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The Slowdown in European Productivity Growth: A Tale of Tigers, Tortoises and Textbook Labor Economics *

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ABSTRACT

This paper takes a different approach to examining the sharp turnaround in EU relative to US labor productivity growth since 1995. Most of the literature focuses on the American growth revival. But close to half of the turnaround was caused by a European retardation. What caused that retardation?

Economists on both sides of the Atlantic have debated the sources of the decline in European hours per capita from 1970 to 1995. But they have not noticed the complete turnaround toward an increase in hours per capita after 1995, and they have not reflected on the implications for productivity growth. Before 1995 Europe made labor more expensive, reducing hours per capita and artificially raising the growth rate of labor productivity. After 1995, Europe made labor less expensive, raising hours per capita and reducing the growth rate of labor productivity. Our paper shows that when the 1981-95 and 1995-2004 periods are compared, the turnaround in European growth in hours is almost as great as its slowdown in labor productivity.

One of the exogenous driving forces in this was an increase in labor taxes before 1995 and a reduction after 1995. We show that a substantial portion of the post-1995 turnaround in the growth of European hours per capita can be explained by a reversal in the previous regime of ever-increasing tax rates. We conclude that Europe must accept slow productivity growth as a consequence of labor market reforms that have achieved a desirable turnaround in growth of hours per capita.

The paper contains an extensive analysis of the industry decomposition of European productivity growth, based on a decomposition of Europe's fastest-growing "Tigers," its slowest-growing "Tortoises", and a Middle group. The decline in tax rates and turnaround in the growth of hours per capita is distinctly more important in the Tortoises than in the Middle group, adding to the case that changes in the cost of labor are driving both the positive turnaround in hours and negative turnaround in productivity in the EU compared with the US

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I. Introduction

Throughout the postwar era until 1995 labor productivity grew much faster in Europe than in the United States. But since 1995, Europe's productivity growth has slowed while that in the United States has accelerated. The level of average labor productivity (ALP) in the fifteen pre-enlargement members of the EU (hereafter the "EU-15" countries) steadily caught up to the level of the United States up until 1995, and at that point several EU members, e.g., France and Belgium, had surpassed the US in the level of ALP. But then the process of catching up ground to a halt and reversed. The data used in this paper, which translate levels of ALP across countries using 1995 PPP exchange rates, show that the ratio of ALP in the EU-15 relative to the US was 77 percent in 1979, reached 94 percent in 1995, and by 2004 had slipped back to 85 percent. [1] Of the post-1995 growth differential between Europe and the US, about half represents a US revival that has been much analyzed and the other half a European slowdown that is more mysterious.

This paper brings together two previously unconnected literatures, that on the role of taxes and labor market regulations in reducing European hours per capita over the period after 1960, and that on the sources of the US productivity growth revival and European slowdown since 1995. We argue that the hours literature provides a partial explanation of productivity behavior that the productivity literature has missed. Through high labor taxation, regulations,

high minimum wages, and other methods, Europe made labor expensive between 1960 and 1995. Europe was pushed northwest up its labor demand curve, reducing hours per capita and raising the marginal and average products of labor. In this sense part of Europe's productivity catch-up through 1995 was in part artificially induced through hours-cutting policies.

While the second strand of literature on the post-1995 US productivity revival and European slowdown has placed heavy emphasis on the change occurring in the mid-1990s, the hours literature has not. Yet there has been a turnaround in European hours per capita as well, as this ratio has grown since 1995 both in absolute terms and relative to the US (where hours per capita in 2006 are below the level of 2000). The new contribution in this paper is to connect the turnaround in hours per capita after 1995 to the European productivity growth slowdown. We suggest that European policy changes have reversed the northwest movement along the labor demand curve and converted it into a southeast movement that has *partially* reversed the effects of the pre-1995 northwest movement. The result has been a revival in growth of European hours per capita but a steady reduction in productivity growth, both ALP and Total Factor Productivity (TFP). The idea in this paper of a productivity-hours tradeoff related to taxation and other policies was originally developed in Gordon (1997) to explain the pre-1995 divergence between European and US growth rates of both productivity and hours, and we

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1. All data in this paper extending to 2004 come from http://www.ggdc.net/dseries/growth-accounting.shtml. Productivity levels for the EU-15 and individual European countries are converted at 1995 PPP "EKS" exchange rates from http://www.oecd.org/dataoecd/61/56/1876133.xls.

now apply these ideas to the post-1995 turnaround in both productivity and hours growth.[2]

The Two Strands of Literature

The first set of papers debates the fundamental causes of the decline in European hours per capita relative to the US A new round in this debate was set off by Blanchard's (2004) claim that shorter hours in Europe represent a greater taste for leisure, and the conflicting argument by Prescott (2004) that all of the decline in European hours can be explained by high taxes on labor. Alesina, Glaeser, and Sacerdote (2006) dispute Prescott's tax-based argument, and while admitting that there is room for a small effect of taxes, they place substantial blame on labor unions and the political process that passed legislation shortening work hours and promoting early retirement. Ljungqvist and Sargent (2006) argue that much of Prescott's tax effect actually reflects the disincentive effects of European welfare systems. We do not take a position on the nuances between these alternative positions. Rather, we try to tease the answer from the data on hours per capita and labor tax rates. Because Blanchard's thesis does not lend itself to empirical analysis, we set it aside.

Rather than estimating complex structural models as does some of the above research , we begin by exploring simple correlations and regressions. We show that part of the differing time path of hours per capita between the US and EU-15, as well as within Europe, can be traced to changes in labor tax rates. Most notably, we show that a turnaround toward lower

2. The Gordon (1997) framework emphasized the "unemployment-productivity tradeoff". This paper broadens that notion to include all the sources of changes in hours per capita, not just the employment or unemployment rate.

taxes after 1995 helps to explain both an increase in hours per capita and a reduction in the growth rate of labor productivity.

The second strand of literature includes the large number of papers on the post-1995 acceleration in US productivity growth and deceleration in European productivity growth. The sources of this turnaround in the relative productivity growth rates of the EU-15 versus the US have been widely discussed, e.g. by O'Mahoney and van Ark (2003), Inklaar, O'Mahony, and Timmer (2005), Timmer and van Ark (2005), and van Ark and Inklaar (2005). Primary attention has been given to differences between the EU and US in producing and exploiting information and communications technology (hereafter ICT). The recent literature, especially Jorgenson, Ho and Stiroh (2006) and Stiroh (2006) have subdivided the US revival into the 1995-2000 period dominated by the contribution of ICT and the 2000-04 period in which ICT apparently played no role at all.

This American literature indirectly raises questions about the European slowdown: if US productivity growth surged after 2000 yet the contribution of ICT investment was negligible, and if Europe uses the same types and approximate quantities of ICT equipment as the US, how could ICT investment provide any significant part of the explanation of the sources of the European slowdown after 1995 and especially after 2000? Moreover, we question the logical justifications for the claim that ICT "drove" productivity growth. The growth accounting framework places no special emphasis on any factor of production. Rather, labor productivity comes from either capital deepening or TFP growth. To note that ICT was the largest part of

capital spending is to simply count up machines. It gives no indication whether certain types of capital have been more productive, nor whether firms have learned to use the new types of capital.

Early in this decade van Ark and his colleagues had identified the retail trade sector as by far the most important source of this TFP growth divergence between Europe and the US.[3] At about the same time, Foster, Haltiwanger, and Krizan (2002) had developed the amazing result from micro establishment panel data that *all* of the productivity acceleration in the US retailing sector after 1990 was attributable to the appearance of new establishments and the disappearance of old establishments, and *none* to continuing establishments. This finding led to speculation that the real reason for the difference between European and US retailing was not just a differential adoption of ICT capital but everything else that differentiates "new" from "old" in retailing, including scale and the greater ability in the US to construct "big boxes" at freeway intersections without regard for the need to preserve and protect small shopkeepers and pedestrian precincts in central cities (Gordon, 2004; McGuckin, Spiegelman, and van Ark, 2005). Indeed, Baily and Kirkegaard (2004) placed at the top of their list of needed European regulatory reforms the freeing up of land-use restrictions that impeded the development of big boxes in Europe.

This paper argues that the previous literature on the EU-US productivity growth turnaround has spent most of its time looking at half of the puzzle. One paper after another has

3. See van Ark, Inklaar and McGuckin, 2003.

identified ICT-producing and ICT-using industries, especially retail/wholesale, as the source of the US advantage. But we find that this analysis is incomplete. By every measure, the turnaround in ALP growth, TFP growth, or in the extent of capital-deepening, *the slowing of EU productivity growth is almost as large a contributor to the EU-US turnaround as the US acceleration.* What caused the EU decline? We show that it had little to do with ICT production or the retail/wholesale trade sector. Europe's failures are across the board and encumber nearly every sector. We will analyze the post-1995 turnaround in tax policy as one source, albeit a partial source, of the European productivity slowdown.

Plan of the Paper

The paper begins in Part II with a discussion of data issues and then in Part III with data since 1980 for the EU-15 versus the United States in growth of output, capital, labor, labor productivity, and total factor productivity (TFP). For these variables we restrict our analysis to H-P filtered trends and see little reason to analyze year-to-year movements. We are more concerned with Blanchard's "medium run" than the short run.[4]

The literature contrasting the EU-15 versus the United States often misses the heterogeneity of productivity growth *within* Europe. A basic theme of the paper is to underline and then explain this heterogeneity within Europe. To simplify this task, we divide the EU-15 into three groups of countries based on the average growth rate of labor productivity in the private economy over 1995-2003, the "Tigers," the "Middle," and the "Tortoises."

4. . See Blanchard, 1997.

To assess the significance of the differences across these groups of countries, in Part IV we compare their productivity growth rates to US states and BEA-defined regions having similar populations. We find that three top-performing US states have similar levels and growth rates of population and productivity growth rates after 1995 as the EU "Tigers," but that the dispersion of productivity growth across larger BEA regions is substantially smaller than across the larger European countries comprising most of the Middle and Tortoise groups. At a purely statistical level, what distinguishes the US is that it has no Tortoises – the states with annual growth rates of real output per employee after 1995 of below 1.0 percent account for just 3 percent of the US population, whereas the European countries with sub-1.0 percent growth rates account for 34 percent of the European population.

In Part V we provide a detailed analysis of changes in productivity growth before and after 1995 across all the EU countries, the Tiger-Middle-Tortoise sub-aggregates, and the US, by industry. We identify a distinct difference between the US post-1995 US productivity growth revival and the post-1995 European productivity growth slowdown. The US revival was concentrated in ICT production and in wholesale and retail trade, especially during 1995-2000. On the other hand, the European slowdown has been widespread in most industries, contradicting the view that Europe has some particular weakness in the production or use of ICT. The detailed analysis of European productivity behavior by industry distinguishes growth rates for 56 industries for the 15 EU countries and the three groups of countries. The shortfall

in post-1995 productivity growth in the Tortoise group relative to the Middle group spans more than three-quarters of the industries.

Then Part VI provides our detailed analysis of the relationship between labor tax rates and the post-1995 turnaround in European hours per capita, from three decades of decline to an increase that has created a distinct rise in the EU/US ratio of hours per capita. By stitching together two data sources on the "tax wedge," we are able to run annual regressions of hours per capita on the tax wedge for all the EU-15 countries and the US over the entire period 1960-2004. We find an overall elasticity of hours per capita to the tax wedge of -0.4 with a very high degree of statistical significance. Part VI then attempts to translate this exogenous effect of taxes on hours per capita into a productivity effect. By how much did tax rate decreases after 1995 contribute to the European productivity growth slowdown? The short-run effect is to explain as much as -0.6 percent of the European productivity slowdown in the short-run, but results in the long-run depend on the adjustment of capital, which is ambiguous.

II. Data and Measurement Issues

This paper is based on an analysis of three different Groningen data bases. The first is the "growth-accounting data base" which refers to the total economy (including government), covers 1980 through 2004, and disaggregates only along the dimensions of output, hours, labor productivity, TFP, and growth in capital investment and capital stock. Previous papers, e.g., van Ark and Inklaar (2005), have used these data to contrast the EU-15 with the US. We go

further by examining the decomposition among labor productivity, TFP, and capital deepening, further subdivided among ICT and non-ICT, for the 15 individual EU countries. We also begin our pre-1995 comparison period in 1979 rather than 1987 or 1990, as in most of the other papers in this literature.

The second part of the paper is based on the Groningen so-called "60-industry" data base, which actually contains data on 56 industries. Here there are no data on capital, and thus we cannot calculate TFP growth or the capital deepening effect. Our focus is thus entirely on differences in ALP growth across industries and countries. We confine ourselves to 51 of these industries in the private business sector, deleting government and nonprofit institutions. Because we focus only on the private business sector, the growth rates of ALP for individual countries are uniformly faster than in the ALP data for the total economy examined in the first part of the paper, and we show that the difference made by removing the government and institutions sectors differs across countries. This annual data base also begins in 1979 rather than 1980 but extends only to 2003 rather than 2004.

The third part of the paper uses the Groningen "total economy" database that runs from 1950 to 2004. This allows us to distinguish between hours of work, employment, and the total population, bringing to center stage a central concept in the paper, the long-term behavior of hours per capita in each country. We examine the relationship between hours per capita and overall tax rates on labor by combining two overlapping data sources on the "tax wedge," one from Davis-Henrekson (2004) that covers 1960-1995 and another from the OECD that covers

1979-2004.

The Emphasis on Sub-Aggregates within Europe, the Tigers, Middle, and Tortoises

Thanks to the efforts of the OECD and especially the Groningen Growth and Development Centre, we are able to look inside the aggregate EU-US differences in multiple dimensions that have not heretofore been adequately explored. Data are available for real and nominal value-added and for 56 individual industries in the 15 countries of the EU, the EU-15 aggregate, and for the US.[5]

The EU-15 is not a homogeneous entity. It includes countries like Ireland and Finland where both ALP and TFP have continued to grow faster than the US, as well as countries like Spain and Italy where ALP has scarcely grown for the past decade and TFP growth has been negative. To highlight differences across countries in ALP growth in the private sector, we create sub-aggregates of the three fastest growing EU countries during 1995-2003 (the "Tigers"), the six slowest growing (the "Tortoises"), and the remaining six (the "Middle"). To focus on differences among countries and between Europe and the US, we distill the 56 available industries into eleven "one-digit" industries, including a breakdown of durable manufacturing into ICT and non-ICT production.

The Tigers, Middle group, and Tortoises are not remotely of the same size, and the Tigers are very odd and special. In 1995 at PPP exchange rates of that year, the Tigers

5. Unfortunately capital data are not available in this data base, but that is a blessing as it simplifies our task of extracting new results for labor productivity. The Groningen 57-industry data base includes a total of 29 countries, virtually the entire OECD, not just the 17 country units that we analyze here.

accounted for only 6.4 percent of EU-15 value added, the Middle group for 60.4 percent, and the Tortoises for 33.2 percent. Thus the real story of this paper is about what went wrong in the Middle and especially in the Tortoise group, and in the empirical analysis we will provide some insight into the productivity growth retardation of these laggard nations.

III. The Post-1995 Turnaround in ALP, Hours, and TFP Growth

The dramatic post-1995 turnaround in EU vs. US economic performance is summarized in Figures 1 and 2, each of which displays trend growth rates displayed as annual percentage rates, using the Hodrick-Prescott filter with a smoothing parameter of 6400. In order to work with per capita variables, we subtracted the average growth rate of population for 1981-2004. These graphs use the Groningen growth accounting data base that extends through 2004.

Dimensions of the Turnaround in EU-15 Productivity and Hours Growth

The top frame of Figure 1 plots trend ALP growth in the EU-15 and in the US. The growth rate of the US productivity trend fluctuated around 1.5 percent until 1995 and then steadily increased to above 3.0 percent in 2004.[6] In contrast, the EU trend was between 2.0 and 2.5 percent until 1995 and then steadily declined to barely 1.0 percent in 2004. The EU-US difference is at or close to 1.0 percent per year during 1981-95 and then starts to decline, reaching zero in 1997 and steadily worsening to -2.0 percent in 2004. The turnaround in the

6. The same method of calculating the trend when applied to quarterly US data through 2006:Q1 show that the trend peaked at about 3.1 percent in mid-2003 and is now back down to about 2.8 percent.

EU-US ALP growth rate difference over the past decade was between +0.9 percent in 1994 and -2.1 percent in 2004. Of this 3.0 percentage point turnaround, 1.1 points or 37 percent was due to the European slowdown and 1.9 points or 63 percent to the US acceleration.

The bottom frame in Figure 1 displays trends for growth in output per capita and labor hours per capita in Europe and the US. These trend growth rates are calculated from separate Hodrick-Prescott trends for output, hours, and population, using the same parameter as before. There was no major turnaround in output growth. The per-capita output growth series look surprisingly similar, with the EU generally lagging US movements by two to three years. The difference between trend EU and US output per capita growth averaged -0.20 percent per year during 1981-95 and a slightly larger -0.43 percent per year during 1995-2004. However, there was a major turnaround in hours growth as suggested in the introduction. The US trend in hours per capita slowed from 0.51 percent in 1981-95 to -0.11 percent in 1995-2004, while the EU hours trend increased from -0.52 percent in 1981-95 to +0.37 percent in 1995-2004. Thus the difference in the EU vs. US hours per capita trend shifted from -1.03 percent in 1981-95 to +0.48 percent in 1995-2004, a turnaround of 1.51 percentage points per annum.

At this point the causation between the productivity and hours turnarounds is ambiguous. An autonomous acceleration in US productivity growth could have cut the growth of hours so much that hours per capita actually fell. Or exogenous policy changes in Europe could have stimulated hiring of lower-productivity employees, thus causing a simultaneous upsurge in hours growth and decline in productivity growth. At this stage we are not talking

about causation but are simply comparing the orders of magnitude. How much of the productivity growth turnaround was the counterpart of the hours turnaround in the opposite direction? Using averages for 1981-95 vs. 1995-2004, the productivity growth turnaround in the favor of the US was 1.73 points and the hours per capita turnaround in favor of the EU was 1.51, so that the hours turnaround was the counterpart of 87 percent of the productivity turnaround, with the remaining 13 percent due to a slight widening of the output growth gap between the EU and US. In other words, Europe could have paid for its decline in productivity growth with either less output or more hours. In fact, Europeans mainly chose to work more, with only a small decline in output per capita growth.

The Turnaround in Capital Input and TFP Growth

We now turn to Figure 2, which compares EU and US growth rates of per-capita capital input, total factor productivity (TFP) growth, and the capital-deepening effect, which is growth in the capital-labor ratio multiplied by capital's income share. In the top frame the trend in per-capita capital input growth is displayed, with faster growth for the US in 1981-86 and 1995-2004, and slower growth in 1987-94. The difference between EU and US per-capita capital input growth widened between 1981-95 and 1995-2004, from -0.01 to -0.78 percent per year. EU per-capita capital growth shows a more muted lagged mimickry of the US trend as do output and hours. This makes sense at least until 1997, given that TFP growth followed nearly the same time path in the EU and US, albeit at slightly different levels, until the U. S. "take-off after 1997.

Also shown in the top frame is trend TFP growth, which exhibits a turnaround slightly

later than trend ALP growth in Figure 1 and with a somewhat smaller magnitude. The EU-US post-1995 turnaround in trend TFP growth is -1.12 percentage points, as compared to -1.73 percentage points for trend ALP growth. The difference is accounted for by the turnaround in trend capital-deepening.

The bottom frame of Figure 2 displays the capital-deepening effect, which is the growth rate of the capital-hours ratio multiplied by capital's income share. Here we see a greater European slowdown than for capital input growth in the top frame, and this reflects the post-1995 turnaround in Europe toward faster hours growth (the denominator of the capital-deepening effect). The fact that the turnaround in capital deepening in the bottom frame of Figure 2 is greater than the trend growth of capital input in the top frame primarily reflects the turnaround toward faster hours growth in the EU after 1995, and negative hours growth in the 2000 recession in the US. Standard growth models would predict that inevitably, a fall in hours per capita will lead to a decline in capital. The reverse should be true in Europe. In other words, unless the US can sustain its historically anomalous advantage in TFP growth, the EU will soon overtake it in ALP growth. Further analysis below will examine the short and long run relationships between capital and hours.

TFP and Capital Deepening in the 15 Individual EU Countries

We now switch from the display of trend growth rates across the full time series as in Figures 1 and 2, to summary growth rates for 1980-95 and 1995-2004, as displayed in Table 1. This is our first look at the performance of the 15 EU countries separately. Table 1 also uses the

growth-accounting database to subdivide TFP growth into the contribution of the ICT and non-ICT sectors,[7] and also to subdivide the capital-deepening effect into the contribution of ICT and non-ICT capital deepening. The 17 rows of the table display growth rates for the US, the EU-15 aggregate, and the 15 member countries of the EU-15. The countries are ordered by the same criterion used in the next section of this paper to define the Tigers, Middle, and Tortoise groups, namely the growth rate of ALP in the private business sector during 1995-2003 (see Table 3 below).

The first six columns of Table 1 refer to average annual growth rates over 1980-95 and the next six columns refer to 1995-2004. Distinguished for each period are ALP growth, TFP growth, TFP growth subdivided between the contributions of the ICT and non-ICT sectors, and finally the capital-deepening effect divided between ICT capital and non-ICT capital.

The top two lines display average annual growth rates for the US and the EU-15. Here we see in the "ALP" and "TFP" columns the same message as in Figures 1 and 2, that everything true in 1979-95 was reversed during 1995-2004. The turnaround in EU minus US productivity growth rates was 2.00 percent, of which 1.33 points was accounted for by TFP growth and the remainder of 0.67 points by the capital-deepening effect, roughly a 2/3 vs. 1/3

7. The data available on the Groningen growth-accounting web site allow us to calculate the ICT and non-ICT capital deepening effect and total TFP growth accurately. However, the division of TFP growth between the ICT and non-ICT sectors is only an approximation. Since the web site has no data on hours or capital use within the ICT-producing sector, we have approximated TFP growth in the ICT-producing sector by multiplying the growth rate of real ICT investment (IT, communications, software) by the share of nominal ICT investment in nominal GDP. This results in a good match to van Ark-Inklaar (2005, Table 2), but it is inaccurate both by failing to subtract out hours of work and capital input in ICT production,

share.

What was the role of ICT in this turnaround? Of the 1.33 point turnaround in TFP growth, only 0.18 points was attributable to ICT production and the rest to non-ICT production, which is consistent with the received wisdom from the literature about the role of the trade and financial sectors.[8] Further, ICT capital deepening contributed only 0.09 points to the turnaround, leaving the rest of the 0.67 point capital-deepening effect to operate outside of ICT capital. Of this 0.67 point shift, 1/3 was due to a rise in US investment, and 2/3 to a fall in EU investment.

Turning to the 15 individual country members of the EU-15, the vertical ordering in Table 1 reflects the growth rate of ALP in the private business sector in 1995-2003. Because Table 1 extends to 2004 and includes the non-private sector, the countries are not ordered exactly in the ALP column for 1995-2004. Nevertheless, the Tigers had much higher ALP and TFP growth rates than the Middle group, which in turn had much higher growth rates than the Tortoises for 1995-2004. What insights are provided by the columns in Table 1 on TFP growth and the capital-deepening effect?

The first fact that jumps out from Table 1 is that relatively rapid EU-15 ALP growth before 1995 was relatively uniform across countries, but this uniformity fizzled after 1995 into

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but also by omitting ICT production other than that for domestic investment, i.e., that destined to domestic consumption, government spending, and net exports.

5.. Any calculation of the "turnaround" takes the US difference for 1995-2004 minus 1979-1995 and subtracts the European difference over the same time intervals. Thus for TFP growth the calculation is 1.40-0.59-0.64+1.16 = 1.33.

much more heterogeneity. The standard deviation of ALP growth rates across the 15 countries increased from 0.80 in 1979-95 to 1.23 in 1995-2004, for a ratio across the two periods (late/early) of 1.53. Looking across the other columns, most of this increase in cross-country variance is accounted for by TFP (standard deviation increases from 0.70 to 1.04, for a ratio of 1.48) and in particular non-ICT TFP (standard deviation increases from 0.71 to 1.03, for a ratio of 1.45). The standard deviation *decreases* both for TFP in ICT producing industries and for ICT capital deepening. There is a small additional contribution from non-ICT capital deepening, where the standard deviation increases from 0.21 to 0.39.[9]

Notice that none of these standard deviations make any reference to the US. But the conclusions are of great importance to understanding what has been going on within Europe. The consensus conclusion of the existing literature is that the EU-US turnaround is driven by differential TFP growth in the non-ICT producing sector (e.g., retailing). We also find that the big distinction across the successful and unsuccessful European countries after 1995 is in TFP growth in the non-ICT-producing sectors. TFP in ICT production and capital deepening in ICT equipment play no role at all. Thus a leading question for this paper is where has this differential in non-ICT TFP growth come from? Is it all retailing, or is something else going on?

Much of the heterogeneity within Europe after 1995 occurs in the growth of non-ICT TFP. Is there any connection between this source of growth and capital accumulation? Van Ark

9. The Groningen data base eliminates measurement differences across countries by imposing the US ICT deflators on all the countries. This helps to explain why the standard deviation of ICT TFP growth and

and Inklaar (2005, Figure 3) display a scatter plot implying that those nations having faster rates of non-ICT TFP growth also have faster rates of ICT capital deepening, implying a spillover effect that is not captured by the conventional methodology of calculating TFP. However, we do not find the same connection. We have estimated regression equations in which there are 16 observations for the 16 countries in Table 1, the dependent variable is the growth rate of non-ICT TFP, and the two explanatory variables are ICT and non-ICT capital deepening. For the 1995-2004 period the adjusted R^2 is zero, and while the coefficients on both types of capital deepening are positive, they are insignificant with p values of 0.9 in contrast to the standard $p<0.05$ significance criterion. For 1979-1995 the results are equally bad, with a coefficient on ICT capital deepening of exactly zero.

While these equations lack any explanatory power, their residuals identify countries that had growth rates of non-ICT TFP that were higher than predicted, and the changes of residuals between 1979-95 and 1995-2004 can be described by country group. Ireland is unique in having a large positive residual in both periods. There were big positive jumps in the residuals for the other Tigers, from big negative to big positive for Greece, and from zero to very big positive for Finland. Residuals in the Middle group were relatively small and in fact were nearly zero for the U. K. in both periods. The only positive movements in the residual were for France and Sweden. The other Middle-group countries had declines in residuals, from positive to negative for Portugal, for Germany a reduction in a positive residual to a lower value, and for Denmark a

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ICT capital deepening is so low, but we agree with the Groningen treatment that this is a feature of the

shift to a much bigger negative residual. In the Tortoise group, changes in residuals were very small for the Netherlands and Belgium but were very large in a negative direction for Italy and Spain.

IV. Heterogeneity within Europe and the United States

The distinction in this paper among the three groups within Europe – the tigers, middle countries and tortoises – raises several interesting questions about heterogeneity within Europe as compared with the states and regions of the US. In this section we examine several dimensions of heterogeneity across the Atlantic, looking at both growth rates of productivity and the dispersion of the level of productivity.[10]

The European tigers are clearly special cases, accounting for only five percent of the EU-15 population. Which states are the American tigers and how do their growth rates compare to those of the European Tigers? Fortunately the US Bureau of Economic Analysis (BEA) provides data on Gross State Product (GSP) and employment by state, allowing us to compare GSP per employee in the US with GDP per worker in the EU. During 1995-2004, the fastest growing states, as shown in Table 2, were Arizona, Massachusetts, and Oregon. The populations of these three states are close enough to those of the three European Tigers to make this an interesting comparison.

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real world, in which computer technology has been equally adapted across all countries.

10. We are grateful to Susanto Basu for suggesting this examination of heterogeneity across U. S. states and regions.

For the three US states, the weighted average acceleration in ALP growth from 1980-95 to 1995-2004 was from 1.38 to 3.29 percent per year, an acceleration of 1.91 points. In a perhaps amazing coincidence, the acceleration for the three European Tigers was from 1.10 to 3.02, or an acceleration of exactly the same 1.91 points. In the EU Tigers, both Finland and Ireland continued to outperform the EU average, whereas in the US one of the Tigers, Massachusetts, outperformed, while both Arizona and Oregon (like Greece) switched from ALP growth substantially below average to substantially above average. The standard deviation of growth rates within the three EU Tigers and the three US "Tiger states" was greatly reduced after 1995, as shown in Table 2.

We have seen in Table 1 that three of the European Tortoises had post-1995 ALP growth rates below 1.0 percent, namely the Netherlands, Spain, and Italy. These slow-growing countries accounted for 30 percent of the EU-15 population in 2004. The US states with 1995-2004 growth in GSP per employee below 1.0 percent were Alaska (-1.15), Hawaii (0.45), Louisiana (0.05), and West Virginia (0.87). But these states constituted only 2.9 percent of the US population in 2000. Thus we would conclude that while there is a small fringe of "Tiger" states within the US, the "Tortoise" phenomenon applies to a much smaller share of the US population than in the EU. This motivates particular attention in this paper to the EU Tortoises.

The population of the EU countries is much more unevenly distributed than the US states. Thus it is interesting to compare the five large European countries (France, Germany, Italy, Spain, U.K.) with the eight BEA-defined economic regions of the US The range of 1995-

2004 growth rates in the US regions is between 1.77 and 2.77 percent per year, a substantially narrower range than for the five big EU countries which achieved (see Table 1 above) between 0.00 and 2.10 percent per year. The smaller dispersion in the US is likely partly due to automatic fiscal stabilizers that exist in the US but are currently impossible in the EU. The softening of regional shocks and the possibility of more homogenous growth are reasons why a more politically integrated Europe might do better economically. Recent increased labor mobility in Europe might be expected to act as an automatic stabilizer. So far though, we have yet to see that effect. It is possible that labor mobility in Europe is still coming mainly in the form of people moving permanently from poorer to richer countries, rather than simply following jobs in temporary and reversible movements, as in the US.

While the post-1995 growth rates of the large EU nations diverged though, the *level* of regional GSP per employee in the US has about the same dispersion as GDP per employee in the five large nations of the EU. The ratio of the standard deviation to the mean across these groups in 1995 was 8.2 percent across the eight BEA regions and 6.5 percent across the five large EU nations.

We conclude that the level of labor productivity is similarly dispersed across US states and regions as across the 15 EU nations. However, the growth rate of labor productivity became more heterogenous within Europe after 1995. While there were a few "Tiger states" in the US that mimicked the performance of the EU Tigers, there was nothing comparable in the US to the European Tortoises. States with less than 3 percent of the US population had

productivity growth rates below 1.0 percent a year during 1995-2004, whereas nations with 30 percent of the EU population had growth rates this low.

V. Productivity Growth within Europe

We now switch to the 56-industry Groningen data base and begin our analysis of differences across industries within Europe. Table 3 displays the US, the EU-15, and the fifteen individual European countries in the same order as in Table 1. For perspective, Table 3 also includes at the bottom three other sub-aggregates of OECD countries, namely two "Asian Tigers" (Korea and Taiwan), "Continental Europe" (the EU-15 minus Ireland and the U.K.), and "Anglo non-US" (Australia, Canada, Ireland, U.K.). The columns show growth rates of ALP for 1979-95, 1995-2003, and the difference between the two time periods. Within each of the sets of columns for a given time period, three columns are shown, first the total economy (GDP divided by aggregate hours), the private economy excluding government and institutions, and the difference between the private and total ALP growth rates.

Differential Growth Between the Total Economy and the Private Sector

The top two lines show that the difference between the private and total definitions increased the US ALP growth rate in 1979-95 by 0.57 and for the EU-15 by 0.49, a very similar difference. But for 1995-2003, the US difference jumped to 1.12 points while the EU-15 difference fell to 0.29 points. This makes sense because productivity growth everywhere in government and institutions is slow and stable, and thus when ALP growth speeds up in the

private sector, the difference between the private sector and the total economy increases. The correlation between the ALP growth difference and the growth rate of ALP in the private sector across the US and the 15 individual EU countries is 0.69.[11] At one extreme ALP growth in the private sector for the US is more than one percentage point faster than in the total economy, more than matched by Ireland and almost matched by Sweden, whereas in Italy and Spain there is no difference at all.

Table 3 also shows that the distinction between the Tigers, Middle, and Tortoises was not relevant before 1995. The respective ALP growth rates in the private economy of the three groups for 1979-95 were, respectively, 2.91, 2.98, and 2.69 percentage points, as contrasted to 4.79, 2.45, and 0.72 percentage points for 1995-2003. Why did European countries become so much more different after 1995? Of the 15 EU countries, only three (Ireland, Greece, and Sweden) achieved a post-1995 acceleration of ALP growth in the private economy, whereas the remaining 12 countries exhibited a deceleration ranging from -0.20 for Germany to -3.54 percent for Luxembourg. Three of the Tortoises (Italy, Luxembourg, and Spain) experienced a deceleration of more than -2.0 percent, and four other countries (Portugal, France, Belgium, and Denmark) experienced decelerations greater than -1.0 percent.

Aggregation Issues

Subsequently we explore many issues in the performance of European ALP and TFP at the level of groups of countries and industries that have been overlooked in the previous

11. A regression of the difference on the private-sector ALP growth yields a constant of 0.13 and a slope

literature that focuses on EU-wide ICT use and retailing ALP performance. It is this aspect of aggregation that allows us to develop an important theme of the paper, that the deceleration in Europe is only minimally related to the previous emphasis in the literature on ICT industries and on the retail/wholesale sector.

Our first step is to convert all data into US dollars, using OECD-provided 1995 PPP exchange rates. We then aggregate using the standard Tornqvist index number formula, in which the growth rate of real value added for a particular industry or country between year *t-1* and year *t* is weighted by the geometric mean of its share in nominal value added in years *t-1* and year *t*. Even though much of our analysis focuses on the difference between growth rates for a particular country or industry between 1979-95 and 1995-2003, the aggregation must be carried out separately for all 24 year-pairs (1979-80 through 2002-03).

For much of this paper we follow Stiroh's (2002) method of decomposing aggregate productivity growth into share-weighted values and a reallocation effect:

$$\Delta \ln y = \sum_i \overline{w}_i \Delta \ln y_i + \left(\sum_i \overline{w}_i \Delta \ln H_i - \Delta \ln \sum_i H_i \right) = \sum_i \overline{w}_i \Delta \ln y_i + R$$

Where w is the share in nominal GDP of a particular industry, and a bar indicates the geometric mean of an industry's share in the given and previous year. R, the reallocation effect, is essentially a correction for the concavity of the natural log, but it also has the convenient feature that it is correlated with a shift of production from low to high productivity industries.[12]

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coefficient of 0.14 that is significant with a P-value of 0.003.

3. See van Ark and Inklaar, 2005

Van Ark and Inklaar (2005) extend Stiroh's decomposition to analyze productivity differences between countries:

$$\Delta \ln y^a - \Delta \ln y^b = \sum_i productivity\_effect + \sum_i share\_effect + R^a - R^b$$

Here the *"a"* and *"b"* subscripts represent two different countries. The productivity effect is the weighted gap between productivity growth rates, and the share effect is the weighted gap between nominal shares.

$$productivity\_effect = \frac{1}{2}\left(\overline{w}_i^a + \overline{w}_i^b\right)\left(\Delta \ln y_i^a - \Delta \ln y_i^b\right)$$

$$share\_effect = \frac{1}{2}\left(\Delta \ln y_i^a + \Delta \ln y_i^b\right)\left(\overline{w}_i^a - \overline{w}_i^b\right)$$

The share effect is larger in a given industry if productivity in that industry is higher. At the end the reallocation terms are added, but since they tend to be small, looking at productivity and share effects by industry gives a good picture of their influence on overall productivity gaps. Moreover, the productivity and share effects can be summed in any given year to create industry aggregates, and they can be averaged over time to look at gaps between average productivity growth rates.

Here we go beyond van Ark and Inklaar's analysis in two ways. First, we not only decompose the difference between EU and US growth, we also look at the three groups of European countries, namely the Tigers, Middle countries, and Tortoises. Second, we use this decomposition to examine productivity growth changes over time. We simply choose, for example, two seven-year periods in one country, and then treat each period as a different

country. This allows a detailed understanding of industry and sectoral effects on aggregate productivity growth changes over time.

Industry Decompositions of the EU-US Growth Turnaround

This paper performs two types of aggregation across the Groningen industry data base. We have already aggregated across the EU countries in Table 3 to form the aggregates of the Tigers, Middle, and Tortoises. Now we turn to aggregation across the 51 private-sector industries in order to determine which industry groups have been most responsible for the EU-US ALP growth turnaround. The columns in Table 4 display ALP growth rates for the EU, US, and the difference, for 1979-95, 1995-2003, and the difference between the second period and the first. Table 4 aggregates the 51 "two-digit" industry groups into 11 "one-digit" industry groups, supplementing the standard division between durable and nondurable manufacturing with an additional distinction between ICT and non-ICT durable manufacturing.

The "Difference" column for 1995-2003 identifies the industry groups where the US has its main advantage, namely ICT durables, retail/wholesale, finance, services, and real estate. The greatest US ALP growth disadvantage is in construction/utilities, non-durables, and communications. Some insight on the sources of the US-EU turnaround is provided in the three right set of columns that displays differences in ALP growth rates when 1995-2003 is subtracted from 1979-95. The right-hand column in Table 4 provides the first hint of a major conclusion of this paper. It is no longer true that the EU-US difference was particularly concentrated in trade and finance. The negative numbers for the post-1995 turnaround difference between the EU

and US extend across most industries and are more negative than -2.0 percent for seven of the 11 lines shown in the table (from this tally we exclude the manufacturing aggregate which is already represented by its three subaggregate components).

Figure 3 shows the contributions of each industry to the total EU-US gap. Each bar has a productivity effect and a share effect corresponding to the equations introduced above. The large contribution of the productivity effect in retail, wholesale, and finance is quite evident and has been discussed in previous papers. However, in these data there is now also a large contribution of services and also a large "share effect" in manufacturing that is mainly attributable to the larger share of ICT manufacturing in the US than in the EU There are small negative EU contributions in Real Estate and positive contributions in non-ICT manufacturing and construction/utilities.

The large "share effect" of ICT manufacturing in explaining the EU-US post-1995 productivity growth gap requires comment. This share effect comes as in the share equation on p. 24 above, where the average productivity growth rate in the EU and US in ICT manufacturing is multiplied by the difference in shares. As is shown in Table 6 below, the ICT share of hours is sufficiently higher in the US to contribute a substantial boost to aggregate productivity from the rapid post-1995 productivity growth observed in ICT production. In this sense, the previous literature that emphasized the role of retail/wholesale in the EU-US difference has understated the role of ICT production, which takes the form primarily not as a difference in productivity growth rates but as a difference in the shares of ICT production in the

economy. As we shall see below, the same share issue differentiates the European Tigers from the Middle countries and the Tortoises.

Figure 4 displays the post-1995 productivity growth changes by industry in a different and interesting way. Here, instead of displaying on a bar chart the differences between the EU and US productivity contributions by industry group, we display the post-1995 accelerations and decelerations of the contributions separately for the EU and the US This method has the advantage of isolating the portion of the EU-US differences caused by the quite separate US acceleration and the EU deceleration, and it has the disadvantage that the distinction between "productivity effects" and "share effects" cannot be applied as it was in Figure 3 above.

As expected, the bars in Figure 4 are mainly positive for the US and negative for the EU They also reflect larger positive contributions for the US than the negative contributions for the EU The most interesting aspect of Figure 4 is that the US 1995-2003 acceleration spans five of the nine industry groups displayed, not just retail/wholesale and finance, but also communications, services and manufacturing. Europe's negative contributions are more narrowly concentrated in three sectors, transportation, manufacturing, and farms/mining, with a small additional contribution from several other sectors. Only in communications and finance did Europe register a positive contribution to the post-1995 change in productivity growth.

An interesting complement to the previous calculations is to provide ratios of *levels* of productivity by industry in the EU vs. the US, as is displayed in Table 5. The bottom line shows that with this particular data set and aggregation method, the ratio of EU to US

productivity rose from 77.5 percent in 1979 to 93.2 percent in 1995 and then retreated back to 82.2 percent in 2003. As shown by the growth rates in the right-hand column, there were turnarounds in the level of productivity in every industry listed except for non-durables and communications. In retail/wholesale, the level of EU productivity declined relative to the US in both 1979-95 and 1995-2003.

Industry Decompositions within Europe

Using the same system of productivity-share decompositions as were applied to the EU vs. the US, we can now explore the differences between the Tigers and Middle group of European countries, keeping in mind that the Tiger countries have only about 5 percent of the European population while the Middle countries have around 60 percent. Figure 5 displays the productivity and share effects. This shows that the overwhelming contribution of the Tiger success is made by manufacturing, constituting both a productivity and a share effect that implies that the Tigers have a higher share of economic activity in industries experiencing rapid productivity growth, the unsurprising consequence of Nokia in Finland and American ICT investment in Ireland. A supplementary aspect of the Tiger dominance in manufacturing, not shown separately here, is that their productivity advantage comes entirely from ICT durables and even more from non-durables, with no contribution at all from non-ICT durable manufacturing.

Figure 6 shows the contributions separately for the Tiger and Middle groups, omitting the share effects to focus on the differences in productivity growth rates. Here manufacturing is

dominant in the Tiger acceleration, as in Figure 5, but we also note that services and retail/wholesale have contributed to the Tiger acceleration. Slowdowns in the middle countries are widely dispersed and are small, reflecting the minor post-1995 slowdown in the European group of Middle countries.

We now turn to the core of the European problem, the slowdown in the Tortoises compared to the Middle countries. Figure 7 displays the productivity and share effects relevant to a comparison of the Tortoises with the Middle group. Surprisingly, the biggest productivity contribution comes from the anomalous "Real Estate" industry which incorporates many possible sources of measurement error. Otherwise, the biggest shortfalls of the Tortoises are in manufacturing and in retail/wholesale, with a smaller contribution from services. Within manufacturing about 75 percent of the Tortoise-Middle difference occurs in durable manufacturing, roughly equally divided between ICT and non-ICT durables, and relatively little occurs in non-durable manufacturing.

Figure 8 shows the separate post-1995 productivity growth changes by industry in the Tortoises compared to the Middle group. Here the failure of the Tortoises appears to be in most of the industries, led by manufacturing but also including Real Estate, Transportation, Retail/Wholesale, Construction/Utilities, and Farms/Mining. The widespread productivity slowdown across most industries in the Tortoise countries is consistent with the basic theme of this paper that after 1995 Europe reversed its previous policies that made labor more expensive and artificially raised productivity. Since 1995 Europe has been creating jobs, raising the level

of hours per capita, and as a consequence has been adding lower-productivity jobs that have reduced the overall growth rate of labor productivity and of TFP.

For reference the shares of hours by industry in the EU and US are shown in Table 6. This helps us to understand the share effects in the graphs that we have just examined. For instance, the ICT share in the US is higher than in the EU, thus explaining the negative EU share effect in ICT production, although the share gap fell by half between 1979 and 2003. Thus the EU problem is not that it has a shrinking share of ICT production over time, just that its share gap continues to be negative and this is multiplied by very high productivity growth rates in ICT production.

The most important difference in hours shares is in retail/wholesale and services. The EU hours share in 1979 in these two industries summed to -10.59 percentage points. This gap fell to -8.39 percent in 1995 and to -6.70 percent in 2004. Davis-Henrekson (2004) emphasize the role of high labor taxes and employment regulations in Europe as the cause of its low share of hours in retail, wholesale, and services, and the shrinking share deficit after 1995 is consistent with the overall hypothesis of this paper that a reversal of labor taxes and employment protection allowed Europe to move southeast down the labor demand curve and to increase the employment of relatively low-productivity workers.

A closer examination of the hours share in the three groups of countries reveals several other interesting details (these are not shown in a separate table). Part of the growth success of the Tigers has come from moving resources into durable manufacturing, including ICT

production, and out of agriculture. Partly due to the primitive starting points of Greece and Ireland in 1979, the Tigers have much higher 1979 hours shares in agriculture than the Middle and Tortoise countries and much lower shares in manufacturing, retail/wholesale, and services. The Tiger shares gradually converged between 1979 and 2003, but the Tigers in 2003 still had lower shares in services and higher shares in agriculture, and the Tiger share in ICT was actually lower than that of the Middle countries.

Table 7 shows growth rates of productivity by industry across the three groups of countries. The Tigers exhibit faster 1995-2003 growth rates than the Middle countries in every industry but real estate. Particularly important is that productivity growth in ICT production is much faster in the Tigers than the other countries in both periods, and with a faster post-1995 acceleration. Except in communications, the Tortoise countries failed across the board, reinforcing the theme of this paper that we need to find broad-based economy-wide explanations of the post-1995 decline in Tortoise labor productivity growth.

VI. Productivity and Textbook Labor Economics

In general, the simplest measure of economic well-being is income per capita. If that is the case, our analysis of output per hour leaves out half the story. We also need to analyze changes in hours per capita. If a country has a rise in output per hour but a simultaneous fall in hours per capita, then actual consumption and investment may stay fixed. Moreover, there is feedback between the two variables. A rise in productivity changes the wage rate, moving the

economy out along the labor supply curve. Similarly, an autonomous rise in labor supply lowers the marginal product of labor, at least in the short run.

We therefore face a daunting task. Simply describing recent changes in hours per capita is easy. Much more difficult is to determine whether those changes have driven labor productivity, or whether labor productivity has driven those changes. We therefore begin by looking at the raw data on hours per capita. Next, we examine taxes as an exogenous factor affecting labor supply. Finally, we measure the reaction of the capital/ labor ratio to labor supply. The elasticities of labor with respect to taxes and capital with respect to labor supply allow us to determine how a reduction in taxes can cause a short run fall in labor productivity.

Hours and Tax Data

The GGDC has data on hours and population for all of the EU-15 and the US going back to 1950. For this analysis, we go back to 1960. Table 8 shows the level and growth rate of hours per person (hereafter H/N) in our 16 countries and three aggregates for 1960, 1979, 1995, and 2004. In 1960, the US had a lower level of H/N than any European country. Germany had the stunning level of 1052 hours per capita. Moreover, six countries were above 900 hours per capita, as were the Middle countries on average. By 1979, this transatlantic comparison had reversed itself. Of the 45 EU observations in table 8 after 1960, in only one instance, Luxembourg in 2004, does a country have a higher level of H/N than the US. Otherwise, the US always has a substantially higher level of H/N than other countries. Moreover, by 2004, Germany's H/N had fallen to only 60 percent of its extraordinary level in 1960.

Clearly, the divergence of the US from the EU has not been constant over time. In 1960, the EU had 120 percent of the US's level of H/N. In 1979, the ratio had fallen all the way to 88 percent, and by 1995 it was down to 74 percent. In those first 19 years, the EU-US ratio fell by more than 1.5 percentage points per year. Several analysts of the decline in Europe's hours per capita (e.g., Prescott 2004, Blanchard 2004, and Alesina, Glaeser, and Sacerdote 2006) have missed the dramatic turnaround after 1995. The data used in this section find that the -0.63 percent annual growth rate of European hours per capita during 1979-95 reversed to a positive 0.57 percent between 1995 and 2004. As suggested above, part of the rapid European productivity growth before 1995 may have been due to taxes and other disincentives to hiring, and part of the European productivity growth slowdown after 1995 may have been due to the reversal of these disincentives to employment.

It is interesting here once again to compare the Tortoises and Middle countries. In both time spans after 1960, i.e. 1979-1995 and 1995-2004, the Tortoises had a faster growth rate (embodied as a slower rate of decline in the first period) of H/N than the Middle countries. In the second span, the Tortoises went on a tear, with an average growth rate of 1.74 percent, outstripping the US and the other European sub-aggregates by at least 0.5 percent per year. The Tigers were led by Ireland, with a growth rate in H/N of over 1.8 percent per year. The three high performing countries managed both to integrate much more labor into their economy and also vastly to raise their level of labor productivity, an impressive feat suggesting that the underlying cause was an exogenous increase in capital imported through foreign investment

and a partly related jump in TFP. The small size of the Tigers, particularly Ireland and Finland, suggest that this sort of growth might not have been feasible in larger countries like Italy or Spain.

An astute observer will note here that we are conflating the two operative margins for employment – the employment to population ratio (E/N) and the level of hours per employee (H/E). There are two reasons for this. The first is that we do not see any overriding theoretical reason to focus on either margin. There are justifications for either one being the location for changes in labor supply, and presumably any factors that we will identify as affecting labor supply could affect both margins. The second reason to focus on just H/N is that H/E is fairly uniform across countries. Looking at the third section from the top of table 9, it is clear that our aggregates all moved in approximately the same way. Between the first and second periods, the rate of decline of H/E fell by about 0.3 percentage points per annum for all groups. Between the 1979-95 and 1995-2004, the declines in H/E were fairly stable for all our aggregates, with the notable exception of the Tigers, where there was a substantial acceleration. Moreover, the changes in the growth of H/E after 1979 are swamped by changes in the growth of E/N, as is evident in Table 9.

In this section we are primarily interested in the influence of labor tax rates on hours per capita, pending a broader investigation of other factors that have influenced labor supply, including employment protection regulation and minimum wages. Our data on taxes raise questions. Unlike hours, employment, and population, we do not have a single consistent

series for labor taxes going all the way back to 1960. However, we have two overlapping series for the total tax wedge. The OECD defines this as social security contributions by employers and employees, plus income taxes, minus transfer payments, divided by gross labor costs, and the OECD series is available for 1979-2004. Magnus Henrekson (see Davis-Henrekson, 2004) provides data for 1960-95 that adds a third tax rate beyond the labor payroll taxes and income taxes, namely indirect taxes divided by total private expenditures. In short, the OECD includes two taxes and the Henrekson data includes three taxes, and accordingly the Henrekson tax rate in the 1979-95 overlap period is always higher than the OECD tax rate.

Essentially, both tax wedges measure how much of a bite government takes out of the total return to labor. Henrekson provides a series we see as more in line with theory, and it matches the type of tax wedge that Prescott (2004) analyzes. When all of the data are pooled, the correlation between the two series for 1979-1995 is a respectable 80 percent. We still must be careful, however, about making inferences about shifts that occur around the time our data sources switch. Our statistical analysis therefore will link the series at both 1979, the beginning of the OECD data, and 1995, the end of the Henrekson data, in order to test for robustness.

The bottom two sections of table 9 display the tax wedge in our benchmark years from both the Henrekson and OECD data sources. Rather than showing the actual level of the tax wedge, we report it as the ratio of the level of each aggregate to the level in the EU-15 as a whole in order to remove the difference in levels between the two data sources. The actual data for the EU is reported in the last line of each section. On average, the Henrekson data is about

10-15 percentage points higher than the OECD data, about the right magnitude to reflect its inclusion of the indirect that rate that the OECD excludes. Importantly though, the ranking of aggregates by the level of the tax wedge is nearly perfectly preserved in the three overlapping years. The only inconsistency is that the Middle countries and Tortoises are reversed in 1979.

Looking at changes over time in the far right sections, it is clear that between 1960 and 1979, tax rates across our sample rose, with the exception of the Tortoises. In the US, Tigers and Middle countries, tax wedges all rose by approximately 10 percentage points. In the Tortoises however, the wedge shrank by six percentage points.

Figure 10 provides a more illuminatingn summary of changes over time in the tax wedges. Vertical lines are placed in 1979 and 1995, corresponding to our benchmark years in the tables. The data used is the average of two series: the first series uses OECD data back to 1979, and then "ratio-links", i.e., multiplies the Henrekson data for 1960-1978 by the ratio of the OECD data to the Henrekson data in 1979. The second series ratio-links in 1995.

The biggest mover in figure 10 is clearly the tax wedge for the Tigers. Between 1960 and 1995, their tax wedge rose from 62 percent of the EU level to 94 percent.[13] By 2004, this ratio was back down to 87 percent. Through the sample, the US is fairly stable. Even the Reagan tax cuts of the early 1980s are barely visible.[14] Interestingly, the tax increases between 1960 and 1979 were entirely reversed in a span of five years between 1998 and 2003. If there is any lag in

13. These numbers are slightly different from those reported in table 9 because of the ratio linking performed to create the plotted series.

the response of hours and capital to changes in tax rates, we should likely still be seeing the U.S. economy evolve in response to that major 1998-2003 tax cut.

The EU as a whole and the Tortoises and Middle countries changed their taxes much more over our sample period. They all rise consistently, not only from 1960 to 1979, but all the way until 1997. Notably, through the sample, the Tortoises always had the highest tax rates, followed by the Middle countries, followed by the Tigers. After 1997, all our aggregates lowered tax rates, led by the Tigers with a decline of 4.7 percentage points, followed by the US with a decline of 4.6 percentage points.

Taxes, Labor Supply, and Productivity Growth

Of the important hours and tax turnaround after 1995 noted above, but not widely noted in other research, how much can be explained by policy, and how much is simply due to exogenous factors? Prescott (2004) claims that all of the divergence between EU and US employment can be explained by taxes on labor. His meaning of "explain" is fundamentally different from ours. Prescott derives the elasticity of hours with respect to tax rates from a structural model. He then looks to see if this elasticity can explain the change in employment over time.

We begin with simple regressions of H/N on the total tax wedge, using the average ratio linked data. Therefore, our model must, on average, "explain" all of the change in employment. Some countries will have a positive residual, some will have a negative one. We are less

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[14] Though it must be noted that his cuts, the largest in history, were followed by the largest tax *increase* in

concerned with the question of how much of the change in H/N that taxes explains (since our model does not actually answer that question). Rather, we will examine the residuals and predicted changes in different countries.

In using H/N, rather than the employment-to-population ratio or average hours per employee, we are conflating the intensive and extensive margins. As in other studies, e.g. Davis and Henrekson (2004), we treat the decision whether to take a job or not and the decision about how much to work as being affected in the same way by the tax wedge.

In order to assess how much of the change in H/N can be explained by the tax wedge, we estimate a fixed effects model and then calculate the predicted change in H/N.[15] We then compare the predicted change in H/N to the actual change. We use a fixed effects model because there are likely factors that are peculiar to each country that affect H/N. In particular, the age profile of a country should significantly affect its level of hours per capita. The fixed effects estimators control for this and similar country-specific effects.[16] Our estimated coefficients represent the effect of a change in the tax wedge on H/N, rather than telling us what level of H/N should be expected for a given level of taxes.

US history.

15. Our tax wedge variable is 1/(1-t), where t is the total tax rate on labor income. Davis and Henrekson (2004) introduced the tax both as the total tax rate *t* and the inverse 1/(1-t) and obtained similar results from the two specifications.

16. We also assume that changes in factors like age profiles are relatively consistent over time. For a span as long as 1960-2004, this is likely not an innocuous assumption. We have two factors working in our favor though. First, there is enough heterogeneity across Europe that our errors are likely still random. Second, much of our analysis relies on splitting the sample in half.

Table 10 provides regression results for a fixed effects model estimated using the three versions of the tax wedge variable (linked at 1979, linked at 1995, and the average of the two). Because the Henrekson data set lacks data for particular EU-15 countries, this is an unbalanced panel. We have full samples for the major EU countries such as France, Germany, the UK, etc.

All regressions in table 10 are run in the double-log format, so coefficients are interpreted as elasticities. The first three columns, representing the three possible data sources for the tax variable, are nearly identical. Our estimated elasticity of hours per capita to taxes is -0.4. This number is consistent with the empirical results of Davis-Henrekson (2004, p. 38) and with those preferred by Alesina, Glaeser and Sacerdote (2006), but is lower than the response assumed (not estimated) by Prescott (2004). The first three rows are self-explanatory, with the reported R^2 referring to the within variance. The fourth row measures the coefficient between the fixed effects coefficient and the average value of log taxes for each country. We have the expected result that countries with higher tax rates tend to have lower levels of hours per capita, with a correlation coefficient of -0.35.

The lower block of numbers reports the values of fixed effects estimators for various aggregates (averaged by population). Here, the US is estimated to have 3.3 percent less employment than its taxes would lead us to expect. This is likely partly due to the fact that the US has much lower tax rates than the rest of the countries in the sample. The Middle countries have employment rates that are higher than one would expect given their tax rates.

The second block of columns in table 10 reports results for regressions on data from 1960 to 1979. In these regressions we find smaller elasticities of about -0.3. The regressions for the first half of the sample have a slight inconsistency in the correlation between the fixed effects estimator and the independent variable: the tax wedge linked in 1995 gives a markedly higher correlation than that linked in 1979. Two factors could explain this difference -- first, there are slightly fewer observations in the variable linked at 1995 because the Henrekson set has less data than the OECD set. Second, as mentioned above, the Henrekson data includes indirect taxes. Given that this is a theoretically more appropriate measure of the total tax burden, we are inclined to place more weight on the data linked in 1995.

The third block of regressions uses data for 1979-2004. These regressions are particularly important because this is the period for which we also have data for growth accounting and can soon make broader inferences about the effects of taxes on labor productivity. The results are reasonable, but give us a couple reasons to worry a bit. We still find an elasticity near past estimates, approximately -0.23. The R^2 declines slightly to about 0.2. What is off is that the correlation between the fixed effects estimators and the average tax rates is now effectively zero. In other words, while taxes are explaining differences over time, they do not seem to explain differences across countries.

Table 11 reports actual and predicted percentage (log) changes in H/N given log changes in the averaged tax wedge and an elasticity of -0.4. The first pair of columns gives results for 1960-1979. As noted above, this was a time in Europe when there were enormous changes in

levels of H/N, with an average EU decline of over 20 percent. All of the declines in Europe were far larger than one would have predicted based on tax changes. If the Tigers are ignored, an elasticity of -0.8 rather than -0.4 would be needed to explain the huge changes in European labor supply.

Between 1979 and 1995, the same trend continued. Tax rates continued to rise, as illustrated in figure 10, and actual and predicted levels of H/N continued to fall. The US continued to increase its labor supply though, even with flat taxes. The main theme before 1995, just as with productivity growth, is one of consistency. Across the EU-15, taxes consistently rose, and labor supply fell. In the US, taxes stayed generally stable, especially following 1979, and labor supply consistently rose. This consistency falls apart after 1995. Taxes everywhere fell, but labor supply behaved differently across our aggregates. Note the residuals in the far right column of table 11. Labor supply in the US, in a turnaround from its pattern in the other sample periods, far underperformed what our regression predicts. The decline in taxes would have implied an increase in labor supply of 7 percent, but rather, the US fell by 1.5 percent. Moreover, it is difficult to attribute this to business cycle effects since the US was in approximately the same place in its business cycle in 1995 and 2004.

The residuals for the Middle countries and Tortoises are also notable. Both groups were predicted to have approximately 3 percent rises in their levels of hours per capita after 1995. Instead though, the Middle countries fell by 1.26 percent and the Tortoises rose by nearly *16 percent*. This rate of increase in labor supply was so fast that the tortoises actually had the

fastest rate of income per capita growth, at about 2.5 percent, than any other aggregate except the Tigers. So while we constantly place the Tortoises behind all the other countries in our rankings, in possibly the most important final economic measure, total income per person, the tortoises have done just fine. To the extent that low labor supply due to taxes and other regulations is suboptimal, an argument can be made that even though the Tortoises have had the slowest ALP growth, because of their growth in output per capita, they are actually outperforming the Middle countries.

The results laid out above give a number of clues as to possible causes for the trends in labor productivity growth identified above in Figure 1 and Tables 1 and 3. When the EU was catching up to US levels of labor productivity, it was also shrinking the amount of labor relative to its population. Analogously, as the EU has introduced reductions in taxation and other reforms in the labor market, it has made it easier for European firms to hire lower-skilled workers, and the consequence of these reforms has been slower productivity growth.

Looking at the sub-aggregates, the Middle countries (by definition) have faster productivity growth than the Tortoises after 1995, but they also have had much smaller growth rates of H/N. These themes also apply to the US. In its era of slow productivity growth before 1995, the US experienced a rise in H/N, and then as productivity picked back up, H/N slowed down. As noted by Jorgenson, Ho, and Stiroh (2006), much of the recent contribution of capital deepening to US productivity growth has been due to negative employment growth, rather than fast capital growth.

One important, and for our purposes, unanswerable, question, is which came first: did fast employment slow productivity growth, or did slow productivity growth lower the incentives to work? The present analysis makes a start by linking exogenous changes in tax rates to the turnaround in Europe's hours per capita and proposes these tax rate reductions as at least part of the slowdown in European labor productivity growth. The remaining sources of the post-1995 acceleration in the Tigers and slowdown in the Tortoises are some combination of other labor market reforms and autonomous changes in total factor productivity. Further research on a broader range of determinants of labor cost will be needed to create a more definitive analysis.

Capital, Hours, and the Future of US and EU Productivity Growth

How much of the recent acceleration in capital deepening in the US, and deceleration in the EU, especially the Tortoises, can be explained by the level of hours per capita? If the capital stock tends to move slowly, then we should expect the short run level of K/H to be almost entirely determined by H. Conversely, as people work more, they will accumulate more capital, and in the long run, the capital to labor ratio may be neutrally or even positively related to the level of hours per capita.

Therefore, we regress the growth of K/H on H/N to distinguish the short and long run effects. Combining these regression results with the elasticities above, we can predict how tax changes should impact labor productivity and output per capita. Moreover, we can predict

how recent changes in hours per capita, those that have only become evident over the past three to five years, will impact labor productivity in the near future.

Table 12 displays results from various regressions of the capital to labor ratio on hours per capita. Column 1 provides results for a simple regression of the three year average growth rate of K/H on the same average of H/N. In what is basically just a raw correlation, we find an elasticity of -1 percent (the null hypothesis that the coefficient is -1 cannot be rejected at the 10 percent level). In other words, K/N does not seem to react at all in the short run, and movements in H/N feed directly into K/H.

The lags of H/N tell a different story. In column two, when we add in the third and sixth lags of the moving average of H/N growth, the sum of coefficients is no longer significantly different from zero. We still find that the initial reaction of K/H is unit elastic, but the long run reaction is perfectly inelastic. Essentially the same result is obtained when the lag of K/H growth is added in column 3.

Columns 4 and 5 give results for fixed effects models. These regressions have entirely different implications from the first three. Now the elasticity between the current growth in the capital to labor ratio and hours per capita is greater than one. This result alone is enough to tempt us to discount these regressions. Moreover, the lags of the growth in hours per capita are no longer significant, so the regressions imply that a 1 percent rise in H/N would drive down K/H by more than 1 percent in the long run.

If we take column 3 as our preferred specification, we can make some back-of-envelope calculations about the reaction of labor productivity in the short and long run to tax changes. Suppose TFP is unaffected by tax rates, and that the capital share of income is about 0.33. Given our finding of an elasticity of -0.4 of hours with respect to taxes, and an elasticity of -1 of capital with respect to hours, a 1 percent rise in taxes implies a short-run acceleration of .4*.33≈0.13 percentage points in productivity growth. Thus the five percentage point decline in tax rates in the Tortoise countries during 1997-2003 could account for roughly 0.65 points of their decline in productivity growth over the same period. Since the long run response of capital to hours is zero, so is the reaction of productivity to taxes, but this long-run effect has yet to play out fully.

VII. Conclusion

The innumerable papers in the literature on the US post-1995 productivity revival have focused primarily on the production and use of ICT equipment, and on the role of the retail/wholesale industrial sector in creating the US growth acceleration. This paper is on a different topic, the "turnaround" in the EU/US productivity growth differential. As shown above in Part III, almost half of the "turnaround" is caused not by the US productivity growth revival but the European productivity growth retardation.

Europe has faltered across the board. Compared to the Tigers and to the US, the 95 percent of the European population living in the Middle and Tortoise countries has fallen short in the share and productivity growth of ICT manufacturing. But more important, its

productivity slowdown has occurred everywhere and is not attributable to a single industry like retailing. Rather, the big European countries in the Middle group (UK, France, Germany), and the big countries within the Tortoises (Italy, Spain), have failed in nearly every dimension.

At the industry level, the poor performance of the Tortoises in Europe reveals shortfalls in most industries. The failing of the Tortoise countries is widespread, spanning industries as diverse as agriculture, wholesale trade, mining, chemicals, construction, fabricated metals, and clothing. The retardation of European labor productivity is not just a matter of land-use planning that prevents Wal-Marts and Home Depots from sprouting at every freeway interchange. The European productivity slowdown is more fundamental. The analyst is first tempted to compare the US productivity growth slowdown of 1965-80 with that in Europe of 1995-2005. While no convincing explanation of the 1965-80 US slowdown was ever delivered, to one of us (Gordon, 2000) it seemed as if the US economy had run out of ways of exploiting the "Great Inventions" of the late nineteenth century. Is it so implausible that the EU-15 had finally run up against a barrier in catching up to the US level of productivity after 1995?

But there is more involved than just running out of ideas. As we have argued in this paper, Europe's productivity catch-up in the years before 1995 was largely artificial, not fundamental. By making labor expensive, a country can thus create both high labor productivity and low hours per capita. What changed after 1995? After three decades of virtually no growth in hours in the private sector, Europe's labor input began to grow. Tax rates on labor that had increased before 1995 began to fall. Restrictions that had made labor

expensive began to crumble, and where they did not crumble, they certainly did not grow stronger. Productivity growth began to fall in most industries, as the European system was brought into closer equality with the American.

Our results in Part VI represent only a preliminary investigation of an important topic, how much of the post-1995 turnaround in Europe's hours per capita were caused by tax rate reductions compared to other causes, and how much of the post-1995 productivity slowdown was caused by exogenous changes in policies that simultaneously raised hours per capita and reduced productivity growth? It is convenient to think of Europe as moving northwest along a labor demand curve from 1960 to 1995, with higher labor taxes and other measures (employment protection regulations, minimum wages, and others) making labor more expensive, thus cutting hours per capita and raising labor's average product. After 1995 this process was reversed. The most important contribution of this paper is to suggest that there is a link between the double post-1995 "turnarounds," that is, faster hours per capita growth in Europe relative to the US simultaneously occurring with slower productivity growth relative to the US. The statistical results in this paper are preliminary and partial, as they examine the effect of tax rates with imperfect data and do not provide any statistical analysis at all of effects of employment protection or other types of regulations.

Subject to these qualifications, the findings of this paper send a mixed message for Europe. Recent reports by the OECD and others join together high unemployment and slow productivity growth as part of a general malaise. Our focus is quite different. Slow

productivity growth is the counterpart of tax rate reductions and labor market reforms that are beneficially raising hours per capita after three decades of decline. Rising hours per capita and declining growth of output per hour are signs of victory for European labor market reform, not signs of defeat. The measure of success in Europe is growth in real income per capita, not in productivity, and by this criterion the Tortoise countries upset the standard productivity rankings of the European countries.

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Table 1

Annual Growth Rates of Labor Productivity, Total Factor Productivity, and Contributions of ICT , and of Capital Deepening, Country Units and Groups, 1980-2004

	1980-95						1995-2004					
	LP	TFP	ICT TFP	Non-ICT TFP	ICT Capital Deepen	non-ICT Capital Deepen	LP	TFP	ICT TFP	Non-ICT TFP	ICT Capital Deepen	non-ICT Capital Deepen
United States	1.41	0.59	0.31	0.28	0.66	0.16	2.53	1.40	0.55	0.84	0.79	0.34
EU-15	2.34	1.16	0.20	0.96	0.42	0.76	1.46	0.64	0.26	0.38	0.46	0.36
Tigers												
Ireland	3.60	2.81	0.09	2.72	0.17	0.66	5.20	3.35	0.28	3.07	0.55	1.31
Finland	2.35	1.27	0.31	0.96	0.47	0.75	3.10	2.73	0.38	2.35	0.56	-0.18
Greece	0.10	-0.33	0.10	-0.43	0.10	0.32	2.90	1.86	0.40	1.46	0.38	0.67
Middle												
Sweden	1.59	0.58	0.31	0.27	0.49	0.51	2.60	1.60	0.39	1.21	0.75	0.25
Austria	1.64	0.55	0.14	0.40	0.40	0.69	2.30	1.04	0.29	0.74	0.47	0.79
United Kingdom	2.46	1.31	0.32	0.99	0.45	0.70	2.10	1.26	0.29	0.97	0.62	0.27
Germany	2.70	1.64	0.16	1.48	0.47	0.62	1.80	0.99	0.21	0.78	0.40	0.39
Portugal	2.37	1.58	0.16	1.42	0.24	0.55	1.60	0.40	0.29	0.11	0.47	0.75
France	2.39	0.92	0.12	0.79	0.29	1.18	2.10	1.01	0.20	0.80	0.32	0.75
Tortoises												
Belgium	2.09	0.94	0.30	0.64	0.69	0.46	1.90	1.06	0.44	0.62	0.70	0.09
Netherlands	1.72	0.93	0.18	0.75	0.44	0.35	0.80	0.40	0.38	0.02	0.39	-0.04
Denmark	2.35	1.11	0.34	0.77	0.64	0.59	1.80	0.31	0.41	-0.10	0.74	0.82
Luxembourg	3.13	1.74	0.28	1.47	0.76	0.63	1.40	0.49	0.33	0.16	0.42	0.51
Spain	2.78	1.61	0.20	1.41	0.32	0.85	0.00	-0.43	0.26	-0.69	0.27	0.14
Italy	1.99	0.91	0.21	0.70	0.35	0.73	0.50	-0.39	0.25	-0.64	0.41	0.50

Table 2
Three Fastest-Growing EU Countries and U.S. States,
Growth Rates of Real GDP or Real Gross State Product per Worker, 1980-2004

	Growth Rates			Deviation from EU or US Growth Rate		
	1980-95	1995-2004	Difference	1980-95	1995-2004	Difference
EU Nation (population in millions)						
Finland (5.2)	2.21	2.45	0.24	0.37	1.41	1.04
Greece (10.6)	-0.20	3.03	3.23	-2.04	2.00	4.04
Ireland (3.8)	3.22	3.77	0.55	1.38	2.73	1.35
US State						
Arizona (5.1)	0.74	3.04	2.30	-0.45	0.81	1.26
Massachusetts (6.3)	2.32	3.42	1.10	1.12	1.18	0.06
Oregon (3.4)	0.60	3.44	2.84	-0.60	1.21	1.81
Standard Deviation of Growth Rates	**0.96**	**0.22**		**1.75**	**0.66**	

Table 3
Labor Productivity Growth by Country

	1979-1995			1995-2003			Change		
	Total	**Private**	**Difference**	**Total**	**Private**	**Difference**	**Total**	**Private**	**Difference**
US	**1.15**	**1.72**	**0.57**	**2.41**	**3.53**	**1.12**	**1.27**	**1.81**	**0.54**
EU-15	**2.38**	**2.87**	**0.49**	**1.66**	**1.95**	**0.29**	**-0.71**	**-0.92**	**-0.21**
Tigers	**2.38**	**2.91**	**0.53**	**3.98**	**4.79**	**0.81**	**1.60**	**1.88**	**0.28**
Ireland	4.03	4.35	0.32	6.83	8.23	1.40	2.80	3.88	1.08
Finland	3.09	3.98	0.89	2.61	3.40	0.79	-0.49	-0.58	-0.09
Greece	0.93	1.38	0.45	2.94	3.32	0.38	2.01	1.94	-0.07
Middle	**2.46**	**2.98**	**0.52**	**2.03**	**2.45**	**0.42**	**-0.43**	**-0.53**	**-0.10**
Sweden	1.72	2.65	0.93	1.87	2.95	1.08	0.15	0.30	0.15
Austria	2.82	3.39	0.57	2.14	2.85	0.71	-0.68	-0.54	0.14
United Kingdom	2.42	2.95	0.53	2.22	2.70	0.48	-0.21	-0.25	-0.04
Germany	2.29	2.67	0.38	2.12	2.47	0.35	-0.16	-0.20	-0.04
Portugal	3.06	3.61	0.55	1.92	2.39	0.47	-1.14	-1.22	-0.08
France	2.75	3.38	0.63	1.87	2.10	0.23	-0.88	-1.28	-0.40
Tortoises	**2.26**	**2.69**	**0.43**	**0.69**	**0.72**	**0.03**	**-1.57**	**-1.97**	**-0.40**
Belgium	2.47	2.95	0.48	1.37	1.77	0.40	-1.10	-1.18	-0.08
Netherlands	2.05	2.34	0.30	1.18	1.63	0.45	-0.87	-0.71	0.16
Denmark	2.37	3.09	0.72	1.01	1.32	0.31	-1.37	-1.77	-0.41
Luxembourg	4.28	4.63	0.35	0.91	1.09	0.18	-3.37	-3.54	-0.17
Spain	2.63	2.97	0.34	0.72	0.64	-0.08	-1.91	-2.34	-0.42
Italy	2.06	2.48	0.42	0.51	0.46	-0.05	-1.55	-2.02	-0.47
Asian tigers	**6.12**	**6.58**	**0.46**	**5.64**	**6.77**	**1.13**	**-0.47**	**0.19**	**0.67**
Continental Europe	**2.35**	**2.84**	**0.49**	**1.48**	**1.70**	**0.22**	**-0.86**	**-1.14**	**-0.28**
Anglo non-US	**1.98**	**2.42**	**0.44**	**2.31**	**2.72**	**0.41**	**0.33**	**0.30**	**-0.03**

Continental Europe is the EU-15 minus the UK and Ireland

Asian tigers and anglo non-US only go to 2002

Table 4
EU and US Labor Productivity Growth Rates by Industry

	1979-1995			1995-2003			Change		
	EU	US	Difference	EU	US	Difference	EU	US	Difference
Farms/Mining	4.93	3.24	1.69	2.48	3.68	-1.21	-2.46	0.44	-2.90
Construction/Utilities	1.78	0.09	1.69	1.40	-0.39	1.79	-0.38	-0.48	0.10
Manufacturing	3.89	3.37	0.52	3.20	5.36	-2.15	-0.69	1.99	-2.67
Non-ICT	3.26	1.46	1.80	1.80	2.52	-0.72	-1.46	1.07	-2.52
ICT	12.31	15.36	-3.05	18.30	24.85	-6.55	5.99	9.49	-3.50
Non-Durables	3.27	2.27	1.01	2.44	2.18	0.26	-0.83	-0.09	-0.74
Retail/Wholesale	2.06	2.70	-0.65	1.87	5.39	-3.52	-0.19	2.68	-2.87
Transportation	3.11	0.77	2.34	1.27	2.67	-1.40	-1.83	1.91	-3.74
Finance	1.55	1.49	0.06	1.96	5.65	-3.69	0.42	4.17	-3.75
Services	0.27	-0.49	0.76	0.19	1.73	-1.54	-0.08	2.22	-2.30
Communications	5.37	2.72	2.65	7.68	6.67	1.01	2.31	3.95	-1.64
Real Estate	0.20	0.89	-0.68	-0.02	1.03	-1.05	-0.22	0.14	-0.36
Total	2.38	1.15	1.23	1.66	2.41	-0.75	-0.71	1.27	-1.98

Table 5
EU-US Productivity Ratios by Industry

				Growth Rates	
	1979	**1995**	**2003**	**1979-1995**	**1995-2003**
Farms/Mining	57.0	74.7	67.8	1.69	-1.21
Construction/Utilities	71.6	93.9	108.3	1.69	1.79
Manufacturing	76.1	82.7	69.6	0.52	-2.15
Non-ICT	63.6	84.9	80.2	1.80	-0.72
ICT	127.5	78.3	46.4	-3.05	-6.55
Non-Durables	71.1	83.5	85.3	1.01	0.26
Retail/Wholesale	110.3	99.4	75.0	-0.65	-3.52
Transportation	69.6	101.2	90.5	2.34	-1.40
Finance	97.0	98.0	72.9	0.06	-3.69
Services	101.2	114.3	101.1	0.76	-1.54
Communications	56.1	85.8	92.9	2.65	1.01
Real Estate	139.9	125.4	115.3	-0.68	-1.05
Total	77.46	93.2	82.16	1.16	-1.58

Table 6
EU and US Hour Shares by Industry

	1979			1995			2003		
	EU	US	Difference	EU	US	Difference	EU	US	Difference
Farms/Mining	13.78	5.80	7.98	7.86	4.00	3.87	6.08	3.52	2.56
Construction/Utilities	12.00	9.93	2.07	11.68	9.66	2.02	11.20	10.87	0.33
Manufacturing	33.33	30.65	2.69	26.95	23.25	3.70	23.77	18.55	5.22
Non-ICT	17.28	14.89	2.39	13.70	10.59	3.11	12.47	8.77	3.70
ICT	1.88	3.23	-1.35	1.61	2.64	-1.03	1.37	1.99	-0.62
Non-Durables	14.17	12.53	1.64	11.64	10.02	1.62	9.93	7.80	2.13
Retail/Wholesale	17.71	23.59	-5.88	20.13	23.24	-3.11	20.34	23.36	-3.02
Transportation	5.93	3.79	2.15	6.03	4.53	1.50	6.22	4.53	1.69
Finance	3.47	5.66	-2.19	4.53	6.01	-1.49	4.41	6.40	-1.99
Services	10.78	15.48	-4.71	19.26	24.54	-5.28	24.40	28.08	-3.68
Communications	2.28	3.47	-1.18	2.34	2.96	-0.62	2.19	2.69	-0.50
Real Estate	0.70	1.62	-0.92	1.22	1.82	-0.59	1.39	2.00	-0.61

Table 7
Productivity Growth Rates by Industry for Tigers, Middle, and Tortoises

	1979-1995			1995-2003			Change		
	Tigers	Middle	Tortoises	Tigers	Middle	Tortoises	Tigers	Middle	Tortoises
Farms/Mining	2.32	4.70	5.94	2.57	2.42	2.45	0.24	-2.28	-3.50
Construction/Utilities	1.63	1.74	1.87	2.25	1.99	0.14	0.62	0.24	-1.74
Manufacturing	5.27	3.93	3.79	9.69	3.74	1.36	4.42	-0.19	-2.43
Non-ICT	3.47	3.35	3.17	3.58	2.36	0.75	0.11	-0.98	-2.42
ICT	20.67	12.75	10.03	30.93	19.51	10.09	10.27	6.76	0.06
Non-Durables	4.56	3.04	3.70	8.28	2.57	1.15	3.72	-0.48	-2.55
Retail/Wholesale	0.23	2.51	1.53	2.96	2.55	0.65	2.73	0.04	-0.88
Transportation	3.29	3.17	3.00	4.17	1.50	0.39	0.88	-1.66	-2.60
Finance	1.11	1.70	1.38	3.44	1.74	2.06	2.34	0.04	0.68
Services	-0.51	0.79	-0.56	2.11	0.31	-0.16	2.61	-0.49	0.40
Communications	4.88	5.60	4.77	9.22	7.48	7.60	4.34	1.88	2.82
Real Estate	2.22	0.10	0.32	-0.79	1.19	-2.99	-3.01	1.09	-3.31
Total	2.91	2.98	2.69	4.79	2.45	0.72	1.88	-0.53	-1.97

Table 8
Hours per Capita by Country and Country Grouping, and Annual Growth Rates, 1979-2004

	Hours per Capita (annual)				Annual Growth Rate		
	1960	1979	1995	2004	1960-1979	1979-1995	1995-2004
Austria	1021	791	724	683	-1.35	-0.55	-0.65
Belgium	894	675	622	644	-1.48	-0.52	0.38
Denmark	893	836	758	763	-0.35	-0.61	0.07
Finland	993	853	679	748	-0.80	-1.43	1.08
France	837	703	600	592	-0.91	-0.99	-0.15
Germany	1048	784	666	628	-1.52	-1.02	-0.66
Greece	753	698	700	778	-0.40	0.02	1.17
Ireland	860	670	645	759	-1.32	-0.24	1.81
Italy	830	634	628	676	-1.41	-0.06	0.82
Luxembourg	961	758	825	961	-1.25	0.53	1.70
Netherlands	731	613	605	677	-0.93	-0.08	1.24
Portugal	794	762	819	836	-0.22	0.45	0.23
Spain	766	658	569	798	-0.80	-0.91	3.76
Sweden	907	763	741	752	-0.91	-0.18	0.16
UK	962	792	733	763	-1.02	-0.48	0.44
Tigers	**841**	**734**	**684**	**766**	**-0.71**	**-0.44**	**1.26**
Middle	**948**	**763**	**678**	**670**	**-1.14**	**-0.73**	**-0.14**
Tortoises	**809**	**651**	**612**	**716**	**-1.15**	**-0.38**	**1.74**
EU total	**893**	**721**	**656**	**691**	**-1.13**	**-0.59**	**0.57**
US	**741**	**820**	**877**	**862**	**0.54**	**0.42**	**-0.19**

Table 9

	1960	1979	1995	2004	Growth rates 60-79	79-95	95-04
H/N							
US	741	820	877	862	0.54	0.42	-0.19
EU	893	721	656	691	-1.13	-0.59	0.57
Tigers	841	734	684	766	-0.71	-0.44	1.26
Middle	948	763	678	670	-1.14	-0.73	-0.14
Tortoises	809	651	612	716	-1.15	-0.38	1.74
E/N							
US	36.43	43.94	47.16	47.40	0.99	0.44	0.06
EU	43.19	41.09	40.69	44.16	-0.26	-0.06	0.91
Tigers	39.21	38.08	37.21	42.89	-0.15	-0.15	1.58
Middle	45.47	44.08	42.84	44.30	-0.16	-0.18	0.37
Tortoises	39.98	36.72	37.43	44.13	-0.45	0.12	1.83
H/E							
US	2033	1867	1859	1819	-0.45	-0.03	-0.24
EU	2067	1754	1612	1564	-0.86	-0.53	-0.34
Tigers	2144	1928	1839	1786	-0.56	-0.30	-0.32
Middle	2084	1731	1583	1512	-0.98	-0.56	-0.51
Tortoises	2024	1773	1636	1622	-0.70	-0.50	-0.09
OECD Tax Wedge (Ratio to EU)					(note: growth rates of tax wedge, not ratio)		
US		0.76	0.69	0.62		-0.01	-2.07
EU		1	1	1		0.61	-0.89
Tigers		0.67	0.93	0.87		2.67	-1.70
Middle		0.98	0.97	0.99		0.60	-0.74
Tortoises		1.09	1.05	1.04		0.42	-1.03
EU Level		36.68	40.42	37.30			
Henrekson Tax wedge (ratio to EU)					(note: growth rates of tax wedge, not ratio)		
US	0.76	0.87	0.81		1.34	0.30	
EU	1	1	1		0.60	0.76	
Tigers	0.70	0.85	0.97		1.65	1.57	
Middle	0.95	1.05	0.99		1.12	0.38	
Tortoises	1.13	0.93	1.02		-0.46	1.37	
EU Level	44.63	50.04	56.55				

Table 10

tw1 - linked in 1995 -- tw2 - linked in 1979

twa - average of two

Years	twa '60-'04	tw1 '60-'04	tw2 '60-'04	twa '60-'79	tw1 '60-'79	tw2 '60-'79	twa '95-'04	tw1 '95-'04	tw2 '95-'04
Coefficient	-0.4	-0.39	-0.41	-0.31	-0.31	-0.31	-0.23	-0.2	-0.26
Standard Error	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.02
R2 - within	0.37	0.36	0.38	0.3	0.3	0.3	0.22	0.27	0.23
Correlation	-0.35	-0.41	-0.28	-0.29	-0.48	-0.13	0.02	0.05	0.01
Observations	663	631	663	263	261	263	416	384	416
Fixed effects estimators:									
US	-3.3			-15.0			11.5		
EU	-0.5			0.9			-3.6		
Tigers	-4.2			4.9			-1.8		
Middle	3.1			5.4			-1.0		
Tortoises	-6.2			-7.4			-8.5		

Table 11

Actual and Predicted Changes in Hours per Capita, Cumulative Changes over Intervals, 1960-2004

	1960-2004		1960-1979		1979-1995		1995-2004		
	Actual	**Predicted**	**Actual**	**Predicted**	**Actual**	**Predicted**	**Actual**	**Predicted**	**Residual**
Austria	-40.29	-16.47	-25.56	-8.75	-8.86	-4.79	-5.88	-2.94	-2.94
Belgium	-32.91	-13.17	-28.10	-10.24	-8.27	-5.84	3.46	2.91	0.55
Denmark	-15.74	-22.25	-6.64	-22.18	-9.77	-2.67	0.67	2.59	-1.92
Finland	-28.34	-17.60	-15.26	-15.90	-22.85	-7.56	9.76	5.86	3.91
France	-34.54	-7.34	-17.34	-5.69	-15.88	-2.66	-1.32	1.01	-2.33
Germany	-51.20	-9.58	-28.96	-5.80	-17.30	-5.92	-5.93	2.14	-8.07
Greece	3.23	--	-7.56	--	0.31	-28.18	10.49	0.41	10.08
Ireland	-12.55	12.49	-25.03	-5.02	-3.78	-12.92	16.26	30.43	-14.16
Italy	-20.48	1.71	-26.88	3.77	-1.03	-8.03	7.42	5.98	1.45
Luxembourg	-0.02	--	-23.76	--	8.45	8.81	15.29	5.33	9.97
Netherlands	-7.68	-3.34	-17.62	-11.02	-1.26	6.75	11.20	0.92	10.28
Portugal	5.19	--	-4.10	--	7.26	-10.84	2.03	3.62	-1.59
Spain	4.09	--	-15.16	--	-14.59	-6.89	33.84	1.27	32.57
Sweden	-18.70	-26.53	-17.26	-27.79	-2.90	0.24	1.46	1.02	0.44
UK	-23.17	-6.26	-19.36	-15.24	-7.74	1.38	3.94	7.60	-3.66
US	15.17	-3.69	10.19	-10.21	6.64	-0.93	-1.67	7.45	-9.11
EU total	-25.70	-8.74	-21.45	-7.52	-9.41	-4.43	5.16	3.21	1.95
Tigers	-9.29	-17.91	-13.53	-12.17	-7.10	-11.85	11.33	6.11	5.22
Middle	-34.71	-10.09	-21.72	-9.27	-11.73	-3.49	-1.26	2.67	-3.93
Tortoises	-12.30	-7.04	-21.77	-5.42	-6.15	-5.34	15.62	3.72	11.90

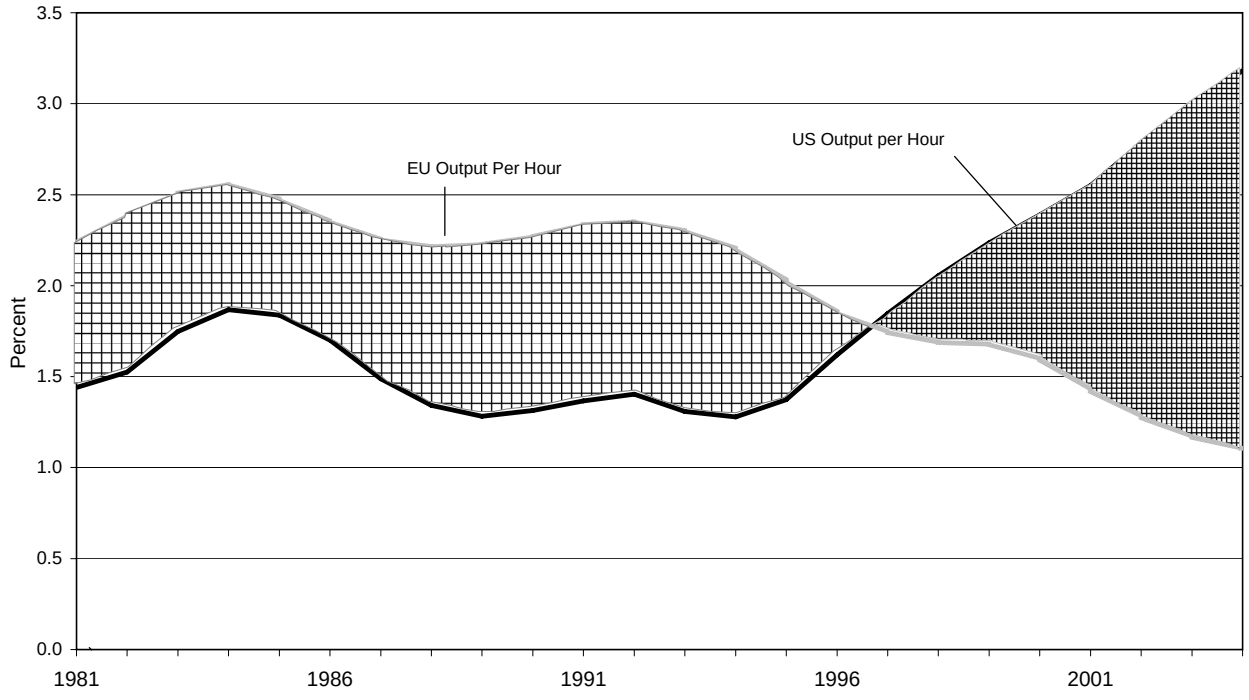
Table 12

Regressions of a 3-year MA of K/H on lags of itself and H/N

		1	2	3	4	5
	lags				Fixed Effects	Fixed Effects
K/H	3			0.37 **		-0.18 **
H/N	3	-1.03 **	-0.92 **	-1.03 **	-1.36 **	-1.38 **
H/N	6		0.52 **	0.9 **	0.18 **	-0.06
H/N	9		0.26 **	0.09	-0.02	0.02
Sum of Coefficients on H/N		-1.03 **	-0.13	-0.04	-1.19 **	-1.41 **
R2		0.36	0.44	0.52	0.65 †	0.66 †

†: refers to within R2

Figure 1. Trend in Output per Hour, Per-capita Output and Per-Capita Hours, US and EU-15, Annual Growth Rates, 1981-2004



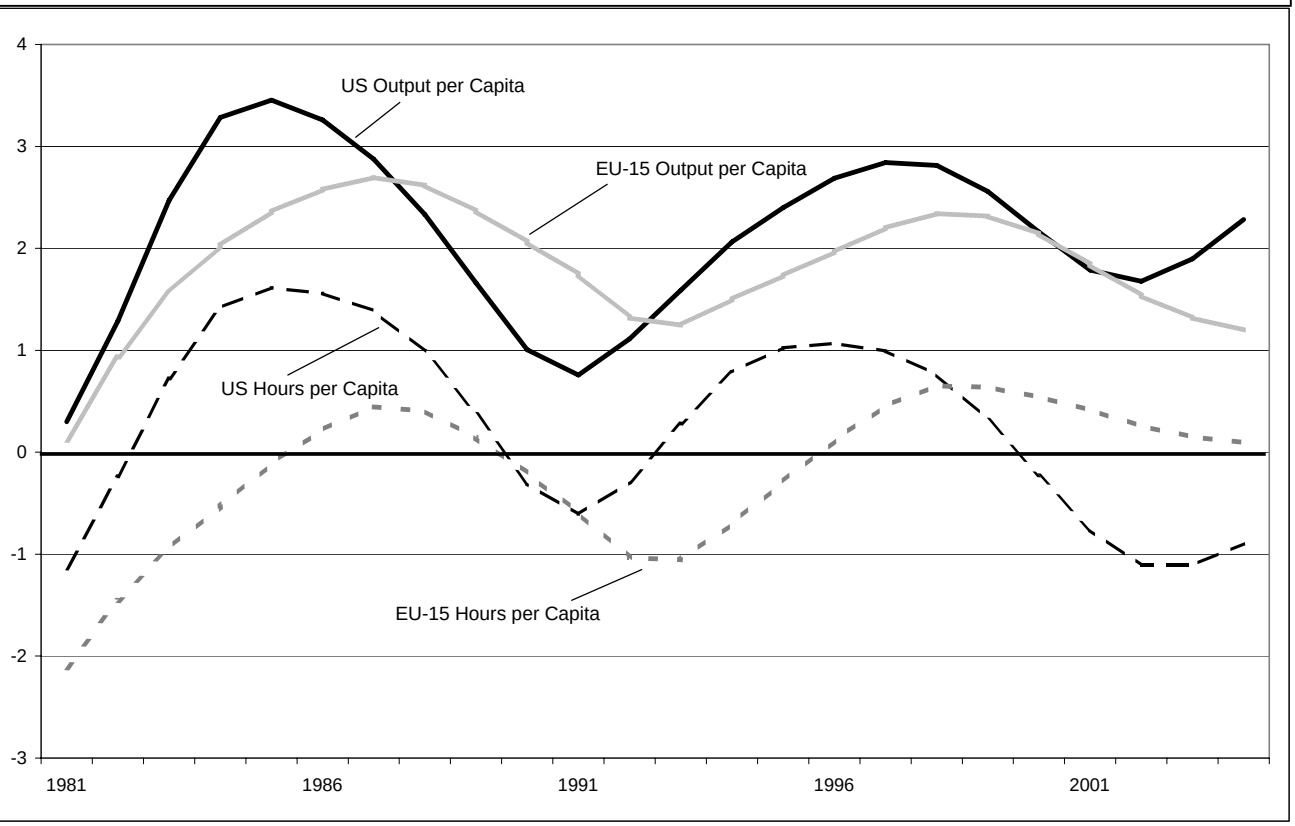
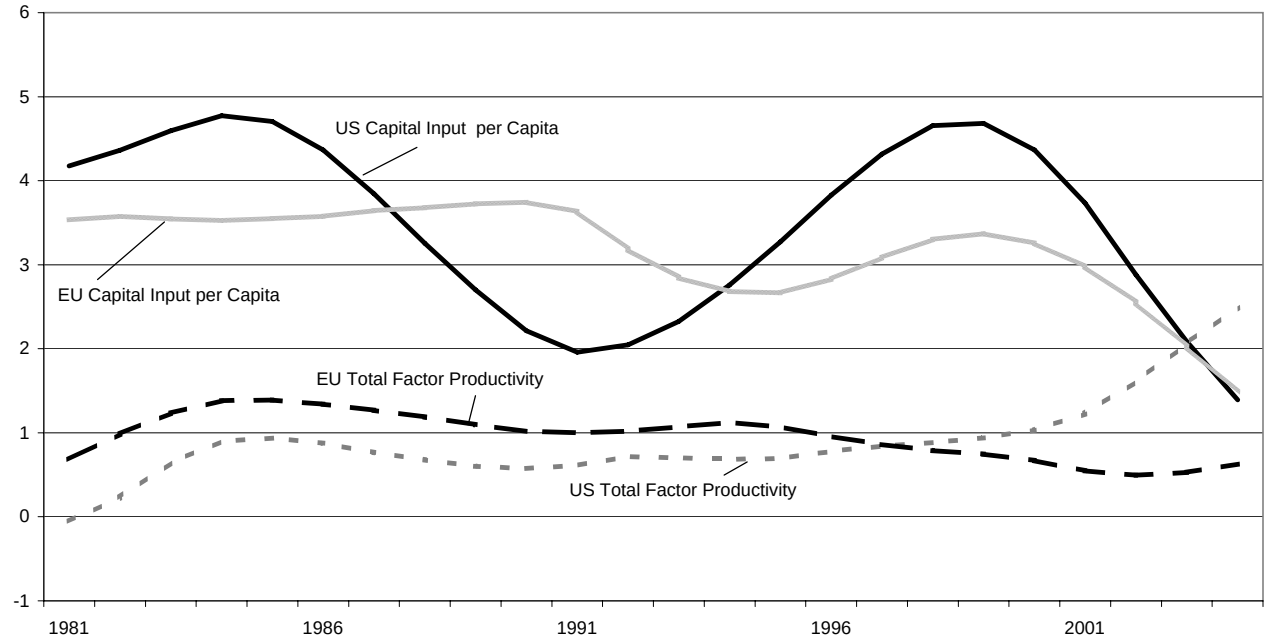


Figure 2. Trend in Total Factor Productivity, Per-Capita Capital Input, and Capital Deepening, US and EU-15, Annual Growth Rates, 1981-2004



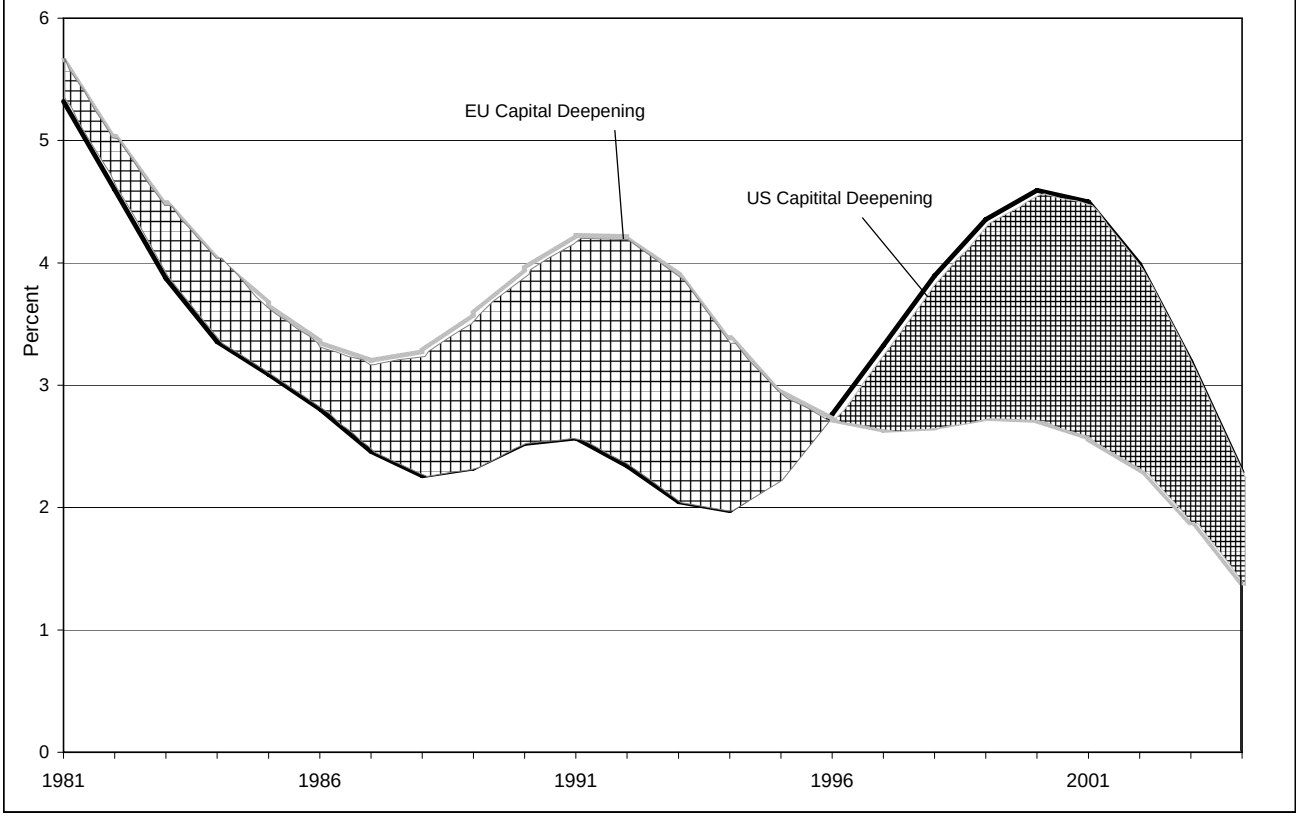


Figure 3. EU-US

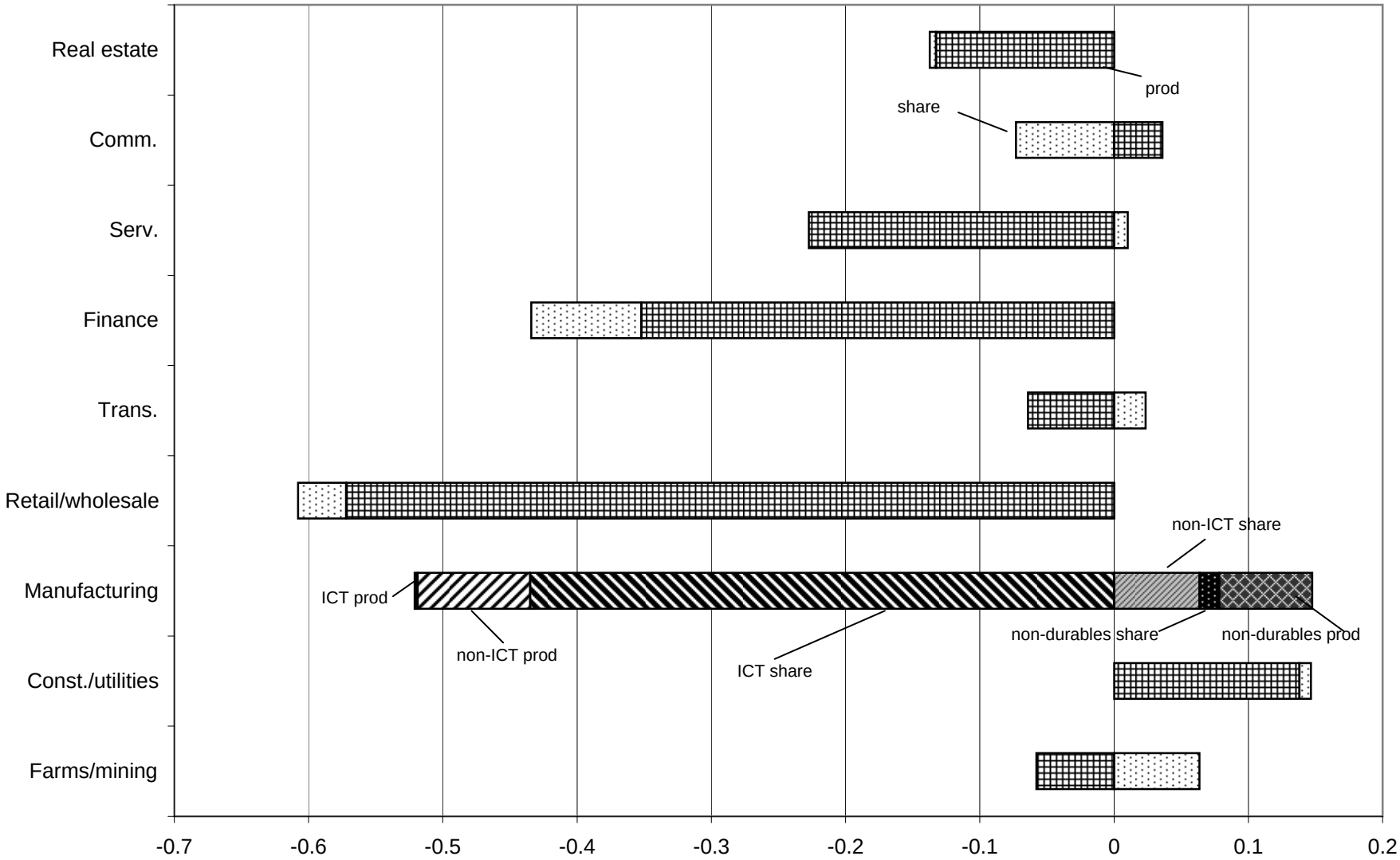


Figure 4. EU vs US

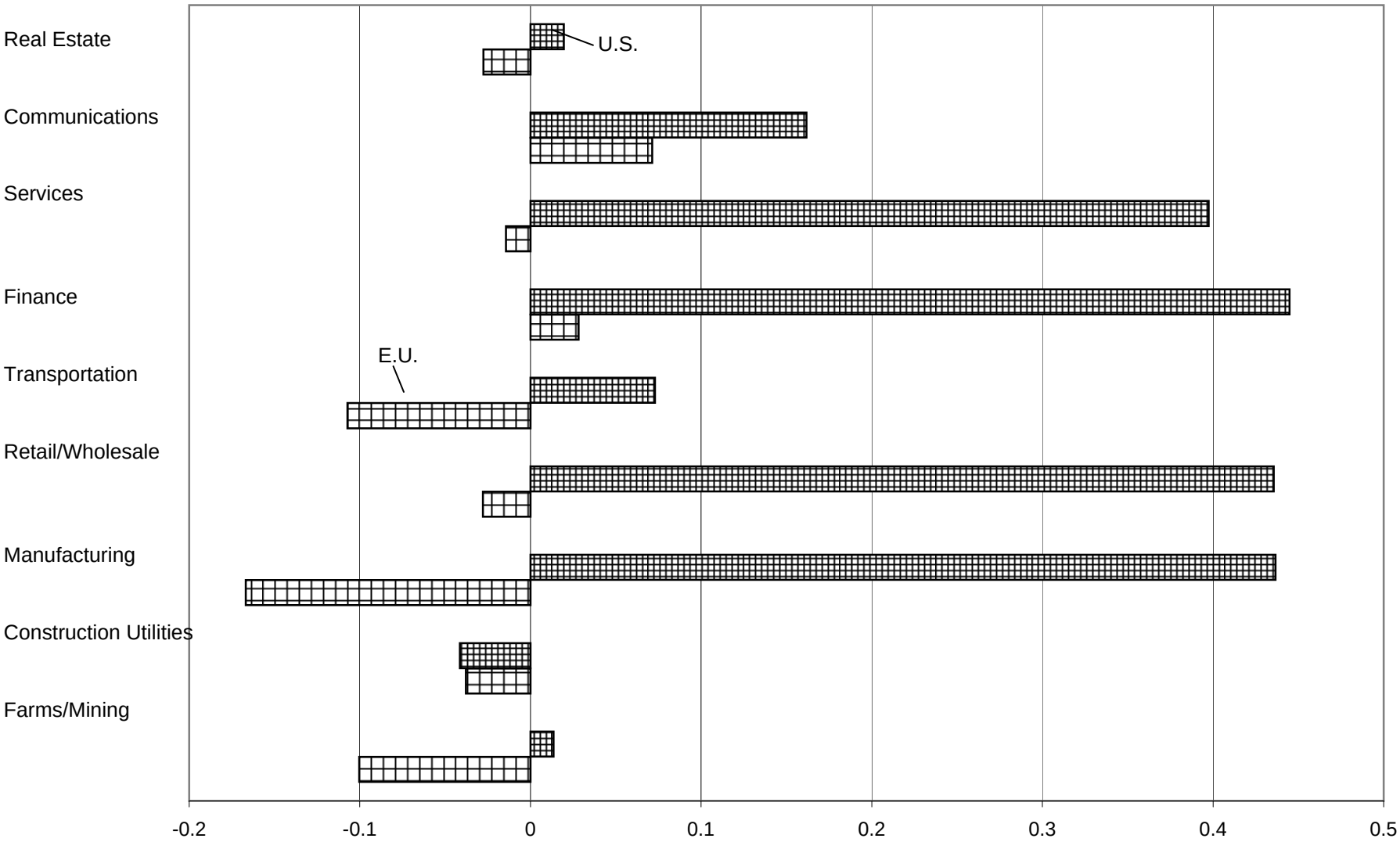


Figure 5. Tigers-Middle

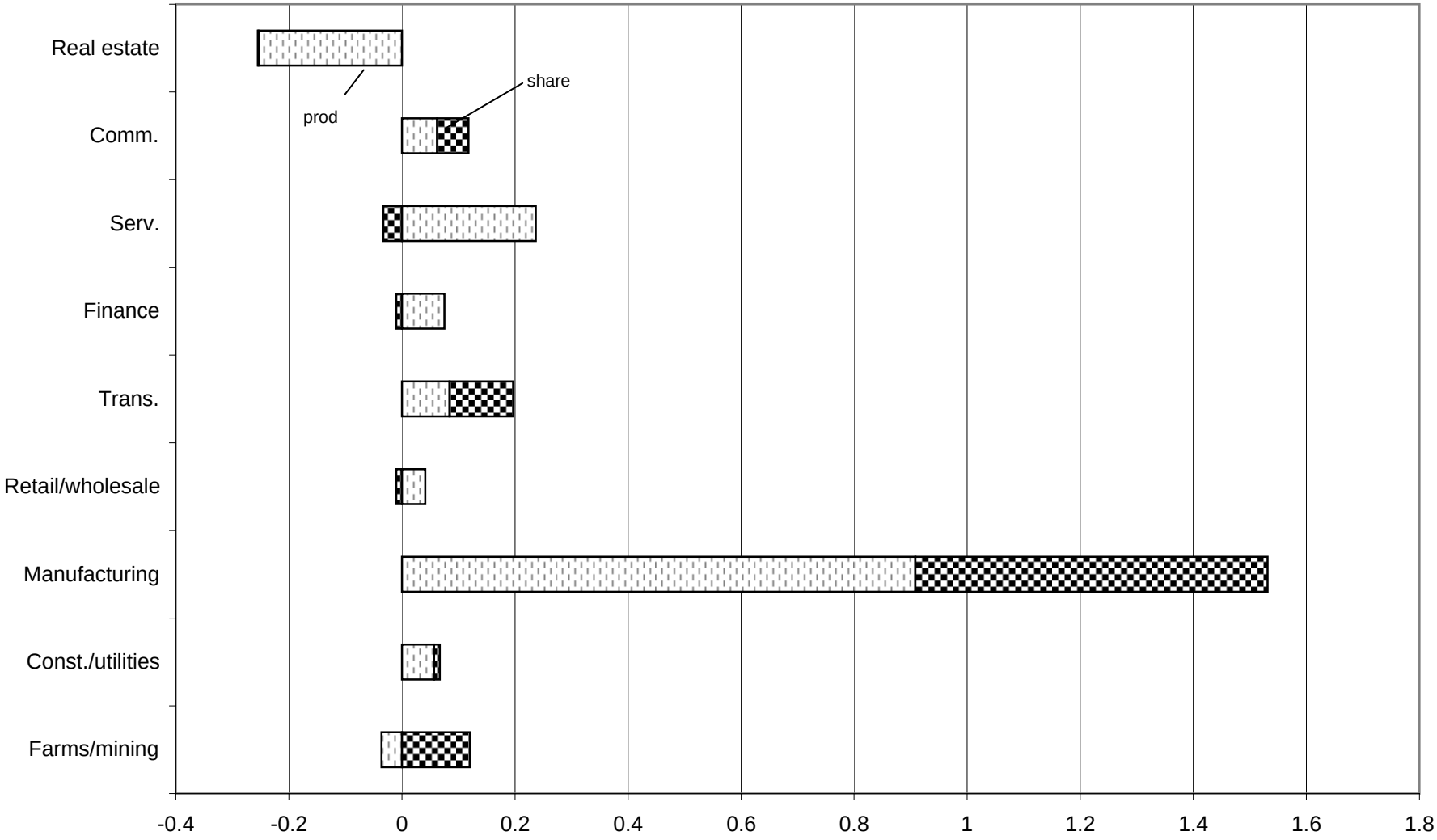


Figure 6. Tigers vs Middle

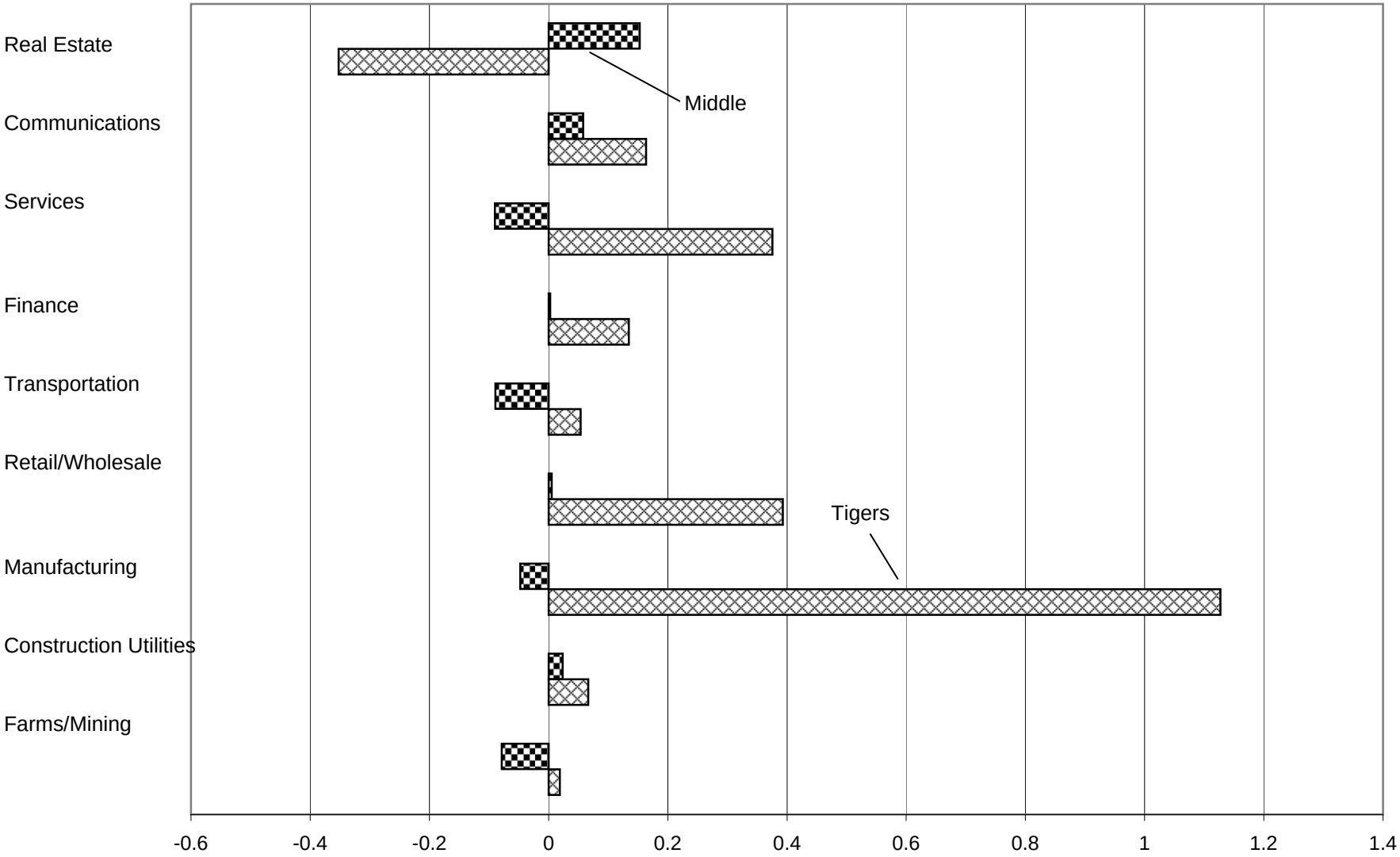


Figure 7. Tortoises-Middle

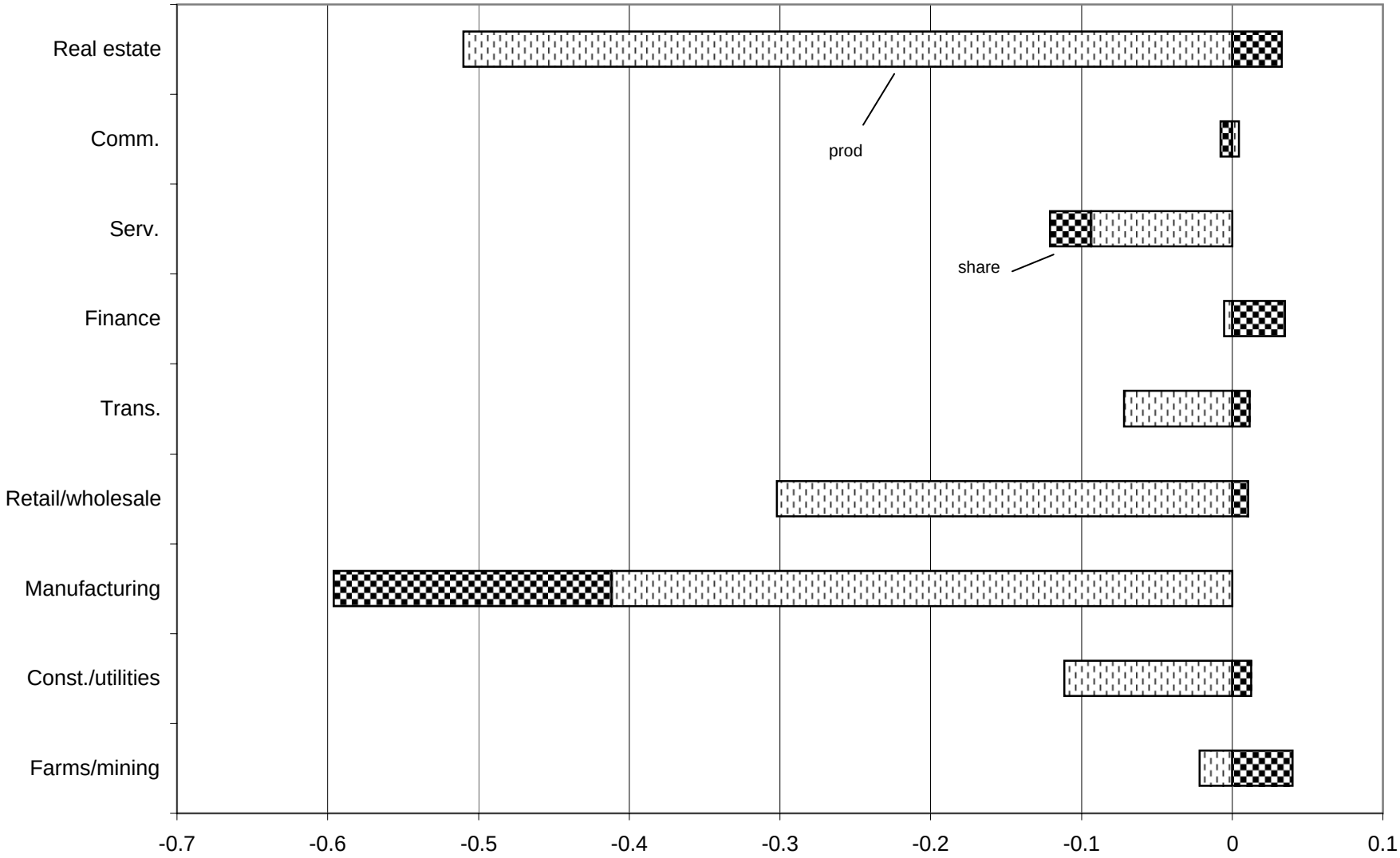


Figure 8. Middle vs Tortoises

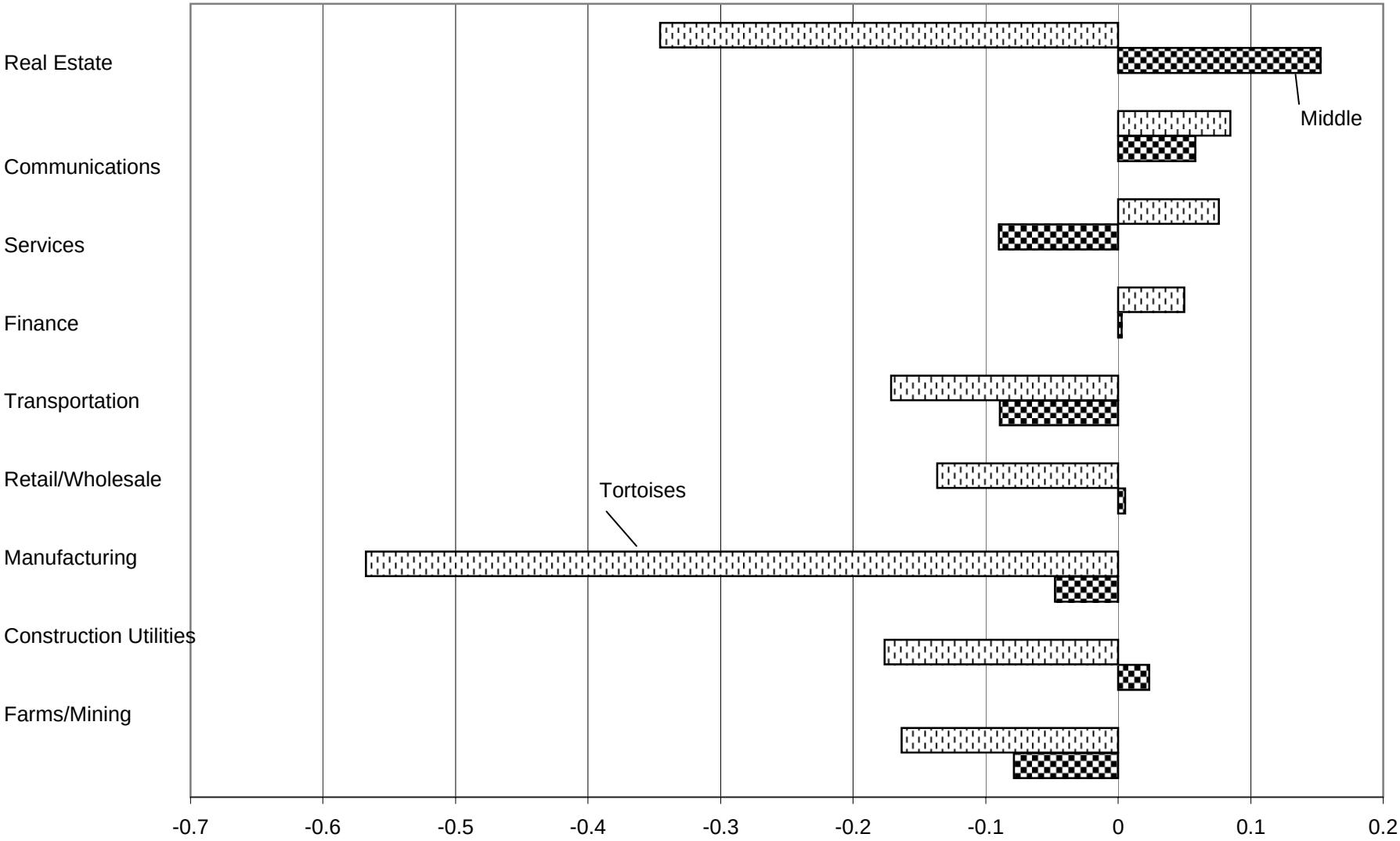


Figure 9. Tortoises-Middle Manufacturing

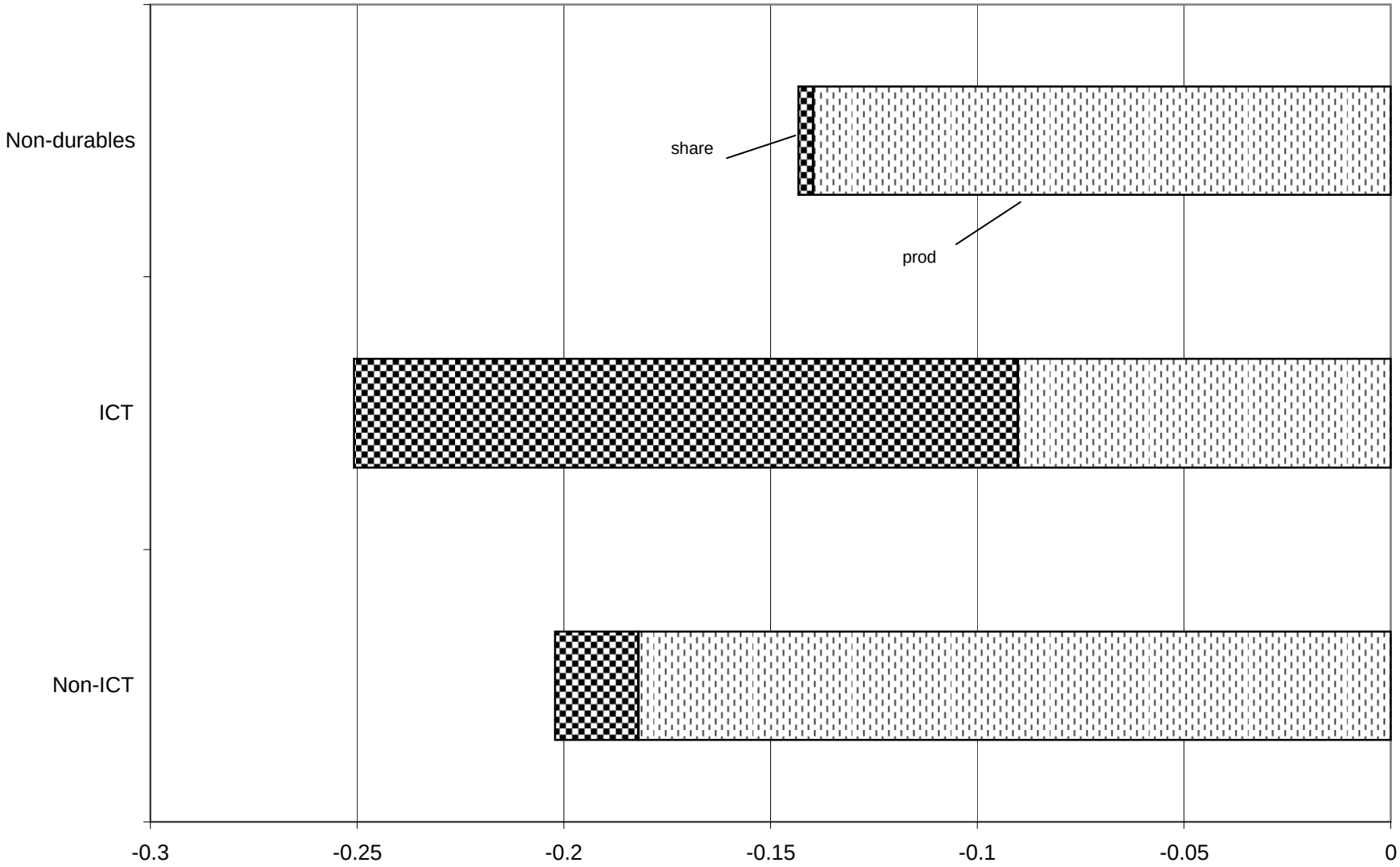


Figure 10. Total Tax Rate on Labor, Average of Davis-Henrekson and OECD data Linked in 1979 and 1995, U. S. and European Country Groups, 1960-2004