, N Gregory; Romer, David; Weil, David N. A Contribution to the Empirics of Economic Growth. The Quarterly Journal of Economics. Vol. 107 (2). p 407-37. May 1992.

Nelson and Phelps (1966): "Investment in Humans, Technological Diffusion and Economic Growth," *AER* 56, 69-75.

Ngai, Rachel and Chris Pissarides (2004): "Balanced Growth with Structural Change," CEP Discussion Paper 627.

Nurske, R. (1953), Problems of Capital Formation in Underdeveloped Countries (Oxford University Press, New York).

Oltheten, E., G. Pinteris and T. Sougiannis (2003): "Greece in the European Union: policy lessons from two decades of membership," *Quarterly Review of Economics and Finance*, 43, 774-806.

Quah, D. (1996): "Regional convergence clusters across Europe," *European Economic Review*, 40.

Ramsey, Frank P. (1928): "A Mathematical Theory of Saving," The Economic Journal, Vol. 38, No. 152. (Dec.), pp. 543-559.

Romer, Paul M. (1990): "Endogenous Technical Change," Journal of Political Economy," 98, 5 (October), part II, S71-S102.

Solow, Robert M. (1956): "A Contribution to the Theory of Economic growth," Quarterly Journal of Economics, 70, 1 (February), 65-94.

Ventura, Jaume. Growth and Interdependence. The Quarterly Journal of Economics. Vol. 112 (1). p 57-84. February 1997.

Young, Alwyn (1995): The Tyranny of Numbers: Confronting the Statistical Realities of the East Asian Growth Experience. Quarterly Journal of Economics.

APPENDIX ON SECTORAL DATA

Data on PPP-adjusted real GDP per worker and total employment come from the *Penn World Tables 6.1*. Real GDP per worker is the variable RGDPWOK and total employment is computed using real GDP per capita (RGDPCH), real GDP per worker, and population (POP) as:

$$Total\ employment = \frac{RGDPCH * POP}{RGDPWOK}$$

Shares of sectoral GDP and sectoral employment were computed from the Organization for Economic Cooperation and Development (OECD)'s "*STAN Database for Industrial Analysis*," Volume 2004, release 03. This database reports the value-added at basic prices (named VALU) and employment (EMPN) by sector (ISIC Rev. 3) from 1970 to 2000. The countries covered (and used in our analysis) are: Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Italy, Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Spain, Sweden, and United Kingdom. There are, however, missing values for some countries/years, which we completed using the OECD's "*National Accounts of OECD Countries*" (Detailed Tables, Volume II, 1970-2001). The variables used are Valu-B (value-added at basic prices), and ETOP (number of persons employed).[21] Both *STAN* and *National Accounts* are available online through *SourceOECD*.

For data on sectoral value-added in the period 1950 through 1970, and for missing values in *SourceOECD* during 1970 through 2000, we use sectoral value-added from various printed editions of the OECD's "*National Accounts of OECD Countries*" (Volume II). In particular, for 1950-1965, we use Table 3 of the 1950-1969 Volume. For 1970-1980, we use Table 12 of the 1970-1982 Volume. For 1985-1990 we use Table 12 of the 1983-1995 Volume, and for 1995 we use Table 7 of the 1989-2000 Volume. (Note that, while available in the books, the information is not always provided by the electronic version of "*National Accounts of OECD Countries*.")[22] For Portugal, "Construction" and "Manufacturing" are aggregated in

[21] Data for Turkey are available from this source.

[22] There are some differences in the classification across books, for which we performed the appropriate adjustments. In particular, in the first volume, some countries do not separate between "Mining and Quarrying" and "Manufacturing." We created an additional industry (Mining and Quarrying and Manufacturing) with these aggregated data. For countries that do report separately "Mining and Quarrying" and "Manufacturing," the aggregate industry is the sum of the two. An analogous rationale is behind the sectors Public administration, education, and health services, which are aggregated under Community Services. To match the categories between the first two periods in the books and the latter ones, we match "Banking etc." with "Finance etc." "Owenrship of dwellings" is always aggregated with "Finance, etc." in the latter issues. Hence we aggregate them through the whole sample. "Public administration" is matched with "Producers of Government Services." "Health and Education" is matched with "Community, Social, and Personal Services."

1955; we split them by applying the corresponding shares obtained from Bank of Portugal's "*Séries Longas para a Economia Portuguesa pós II Guerra Mundial*," available online at http://www.bportugal.pt/.

For sectoral employment information missing from *SourceOECD* during 1970 through 2000, we use employment data from the International Labor Office (ILO)'s "*LABORSTA Labour Statistics Database*," available on line at http://laborsta.ilo.org/. For the period 1950 through 1970, we use data from "*ILO Yearbook of Labor Statistics - Retrospective Edition - Population Censuses*," along with three editions (1961, 1966, and 1972) of the Book "*ILO Yearbook of Labor Statistics.*" The general strategy is to use overlapping years across different volumes to construct a consistent series. In the case of Italy, for 1965 we split some sectors that were aggregated using the corresponding shares of 1966. Still, labor share data were missing for some country-years. We completed them using Table 1, page 20*, of the "*Annuaire Statistique de la France 1972*," edited by the Institut National de la Statisque et des Etudes Economiques (INSEE). From this report, we used data for France and the United Kingdom (taking the figures in 1954 in lieu of 1955, which were missing; we also took the averages between 1958 and 1962 in lieu of 1960, and 1964 in lieu of 1965). We used these data also for Italy and Spain, in combination with the ILO's *Yearbook of Labor Statistics* data (for 1955 we used 1954; for 1960 we used the average of 1958 and 1962). Finally, we filled in data for Spain in 1965 using data from the book "*Población, Actividad y Ocupación en España: Reconstrucción de la series históricas: 1960-1978.*"

Given that part of the data are based on ISIC. Rev. 1, ISIC Rev. 2 and part are based on ISIC Rev 3., we converted the data into a maximum common denominator. The resulting sectors are 1) Agriculture, Fishing, Forestry and Hunting; 2) Manufacturing, Mining and Quarrying; 3) Construction; 4) Transport, Storage, and Communications; 5) Electricity, Gas, and Water; and 5) Services (including Trade, Restaurants and Hotels, Finance, Insurance, Real State and Business Services, and Community, Social, and Personal Services).

For a group of Easterners, *SourceOECD* has complete data in 2000. This group includes Czech Republic, Hungary, Poland, Slovakia, and Turkey. For the remaining Easterners, we took the sectoral shares of GDP and employment from the 2002 regular reports by the European Economic Commission on each country's progress towards accession. Hence, data for Bulgaria, Cyprus, Estonia, Latvia, Lithuania, Romania, Slovenia, and Malta come from this source.

Sectoral value-added and sectoral employment are obtained by applying the sectoral shares to total real GDP and employment from the Penn World Tables.

REFERENCES FOR DATA APPENDIX

"LABORSTA Labour Statistics Database," (1970-2000), available on line at http://laborsta.ilo.org/.

"ILO Yearbook of Labor Statistics - Retrospective Edition - Population Censuses," (1990), International Labor Office.

"ILO Yearbook of Labor Statistics," various issues. (1961, 1966, and 1972).

"National Accounts of OECD Countries" (Detailed Tables, Volume II, 1970-2001), available on line through SourceOECD.

"National Accounts of OECD Countries," Volume II, various issues (1950-1969, 1970-1982, 1989-2000).

"Población, Actividad y Ocupación en España: Reconstrucción de la series históricas: 1960-1978," (1979), Ministerio de Economia del Gobierno de España.

Regular Report on Bulgaria's Progress Towards Accession, 2002. Commission of the European Communities.

Regular Report on Cyprus's Progress Towards Accession, 2002. Commission of the European Communities.

Regular Report on Estonia's Progress Towards Accession, 2002. Commission of the European Communities.

Regular Report on Latvia's Progress Towards Accession, 2002. Commission of the European Communities.

Regular Report on Lithuania's Progress Towards Accession, 2002. Commission of the European Communities.

Regular Report on Romania's Progress Towards Accession, 2002. Commission of the European Communities.

Regular Report on Slovenia's Progress Towards Accession, 2002. Commission of the European Communities.

Regular Report on Malta's Progress Towards Accession, 2002. Commission of the European Communities.

(All countries' regular reports can be downloaded from: http://europa.eu.int/comm/enlargement/report2002/.)

"Séries Longas para a Economia Portuguesa pós II Guerra Mundial," Bank of Portugal, available online at http://www.bportugal.pt/.

"STAN Database for Industrial Analysis," OECD, Volume 2004, release 03, available on line through SourceOECD.

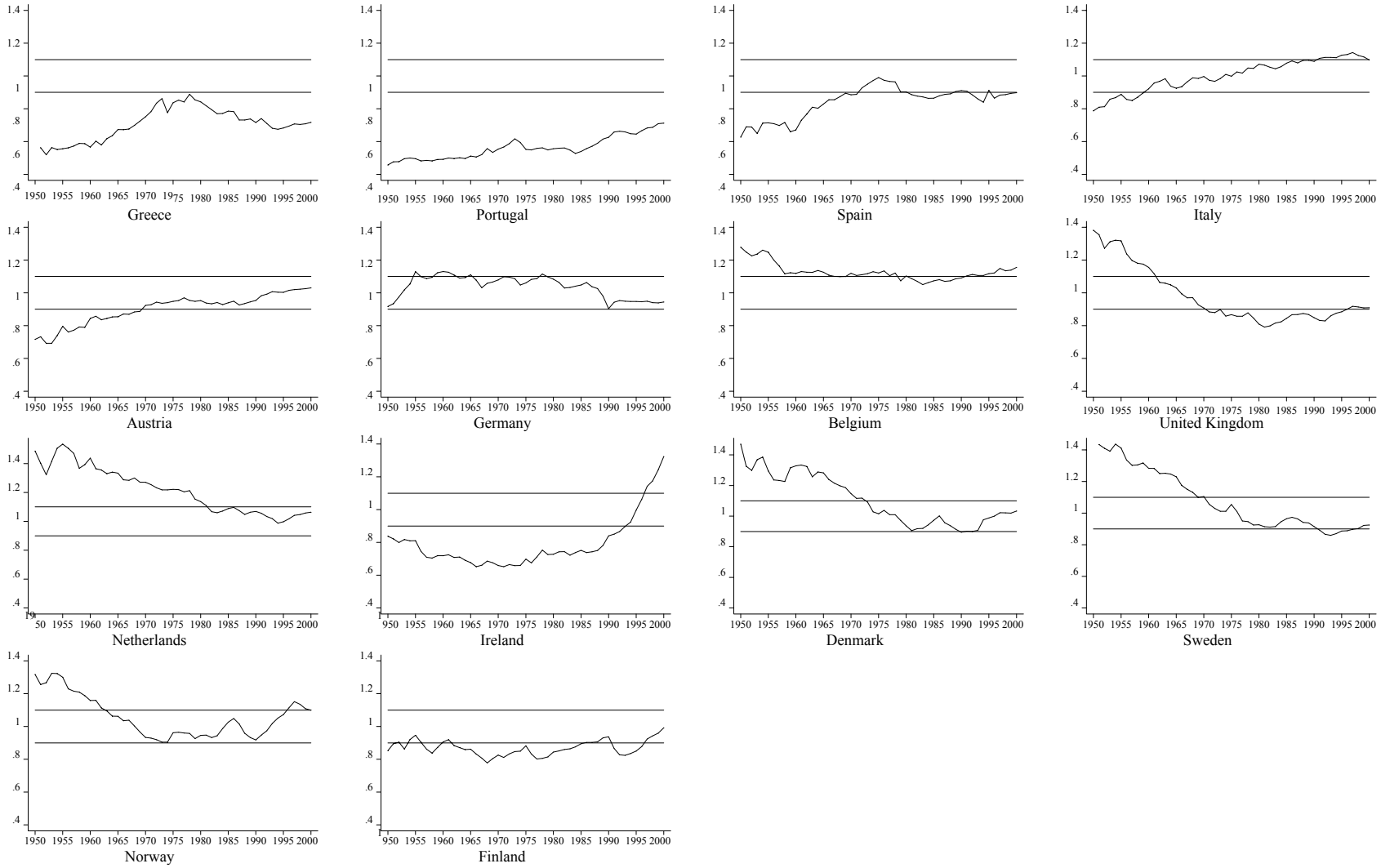

Figure 2.1: GDP per Worker Relative to France

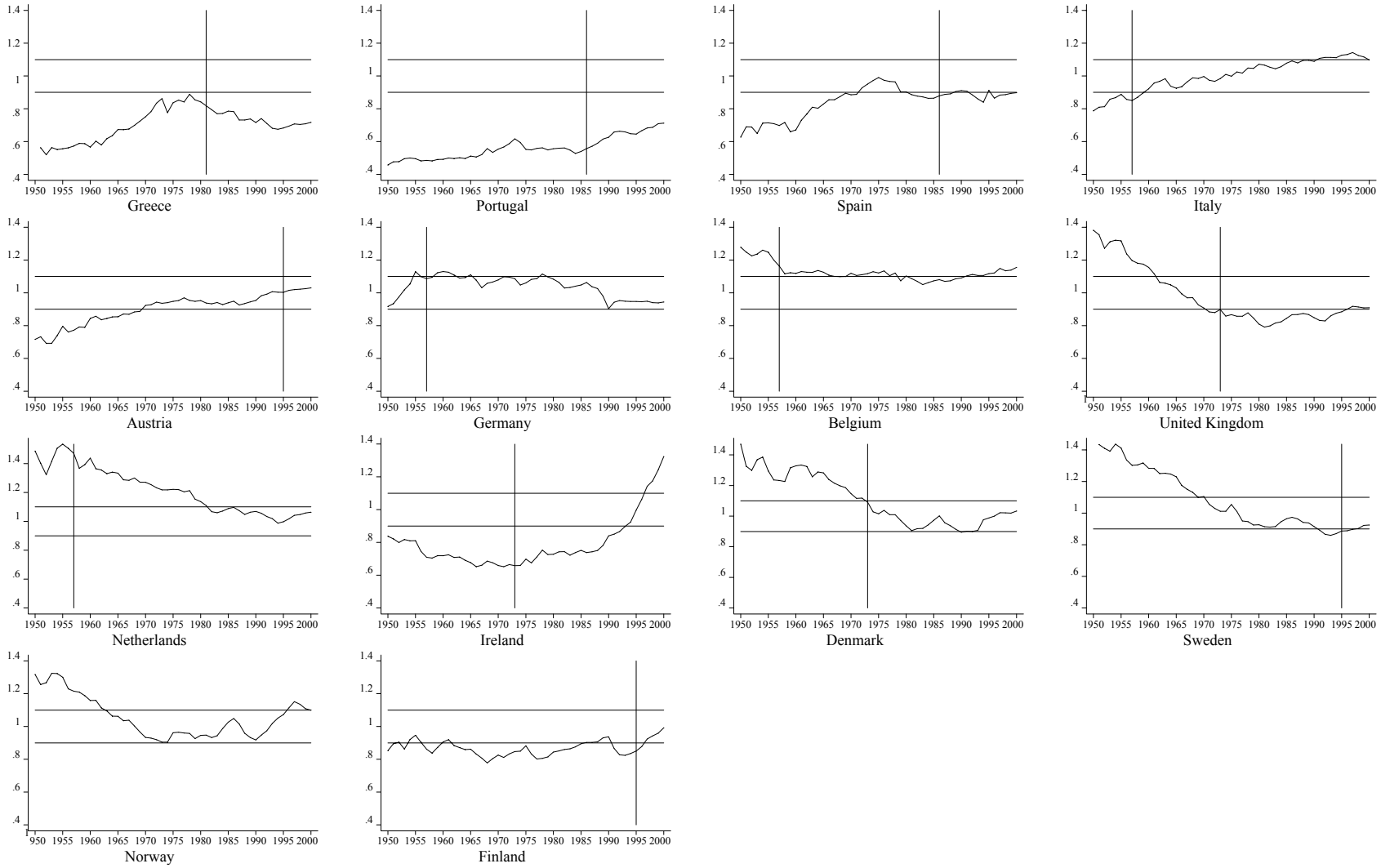

Figure 2.2: Relative GDP and Year of EC Membership

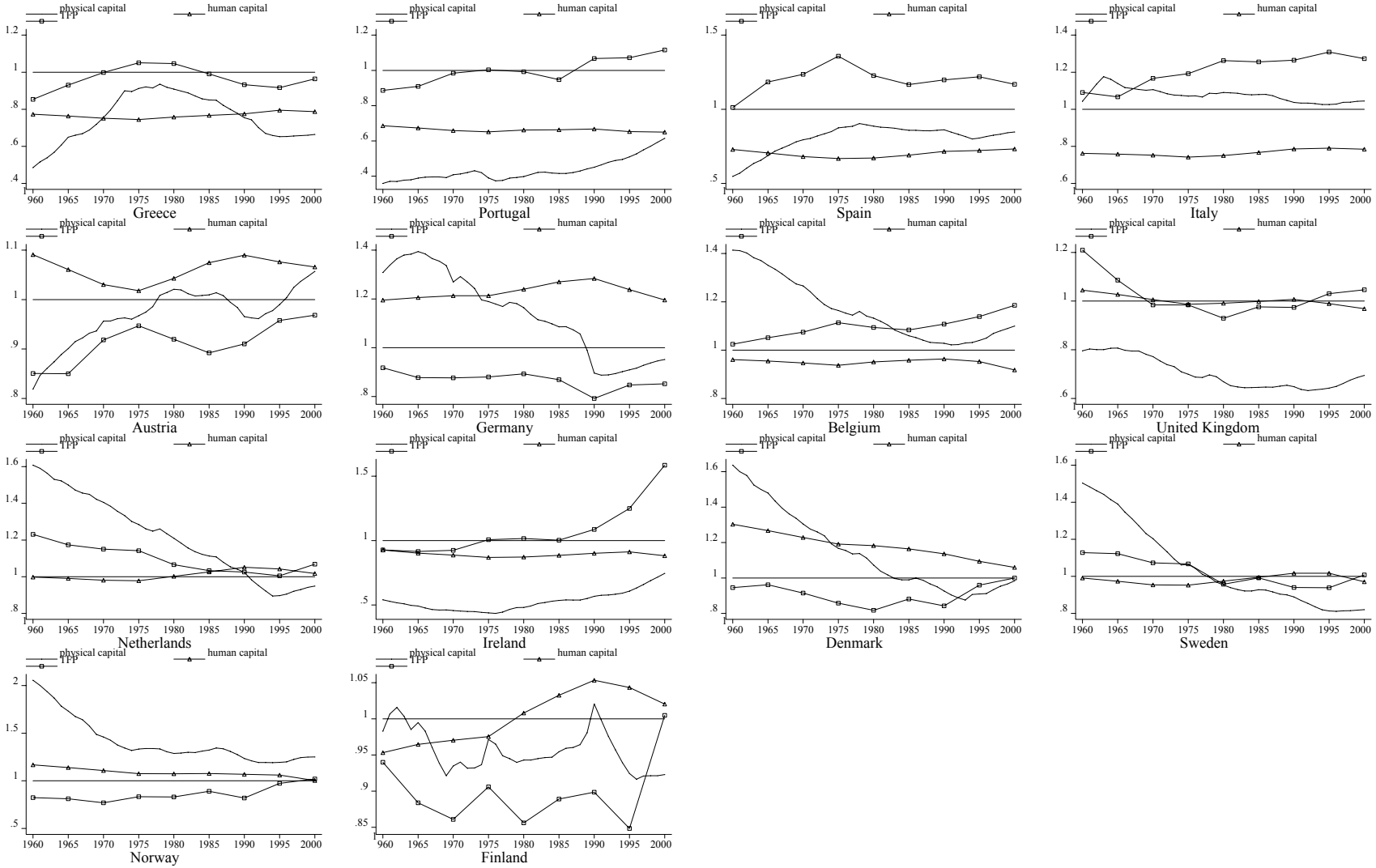

Figure 4.1: Capital Intensity and TFP Relative to France

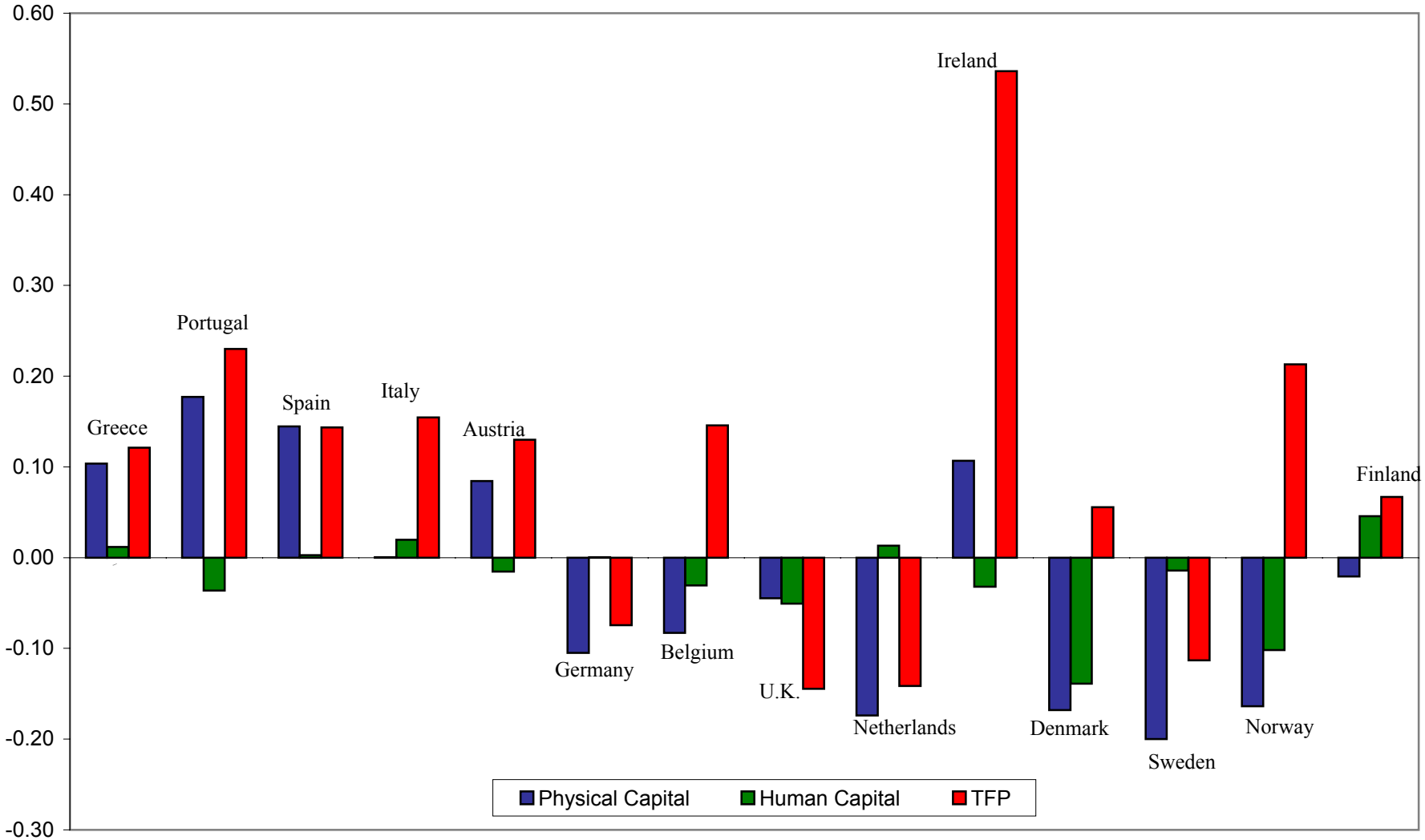

Figure 4.2. Contribution of Physical/Human Capital and TFP to Convergence

Table 4.1. Convergence Decomposition 1960-2000

Country	Total	Physical Capital	Human Capital	TFP
Greece	0.24	0.10	0.01	0.12
Portugal	0.37	0.18	-0.04	0.23
Spain	0.29	0.14	0.00	0.14
Italy	0.17	0.00	0.02	0.15
Austria	0.20	0.08	-0.02	0.13
Germany	-0.18	-0.11	0.00	-0.07
Belgium	0.03	-0.08	-0.03	0.15
United Kingdom	-0.24	-0.04	-0.05	-0.14
Netherlands	-0.30	-0.17	0.01	-0.14
Ireland	0.61	0.11	-0.03	0.54
Denmark	-0.25	-0.17	-0.14	0.06
Sweden	-0.33	-0.20	-0.01	-0.11
Norway	-0.05	-0.16	-0.10	0.21
Finland	0.09	-0.02	0.05	0.07

Table 4.2. Convergence Decomposition 1960-1975

Country	Total	Physical Capital	Human Capital	TFP
Greece	0.39	0.21	-0.03	0.21
Portugal	0.12	0.03	-0.03	0.12
Spain	0.39	0.16	-0.06	0.29
Italy	0.08	0.01	-0.02	0.09
Austria	0.12	0.06	-0.05	0.11
Germany	-0.06	-0.03	0.01	-0.04
Belgium	0.00	-0.06	-0.02	0.08
United Kingdom	-0.29	-0.04	-0.04	-0.21
Netherlands	-0.16	-0.07	-0.01	-0.08
Ireland	-0.03	-0.07	-0.04	0.08
Denmark	-0.27	-0.11	-0.06	-0.10
Sweden	-0.20	-0.11	-0.03	-0.06
Norway	-0.19	-0.14	-0.06	0.01
Finland	-0.03	0.00	0.02	-0.04

Table 4.3. Convergence Decomposition 1975-2000

Country	Total	Physical Capital	Human Capital	TFP
Greece	-0.15	-0.10	0.04	-0.09
Portugal	0.25	0.15	0.00	0.11
Spain	-0.10	-0.01	0.06	-0.15
Italy	0.10	-0.01	0.04	0.07
Austria	0.08	0.03	0.03	0.02
Germany	-0.12	-0.07	-0.01	-0.03
Belgium	0.03	-0.02	-0.01	0.06
United Kingdom	0.05	0.00	-0.01	0.06
Netherlands	-0.14	-0.10	0.03	-0.07
Ireland	0.64	0.18	0.01	0.45
Denmark	0.02	-0.06	-0.08	0.15
Sweden	-0.13	-0.09	0.01	-0.06
Norway	0.13	-0.02	-0.05	0.20
Finland	0.12	-0.02	0.03	0.10

Table 4.4. Convergence Decomposition with Country Specific Capital Shares, 1960-200(

Country	Total	Physical Capital	Human Capital	TFP
Greece	0.24	0.00	0.03	0.21
Portugal	0.37	0.18	-0.05	0.24
Spain	0.29	0.24	-0.02	0.07
Italy	0.17	0.04	0.01	0.12
Austria	0.20	0.13	-0.03	0.10
Germany	-0.18	-0.03	-0.02	-0.13
Belgium	0.03	-0.07	-0.03	0.13
United Kingdom	-0.24	-0.05	-0.05	-0.14
Netherlands	-0.30	-0.07	-0.01	-0.22
Ireland	0.61	0.10	-0.04	0.55
Denmark	-0.25	-0.11	-0.16	0.01
Sweden	-0.33	-0.18	-0.01	-0.14
Norway	-0.05	-0.01	-0.14	0.09
Finland	0.09	0.02	0.04	0.03

Table 4.5. Convergence Decomposition with Country Specific Capital Shares, 1960-197[illegible]

Country	Total	Physical Capital	Human Capital	TFP
Greece	0.39	0.09	-0.02	0.32
Portugal	0.12	0.04	-0.04	0.12
Spain	0.39	0.22	-0.07	0.24
Italy	0.08	0.03	-0.02	0.07
Austria	0.12	0.09	-0.05	0.09
Germany	-0.06	0.01	0.00	-0.08
Belgium	0.00	-0.05	-0.02	0.07
United Kingdom	-0.29	-0.04	-0.04	-0.20
Netherlands	-0.16	-0.01	-0.02	-0.13
Ireland	-0.03	-0.05	-0.05	0.07
Denmark	-0.27	-0.07	-0.07	-0.13
Sweden	-0.20	-0.11	-0.03	-0.06
Norway	-0.19	-0.06	-0.07	-0.06
Finland	-0.03	0.02	0.01	-0.06

Table 4.6. Convergence Decomposition with Country Specific Capital Shares, 1975-200(

Country	Total	Physical Capital	Human Capital	TFP
Greece	-0.15	-0.09	0.05	-0.11
Portugal	0.25	0.14	-0.01	0.12
Spain	-0.10	0.03	0.05	-0.17
Italy	0.10	0.01	0.03	0.05
Austria	0.08	0.05	0.02	0.01
Germany	-0.12	-0.04	-0.02	-0.05
Belgium	0.03	-0.01	-0.02	0.06
United Kingdom	0.05	-0.01	-0.01	0.07
Netherlands	-0.14	-0.06	0.01	-0.09
Ireland	0.64	0.15	0.01	0.48
Denmark	0.02	-0.03	-0.09	0.14
Sweden	-0.13	-0.08	0.02	-0.08
Norway	0.13	0.05	-0.07	0.16
Finland	0.12	0.00	0.03	0.09

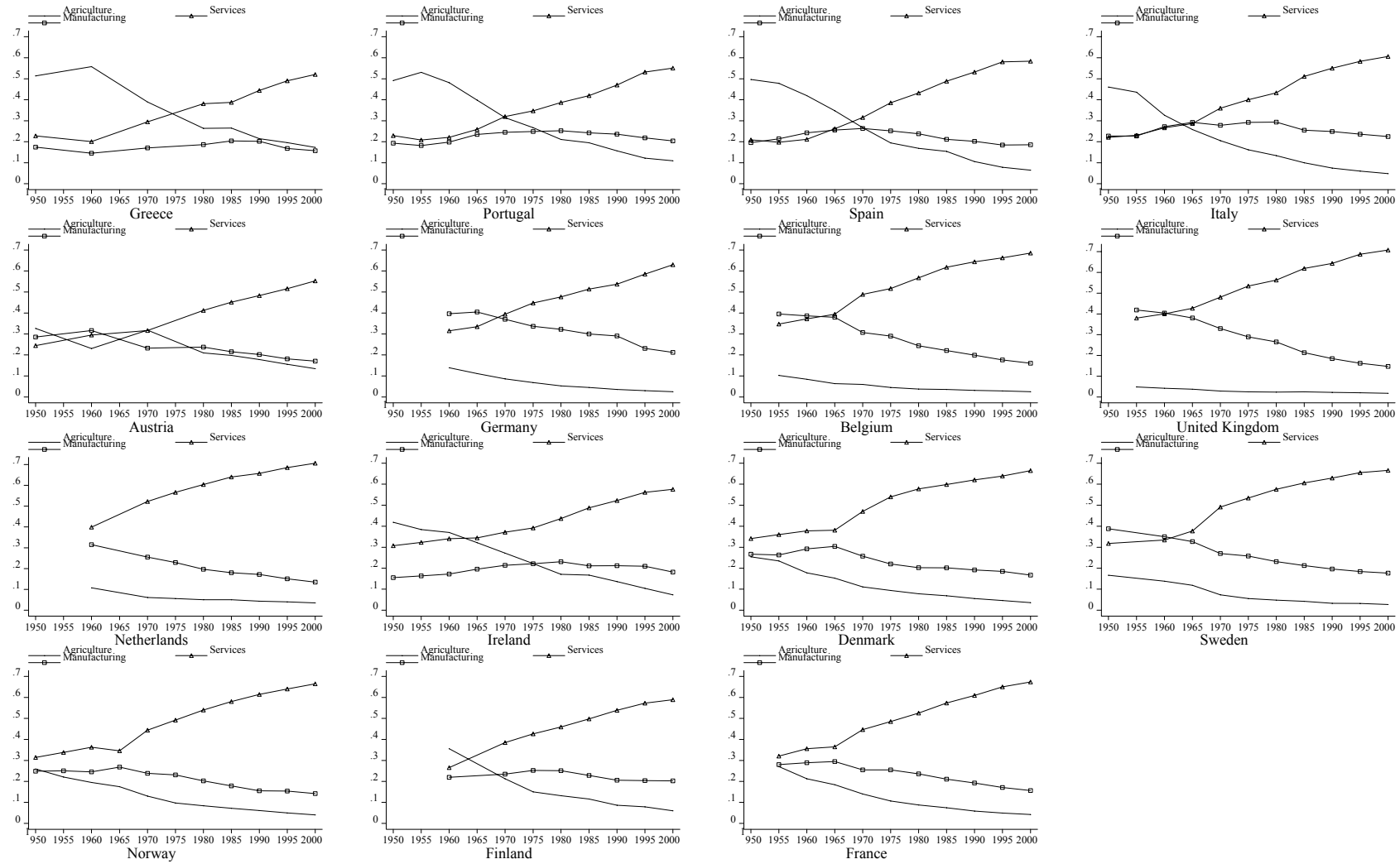

Figure 5.1: Sectoral Employment Shares, Large Sectors

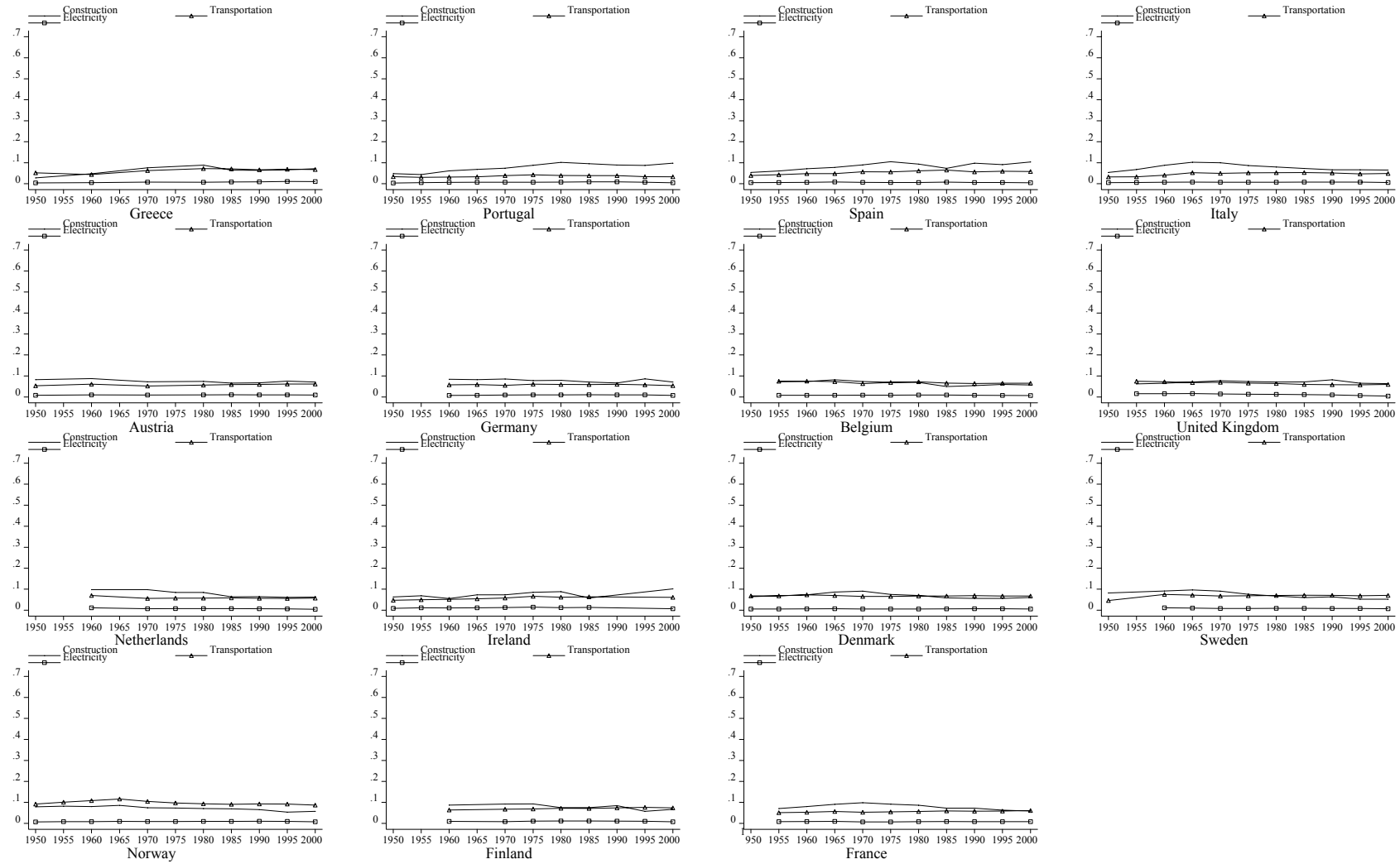

Figure 5.2: Sectoral Employment Shares, Small Sectors

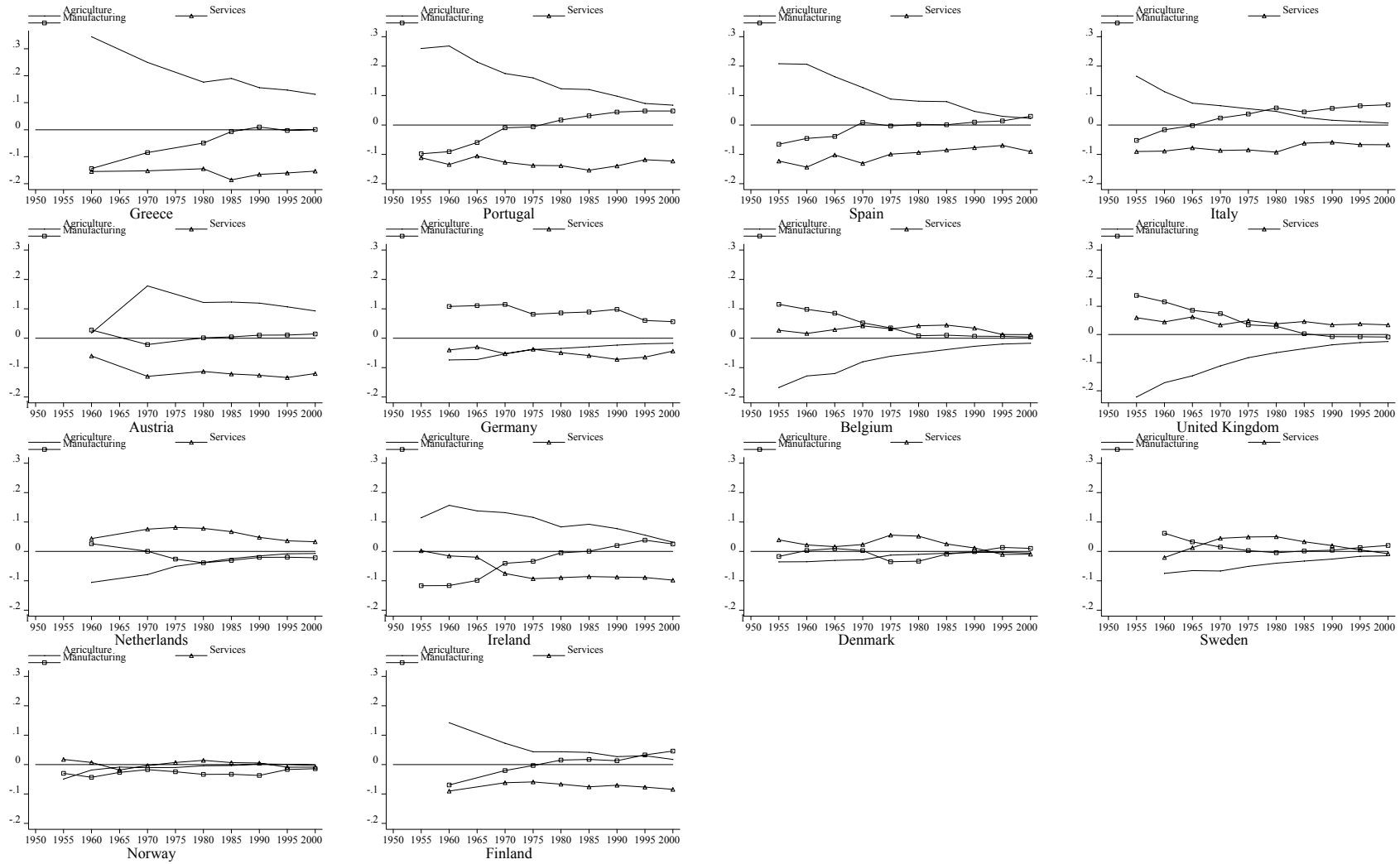

Figure 5.3: Sectoral Employment Difference with France, Large Sectors

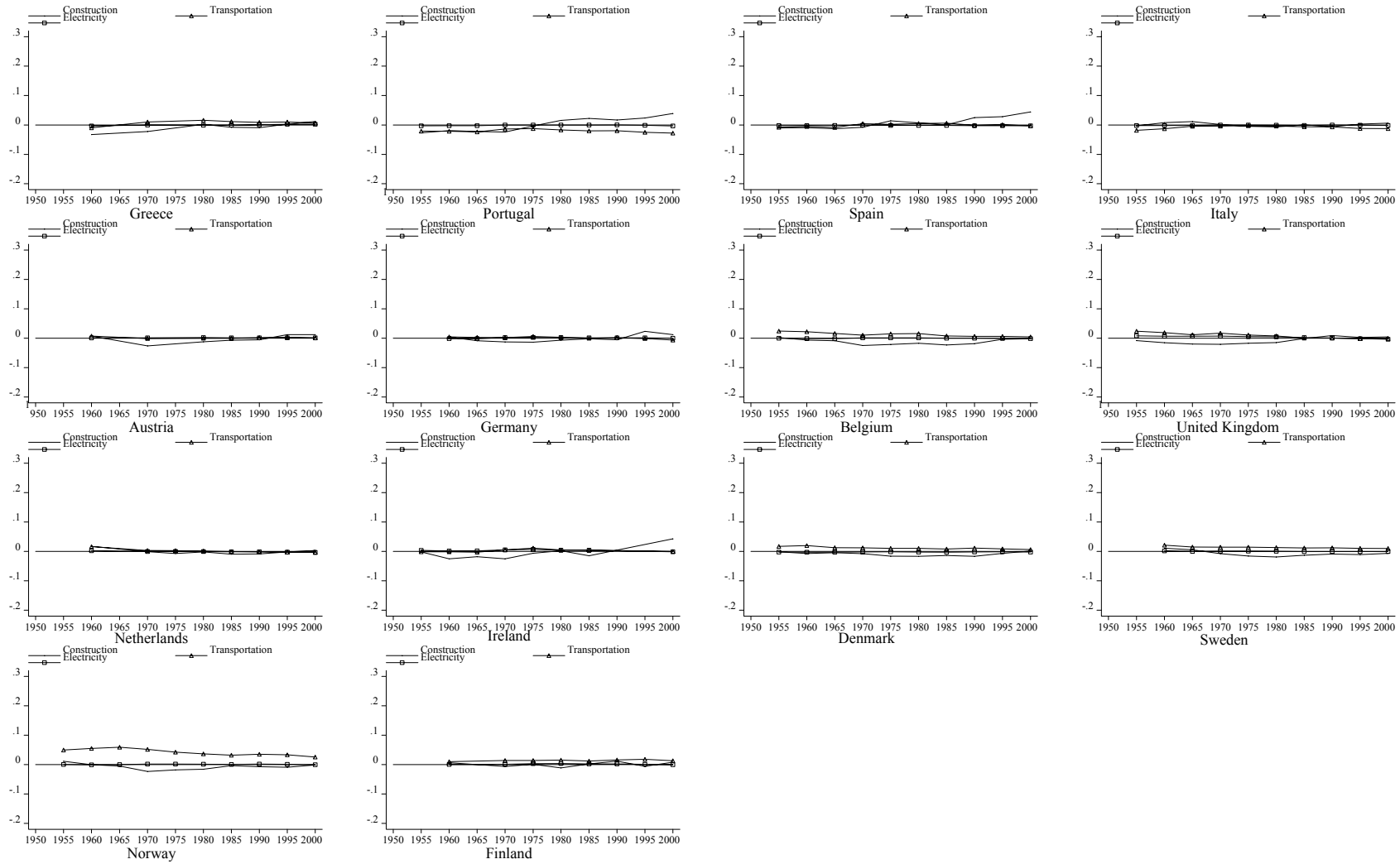

Figure 5.4: Sectoral Difference with France, Small Sectors

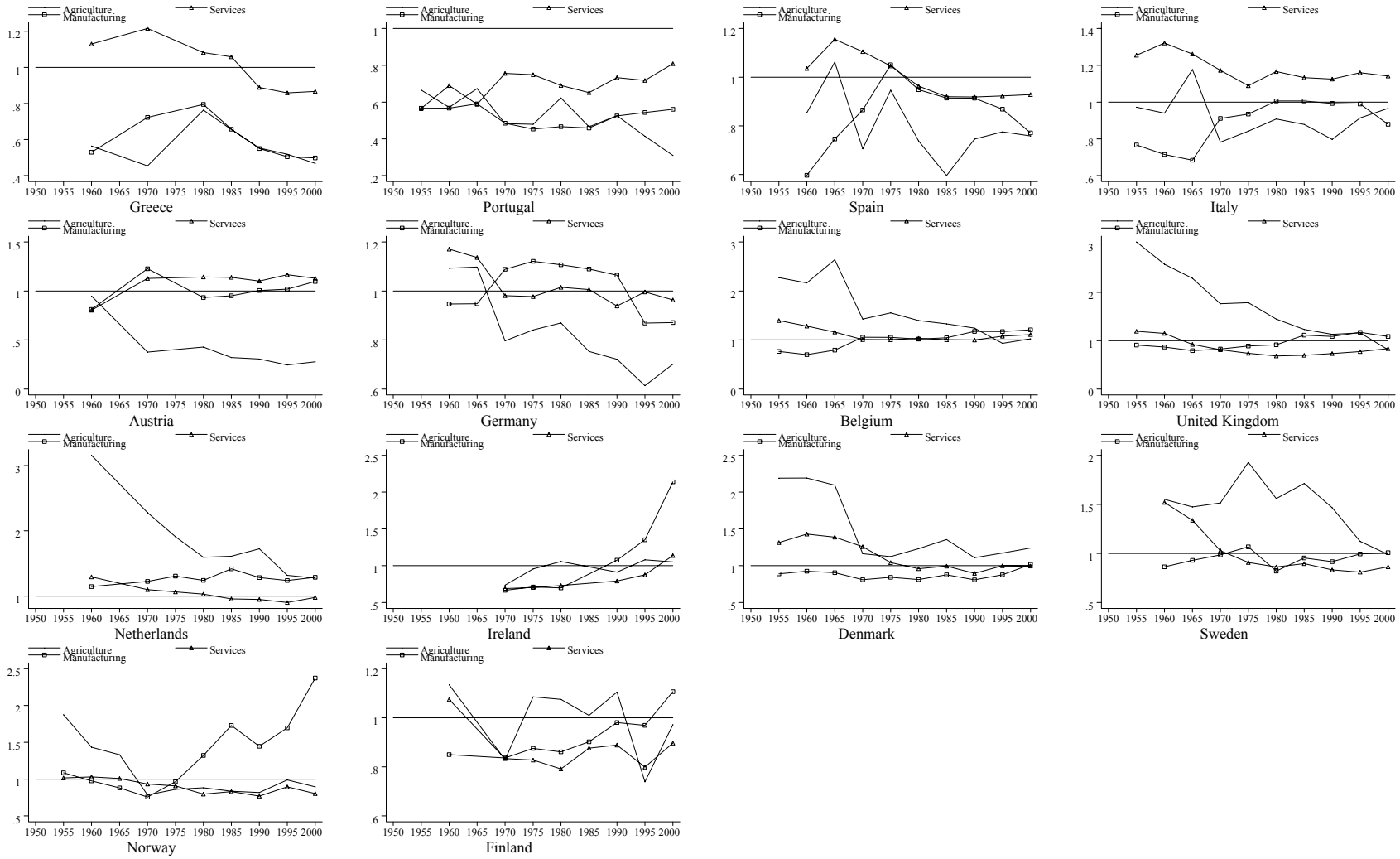

Figure 5.5: Sectoral GDP per Worker Relative to France, Large Sectors

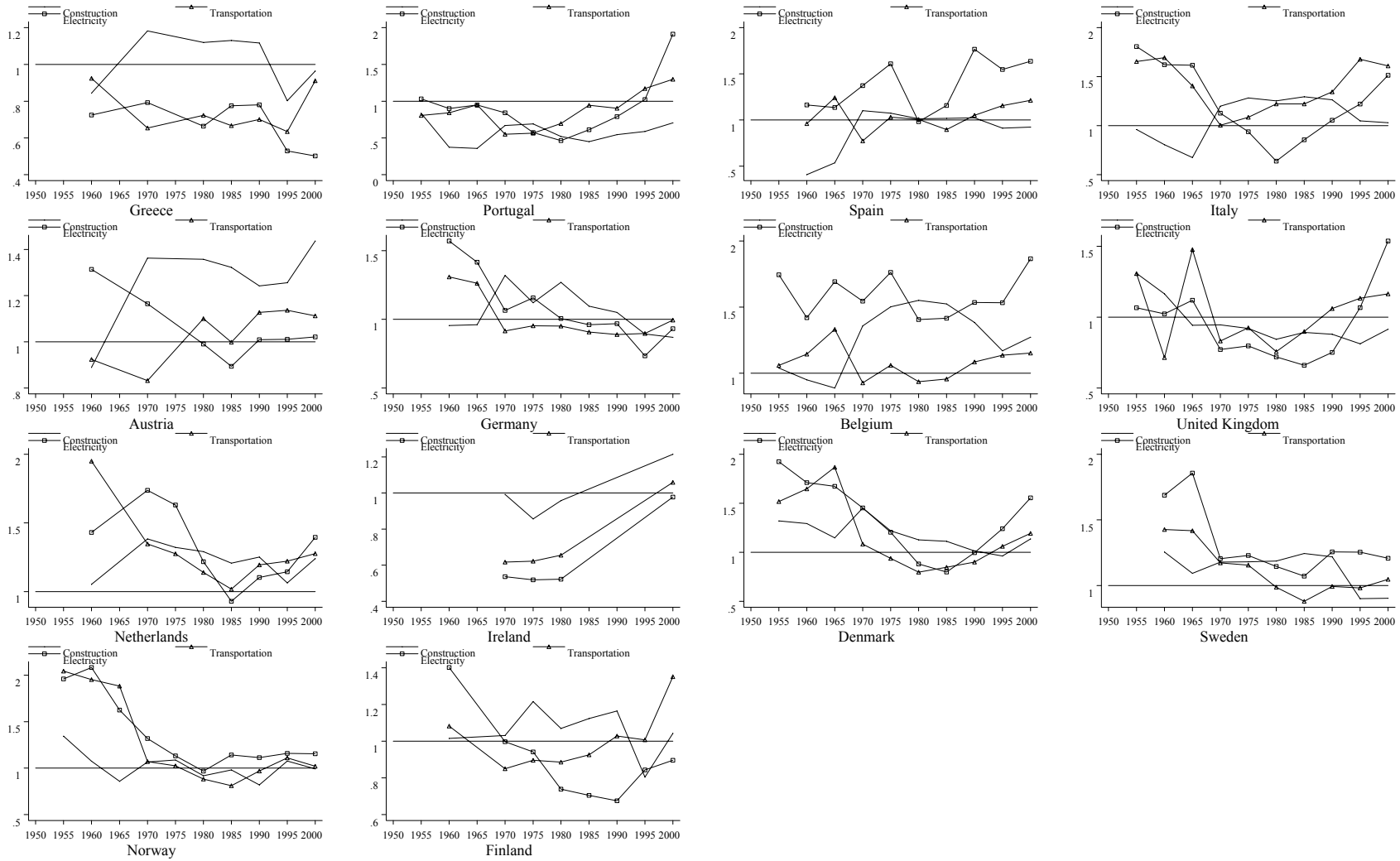

Figure 5.6: Sectoral GDP per Worker Relative to France, Small Sectors

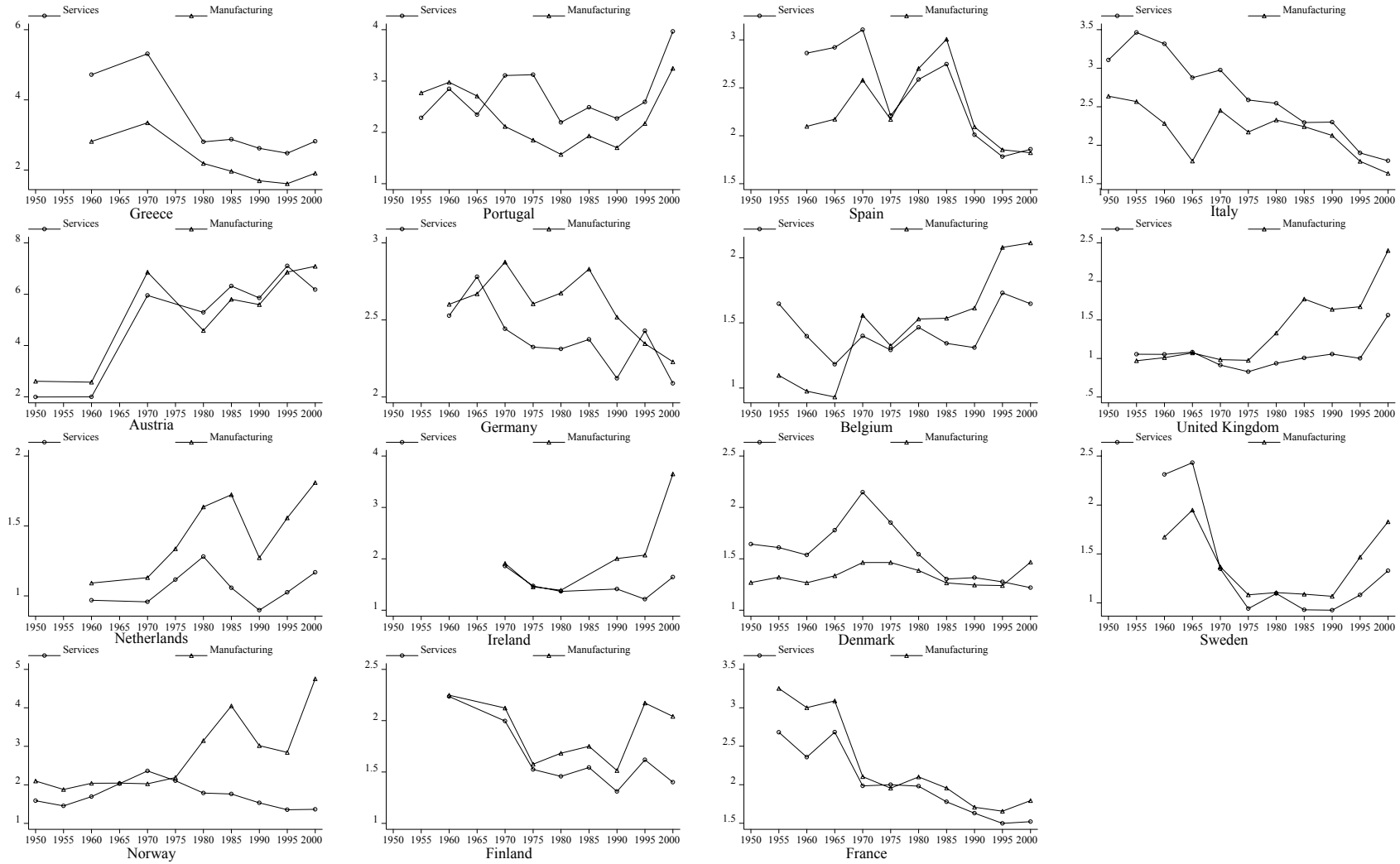

Figure 5.7: GDP per Worker Relative to Agriculture, Large Sectors

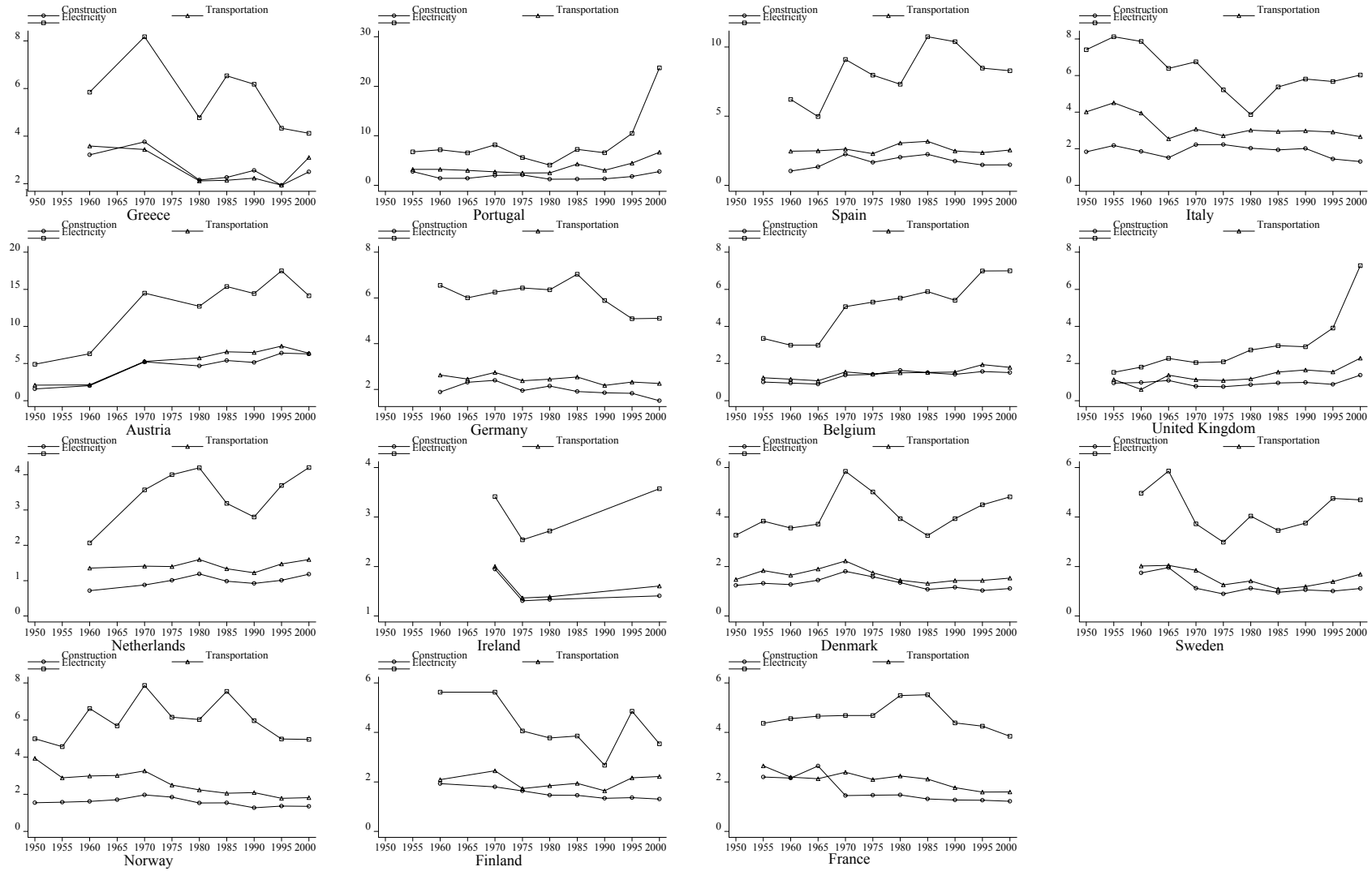

Figure 5.8: GDP per Worker Relative to Agriculture, Small Sectors

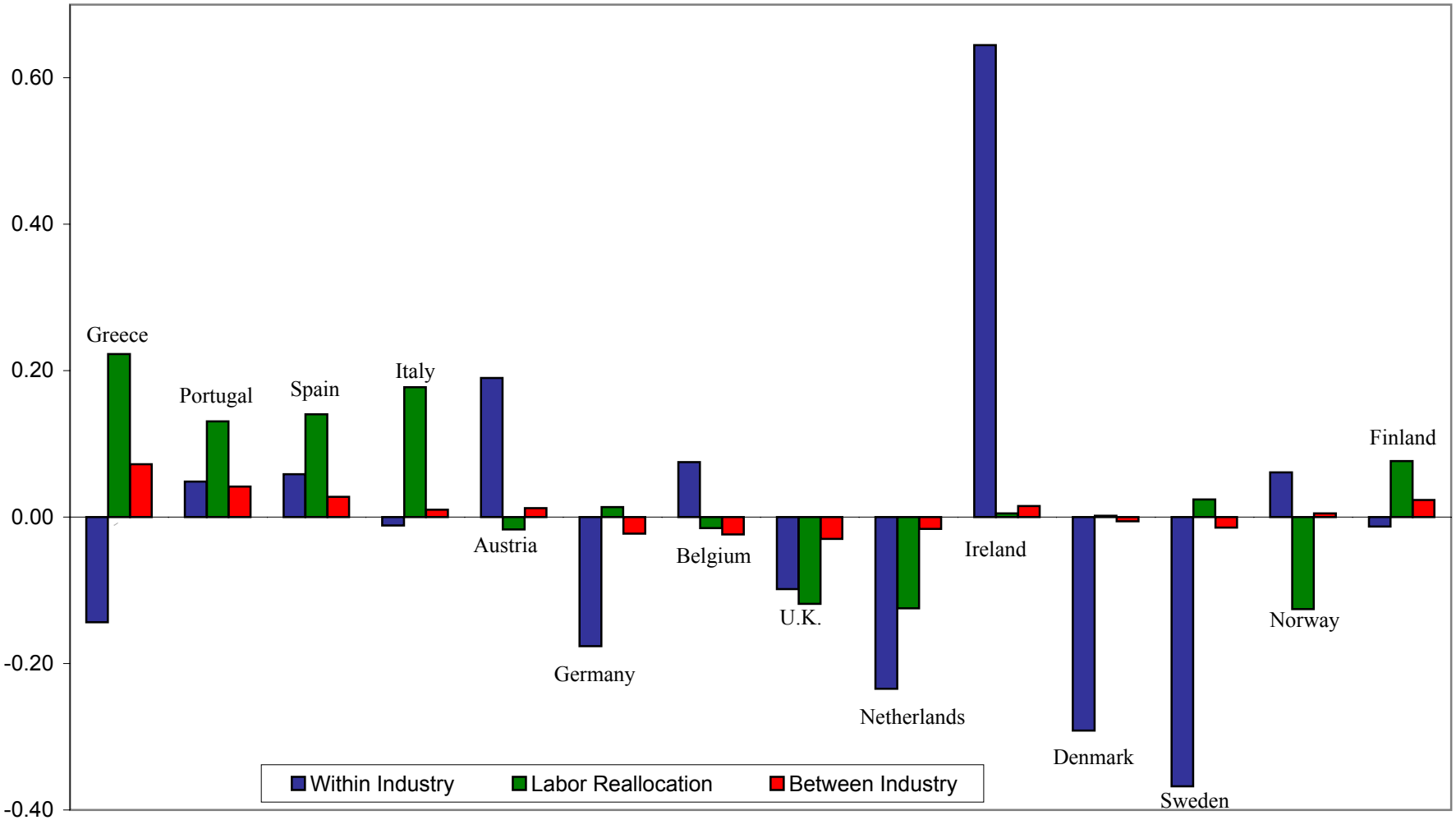

Fig 5.9. Contribution of Within/Between-Industry and Labor Reallocation to Convergence

Table 5.1. Convergence Decomposition 1960-2000

Panel A. Sources of Convergence

Country	Total	Within Industry	Labor Reallocation	Between Industry
Austria	0.18574	0.19021	-0.01690	0.01243
Belgium	0.03656	0.07528	-0.01508	-0.02364
Denmark	-0.29550	-0.29159	0.00174	-0.00566
Finland	0.08694	-0.01294	0.07648	0.02339
Germany	-0.18532	-0.17639	0.01365	-0.02259
Greece	0.15108	-0.14367	0.22265	0.07211
Ireland[a]	0.66513	0.64484	0.00509	0.01519
Italy	0.17588	-0.01138	0.17731	0.00994
Netherlands	-0.37501	-0.23461	-0.12447	-0.01593
Norway	-0.05943	0.06120	-0.12580	0.00517
Portugal	0.22085	0.04858	0.13063	0.04164
Spain	0.22670	0.05847	0.14043	0.02780
Sweden	-0.35827	-0.36782	0.02396	-0.01440
United Kingdom	-0.24639	-0.09833	-0.11848	-0.02958

Panel B. Relative Contribution of Different Sources

Country	Total	Within Industry	Labor Reallocation	Between Industry
Austria	100.00%	102.41%	-9.10%	6.69%
Belgium	100.00%	205.91%	-41.24%	-64.67%
Denmark	100.00%	98.68%	-0.59%	1.91%
Finland	100.00%	-14.88%	87.98%	26.90%
Germany	100.00%	95.18%	-7.37%	12.19%
Greece	100.00%	-95.09%	147.37%	47.73%
Ireland[a]	100.00%	96.95%	0.77%	2.28%
Italy	100.00%	-6.47%	100.81%	5.65%
Netherlands	100.00%	62.56%	33.19%	4.25%
Norway	100.00%	-102.98%	211.68%	-8.70%
Portugal	100.00%	22.00%	59.15%	18.85%
Spain	100.00%	25.79%	61.95%	12.26%
Sweden	100.00%	102.67%	-6.69%	4.02%
United Kingdom	100.00%	39.91%	48.09%	12.00%

[a] The values for Ireland correspond to 1970-2000.

Table 5.2. Within-Industry Convergence. 1960-1975 and 1975-2000.

Panel A. Within-Industry Convergence, by sub-period

Country	1960-2000	1960-1975	1975-2000
Austria[a]	0.19021	0.17845	0.01176
Belgium	0.07528	-0.01176	0.08704
Denmark	-0.29159	-0.33765	0.04606
Finland	-0.01294	-0.11098	0.09804
Germany	-0.17639	-0.06089	-0.11550
Greece[a]	-0.14367	0.06531	-0.20898
Ireland[b]	0.64484	0.03368	0.61117
Italy	-0.01138	-0.04220	0.03083
Netherlands	-0.23461	-0.15446	-0.08015
Norway	0.06120	-0.20269	0.26389
Portugal	0.04858	0.00786	0.04071
Spain	0.05847	0.20573	-0.14727
Sweden	-0.36782	-0.26671	-0.10111
United Kingdom	-0.09833	-0.24155	0.14322

Panel B. Contribution of each subperiod to Within-Industry Convergence

Country	1960-2000	1960-1975	1975-2000
Austria[a]	100.00%	93.82%	6.18%
Belgium	100.00%	-15.62%	115.62%
Denmark	100.00%	115.80%	-15.80%
Finland	100.00%	857.81%	-757.81%
Germany	100.00%	34.52%	65.48%
Greece[a]	100.00%	-45.46%	145.46%
Ireland[b]	100.00%	5.22%	94.78%
Italy	100.00%	370.99%	-270.99%
Netherlands	100.00%	65.84%	34.16%
Norway	100.00%	-331.18%	431.18%
Portugal	100.00%	16.19%	83.81%
Spain	100.00%	351.88%	-251.88%
Sweden	100.00%	72.51%	27.49%
United Kingdom	100.00%	245.66%	-145.66%

[a] Values for Austria and Greece correspond to the subperiods 1960-1980 and 1980-2000. [b] Values for Ireland correspond to the subperiods 1970-1975 and 1975-2000.

Table 5.3. Labor Realllocation. 1960-1975 and 1975-2000

Panel A. Labor Reallocation Convergence, by sub-period

Country	1960-2000	1960-1975	1975-2000
Austria[a]	-0.01690	-0.04635	0.0294519
Belgium	-0.01508	-0.01534	0.00026
Denmark	0.00174	-0.01001	0.01175
Finland	0.07648	0.06019	0.01629
Germany	0.01365	0.00791	0.00574
Greece[a]	0.22265	0.14552	0.07713
Ireland[b]	0.00509	0.00882	-0.00373
Italy	0.17731	0.08253	0.09478
Netherlands	-0.12447	-0.07747	-0.04700
Norway	-0.12580	-0.02582	-0.09999
Portugal	0.13063	0.06996	0.06067
Spain	0.14043	0.07103	0.06941
Sweden	0.02396	0.01126	0.01269
United Kingdom	-0.11848	-0.06430	-0.05418

Panel B. Contribution of each subperiod to Labor Reallocation

Country	1960-2000	1960-1975	1975-2000
Austria[a]	100.00%	101.71%	-1.71%
Belgium	100.00%	101.71%	-1.71%
Denmark	100.00%	-573.88%	673.87%
Finland	100.00%	78.70%	21.30%
Germany	100.00%	57.93%	42.07%
Greece[a]	100.00%	65.36%	34.64%
Ireland[b]	100.00%	173.15%	-73.14%
Italy	100.00%	46.55%	53.45%
Netherlands	100.00%	62.24%	37.76%
Norway	100.00%	20.52%	79.48%
Portugal	100.00%	53.55%	46.45%
Spain	100.00%	50.58%	49.42%
Sweden	100.00%	47.01%	52.99%
United Kingdom	100.00%	54.27%	45.73%

[a] Values for Austria and Greece correspond to the subperiods 1960-1980 and 1980-2000. [b] Values for Ireland correspond to the subperiods 1970-1975 and 1975-2000.

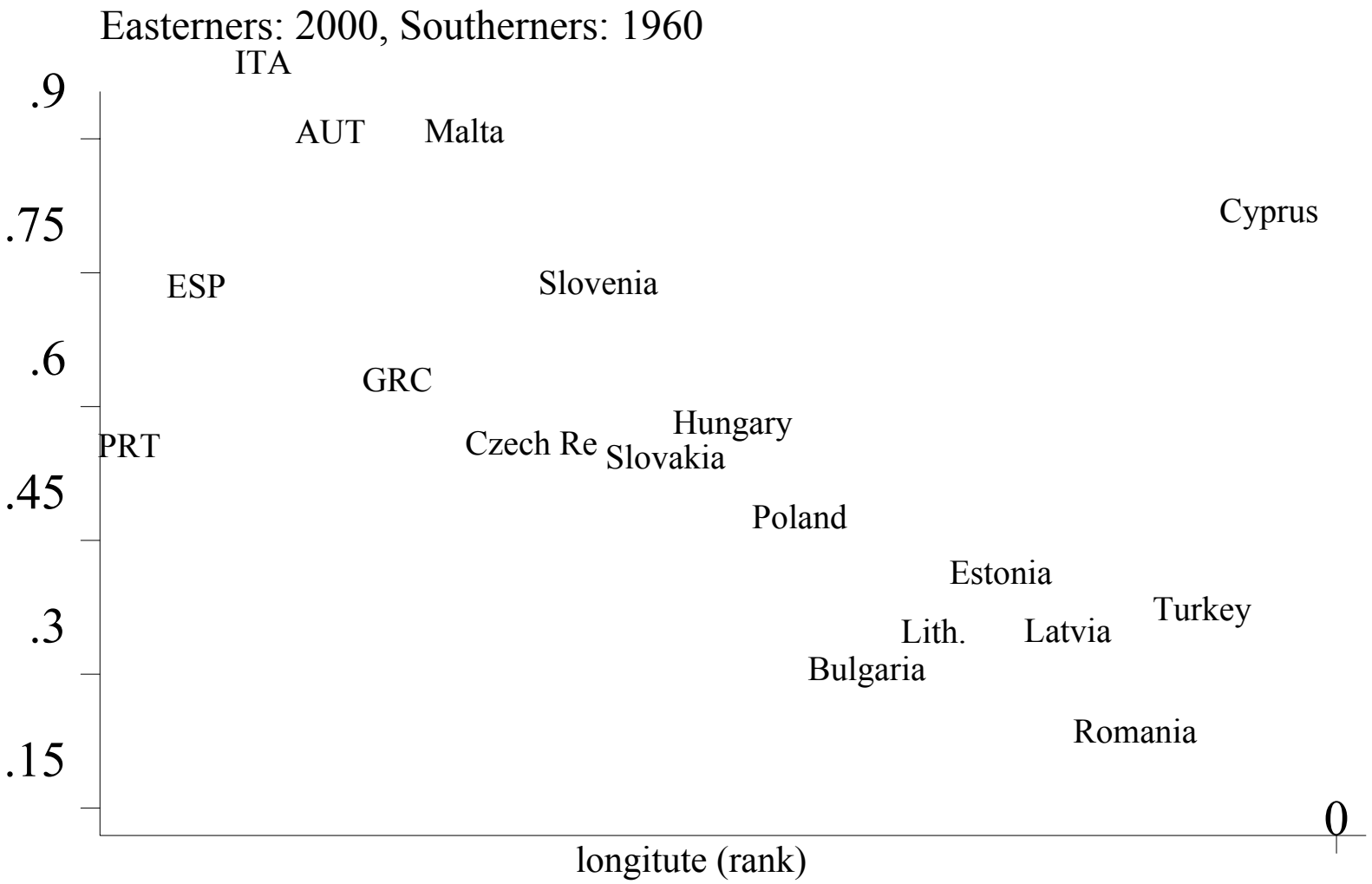

Figure 6.1: GDP per Worker Relative to France

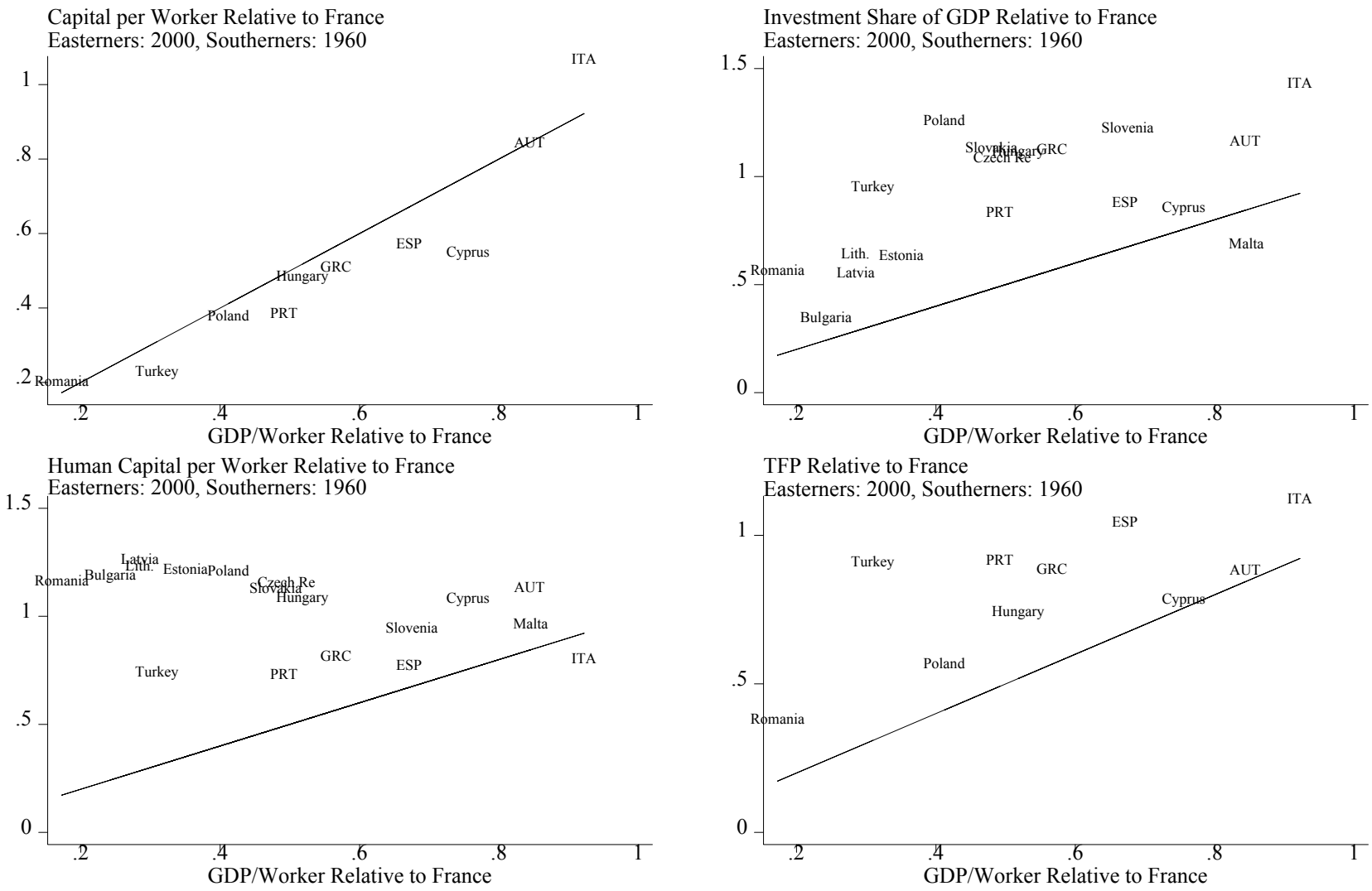

Figure 6.2: Capital Intensity and TFP Relative to France

Table 6.1. The Southerners in 1960 and the Easterners in 2000

Country	Year	Difference in Employment Shares Relative to France			Sectoral Productivity Relative to France			Sectoral Productivity Relative to Agricultural Productivity	
		Agriculture	Manufacturing	Services	Agriculture	Manufacturing	Services	Manufacturing	Services
Spain	1960	0.207	-0.046	-0.144	0.854	0.597	1.036	2.099	2.863
Italy	1960	0.113	-0.017	-0.089	0.940	0.715	1.321	2.283	3.315
Austria	1960	0.017	0.028	-0.060	0.948	0.812	0.803	2.572	1.998
Greece	1960	0.344	-0.144	-0.155	0.565	0.529	1.130	2.815	4.719
Portugal	1960	0.268	-0.091	-0.135	0.571	0.567	0.690	2.977	2.848
Malta	2000	-0.025	0.105	-0.022	1.983	0.829	1.016	0.750	0.779
Estonia	2000	0.028	0.112	-0.091	0.472	0.252	0.400	0.959	1.287
Czech Republic	2000	0.013	0.152	-0.240	0.599	0.392	0.559	1.174	1.420
Cyprus	2000	0.012	-0.015	0.031	0.852	0.644	0.869	1.356	1.551
Hungary	2000	0.024	0.092	-0.160	0.521	0.435	0.556	1.499	1.621
Slovak Republic	2000	0.050	0.098	-0.216	0.379	0.384	0.549	1.821	2.203
Bulgaria	2000	0.225	0.075	-0.213	0.194	0.208	0.320	1.926	2.510
Latvia	2000	0.102	0.052	-0.087	0.150	0.219	0.344	2.628	3.494
Slovenia	2000	0.054	0.167	-0.147	0.359	0.562	0.769	2.810	3.257
Lithuania	2000	0.142	0.059	-0.132	0.184	0.294	0.322	2.868	2.663
Turkey	2000	0.303	0.026	-0.265	0.189	0.331	0.453	3.150	3.647
Romania	2000	0.410	0.065	-0.384	0.072	0.190	0.327	4.728	6.899
Poland	2000	0.220	0.042	-0.263	0.087	0.404	0.568	8.368	9.973

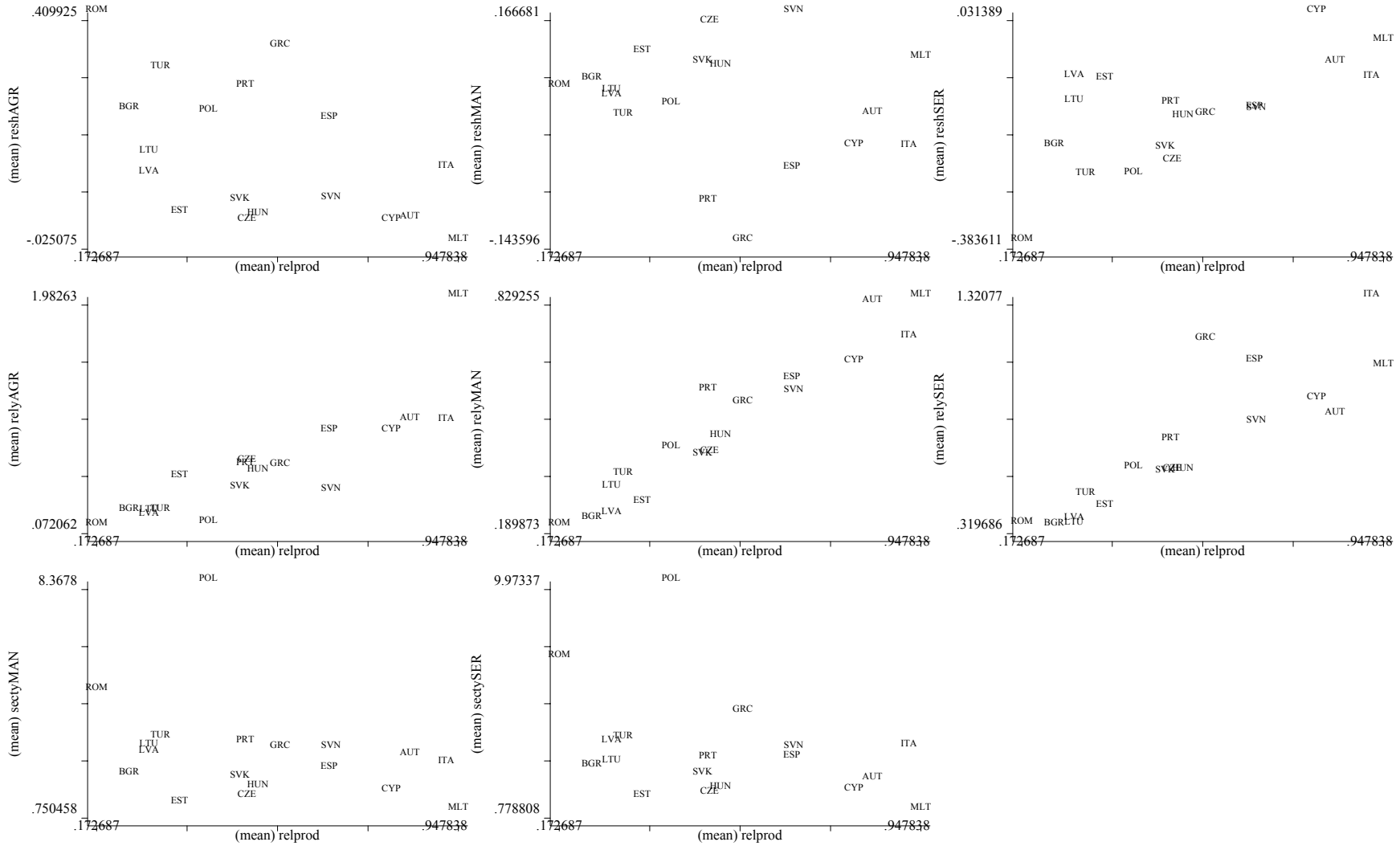

Figure 6.3: Sectoral Data for the Easterners

Table 6.2. Sectoral Sources of Income Gaps

Country	Year	Total Gap	Within	Between	Covariance
Italy	1960	0.08	0.00	0.12	-0.04
Austria	1960	0.19	0.18	0.00	0.00
Spain	1960	0.49	0.28	0.19	0.02
Greece	1960	0.77	0.33	0.42	0.02
Portugal	1960	1.03	0.65	0.26	0.12
Malta	2000	0.06	0.09	0.02	-0.05
Cyprus	2000	0.24	0.23	0.02	0.01
Slovenia	2000	0.48	0.51	0.07	-0.10
Hunagary	2000	0.93	0.98	0.01	-0.06
Czech Rep.	2000	1.02	1.08	0.04	-0.10
Slovakia	2000	1.08	1.09	0.06	-0.06
Poland	2000	1.43	1.30	0.27	-0.14
Estonia	2000	1.85	1.88	0.04	-0.07
Turkey	2000	2.23	1.91	0.32	0.00
Latvia	2000	2.51	2.42	0.10	-0.01
Lithuania	2000	2.52	2.39	0.09	0.03
Bulgaria	2000	3.13	2.89	0.19	0.05
Romania	2000	4.79	4.09	0.68	0.03

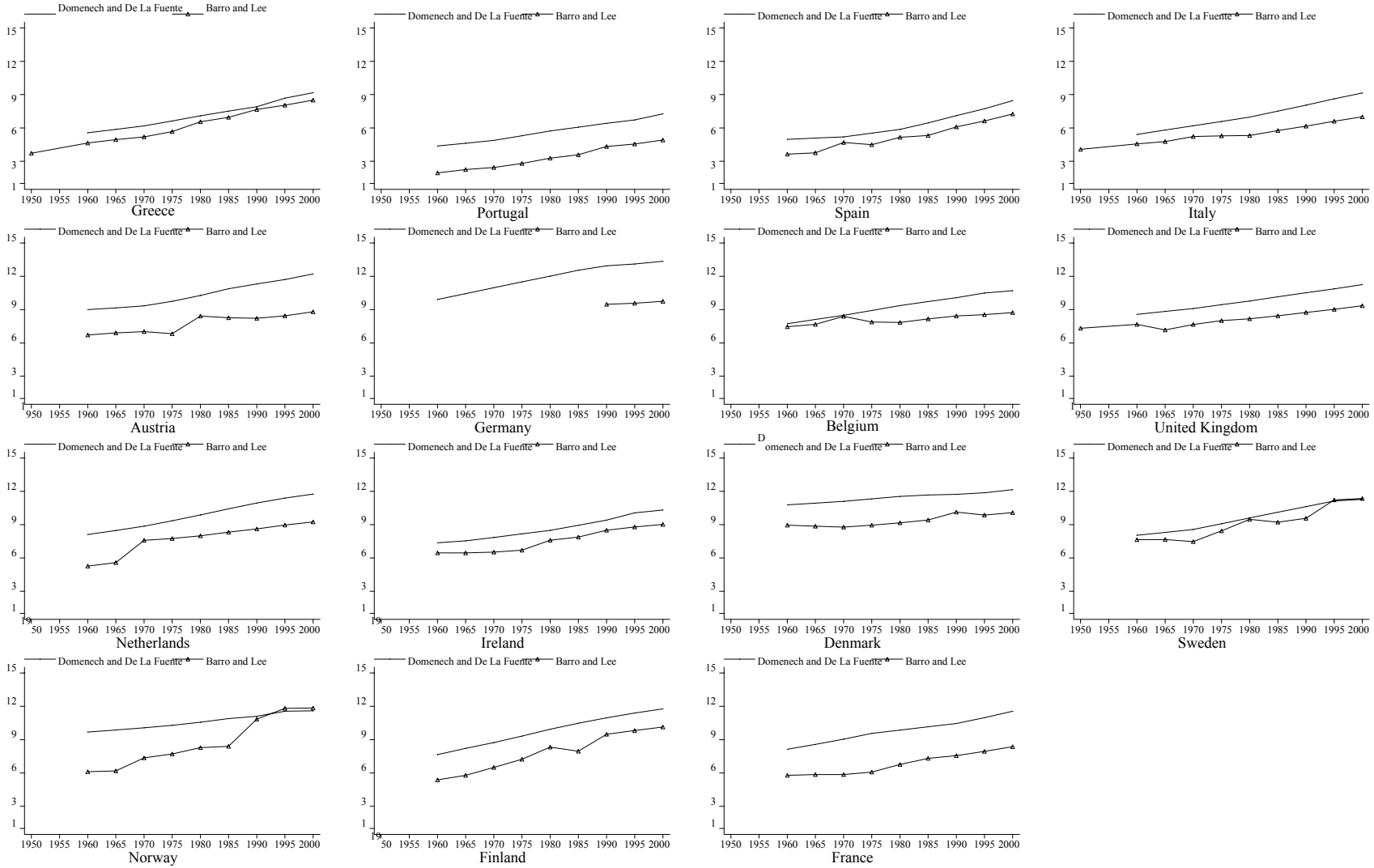

Figure A.1: Two Measures of Years of Schooling