Structural Transformation and the Deterioration of European Labor Market Outcomes

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1. Introduction

A large literature attempts to determine which factors account for the deterioration of labor market outcomes in Europe relative to the US. Even a casual reading of this literature makes two points clear. First, there is a consensus as to what needs to be explained, and second, there is no consensus as to what factor may be most important in providing an explanation. Regarding the facts to be explained, the consensus in this literature is that beginning in the early to mid 1970's most economies of continental Europe experienced a sharp increase in unemployment rates relative to the US that continued throughout the 1980's and lead overall to a sustained increase in relative unemployment of roughly six percent. Regarding explanations for this pattern there are several. Blanchard and Wolfers (2000) argue in general terms that a model with common shocks but country specific and time invariant institutions is a promising approach. Examples of this general approach include Bertola and Ichino (1996), Ljungqvist and Sargent (1998), Mortensen and Pissarides (1999a), den Haan, Haefke and Ramey (2002), and den Haan (2003). However, others have argued that changing institutions can account for a substantial amount of the deterioration. Examples include Prescott (2002, 2003) and Daveri and Tabellini (1997).

This paper makes several contributions to this literature. First, it challenges the consensus view of the facts to be explained. The consensus view is based on an analysis of relative changes in unemployment rates. This paper argues that labor input is a more informative measure of labor market outcomes and therefore examines the behavior of employment to population rates and hours of work per employed person. Two key findings emerge. First, the timing of changes is very different. Whereas an analysis of unemployment rates suggests that the differences emerge in the mid 1970's, an analysis of labor input shows that the deterioration of European labor market outcomes relative to the US begins in the mid 1950's, and continues at a fairly steady rate until the mid 1990's. Second, the magnitude of the changes is much larger than suggested by an analysis of unemployment rates. The relative deterioration measured in terms of employment to population rates is almost 20%, and the deterioration in hours per worker is roughly 25%. The relative increase in unemployment rates is only on the order of 6%. This radically different view of what needs to be explained suggests that existing explanations which stress either institutional changes in the 1970's or differential responses to common shocks in the 1970's are likely to be insufficient.

The second contribution of the paper is to argue that the key to understanding the relative deterioration of European labor market outcomes relative to the

US lies in understanding why European economies have failed to develop a market service sector similar to that in the US. In particular, I argue that one must view labor market allocations in the US and Europe from the perspective of the structural transformation of economic activity that accompanies the process of development. Kuznets argued that this structural transformation was one of the six main features of the process of development. This reflects the observation that as economies become richer, activity moves first from agricultural to manufacturing and then later to services. In the mid 1950's Europe lags the US in terms of development, but closes much of the gap during the subsequent 45 years. Accordingly, it is not surprising that in the mid 1950's Europe has a much higher employment rate for agriculture and industry, and much lower employment rate for services, relative to the US. By 2000, however, Europe has largely converged to the US levels for employment rates in agriculture and industry, but has not converged at all in services.

Third, I develop a simple model of structural transformation and within the context of this model provide an account of Europe's labor input performance relative to the US which is based entirely on different evolutions of aggregate tax rates and sectoral productivities. The results indicate that in 1956 it is productivity factors which dominate the differences in labor market outcomes, while in

2000 it is differences in tax rates. Almost 95% of the differences in hours of market work in 2000 are accounted for by differences in tax rates. But the model also accounts for the fact that in 1956 labor input is almost ten percent higher in Europe despite the fact that tax rates are somewhat higher. A key feature of the model is that individuals are able to produce substitutes for many market services using a home production technology. As a result, the increasing tax rates in Europe over the last 45 years have increasingly discouraged the production of services in the market. This outcome is similar to the marketization of production view stressed by Freeman and Shettkat (2002) and supported by time use studies in Germany and the US. While the outcome is similar to that in Messina (2003), the economic mechanism is different. He stresses entry barriers in the service sector rather than tax rates.

An outline of the paper follows. Section 2 contrasts two views of the relative deterioration of European labor market outcomes. Section 3 argues that the structural transformation is a good candidate as a driving force and that the deterioration is characterized as a failure of Europe to develop a market service sector similar to that in the US. Section 4 presents a model of structural transformation, calibrates it to the US experience, and uses it to assess what returns to work across activities in Europe must have been in order to reconcile the different evolutions

in the context of the model. Section 5 concludes.

2. The European Employment Problem

While there is a large literature contrasting the evolution of aggregate labor market outcomes between the US and continental Europe, the bulk of this literature uses the aggregate unemployment rate as its reference measure for aggregate labor market outcomes. The purpose of this section is to demonstrate that one obtains a very different perspective on the aggregate labor market outcome differences if one instead focuses on the amount of work being performed.

For the main results presented here I contrast average outcomes in France, Germany and Italy with those in the US, and will refer to the average of France, Germany and Italy as corresponding to Europe. Similar results emerge with a larger set of countries from the continent chosen to represent Europe, but I focus on these three as my benchmark case since they are the three largest economies in continental Europe and hence are of particular interest.

2.1. Data

All of the data used here is obtained from the OECD Employment Database. OECD data for the countries considered is available going back to 1956, so the

period considered is 1956-2000. For each country I consider two series. The first is the series for the unemployment rate. The second is the series for total employment divided by the population 15-64. A few comments are in order regarding this second choice. The objective of the second measure is to capture differences in labor input across countries. Ideally, one would use aggregate hours of work as the measure of aggregate labor input, but unfortunately these measures are not available sufficiently far back in time. Because of this I use aggregate employment as my measure. I will show later that based on the limited data available, the results that I find based on employment carry over as well to the case of total hours of work. To make comparisons across time and countries, one needs to normalize aggregate employment by some measure of population. I choose the size of the population aged 15-64 as the normalizing factor, and will refer to aggregate employment divided by the size of the population aged 15-64 as the working age population. One point to note is that due to data limitations, the aggregate employment measure includes workers above the age of 65.

2.2. Comparing the US and Europe

In this subsection we contrast the relative evolutions of aggregate labor market outcomes between the US and Europe based on the two different measures.

Though we should not attach any welfare implications to these measures, we will refer to these as two measures of the deterioration of European labor market outcomes relative to the US. Specifically, based on the unemployment rate measure we will say that European labor market outcomes deteriorate by 1% relative to the US if the unemployment rate in Europe increases by 1% relative to the US level. Analogously, based on the employment rate measure we will say that labor market outcomes in Europe deteriorate by 1% relative to the US if the employment rate in Europe decreases by one percentage point relative to the level in the US.

Figure 2.1 displays the findings. In each case the heavy line represents the trend component based on using the Hodrick Prescott filter, while the dotted line shows the actual values.[1] In both cases the 1956 trend value is normalized to 0, so that each figure is measuring deterioration relative to 1956.

The two measures present very different pictures of the deterioration of European labor market outcomes relative to the US. Consistent with the consensus view described in the introduction, the measure based on unemployment rates shows a concentrated deterioration that begins in the mid to late 1970's, and an overall deterioration of roughly 6%. In contrast, the measure based on employ-

[1] Since the data are annual a smoothing parameter of 100 was used.

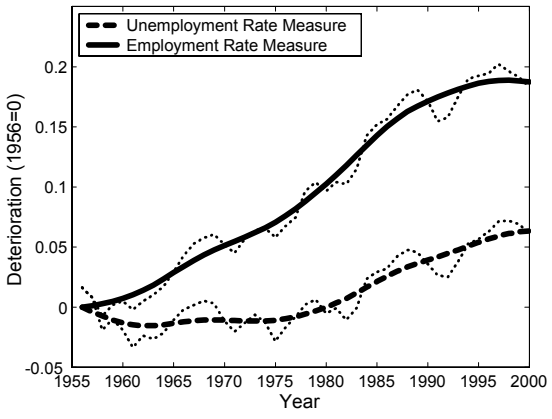
Unemployment Rate Measure
Employment Rate Measure
Deterioration (1956=0)
0.2
0.15
0.1
0.05
0
-0.05
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
Year

Figure 2.1:

ment rates shows a steady deterioration that begins in the mid 1950's and an overall deterioration of roughly 18%.

The key point is that when one looks at labor input one rather than unemployment, one is lead to a radically different description of what needs to be accounted for.[2] The timing of changes, the concentration of the changes and the magnitude of the changes are all very different when deterioration is measured in terms of employment rates rather than in terms of unemployment rates. The difference in these views is potentially very significant. Much of the existing literature is based on the picture corresponding to the unemployment rate measure and has lead many researchers to look for shocks that occurred during the mid to late 1970's as the potential driving force behind the changes. However, based on the picture corresponding to employment rates, the driving forces must be present going back to the mid 1950's.

Before moving on we consider two adjustments to the above figure. First, note that the units of the two measures are not strictly comparable–if we reduce the unemployment rate by one percentage point by moving all of the associated workers into employment, the employment rate will actually increase by less than

[2]I note that Mortensen and Pissarides (1999b) note that differences in employment rates are mostly captured by differences in participation rates rather than unemployment rates, but do not study the time series evolution of the series.

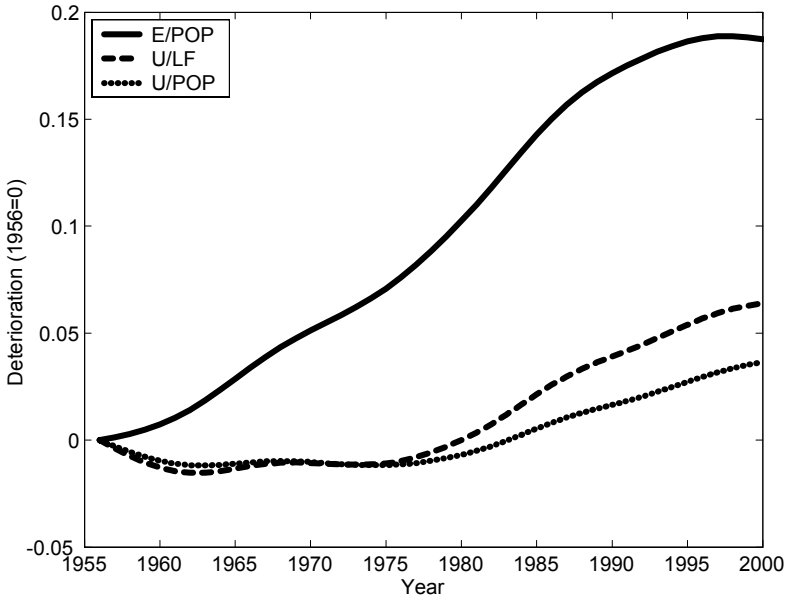

Figure 2.2:

one percent, because the base for this measure is the size of the population aged 15-64, which is larger than the size of the labor force. To correct for this discrepancy the next figure shows the two measures when we use the ratio of the number unemployed to the size of the population aged 15-64.

Note that the discrepancy between the two measures becomes even larger in the post 1975 period.

Second, to emphasize the fact that the deterioration measured using employment rates is much larger than the deterioration measured using unemployment

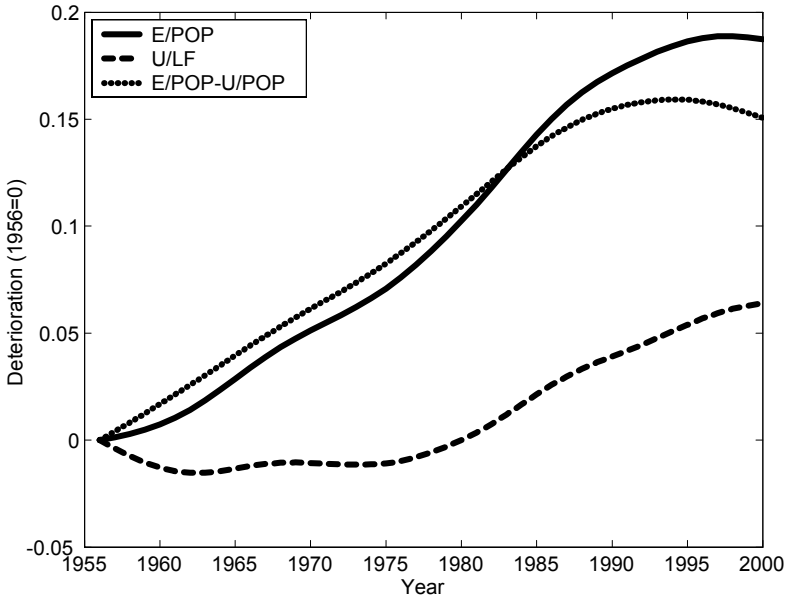

Figure 2.3:

rates, the next figure shows how the employment rate deterioration figure would have looked under the counterfactual that the European unemployment to population ratio had evolved exactly as in the US, and all of the "excess" unemployed were assumed to have been employed.

The result is shown by the dotted line in this figure and is quite striking. Even if the European unemployment to population ratio had behaved exactly as in the US, we still see a steady deterioration that begins in the mid 1950's and continues through the mid 1990's, with the total deterioration of roughly 15%.

This change is roughly two and one-times the magnitude of the deterioration based on unemployment rates.

Lastly, we have been using the employment rate as a measure of labor input. Ideally, hours of work per person aged 15-64 would seem to be a preferable measure. This measure is not available going back to 1956 for each of these countries, but a series for annual hours worked per person in employment is available from the Groningen Growth and Development Centre and the Conference Board, Total Economy Database, January 2005, http://www.ggdc.net. The next figure uses these data to plot the deterioration in annual hours worked per empoyed worker in France, Germany and Italy relative to the US. Specifically, this graph plots the ratio of the trend component in the US to average of that for the other three countries, normalized to equal zero in 1956.

The figure shows that this value also begins to deteriorate in 1956 and continues at a fairly steady rate throughout the period. Note that the magnitude of the deterioration is very substantial, on the order of 25%. Note that if we are measuring deterioration in labor input per individual aged 15-64 that the deterioration in this measure should be added to the deterioration in the employment rate. This further emphasizes the point that the deterioration measure based on unemployment rates captures a small fraction of the changes in time allocations

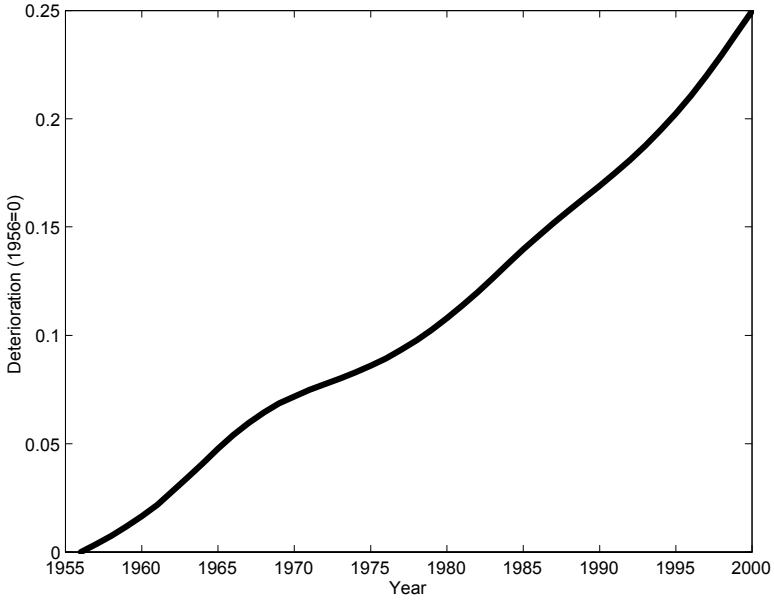
0.25
0.2
0.15
0.1
0.05
0
Deterioration (1956=0)
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
Year

Figure 2.4:

found in the data.

3. Structural Transformation and the Role of Services

The previous section documented a steady decline of the employment rate in Europe relative to the US since 1956. If less time is being devoted to market production in Europe relative to the US, it is potentially of interest to ask which (market) activities are not being done. If the decreases are concentrated among a given set of activities this information may help to shed light on potential sources of the decrease. This is the issue addressed in this section.

I consider three broad sectors–agriculture, industry and services, and for each sector I compute a sectoral employment rate which is total sectoral employment divided by total population aged 15-64.[3] Figure xx displays the relative employment rates of Europe as compared to the US across these three sectors over the period 1956-2000.

The key pattern to notice in this figure is that the relative employment rates in agriculture and industry have been decreasing in Europe since around 1970

[3]I note that these three activities do not represent the universe of employment since military is not included, whereas the aggregate numbers presented earlier did include employment in the military.

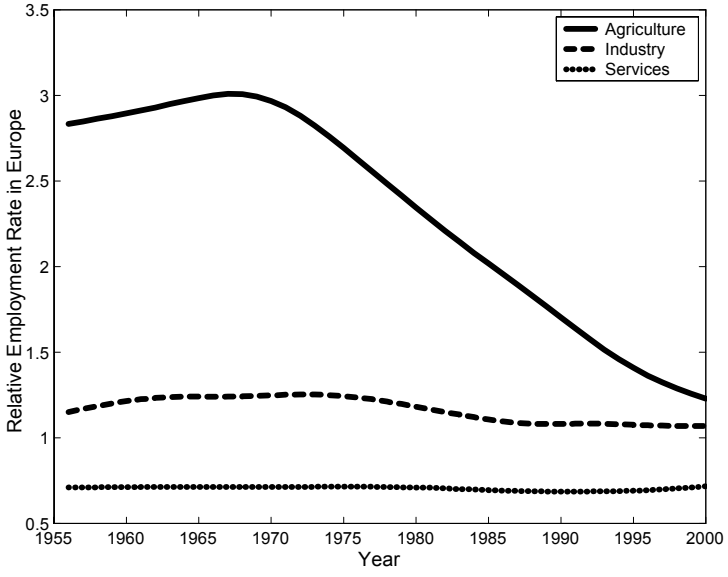
Agriculture
Industry
Services
Relative Employment Rate in Europe
Year
3.5
3
2.5
2
1.5
1
0.5
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000

Figure 3.1:

while the relative employment rate in services has been roughly constant.[4] One may be tempted to conclude that the key to understanding the relative decline in employment in Europe is to understand the relative decline in agriculture and industry. However, we argue next that this is precisely the wrong interpretation of these findings. The reason for this is that these evolutions of relative employment levels need to be interpreted in the context of the process of structural transformation. Kuznets claimed that the process of structural transformation is one of the six main features of the development process. The basic pattern that is followed by economies is that at low levels of development most resources are devoted to agriculture. As the economy develops resources are transferred to the industrial sector and the service sector, and at yet higher levels of development resources shift out of the industrial sector into the service sector.

The next two figures show that both Europe and the US have been experiencing this transformation in the 1956-2000 period.

To understand the significance of the process of structural transformation for the issue at hand, consider the following situation. If one set of economies lags

[4]It may seem puzzling that relative sectoral employment rates only begin to decline after 1970 while relative aggregate employment declines starting in 1956. This apparent puzzle is resolved by noting that the weights on the sectoral employment rates are changing over time. Services is becoming more important and Europe has a much smaller relative employment rate in that sector.

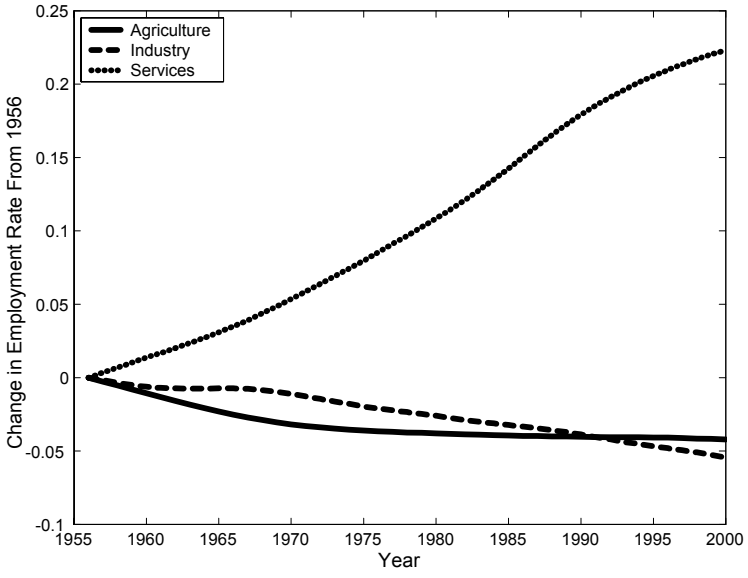
Agriculture
Industry
Services
Change in Employment Rate From 1956
Year
0.25
0.2
0.15
0.1
0.05
0
-0.05
-0.1
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000

Figure 3.2:

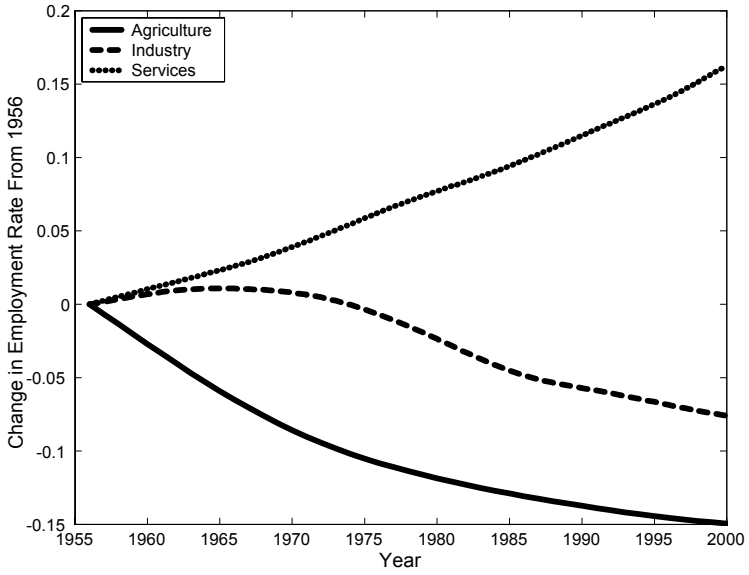
Agriculture
Industry
Services
Change in Employment Rate From 1956
Year
0.2
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000

Figure 3.3:

another in the development process, we should expect to see higher relative employment rates in industry and agriculture, and lower relative employment rates in services. Moreover, if this set of economies catches up, we would expect to see a reduction in relative employment rates in industry and agriculture and a rise in relative employment rates in services. It is well known that Europe experienced a significant degree of catch up to the US over the period 1956-2000, so this is precisely the pattern that should be expected.[5]

With this in mind the next table shows the gap between European employment rates and US employment rates by sector in both 1956 and 2000.

Employment Rate Differential in Europe

Year	Agriculture	Industry	Services
1956	11.2	3.4	-9.4
2000	0.5	1.2	-15.5

This table shows that as of 1956, Europe has higher employment rates in both agriculture and industry, and a lower employment rate in services. Qualitatively this is consistent with the notion that as of 1956 Europe is lagging the US in the development process and hence has a larger amount of economic activity taking

[5]In 1950, output per hour in these three European countries was roughly one-half of the US level, but as of 2000 the gap is largely closed.

place in agriculture and industry. Given that over the period 1956-2000 Europe closes much of the gap between itself and the US in terms of output per hour, at a qualitative level this would lead us to expect that Europe's employment rates for agriculture and industry would decrease and approach those of the US, and in fact this is exactly what we observed. So, although the largest deterioration in employment rates occurs in agriculture, this is consistent qualitatively with the notion that Europe was catching up to the US over this time period. Similarly, much of the gap in industry is also closed over this period. However, from the perspective of structural transformation and catch-up, we would expect that Europe's employment rate in services would have increased relative to that in the US, but in fact the gap has actually widened.

The conclusion that emerges from this analysis is that the key to understanding the deterioration of employment rates in Europe relative to the US is the failure of Europe to move workers into the service sector as it closed the gap between itself and the US in terms of productivity.

4. A Time Allocation Problem

This section develops a simple model of structural transformation and then uses it to interpret the labor input evolutions in Europe and the US over the period

1956-2000 as documented in the previous sections. Specifically, the model will view movements in actual labor inputs as resulting from two differences across economies: differences in tax rates and differences in labor productivities. Loosely speaking the tax rate differences shift labor supply, while the productivity differences shift labor demand. Differences in labor productivities are meant to capture differences that may be due to any number of factors including labor and product market regulations.

4.1. Model

A key criterion for the model is that it be able to generate the structural transformation found in the data. Two main classes of models have been used in the literature to generate this process. The first emphasizes non-homotheticities in preferences–if income elasticities are not all unitary then as an economy becomes richer it will change the allocation of resources across sectors. Examples following this approach include Echevarria (1997) and Kongsamut, Rebelo and Xie (2001). A key implication of this class of models is that technological change which is neutral across sectors can produce an ongoing reallocation of activity across sectors. A second class of models stresses uneven technological progress across sectors. Baumol (1967) is an early example of this class, and Ngai and Pissarides (2004)

provide a recent generalization. A key feature of this approach is that one can generate structural transformation with homothetic preferences, as long as the elasticity of substitution between goods is not unity.

The model adopted here is a hybrid of these two approaches. Non-homotheticities will be central to the reduction of employment in agriculture, but uneven technological progress will be central to the movement of resources from industry into services. This hybrid approach is in part motivated by the work of Ngai and Pissarides, who find that uneven technological change can account for much of the reallocation between industry and services but is not sufficient to explain the reallocation of resources out of agriculture.

The model is effectively a sequence of static time allocation problems. Preferences are assumed to be constant over time and across economies, but productivitities and tax rates will be allowed to differ. The focus of the analysis is on how these factors affect time allocations. To ease notation in what follows I suppress time subscripts and focus on the time allocation problem solved in a particular period.

There is a representative household with preferences given by:

$$U(C, 1-H) + V(A)$$

where C is a composite good representing consumption of non-agricultural goods and services produced in the market, N is consumption of nonmarket produced services, H is total time allocated to work ($1-H$ is leisure), and A is consumption of agricultural goods. The function U is assumed to be log-linear in C and $1-H$:[6]

$$U(C, 1-H) = a_C \log(C) + (1-a_C)\log(1-H)$$

The composite consumption good C is defined by:

$$C = [a_I I^{\varepsilon} + (1-a_I)F(S,N)^{\varepsilon}]^{1/\varepsilon}$$

where I is consumption of goods produced in the industrial sector, and F is an aggregate of market services (S) and nonmarket production (N).[7] We further assume that the aggregator F is also CES:

$$F(S,N) = [a_S S^{\eta} + (1-a_S)N^{\eta}]^{1/\eta}.$$

[6]Note that as the size of the agricultural sector becomes small, these preferences are consistent with balanced growth.

[7]Implicitly we assume that most nonmarket production consists of services that are substitutable with market provided services. One could easily allow for the possibility that industrial goods can be produced at home. As an empirical matter this does not seem to be a particularly important component of production in rich economies, and hence we abstract from it.

Utility derived from the consumption of agricultural products, $V(A)$, is assumed to take a very simple form. Specifically, it is assumed that individuals do not desire more than $\bar{A}$ units of the agricultural good, but also that they require consumption of at least this amount. This is accomplished by assuming that V satisfies $V(A) = \min\{A, \bar{A}\}$ if $A \geq \bar{A}$ and that $V(A) = -\infty$ if $A < \bar{A}$. In equilibrium this will imply that the allocation of labor to agriculture is completely determined by productivity in agriculture and hence that that movement of labor out of agriculture is completely determined by improvements in agricultural productivity.

Next we turn to a description of technology. For simplicity we abstract from capital and assume that all technologies are linear in labor:

$$I = A_I H_I,\ A = A_A H_a,\ S = A_S H_S,\ N = A_N H_N.$$

where the H_i are the time allocations to sector i, and the A_i are productivity parameters.

As noted earlier, we also allow for a government in the model. We assume that there is a proportional tax rate levied on labor income at rate τ, and that this tax is used to finance a lump-sum transfer T to the representative agent.

4.1.1. Equilibrium

We study a competitive equilibrium for this economy. With the linear production technologies this implies that one can determine all of the prices based on the technology parameters. Specifically, if we normalize the wage rate to one, it follows that the prices of the agricultural good (P_A), the industrial good (P_I) and (market) services (P_S) must be the inverse of the respective productivity in each activity:

$$P_A = \frac{1}{A_a},\ P_I = \frac{1}{A_I},\ P_S = \frac{1}{A_S} \tag{4.1}$$

.

Taking these prices and the transfers from the government as given, in equilibrium the representative agent chooses values of consumption (A, I, S, N), time allocated to market work (H_M) and time allocated to home work (H_N) to maximize:

$$U(C, 1 - H_M - H_N) + V(A)$$

subject to the constraints:

$$\begin{aligned} P_I I + P_S S + P_A A &= (1-\tau)H_M + T \\ N &= A_N H_N \\ H_M + H_N &\leq 1 \end{aligned}$$

plus nonnegativity constraints. Equilibrium also requires an allocation of market time across sectors that is consistent with market clearing:

$$A = A_A H_A,\ I = A_I H_I,\ S = A_S H_S,\ H_M = H_A + H_I + H_S \tag{4.2}$$

and a value of transfers that is consistent with the government budget constraint:

$$T = \tau H_M. \tag{4.3}$$

One can combine the first order conditions for the consumer maximization problem with the market clearing conditions and the government budget constraint to obtain the following four equations that characterize the equilibrium allocation of time across activities:

$$\frac{a_S}{1-a_S}[\frac{S}{N}]^{(\eta-1)} = \frac{A_N}{(1-\tau)A_S} \tag{4.4}$$

$$\frac{(1-a_I)a_S}{a_I}\frac{F(S,N)^{(\varepsilon-\eta)}S^{\eta-1}}{I^{\varepsilon-1}} = \frac{A_I}{A_S} \tag{4.5}$$

$$a_C a_I(1-\tau)A_I C^{-1} I^{\varepsilon-1} = \frac{1-a_C}{1-H} \tag{4.6}$$

$$H_A A_A = \bar{A} \tag{4.7}$$

The first equation states that the marginal rate of substitution between home and market services is equal to the (tax-distorted) marginal rate of transformation between home and market services. The second equation states that the marginal rate of substitution between industrial goods and (market) services is equal to the marginal rate of transformation between the manufacturing good and (market) services. Note that taxes affect these two activities equally so the tax rate does not explicitly enter this expression. The third equation states that at the margin the consumer is indifferent between working a bit more in the industrial sector and taking a bit more leisure. Of course, given the first two equations, this

indifference extends to the consideration of working additional time in any of the sectors. Finally, the fourth equation states that output from the agricultural sector is equal to the food requirement $\bar{A}$. Given the form of the utility function for utility derived from food there is no standard marginal condition for time devoted to agriculture.

The last equation can be easily solved for the value of H_A, leaving three equations in the three unknowns H_I, H_S, and H_N. Moreover, simple algebraic manipulation shows that the first equation can be used to derive a linear relationship between H_N and H_S:

$$H_N = \frac{A_S}{A_N}[\frac{a_S}{(1-a_S)}\frac{A_S}{A_I}(1-\tau)]^{\frac{1}{\eta-1}}H_S \tag{4.8}$$

It follows that the model can be reduced to solving a system of two equations for the two unknowns H_I and H_S.

It will be of interest later on to note the following implication of the model for time allocations. Given a value of agricultural productivity (which effectively determines h_A), the remaining elements of the time allocation (h_I, h_S, h_N) are homogeneous of degree zero in the three remaining productivity parameters, (A_I, A_S, A_N). That is, scaling all three of these productivities proportionately will

not change the time allocation. This follows from the fact that preferences are homothetic in the non-agricultural allocation. It follows that time allocations alone can only determine productivities in these three activities up to a scale factor.

4.2. Remarks About the Model

Several remarks should be noted concerning the model and some of the simplifying assumptions. First, the production structure assumes that there are four technologies that all produce final goods and services using labor as the only input. In reality some business services, for example, are inputs into the production of manufactured goods, and some manufactured goods are inputs into the production of some services. Many agricultural goods serve as inputs into the manufacturing sector. The final goods and services offered by supermarkets entail inputs from agriculture and manufacturing, but workers in supermarkets are recorded as employed in the service sector. While a more complex production structure would allow for a richer set of interactions, the simpler structure here allows us to better isolate the role of some basic forces and seems a useful starting point.

The model also assumes that there is a single good produced by each sector. In reality there is tremendous heterogeneity of goods even within each sector, and this is probably especially true for the service sector. The service sector

includes such diverse items as health services, education, legal services, restaurant meals and cleaning services. Undoubtedly the factors that influence how many advanced medical procedures are provided in the market and how many home cleaning services are provided in the market are quite different. A model that was designed to focus on the former would probably include some features different than a model designed to shed light on the latter. While one strategy to deal with this would be to allow for heterogeneity of goods within a given sector, we have chosen not to do this to minimize the dimensionality of the model. As will be seen in the next section however, the model will be calibrated so as to emphasize that part of the service sector for which there are good nonmarket substitutes.

Having assumed a single agent representative household, the model also abstracts from heterogeneity in the distribution of human capital as a factor that influences the allocation of time across activities. One might suspect that greater heterogeneity in the ratio of market productivity to home productivity across individuals would influence how an economy allocates time across market and nonmarket activities. This factor is stressed in a recent paper by Davis and Henreksson (2003). In such a framework, differences in market wage structures holding the distribution of skills constant would also play a role in shaping how time is allocated between market and nonmarket activities. Once again, although it is

possible that these interactions are quantitatively significant, the view here is that the simpler model remains a useful starting point.

An additional factor that the model abstracts from is trade, i.e., the model just described is for a closed economy. Over the last several decades there might have been some interaction between trade among countries and the process of structural transformation, as production of certain goods migrates to less-developed countries. These interactions are definitely of interest, but the underlying premise of the analysis carried out here is that trade *per se* is not the driving force behind the process of structural transformation, and that we can therefore learn something about the underlying forces that shape the structural transformation without allowing for trade. Again, while it is of interest to consider how factors that influence trade have influenced the observed pattern of structural transformation, a model without trade seems a useful starting point. To the extent that increased trade has allowed for increased specialization, the model can capture this as an effective increase in productivity.

There are of course a variety of factors that can influence measured labor productivity, including product and labor market regulation, tax policies which influence the incentive to invest in capital or adopt new technologies, and labor unions just to mention a few. Ultimately, it is important to understand which

particular factors are responsible for differences in average labor productivity. The model as currently set up is only intended to assess the consequences for time allocations of a given exogenous pattern of productivity differences.

5. Calibrating the Model

In this section the model is calibrated to match the evolution of labor input of the US economy between 1956 and 2000. As stated earlier, we will assume that preference parameters are unchanged over this period and hence that any changes in hours worked across sectors is due to changes in sectoral productivities and/or taxes.

5.1. Labor Input Across Sectors

The data presented earlier in the paper considered differences in employment rates across sectors. From the perspective of the model the key data is labor input across sectors. If hours per worker were the same across sectors, time and countries, then differences in employment rates would capture differences in labor inputs. Unfortunately, this is not the case. The data indicate substantial differences across sectors and countries, and moreover, that these differences are not constant over time. As noted earlier, the Groninger Growth and Development

Center provides data on annual hours worked per worker in employment over the period 1956-2000 for all of the countries in our study. It also includes average hours worked per person in employment by sector for France, Germany and the US for selected years between 1950 and 1997.[8] These data are used to produce series for hours of labor input per person aged 15-64 across sectors. The details are described in the Appendix.

In the model time endowment is normalized to one. To map actual hours into fractions of time endowment devoted to work I follow the standard practice of assuming that total time devoted to market work in the US in 1956 is equal to 1/3. The following Table provides the labor input across market sectors for both Europe and the US in 1956 and 2000 that will be used in the analysis.

Table

Sectoral Labor Inputs Relative to Time Endowments

	US				Europe			
	h_A	h_I	h_S	Agg	h_A	h_I	h_S	Agg
1956	.039	.117	.174	.330	.099	.135	.126	.360
2000	.0102	.095	.250	.355	.0105	.071	.151	.233

[8] In particular, these data come from the Groningen Growth and Development Center 10-Sector Database, November 2003, http://www.ggdc.net.

As described below, the calibration procedure will also require information on time allocated to the home sector in the US in 1956. The other values will simply be implied by the calibration of the model's parameters. Long time series on time devoted to homework are not available. In the business cycle literature on home production models, standard point estimates used are that .33 of the time endowment is allocated to market work and .25 is allocated to home work. Hence, we target a level of home work in 1956 equal to .25 for the US.

5.2. Tax Rate Differences

Computing effective marginal tax rates on labor and how they have changed over time for a representative worker is a difficult task. We do not attempt to contribute to the literature on how best to measure these taxes but instead rely on the estimates that have been provided by others. Mendoza et al (1994) develop a methodology for determining average tax rates on labor, capital and consumption across countries. Data limitations preclude one from carrying out this procedure for years prior to 1965. In a recent paper, Prescott (2004) modifies the method of Mendoza et al and incorporates progressivity in marginal income tax rates into the analysis. He concludes that effective marginal tax rates on labor in the US have been relatively constant over the last 35 years, at the rate of .40. Evidence on

average tax rates suggests that tax rates probably increased modestly in the US during the period 1956-1970. However, for the analysis that follows, what is most important is the extent to which European tax rates have increased relative to US tax rates over the period 1956-2000. Hence, in calibrating the model I simply assume a constant tax rate on labor income of .4 for the US, while in Europe I assume a tax rate of .45 in 1956 and .60 in 2000.

5.3. Preference and Technology Parameters

All productivities are normalized to one for the US in the initial period, i.e., in 1956 we assume $A_I = A_S = A_N = A_A = 1$. This corresponds to a choice of units.

There are two key elasticity parameters: η and ε. The parameter η determines the elasticity of substitution between home and market produced services, and will be important in determining how time is reallocated between the home and the market in response to tax changes and changes in relative productivities. The calibration sets $\eta = .5$, implying a reasonably high elasticity of substitution between the two types of goods. There is relatively little empirical work that estimates this elasticity. The estimates that are available (see McGrattan et al (1997) and Rupert et al (1996) suggest values in the range of $.4 - .45$, but these applied to the elasticity of substitution between all market and nonmarket con-

sumption, while in the model studied here it only refers to the substitutability between the market and home service component. To the extent that many of the most easily substitutable components of consumption are services, it seems desirable to choose a slightly higher value of the elasticity, thus motivating the choice of $\eta = .5$.[9]

The parameter ε determines the amount of substitution between manufactured goods and services. This parameter determines how much labor will be reallocated between the industry and service sector in response to uneven changes in productivity growth. If ε approaches zero, preferences over I and $F(S, N)$ approach a Cobb-Douglas, and in this case there is no reallocation of labor in response to relative productivity changes. To get reallocation from a sector with higher productivity growth to one with lower productivity growth it is necessary for ε to be negative. As we describe in more detail below, we choose ε to be consistent with the amount of observed reallocation of labor given observed productivity changes.

Specifically, given values of η and ε we choose the remaining parameters as follows. The four preference parameters $\bar{A}$, a_C, a_I and a_S are chosen so that the model reproduces the 1956 time allocation for the US displayed previously,

[9] There are many market services that do not have good nonmarket produced substitutes (e.g., advanced medical procedures). As noted earlier, a richer model would incorporate heterogeneity within services to reflect this fact, but the above value is chosen to reflect that at the margin there is substantial opportunity for substitution between home and market produced services.

including the target of $h_N = .25$. We then choose the four productivity values for the US in 2000 to match the observed time allocations for the US in the three market activities. As noted earlier, this will uniquely determine the value of A_A in 2000 and will only determine the profile (A_I, A_S, A_N) up to a scale factor. We choose this scale factor so that aggregate growth in output per hour measured in base period prices is 2% per year.

This procedure implies values for sector specific growth rates in labor productivity. Different choices of ε will induce different patterns of relative productivity growth across industry and market services, given that we are choosing productivities to be consistent with the observed amount of labor reallocation. We choose the value of ε so that labor productivity growth in industry is 2.5% per year. This implies a value of $\varepsilon = -1.5$. This value is intermediate to the values considered by Ngai and Pissarides (2004) in their analysis of structural change. The chosen ratio of labor productivity growth in industry relative to the aggregate economy was chosen to be consistent with the implied ratios in the Groninger Growth and Development Center 10-Sector Database, and in the OECD Historical Statistics for the period 1960-1997.

With this procedure the time devoted to nonmarket work in 2000 is viewed as a free parameter. The implied value for time spent in nonmarket services is .2012

Table xx shows the parameter values implied by the above procedure. Rather than report the levels of the technology parameters in 2000 I have reported the implied annual growth rates (in percent), denoted by γ_i for sector i.

Table

Calibrated Values for the US Economy

ε	η	γ_A	γ_I	γ_S	γ_N	a_C	a_I	a_S	$\bar{A}$
-1.5	.5	3.1	2.5	1.7	0.4	.64	.14	.58	.039

6. Application to Europe

Given the model calibrated to match the US experience we now use the model to interpret the European experience. We assume that preference parameters in Europe are the same as in the US, but that tax rates and productivities may differ. The objective of the exercise is three fold. First, given observed changes in taxes over time, we compute what productivity movements must have been in the context of our model to produce the observed changes in market hours in Europe. Second, having done this we can ask how important tax effects versus productivity effects are in accounting for the differences between Europe and the US. Lastly, we can carry out a welfare analysis of the relative importance of tax and productivity factors.

As noted earlier, we assume a tax rate of .45 in Europe in 1956 and .60 in 2000.The remainder of the exercise consists of picking values for the eight productivity parameters (four at each of the two dates) so as to match the (market) sectoral time allocations for Europe in 1956 and 2000. The productivity of agriculture in Europe at both dates is easily determined given the observations in Table xx, leaving six productivity parameters to be determined. However, as noted earlier, since the remaining hours are homogeneous of degree one in the (non-agricultural) productivity parameters, there are really only four free parameters plus two scale factors. The hours data can be used to determine the productivities up to scale factors, but then we need to use some additional information to determine the scale factors. We determine the scale factors by requiring that Europe has average labor productivity equal to .45 of the US in 1956 and equal to .95 of the US in 2000. We chose these values based on the data in the Penn World Tables regarding output per worker and adjusting for hours per worker using the data used earlier.

The results of this exercise are shown in the next Table..

Table

Relative Productivities in Europe

	1956	2000
Agriculture	.39	.97
Industry	.35	.98
Services	.61	.89
Home	.66	.93

As the table indicates, the exercise produces very large productivity differences in 1956 in all sectors, but particularly large in agriculture and industry. While these differences might seem large, we note that the figures reported in Cobet and Wilson (2002) imply that relative labor productivity in manufacturing was about .4 in Europe compared to the US in 1950. The above table also shows that there is substantial narrowing of productivity differences over this period. The relative productivities of market services and the home sector have remained roughly constant over time, but the single largest productivity difference in 2000 is in the service sector.

We now ask two counterfactuals about the European experience. First, if tax rates had remained unchanged at .45 over this period, what would the time allocation have been in 2000? The answer is shown in the next Table.

Table

Taxes and 2000 European Time Allocation

	$\tau = .60$	$\tau = .45$	$\tau = .40$
h_A	.105	.105	.105
h_I	.0714	.0872	.0912
h_S	.1509	.2251	.2471
h_N	.2864	.2257	.2082
h_M rel to US	.66	.91	.98

We find that Europe would have devoted more time to both the industry and market service sector and less time to the home sector. Instead of having market hours equal to .66 of the US value, Europe would have had market hours equal to .91 of the US value. We can also ask what the labor allocation would be in Europe if they were to adopt the US tax rate of .40. This is shown in the final column of the above table. As can be seen, in this scenario aggregate market labor would be equal to .98 of the US value. This 2% differential can be interpreted as the difference that is due solely to the non-tax factors in the model. While this differential represents a small piece of the overall difference between Europe and the US, we note that this estimate is of the same order of magnitude that some other studies have found for the effects of specific non-tax factors, such as

employment protection. (See e.g., Hopenhayn and Rogerson (1993) and Veracierto (2003).)

The previous calculation indicates that non-tax factors play a very small role in accounting for the differences in time allocations in 2000. Next we ask the same question about the 1956 time allocations. Specifically, we compute what the US time allocation would have been in 1956 if they had the same tax as Europe, i.e., a tax rate of .45 instead of a tax rate of .40. The answer is that this would have reduced market hours in the US by 7%, meaning that the ratio of Europe to the US would have been 1.18. It follows that the effect of non-tax factors in accounting for the 1956 differences are very substantial. In interpreting this statement one should keep in mind that productivity differences are much greater in 1956 than in 2000. However, it is also of interest to note that in 1956 the productivity differences lead to greater market work in Europe whereas in 2000 they lead to less market work. A key component of this difference is the relative disparity in agricultural productivity.

We can also use our model to compute welfare effects associated with tax and productivity differences. Specifically, we compute the compensating variation in terms of the consumption bundle (I, S, N) that is required to make Europeans equally well off as their American counterparts in 2000. We find that Europeans

would need an additional 26.9% of consumption in order to be as well off as Americans. We also decompose this between a productivity effect and a tax effect. If Europeans were to adopt the American tax rate of .40 but keep their 2000 productivity profile, they would still be worse off than American's but the compensating variation would be reduced to 9.4%. It follows that roughly 1/3 of the welfare differences are due to productivity differences. Note the very different role of taxes and productivity effects in terms of accounting for hours differences versus accounting for welfare differences. In the context of differences in hours of market work, tax effects accounted for more than 90% of the differences, whereas in the case of welfare effects this is reduced to roughly 2/3.

7. Conclusion

This paper makes three key points. First, it argues that much of the literature on the European labor market problem has misdiagnosed the problem by focusing on relative unemployment rather than relative employment levels. Specifically, the European labor market problem seems to date back to the mid 1950's. Second, the key to the understanding the source of the European labor market problem is to understand why Europe has not developed a market service sector more similar to that of the US as it has closed the gap with the US in terms of output per hour.

Third, it shows that a story in which productivity differences and/or taxes are central can potentially go a long way to accounting for the relative deterioration of European labor market outcomes. To be sure, the model analyzed here is very simple and it will be important to see the extent to which the quantitative conclusions are affected by adding various features.

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