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Wage Inequality and Unemployment: United States vs. Europe

1. *Introduction*

Two important labor-market developments of the last two decades have attracted much attention in recent literature: increasing and persistent unemployment in Europe, and widening wage differentials across U.S. workers. The marked increase of U.S. inequality is particularly striking if compared with the much lower and decreasing wage dispersion of continental European labor markets. A transatlantic comparison also reveals significant differences with respect to unemployment, which in Europe not only is higher than in the United States, but also appears more persistent across regions and has larger long-term and youth components.

This paper documents such facts, reviews the relevant literature, and proposes a unifying perspective on these and other pieces of evidence. We organize our discussion around a characterization of labor-market institutions' effects on labor mobility and wage determination under uncertainty. In a relatively "flexible" dynamic equilibrium, as in Lucas and Prescott (1974) and Topel (1986), wage differentials across standardized units of labor are consistent with equilibrium at a point in time if mobility is costly for workers. Such dynamic interactions may help interpret the portion of wage inequality which remains unexplained by static models of wage determination in the United States, where workers do move across firms, occupations, and regions in response to productivity

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and demand shocks. In Europe, conversely, institutional rigidities reduce wage dispersion and employment fluctuations: hence, mobility offers limited gains to individual workers and occurs at a much lower speed. Productivity and demand fluctuations have more important effects on firms' profits if they cannot induce employment and wage changes and, as in the models of Bentolila and Bertola (1990) and Bertola (1990), expectations of future downturns induce employers to exercise caution when hiring in upturns. Job-security restrictions and wage compression reduce or eliminate frictional unemployment, but generate persistent or even permanent unemployment if wages are set above the full-employment level in the aggregate and in each of different regions or other labor-market segments.

We analyze such standard models' comparative-dynamics properties in the face of increased idiosyncratic uncertainty. In flexible labor markets where mobility costs are paid by workers, the differentials needed to trigger labor reallocation are larger in a more volatile environment: more frequent shocks to labor's relative productivity in different sectors, regions, or occupations lead to wider cross-sectional wage inequality and to more labor-income variability at the individual level. In labor markets where wages and labor flows are constrained by institutional rigidities, conversely, the model suggests that a similar increase in idiosyncratic volatility should be associated with higher aggregate unemployment at given wages, as hiring employers attach more weight to less heavily discounted negative shocks. These results match the evidence well, suggesting that increased volatility of labor demand may be a common cause of increasing wage dispersion in the United States and higher unemployment in Europe.

We are certainly not the first to try and provide a coherent explanation for the set of facts that motivates our analysis. Section 2 collects some relevant empirical evidence and reviews previous approaches to its explanation. Wood (1994) argues that the earning power of less-skilled workers in developed countries was hurt by trade linkages with developing countries, which reduced low-skill wages in the United States and pushed low-skill labor jobs in Europe. Krugman (1994) similarly focuses on relative demand shifts for workers with different skills: while in the United States technological change has been absorbed by larger wage inequality, in Europe the preference for lower wage dispersion has priced out of the market a large number of workers, thereby increasing unemployment. Both technology and trade can certainly explain the increase in U.S. wage inequality between skill levels, but it is harder for such theoretical perspectives to interpret the equally sharp increase in wage dispersion across observationally equivalent workers. As to European unemployment, it may or may not have hit unskilled workers harder than their skilled cohorts, but it certainly featured substantial and persistent heterogeneity across regions and age groups.

Section 3 considers a simple model of labor allocation under idiosyncratic uncertainty, and solves it under two polar sets of assumptions: in "flexible" markets, workers take mobility decisions and wage differentials insure that efficient labor reallocation does take place in equilibrium; in "rigid" markets, the wage is centrally set (hence independent of idiosyncratic conditions), and labor shedding is difficult—or, for simplicity, impossible—for employers. We then return to the evidence. In Section 4.1 we argue that various stylized facts may, at least qualitatively, be interpreted in light of American and European labor markets' "flexibility" or "rigidity." Section 4.2 brings the comparative-dynamics theoretical implications of higher idiosyncratic uncertainty to bear on labor-market developments of the last two decades. Section 5 concludes, outlining directions for further research and offering some speculation on the deeper determinants of different institutional structures across the Atlantic.

2. *Some Comparative Facts*

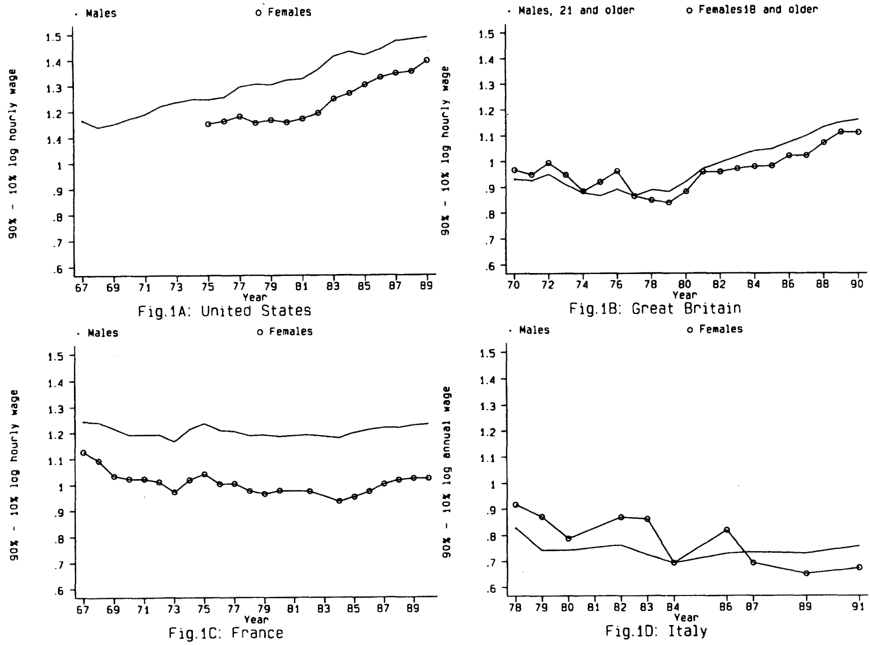
2.1 WAGE INEQUALITY

Increasing U.S. wage inequality during the 1970s and 1980s is extensively documented in the literature (see Levy and Murnane, 1992). Evidence on European wage dispersion, while not as plentiful, indicates patterns of decreasing (or nonincreasing) inequality instead.[1]

The four panels of Figure 1 plot log differentials between the 90th and the 10th percentile of wage distributions. The data are from Katz, Loveman, and Blanchflower (1995) and Erickson and Ichino (1995a), and we display them to the same scale for the United States, Great Britain, France, and Italy. In most years when comparable data are available, wage differentials are smallest in Italy and largest in the United States: only Britain's inequality is as low as Italy's, and only in the 1970s; only France's wage differentials are as high as the American ones, and only in the 1960s. In the United States, the 90%–10% wage differential increases over the entire period for both males and females, and a similar pattern is observed in Great Britain during the 1980s. Conversely, wage differen-

1. Davis (1992) also presents comparative international evidence on wage inequality trends and contrasts increasing dispersion within advanced economies to wage compression in some developing countries (the latter fact is questioned by Feenstra and Hanson, 1994). We focus on the less dramatic, but still quite pronounced differences between wage inequality trends in the United States and Europe.

Figure 1 OVERALL WAGE INEQUALITY



Notes: Log differences between the 90th and 10th percentile of the following data: United States: hourly wages (annual earnings divided by product of weeks worked and usual weekly hours) of 18–64-year-old full-time workers from March CPS. United Kingdom: Gross hourly earnings for full-time workers from New Earnings Survey. France: Gross annual earnings adjusted for hours differences for full-time, full-year workers from Declaration Annual de Salaires. Italy: Annual wage and salary earnings for full-time, full-year, nonagricultural, non-self-employed workers, 18 to 65 years old.

tials are stable or moderately decreasing in France, in Italy, and in pre-1980 Great Britain.

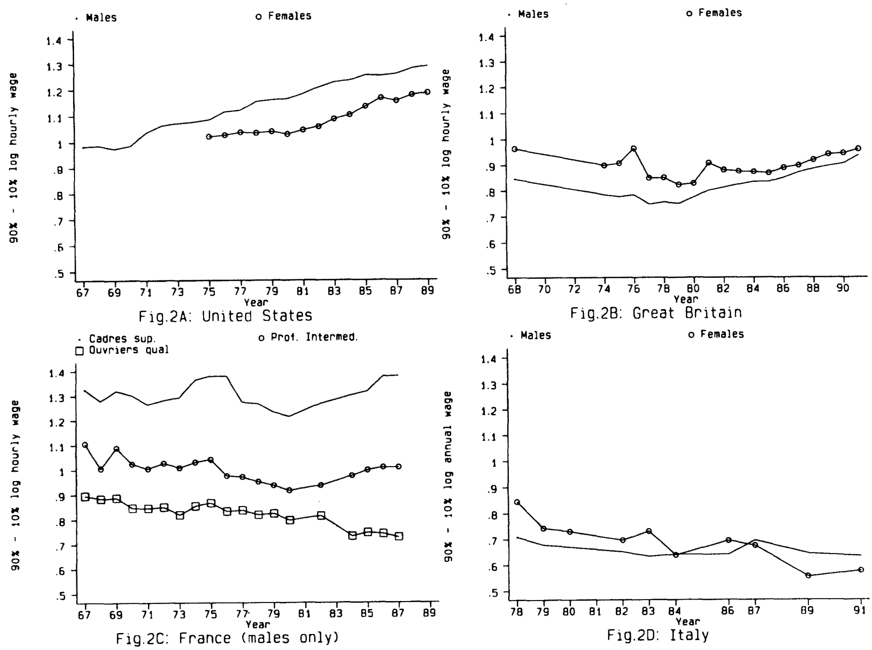
To some extent, the overall distribution of wages and its dynamic evolution may be explained by the changing structure of labor supply and demand across skill levels. The theoretical perspective of Murphy and Welch (1991), Krugman (1994), Wood (1994), and many other recent contributions suggests that when technological progress generates a higher relative demand for skilled labor, competitive markets increase wage differentials across skill levels in the United States, while in Europe compressed and rigid wage differentials cause higher unemployment among unskilled workers. Increasing openness to trade with developing countries, where cheap unskilled labor abounds, similarly threatens the wages (or the employment opportunities) of unskilled workers in advanced economies: competition from LDCs decreases low-skill wages in full-employment equilibrium, and prices the unskilled out of work if their wages fail to respond.

Even when jointly considered, however, technology- or trade-based demand–supply mechanisms may not account for the whole evidence. Technology and trade are certainly largely responsible for the increasing inequality *between* skill levels in the United States, where demand for high-skill workers was met by a strongly increasing supply of college-educated workers in the 1960s and 1970s, but not in the 1980s (Katz and Murphy, 1992). However, similar patterns of wage dispersion are observed *within* groups of workers with the same measured attributes. Figure 2 plots the time series behavior of the 90%–10% differential of the residuals obtained from regressing wages on experience, education, and other observable characteristics. The qualitative character of this evidence is the same as in Figure 1. Residual wage differentials are stable in France and actually decrease in Italy, where wages are extremely homogeneous within worker-characteristic cells.[2] But unexplained inequality increases very strongly in the United States (throughout the period) and in Britain (in the 1980s). This is more difficult, but certainly not impossible, to interpret from the vantage point of standard demand-and-supply mechanisms. The very similarity of Figures 1 and 2 makes it clear that the few observable worker characteristics have low explanatory power throughout the period considered and for all countries. If the market value of unobservable skill components changes in parallel with that of readily measurable worker characteristics, then, as argued by Juhn, Murphy, and Pierce (1993), common factors such as skill-biased progress or trade may explain the similar dynamics of "within" and "between" wage inequality.

Reliance on unobservable factors makes it difficult to evaluate the relevance of structural imbalances, however, and leaves unexplained the different dynamic behavior of skill premia across observed and unobserved components: the former fall in the 1970s, while the latter increase throughout the post-1970 period in Juhn, Murphy, and Pierce's empirical results. The causes of the increasing within-group U.S. wage dispersion may become easier to identify on analyzing it jointly with the similarly puzzling within-group wage compression that characterizes European

2. Erickson and Ichino (1995b) use wage data from the 1985 ENI survey of Italian firms to compute empirical measures of wage dispersion within detailed occupational categories. In the 47 categories for which comparable data are available in the 1985 U.S. Current Population Survey, the standard deviation of log wages averages to 13% in the Italian sample, to 37% in the whole U.S. sample, and to a still very high 30% in the unionized portion of the U.S. sample.

Figure 2 WITHIN-GROUP WAGE INEQUALITY



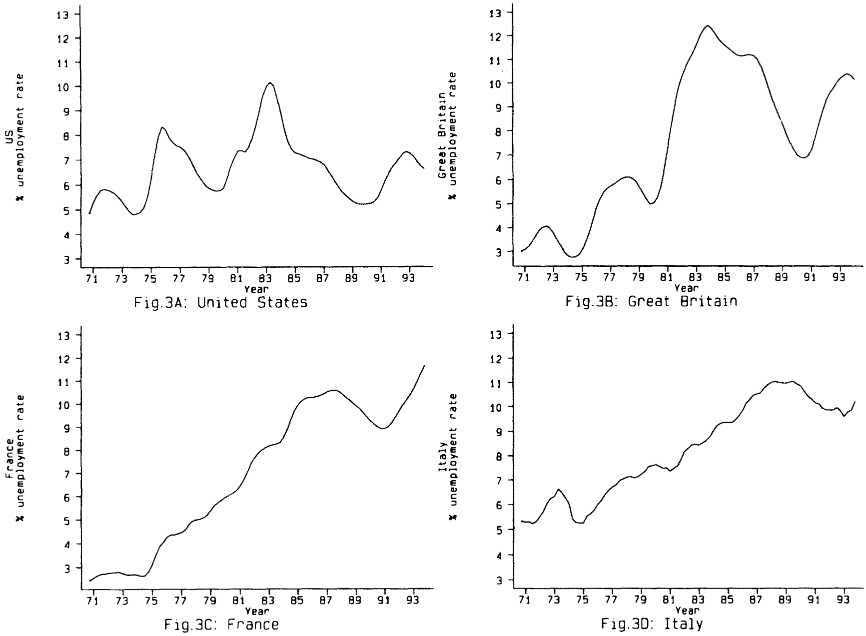
Notes: Log differences between the 90th and 10th percentile of the following: United States: Residuals from cross-section regression for full-time workers, by sex and year, of log hourly earnings on 10 schooling dummies, a quartic in experience, interactions of all the experience terms with broad education-level dummies, and a metropolitan-area dummy. Sources: see Katz, Loveman, and Blanchflower (1995). United Kingdom: Residual from separate cross-section regression for full-time workers, by sex and year, of gross hourly earnings on age dummies and a manual-worker dummy. Sources: see Katz, Loveman, and Blanchflower (1995). France: Dispersion of wages within occupation, controlling for eight age groups. Sources: see Katz, Loveman, and Blanchflower (1995). Italy: Residuals of separate cross-section regressions, by years and sex, of annual wage and salary earnings for full-time, full-year, nonagricultural workers, on experience, experience squared, five education dummies, and five age dummies. Sources: see Erickson and Ichino (1995a).

economies and by considering the comparative evidence on regional unemployment rates in the next subsection.

2.2 PERSISTENCE OF REGIONAL UNEMPLOYMENT RATES

If the comparison between Europe and the United States were limited to trends in wage inequality, one might think that what caused increasing

Figure 3 STANDARDIZED UNEMPLOYMENT RATES
Source: OECD.



U.S. dispersion spared the old continent. But we see in Figure 3 that, while in the 1970s all countries display similar patterns of increasing unemployment, in the 1980s France's and Italy's stable wage differentials are accompanied by persistently high unemployment, while in the United States and Great Britain the counterpart of trending wage differentials in the last 15 years is a trendless and widely fluctuating unemployment rate.

This evidence suggests that whatever caused wage dispersion in the United States did hit continental Europe too but, for institutional reasons, affected employment rather than wages. As argued by Krugman (1994) and Wood (1994), minimum-wage regulations and other wage rigidities may have prevented European labor markets from reacting to skill-biased technological progress and to increased exposure to LDC imports by reducing low-end wages. In this view, aggregate shocks are accommodated in the United States by lower real wages and in Europe by higher unemployment; at a more disaggregated level, structural shocks which lead to wider wage differentials in the American labor market cause more dispersion of European unemployment rates (Burda and Mertens, 1994).

The evidence on disaggregated European unemployment rates, however, is not conclusively supportive of a structural view of labor-market inequality. If compressed wage differentials and rigid low-end wages clashed with reduced demand for low-skill labor, then the unemployment experience of low-skill European workers should have been much worse than that of their high-skill contemporaries. But while the structure of unemployment is markedly different across the Atlantic with regard to the incidence of long-term and youth unemployment, which are much more important in Europe than in the United States,[3] the unemployment experience has been roughly similar across different skill groups (Blanchard, 1995; Nickell and Bell, 1994). In Europe, low-skill unemployment increased by more percentage points than high-skill unemployment, but it was also much higher to start with—and is proportionally higher in the United States as well.

Comparative evidence on the persistence of regional unemployment rates offers further insights into the structural features of U.S. and European labor markets. Blanchard and Katz (1992) find that relative unemployment rates increase in American states hit by negative shocks, and that this triggers a dynamic process of wage and participation rate reduction, outmigration, and gradual return to the initial unemployment rate. While disaggregated wage data are not available for European regions, strongly centralized wage setting does not allow relative wages to vary as much in Europe as in the United States (Burda and Mertens, 1994). Decressin and Fatàs (1994) use employment, unemployment, and labor participation data to replicate some of Blanchard and Katz's estimates on data from various European countries. They find that, while (heterogeneous) regional unemployment rates do appear mean-reverting in time series, the long-run response of employment shares to regional shocks is much stronger in the United States than in Europe, where labor-force participation (rather than migration) plays the most important role in the medium-run adjustment process. Jimeno and Bentolila (1995) also find that region-specific shocks have persistent employment effects in Spain, where available regional wage data indicate that wages do *not* strongly respond to local unemployment rates.

We report simpler and slightly different statistics on the geographic structure of unemployment in Europe and the United States, with an eye

3. The long-term (one year or more) component of U.S. unemployment was 4.2% in 1979, 9.5% in 1985, and 5.6% in 1990; in Italy, over the same period, the incidence of long-term unemployment rose from 51.2% to 71.1% (see *OECD Employment Outlook*, 1993, p. 87, for these and other data). Unemployed teenagers are about three times more numerous than their adult counterparts in the U.S., and up to 9 times in Italy (see *OECD Employment Outlook*, 1994, p. 22, for these and other data).

Table 1 MEAN REGRESSION OF REGIONAL UNEMPLOYMENT RATES

Country	After 2 Years	After 5 Years	After 7 Years
U.S.	−.21	−.49	−.60
	(.07)	(.11)	(.10)
Great Britain	.00	−.01	−.12
	(.03)	(.04)	(.05)
France	.13	.04	−.01
	(.05)	(.06)	(.07)
Italy	.03	.36	.68
	(.07)	(.08)	(.12)

Note: The table reports the point estimate and standard error (in parentheses) of β from cross-sectional regressions in the form $\Delta u_t^i = \alpha + \beta u_0^i + \epsilon$, run separately for each country and period: i denotes a region, u_0^i is regional unemployment in 1982 (for the United States) and 1983 (for the other countries), and Δu_t^i is the variation of the unemployment rate over the following t years. The constant (not shown) absorbs the effects of aggregate unemployment changes. Regional units: 50 states for the U.S., and provinces at the NUTS 3 level of disaggregation of the REGIO Eurostat Databank (62 for Great Britain; 96 for France; 95 for Italy).

to showing that what Blanchard and Katz call a "moderately rapid return to the mean" for the United States is indeed quite fast in comparison with the evidence for Great Britain, France, and Italy. We regress regional unemployment-rate changes on their initial values, for periods of different length during the 1980s. We have experimented with various specifications of this regression on available regional unemployment data for U.S. states and for regions defined at the NUTS 3 level of disaggregation from the Eurostat Databank REGIO. Regardless of whether unemployment enters the regression in logs or in levels, and of the starting year, we find that regression to the aggregate mean is much faster in the United States than in European countries.

We report one example in Table 1. The starting year is 1983 (1982 for the U.S.), and unemployment is measured in levels; the intercept, which is allowed to differ across countries, absorbs the effects of aggregate unemployment changes and is not reported. In the United States, the cross-sectional coefficient of the states' initial unemployment rate becomes more negative (and significant) when the length of the spell increases. In agreement with Blanchard and Katz's findings, regional unemployment rates are not persistent, and their reversion towards the aggregate mean is stronger over longer intervals.[4] Great Britain offers a

4. Blanchard and Katz's specification constrains dynamic adjustment to be the same for different years, and allows for region-specific intercepts, or "permanent" differences in regional unemployment rates. The dispersion of such intercepts and the speed of mean reversion jointly determine the size of the coefficient reported in the table, which indexes the extent to which unemployment rates tend towards a *common* mean over the period considered.

different picture: mean regression becomes significant only over the longer spell of 7 years, and even then the estimate implies a much higher persistence than in the United States; in France, there is no sign of statistically significant mean regression even after 7 years; in Italy, the coefficient of lagged regional unemployment is significantly *positive* and increases with the length of the time spell—indicating that regional unemployment rates diverged from each other over the sample period. Taken at face value, this regression evidence indicates that regional fixed effects are relatively unimportant in the United States: the states do tend all to return to the same mean, and fairly quickly. In Europe, quite the opposite seems to happen: regional unemployment rates at best regress very slowly to the mean, or even diverge widely as in the case of Italy.

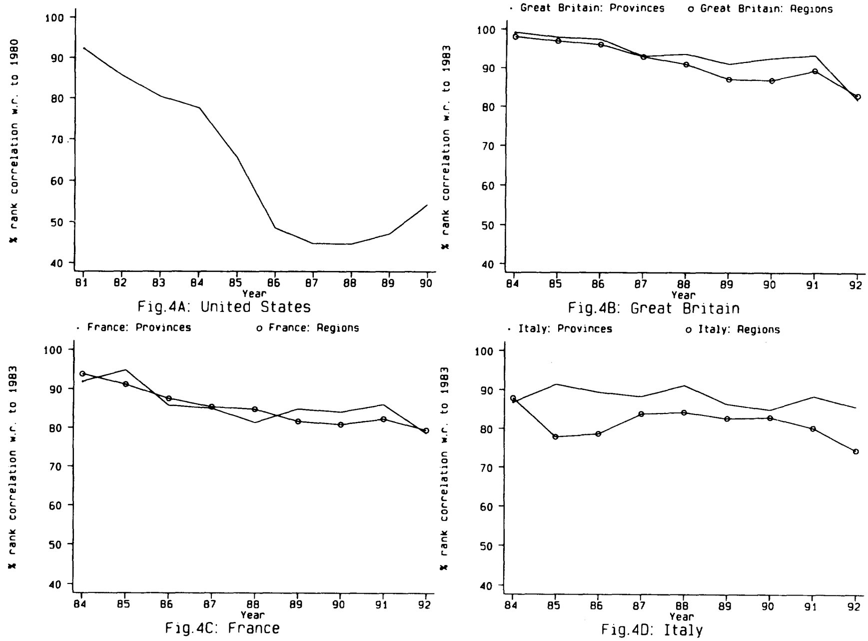
Such regression results may or may not indicate that regional unemployment rates are continuously reshuffled over time, as negative coefficients in Table 1 would be consistent with unemployment converging to similar values from initial unexplained heterogeneity. For the same four countries, we have computed the rank correlation coefficients between regional unemployment rates in a given year and in the years that follow. Figure 4 is based on 1980 as the initial year for the United States and on 1983 for Great Britain, France, and Italy.[5] In Europe, even after 10 years, the rank correlation coefficient is high and stable. In the United States, the rank correlation is comparable to its European counterparts after one year, but drops quickly to almost half the initial value when longer periods are considered.

2.3 THE PIECES OF THE PUZZLE

This section has drawn attention to two sets of facts. Wages of workers with similar observable characteristics are highly and increasingly *dispersed* in the United States, highly and increasingly *compressed* in Europe. The size and ranking of regional unemployment rates are both strongly persistent in Europe, while in the United States unemployment rates are reshuffled quite rapidly. When jointly considered, these labor-market facts suggest that within-group wage inequality may be the driving force of labor reallocation in the United States, while the absence of wage dispersion limits the extent of labor reallocation in Europe. This simple observation sets the stage for our formal analysis in the next section. Leaving in the background the relatively familiar implications of aggre-

5. Within the time period for which data are available (1970–1990 for the U.S. and 1983–1992 for Europe) the substance of the results does not change across initial years. This figure is the least favorable to our case. For most of the other initial years on which we have experimented the U.S. rank correlation coefficient decreases even more strongly and often reaches zero, while European data always display strong and positive persistence.

Figure 4 PERSISTENCE OF REGIONAL UNEMPLOYMENT RANKING



Notes: United States: Rank correlations with 1980 values of 50 state unemployment rates. Source: see Blanchard and Katz (1992). Other countries: Rank correlations with 1983 values of regional unemployment data at the NUTS 2 (34 regions for Great Britain, 21 for France, 20 for Italy) and NUTS 3 (see Table 1) levels of aggregation. Source: REGIO Databank, Eurostat.

gate events, we focus on the idiosyncratic and dynamic dimensions of available evidence.

3. *Flexible vs. Rigid Labor Markets*

We proceed to specify a simple dynamic model of idiosyncratic uncertainty and to derive its solution under different labor-market institutions, meant to represent in a stylized way the U.S. process of wage and employment adjustment in contrast to the labor demand and wage rigidities which characterize European markets. The demand side of the labor market is populated by a continuum of production sites, indexed by $i \in [0, 1]$, which may represent different industries, or different geographical locations, or different occupations within a single productive structure: in what follows, we shall refer to them as "firms" for brevity. Individual firms are distinct from each other because of heterogeneous labor productivity and, crucially, because labor mobility across them is costly. We let the marginal revenue product of labor at firm i and time t be a decreasing function $\pi_t^i(\cdot)$ of l_t^i, the number (or measure) of workers employed. For purposes of illustration, we will work with a linear functional form with constant slope:[6]

$$\pi_t^i(l_t^i) = \alpha_t^i - \beta l_t^i. \tag{1}$$

To introduce (potential) labor mobility in the simplest possible way, we let the productivity index α follow a two-state Markov chain. If α_t^i equals α^G (for "good"), firm i continues to enjoy good productivity with probability $1 - p$, but with probability p it experiences a negative shock and $\alpha_{t+1}^i = \alpha^B < \alpha^G$. To simplify notation, let the opposite transition have the same probability, so that the "bad" state where $\alpha_t^i = \alpha^B$ also persists with probability $1 - p$.

The symmetric transition probabilities of firm-level productivity

$$\alpha_{t+1}^i = \begin{cases} \alpha^G \text{ with prob. } p \text{ if } \alpha_t^i = \alpha^B, \text{ with prob. } 1 - p \text{ if } \alpha_t^i = \alpha^G, \\ \alpha^B \text{ with prob. } 1 - p \text{ if } \alpha_t^i = \alpha^B, \text{ with prob. } p \text{ if } \alpha_t^i = \alpha^G \end{cases} \tag{2}$$

imply that the ergodic or long-run probability is 50% that a given firm is in either state. We shall study the cross-sectional characteristics of a steady state where $\alpha_t^i = \alpha^G$ for half of the fixed measure of existing firms, while $\alpha_t^i = \alpha^B$ for the others. Again for simplicity, and consistently with our focus on cross-sectional issues within the labor market rather than on aggregate aspects, we take the aggregate labor supply to be fixed and homogeneous: L units of standardized labor input are available for employment by the firms in question. We refer to such units as "workers" for brevity, but we emphasize at the outset that they need not correspond to real (nonstandardized) individuals, whose productivity and labor income would depend on their education, strength, health, and other observable or unobservable indicators of ability. All such heterogeneity across individuals is, by assumption, absent from our model, which concentrates on how wage dynamics and wage dispersion may originate from heterogeneity on the demand rather than on the supply side of the labor market.

To understand how productivity dynamics translate into wage differentials, it is useful to briefly review a familiar case where they do not. If

6. This choice of functional form entails some loss of generality, of course, but recommends itself for its tractability and because a linear marginal revenue product schedule is neutral with respect to the average-employment issues studied by, e.g., Bertola (1990).

labor can be freely allocated to the highest bidder among potential employers, and competitive labor demand equates wages to marginal productivity, then employers' heterogeneity does *not*, in equilibrium, imply heterogeneous wages for identical workers. Labor must be allocated at time t so that $\pi_t^{i\prime}(l_t^i) = w_t$ for all i, i.e., so as to equalize labor's marginal productivity in all active firms. In the linear case of equation (1), this condition is readily solved for the levels of employment as functions of the wage and the firm's productivity index α:

$$l_t^G = \frac{\alpha^G - w_t}{\beta}, \; l_t^B = \frac{\alpha^B - w_t}{\beta}. \tag{3}$$

In steady state, the unit measure of firms is evenly split across the two productivity states, and the market's full-employment condition reads $(l_t^G + l_t^B)/2 = L$. The market-clearing wage rate (and all labor units' marginal revenue product) is given by

$$\tilde{w} = \frac{1}{2}(\alpha^G + \alpha^B) - \beta L, \tag{4}$$

and labor is allocated across firms according to

$$\tilde{l}^G = L + \frac{1}{2}\frac{\alpha^G - \alpha_B}{\beta}, \quad \tilde{l}^B = L - \frac{1}{2}\frac{\alpha^G - \alpha^B}{\beta} \tag{5}$$

as long as the parameters are such that $\tilde{l}^B > 0$.

The labor allocation $(\tilde{l}^G, \tilde{l}^B)$ and the (single) wage rate that supports it are not at all influenced by the stochastic nature of firms' labor demand, as indexed by p. Productivity differences across firms lead to unbalanced labor allocation: to equalize the decreasing marginal productivity of all employment opportunities, more than the mean available labor L is allocated to good firms, less to bad firms. An allocation where all standardized units of labor are paid the same wage regardless of where they are employed, of course, maximizes the market's efficiency, or the total producers' surplus as measured by the area beneath the marginal revenue product schedules. All that matters for wage determination in this essentially static equilibrium is average productivity across firms and total labor supply, at a given point in time: both quantities are constant in our simple model, but time variation would be irrelevant to an equilibrium where neither firms nor workers ever need to take forward-looking decisions.

3.1 A FLEXIBLE LABOR MARKET WITH MOBILITY COSTS

Despite its essentially static nature, the perfect-flexibility equilibrium just discussed is supported by ongoing labor reallocation, since, by (2), the *identity* (if not the number) of good and bad firms changes over time. In every period, a proportion p of the firms experiences a productivity shock: $\frac{1}{2}p$ firms suffer a transition from high to low productivity, $\frac{1}{2}p$ firms enjoy the opposite transition, and $p(\bar{l}^G - \bar{l}^B)/2$ units of labor are relocated from formerly good to newly good firms.

The simple derivations above assumed such reallocation to be completely costless, so that worker mobility across firms could bid wage rates into complete equality. In a modern economy, by contrast, employment relationships entail highly specific human capital, and mobility across employers (occupations, geographic locations, etc.) is costly and time-consuming. Some but certainly not all such costs are financed by employers in reality: the portion of mobility and retraining costs that would qualify a worker for employment by any of a group of independently managed firms cannot be financed by one of them, as the others could free-ride on this investment. We proceed to study the equilibrium effects of worker-financed mobility costs, maintaining for simplicity the assumption that all market participants are wage takers.[7]

As will be apparent below, equilibrium wage rates do differ across currently "good" and currently "bad" firms in equilibrium. Let the productivity state of firms be revealed at the beginning of each period. Employees then choose whether to stay, earning w^B (w^G) if their employer is "bad" ("good"), or move to a different employer. If $p < \frac{1}{2}$, so that productivity states have positive persistence, the mobility option will only need to be considered by the employees of currently bad firms. These are faced with a choice between staying in the current job, which pays a low and likely stagnant wage, and moving to a firm that currently is (and is expected to remain) more highly productive.

We shall measure mobility costs in terms of the *difference* between the labor income of a stayer and that of a mover. If w^B denotes the equilibrium wage of a worker who chooses to remain in a "bad" firm, let $w^B - k$ denote the period income of a worker who prefers to try and seek a higher wage elsewhere: this expression, which might well be negative, could literally represent income w^b net of a search cost k if we picture

7. This is readily rationalized if two or more employers engage in Bertrand wage competition at each site. More complex models recognize that match-specific investments introduce elements of monopsony and/or monopoly in employment relationships, and replace wage-taking behavior by bilateral bargaining; see Mortensen and Pissarides (1994) and Bertola and Caballero (1994) for recent treatments and further references. This realistic refinement does not appear crucial to the issues we focus on.

such individuals as still employed in their old job while searching. It is quite convenient, however, to index mobility costs in such differential-income terms even if individuals are unemployed when searching, as we assume below.[8]

Mobility occurs in equilibrium if the costly investment of k in terms of current income is compensated by (the expectation of) higher labor income in the future. The forward-looking nature of this choice makes it necessary to specify the workers' dynamic opportunity set. We denote by $r \geq 0$ the opportunity cost of funds for all workers, and we suppose for simplicity that workers are risk-neutral.[9] Further, we suppose that each worker ceases to participate in the labor market (or quits for reasons unrelated to wages) with constant probability $\delta/(1 + \delta) \geq 0$, while an inflow of new workers of measure $L\delta/(1 + \delta)$ per period keeps the labor force constant at L.

If mobility does take place and both good and bad firms have positive employment levels in equilibrium, then the employees of a firm in bad business conditions must be indifferent between the two alternatives open to them: that of remaining employed in a bad firm, at the relatively low wage w^B, and that of paying the mobility cost k with an eye to improving their future labor-income outlook. Appendix A shows that the wage differential across good and bad jobs in our model satisfies

$$w^G - w^B \leq \left(\frac{(1 + r)(1 + \delta)}{1 - 2p} - 1 \right) k \equiv \xi, \tag{6}$$

with equality if labor mobility occurs in equilibrium.

Condition (6) is readily interpreted. Identical labor units can and do receive different pay at a point in time if $k > 0$, so that mobility is costly for workers. The sustainable wage differential is smallest when $p = 0$: if productivity differences across firms are permanent, then $w^G - w^B \approx (r + \delta)k$, the annuity value of the mobility cost. Less persistence of productivity differences increases the option value of *not* moving, and the equilibrium wage differential is larger the closer to ½ is the probability p that the firm towards which the worker moves turns bad immediately and the

8. Readers should be warned at this point that the k featured in our formulae may or may not have a structural interpretation if mobility costs realistically include the opportunity cost of time spent relocating and searching for a new job and, like wages, are endogenous in equilibrium.

9. Alternatively, workers could be risk-averse, but use insurance contracts to finance mobility costs and maintain a smooth consumption profile in the face of their employers' productivity shocks. Such contracts hardly exist in reality, of course: we briefly discuss the implications of workers' attitudes towards risk in the concluding section below.

reallocation cost is ex post wasted. If $p = ½$, wages are independently distributed over time at every firm: the present discounted value of future wages is then independent of current wages, no wage differential can be so large as to induce costly mobility choices, and (6) reduces to a nonbinding inequality (as is always the case if costly mobility is not attractive) with an infinite right-hand side.

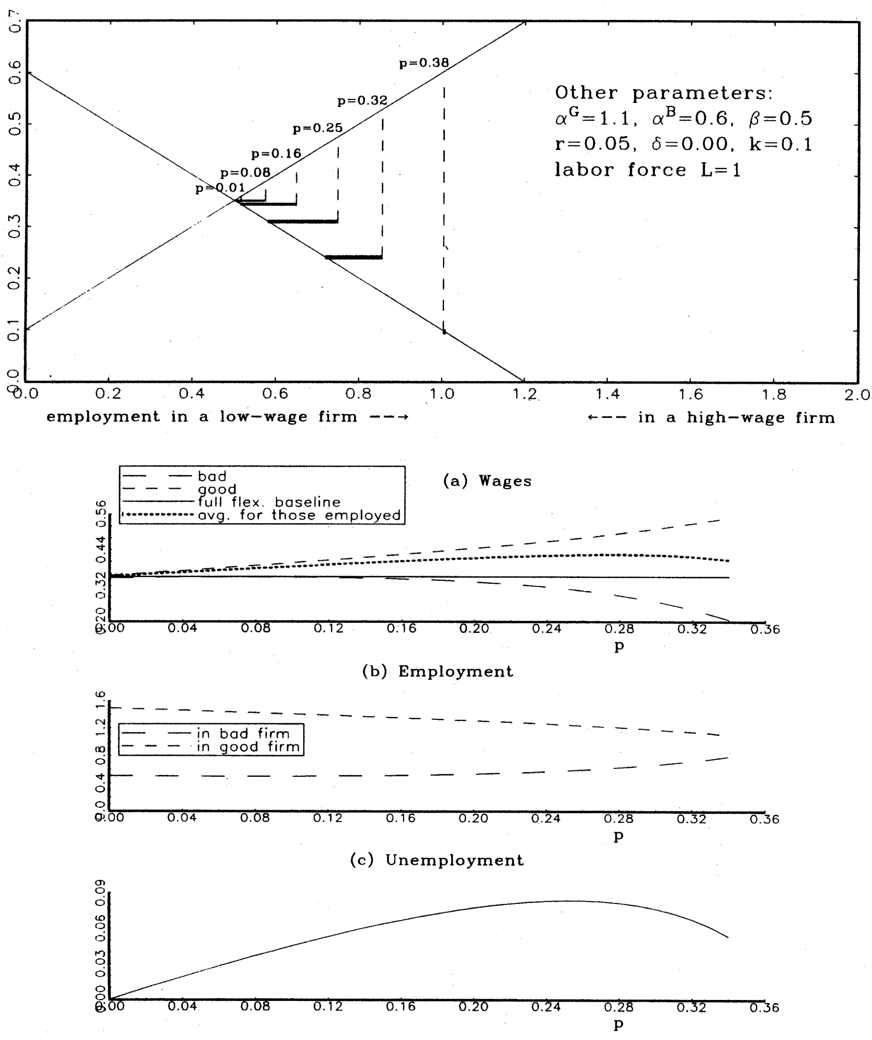
In the more interesting case where productivity is persistent ($p < ½$), workers compare the future (and discounted) expected benefits of mobility with its immediate cost k. If the model does feature equilibrium mobility, then (6) holds with equality, and good firms pay higher wages than bad ones. The equilibrium wage differential ξ, as defined in (6), depends on $k > 0$ and on dynamic parameters such as p, r, and δ, which were completely irrelevant in the full-flexibility $k = 0$ case. Symmetrically, it does not depend on any of the parameters which determine the full-flexibility wage in our simple model, not even on the absolute productivity differential $\alpha^G - \alpha^B$. In the class of models represented by the one we discuss, equilibrium wage differentials reflect the degree of dynamic instability, as indexed by p, rather than other determinants of static heterogeneity and idiosyncratic dynamics across employment opportunities.

The shape and position of the marginal-revenue functions $\pi_t^i(\cdot)$ only become relevant as we proceed to close the model. Since firms bear no turnover costs, $\pi_t^i(l_t^i)$ must be equal to the relevant market wage at every point in time, and labor demand must be consistent with (given) labor supply at the aggregate level. In this respect, it is useful to recognize explicitly that labor relocation is time- as well as resource-consuming: to capture the idea of "frictional unemployment" in the simplest possible way, we let all workers who choose to exercise the mobility option remain unemployed for the duration of one period. Then, the market-clearing condition equates the total employment, $½l^G + ½l^B$, to the difference between the labor force L and the measure $p(l^G - l^B)/2$ of frictional unemployment: in equilibrium,

$$(1 + p)l^G + (1 - p)l^B = 2L. \tag{7}$$

In the linear case, equilibrium wages and employment levels are readily obtained by inserting in (7) labor-demand expression similar to (3), and recognizing that wages paid by good and bad firms differ according to (6). The resulting expressions are reported in the Appendix, and the character of the solution is illustrated in Figure 5. The length of the top panel's horizontal axis equals $2L$, employment at a low-productivity firm is measured from left to right, employment at a high-productivity firm is measured from right to left, and the sloping lines plot the corre-

Figure 5 EQUILIBRIA OF A FLEXIBLE LABOR MARKET WITH COSTLY WORKER MOBILITY



sponding marginal-revenue product schedules. The perfect-flexibility equilibrium is found at their intersection: if mobility were costless ($k = 0$), there would be no unemployment, and all standardized units of labor would earn the same wage regardless of the frequency p of idiosyncratic productivity shocks. For the values of other parameters reported in the figure, about 20% of the labor force would be employed by low-productivity firms, about 80% by high-productivity firms.

The figure illustrates costly-mobility equilibria for a variety of p-values, taking $k = 0.1$ (about a third of the perfect-flexibility wage rate) in all cases.[10] In the top panel, the length of the vertical dashed lines represents ξ, the equilibrium wage differential: it follows from (6), and is apparent in Figure 5, that wage differentials unambiguously grow larger when larger and larger values of p are considered. Panel (a) of the figure plots against p the level of "good" and "bad" wages, as dashed lines, along with a continuous line representing the reference value $\tilde{w}$ of wages in the perfectly flexible baseline from equation (4). For the parameter values in the figure, the "bad" wage is always lower than $\tilde{w}$, and the "good" wage always higher.[11] It may also be interesting to note that the average wage earned by employed workers, displayed as a dotted line, is always higher than the reference level $\tilde{w}$ when mobility is costly and $p > 0$: if workers do need to relocate in equilibrium, unemployed workers not only contribute nothing to total production in a static sense, but also fail to bid down marginal productivity and wages at either their former or next employer's downward-sloping labor demands.

In the top panel of Figure 5, horizontal solid lines are drawn at the level of the market-clearing "bad" wage. The model's equilibrium condition requires that the marginal revenue product (and wage) of bad-firm employees be ξ units lower than its counterpart at good firms, and the reverse-L shapes formed by pairs of solid and dashed lines labeled by a p-value identify the corresponding steady-state equilibria: for larger values of p, the difference between l^G and l^B becomes smaller because, despite the increasing wage differentials, mobility becomes less attractive for workers.

Panel (b) of Figure 5 displays the employment levels of good and bad firms, and panel (c) the rate of unemployment in the market's equilibrium. A larger p decreases the difference between employment at good and bad firms and, as the overall productivity of labor is higher in the former than in the latter, reduces the total producer surplus (measured by

10. The mobility cost k was defined above as the difference between the labor income of a stayer and the labor income of an otherwise identical mover. We acknowledge in this footnote that mobility costs are not independent of equilibrium wages if, as we assume, they include forgone income from unemployment. If the model is taken literally, the difference between k and w^b represents out-of-pocket mobility costs (or subsidies, if negative). It might be desirable to keep these rather than k fixed as we vary p in the figure, but this would complicate the algebra without adding much to our stylized model.

11. This need not be the case in general: for small values of ξ, mobility costs may increase the equilibrium wage rate paid by "bad" firms.

the area below the marginal-revenue product schedules in the first panel) even before taking relocation costs into account. Panel (c) of Figure 5 plots the unemployment rate, which, conversely, is not a monotonic function of the "turbulence" index p. Unemployment is directly related to the equilibrium amount of mobility, as the unemployment rate at a point in time is given by the ratio of the measure of workers moving each period, $p(l^G - l^B)/2$, to the fixed measure L of the total labor force. A "Laffer curve" mechanism is at work: if the employment differential $l^G - l^B$ could be kept fixed, a higher p would certainly lead to more unemployment; but a higher p discourages mobility, and the model has ambiguous predictions as to the relationship between p and frictional unemployment.

3.2 A RIGID LABOR MARKET

We contrast the previous section's market model with the allocation implied by different institutional arrangements, meant to represent a caricature of "rigid" European labor markets: labor reallocation is hampered by centralized wage setting, which reduces or eliminates workers' incentives to bear mobility costs, and by job-security provisions, which reduce flows into and out of unemployment.

The technological structure of the market is identical to that assumed above: a continuum of production sites or "firms" employ units of homogeneous labor, whose marginal productivity is a decreasing (and stochastic) function of employment at each firm; we shall again use as a simple example the linear relationship (1) with stochastic intercept. We suppose, however, that the wage rate is exogenously set and, crucially, that it does not differ across firms. Further, we assume that employment relationships may not be dissolved because of changing business conditions: workers cannot be "fired," and employment at firm i varies only through labor attrition at rate δ and hiring.

For simplicity, we assume that no costs other than wage payments are borne by firms: hiring costs are zero, and firing costs are prohibitively large. We let employers be risk-neutral, still denoting their discount rate by r, and we may again allow for possible labor attrition at rate δ: only a fraction $1/(1+\delta)$ of the current employees remain with the firms across periods, while new entrants in the market keep the labor force constant. Given that no worker is ever fired, as long as worker-initiated turnover corresponds to flows into and out of the labor force, only new entrants in the market can ever be unemployed. We shall refer to this obvious implication of our and similar models of "job security" when returning to the data below, and contrast it with the potentially very different structure of unemployment in the costly-worker-mobility model above—where all the employees of a "bad" firm were indifferent to the mobility option in equilibrium, and little could be said as to (say) the age composition of those among them who did choose to move rather than accept a wage reduction.

A positive rate of labor attrition complicates derivation of labor-demand policies, however, and we prefer to discuss the relevant intuition on the role of p in a rigid labor market for the limit case of no labor attrition ($\delta = 0$). In a steady state, half the firms are "good," while the other half find themselves in bad business conditions and, having inherited a stable labor force from their own past hiring decisions, have no choice but to wait for better times. The allocation of employment is then strongly history-dependent, but we shall focus on a symmetric steady state where employment is the same $\bar{l}$ across all firms and for all time.

Appendix B shows that, under the linear specification of equation (1), optimal labor-demand policies by firms lead to

$$\begin{aligned} \bar{l} &= \frac{1}{\beta}\left[\left(1 - \frac{p}{2p + r}\right)\alpha^G + \left(\frac{p}{2p + r}\right)\alpha^B - w\right] \\ &= \frac{\alpha^G - w}{\beta} - \left(\frac{p}{2p + r}\right)\left(\frac{\alpha^G - \alpha^B}{\beta}\right). \end{aligned} \tag{8}$$

This expression is readily interpreted as the employment level chosen by a firm which, experiencing "good" business conditions, is at least potentially hiring at the margin—and knows labor will never leave it. The given wage is compared not with the current ("good") marginal revenue product of labor, but with a weighted average of that and of the lower marginal revenue product it will experience in bad business conditions (which arrive with probability p per period). For the linear specification of our example, we see in the first line of (8) that also the level of employment is a weighted average of the two levels that would be chosen if firing (as well as hiring) were allowed at the given wage. The weight given to the "good"-business-conditions indicator is increasing in the firm's discount rate r: clearly, in the limit $r \to \infty$ firms would behave myopically, and the ex post negative marginal value of employment in bad states would not discourage them from hiring in good times.

If the discount rate is zero, at the other extreme, employment at all firms is determined by a simple average of α^G and α^B. As the two productivity states have equal weights in the market's cross section as well as in each firm's (linear) labor-demand policy, the relationship between aggregate labor demand and the single wage w is the same as in the flexible market with no mobility costs that was analyzed at the beginning of this section. With linear marginal productivities, therefore, the same wage is consistent with full employment in a rigid model where $r = 0$ and in a hypothetical fully flexible model. If $r > 0$, conversely, current business conditions receive a larger weight than future (and discounted) developments: since only "good" firms are hiring, this induces an upward bias both in the average labor demand of an individual firm and in the aggregate labor demand of a large group of similar firms.[12]

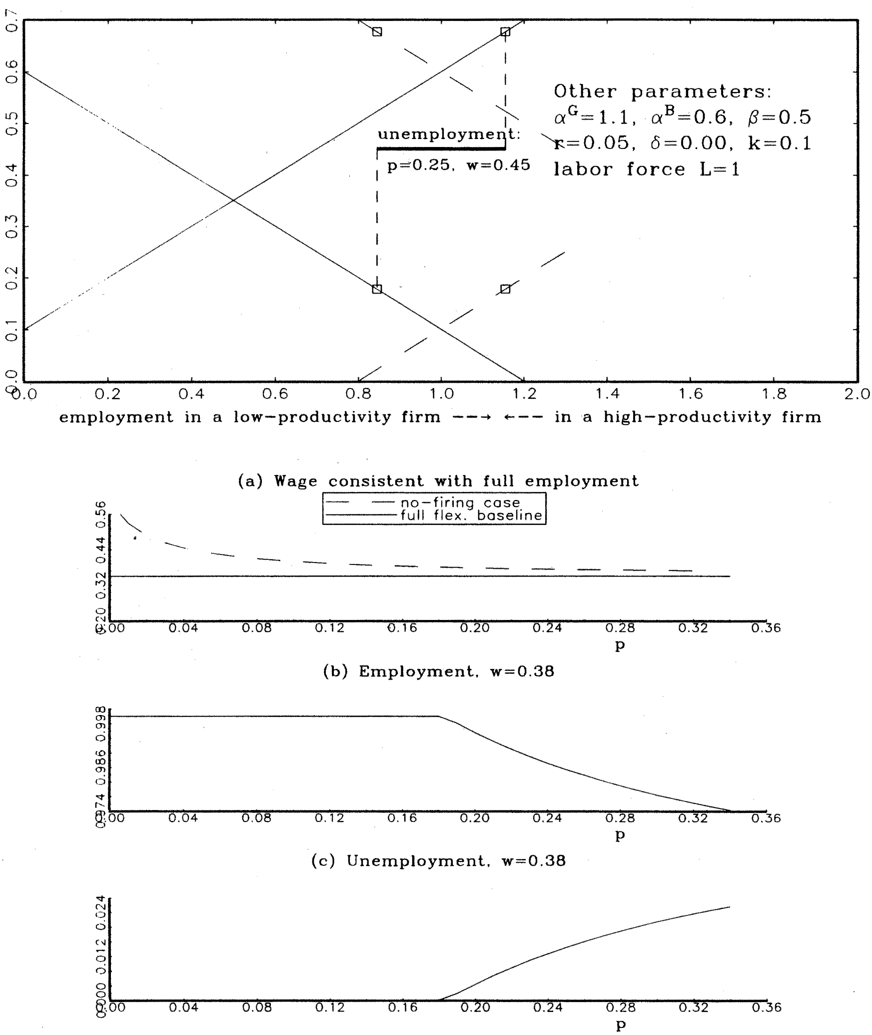
Figure 6 illustrates the character of the solution, for the same parameter values used in Figure 5. In the top panel, the solid lines again plot the marginal revenue product of a "bad" firm as a function of its employment (measured left to right), and of a "good" firm that employs the complement to full employment (measured right to left). Dashed lines plot the mirror images of these schedules: a currently "bad" firm knows that with probability p it may receive a positive shock, in which case the marginal revenue of its unchanged labor force would be evaluated along the downward-sloping dashed line; symmetrically, a currently "good" firm's marginal revenue schedule may drop from the upward-sloping solid line to the lower dashed line.

We know from (8) that the present discounted value of marginal productivity is a weighted average of the two relevant schedules for each firm, and that it should be equal to the wage if the currently good firm is not hiring: the solid horizontal line in the figure is drawn at an arbitrary wage level ($w = 0.45$), and its length measures the units of labor that remain unemployed, at that wage, if the probability of shocks equals an equally arbitrary $p = 0.25$. The wage is higher than labor's marginal revenue product at the bad firm (marked by a square on the downward-sloping solid line), but lower than its counterpart along the good firm's marginal revenue product (also marked by a square on the solid line representing a currently good firm's marginal revenue product schedule, and on the mirror-image dashed line representing the currently bad firm's notional labor demand upon realization of a positive shock).

The lower three panels of Figure 6 explore the implications of more pronounced instability for the rigid labor market. It is apparent in the top panel that, for any value of p, there exists a wage level low enough to insure full employment of the given labor force: panel (a) displays the full-employment wage level as a function of p, along with the reference

12. See Bertola (1990, 1994) for further discussion of such "discounting effects," and of the effects of nonlinear functional forms. For realistic parametrizations, the order of magnitude of the discounting effect is the same as that of Jensen-inequality biases due to nonlinear marginal revenue product schedules, which are of ambiguous sign and may be safely disregarded for quantitative purposes.

Figure 6 A RIGID LABOR MARKET WITH UNIFORM WAGES AND NO-FIRING CONSTRAINTS



wage $\tilde{w}$ which would clear the hypothetical perfectly flexible labor market discussed at the beginning of this section. Under linear labor demand, the two lines would coincide for $r = 0$: but $r = 0.05 > 0$ in the figure, and the discounting effect yields full employment at wage levels that are uniformly *higher* than the crossing point of the solid lines in the top panel. As p increases, negative productivity shocks are expected to occur sooner and are less heavily discounted by hiring firms, who will employ half of the labor force only at lower and lower wages.

Panel (b) displays the labor-demand effects of larger p-values, and panel (c) displays the complementary unemployment schedule, when the wage w is kept fixed at the level that would yield full employment for $p = 0.18$. As for all the other parameters of this extremely stylized model, it would be misleading to attach much meaning to the value of p: in the figure, we choose to illustrate the effects of higher uncertainty starting from full employment at $p = 0.18$, because Figure 5 (drawn for the same parameter values) tells us that p-values in that region would not have dramatic effects on unemployment in a flexible labor market. The unemployment rate of the rigid market, conversely, definitely rises with p in panel (c) of Figure 6: the next section will bring this finding to bear on the evidence.

3.2.1 On Wage Determination The derivations and figures above not only constrain the wage to be the same at all firms, but also take its absolute level as given. It is conceptually straightforward, however, to append a wage-setting mechanism to the disaggregated model outlined above (or to more complex variants with positive rates of labor attrition and/or realistic dynamics of productivity). Involuntary unemployment may persist in equilibrium without exerting pressure on wages if these are contracted by currently employed workers, as in the standard *insider–outsider* models (Lindbeck and Snower, 1988). Alternatively, firms may find it profitable not to lower wages if higher compensation levels enhance workers' productivity according to efficiency-wage theories (Katz, 1986). We have little new to say on wage-setting mechanisms, and in the rest of the paper we analyze empirical implications of our stylized description of rigid and flexible economies, taking it for granted that standard explanations of wage rigidity may be at work.

Some obvious interactions of institutional rigidities for wage determination are worth mentioning, however. In the presence of a contrast between insiders and outsiders, the wage of the former depends on the rents that a monopolistic union can extract from firms. Since firing costs prevent the substitution of the employed workers, their presence increases the bargaining power of the insiders and therefore the size of the rents that they can extract. Thus, the interaction between insider–outsider mechanisms and firing costs exacerbates the unemployment problems of a rigid economy in the presence of idiosyncratic uncertainty. Similar consequences obtain in the Shapiro–Stiglitz (1984) "shirking" model of efficiency-wage determination. The basic idea of this mechanism is that unemployment may represent a device to enforce workers' discipline. By raising wages and causing unemployment, firms increase workers' productivity because workers fear the risk of being "caught shirking" and sent back into the unemployment pool. If at least partially this mechanism is indeed at work in real rigid economies, it should be clear that the presence of firing regulations worsens the unemployment problem. If firing a worker is more difficult, wages in the primary sector have to be raised even more in order to increase the risk of joblessness. Other efficiency-wage arguments lead, however, to different conclusions. For example, higher wages may be granted to primary-sector workers as part of a "mutual exchange of gifts," in which workers' sense of "fairness" induces more effort on their part (Akerlof, 1984). Job security may decrease the efficiency-wage premium in this case, since the same "gift" offered by the employer may be constituted by different combinations of wage increases and protection from the risk of unemployment.

4. *Back to the Evidence*

The model of the previous section was kept as simple as possible, but it arguably does capture the economic mechanics of labor allocation and compensation under different labor-market institutions. Many features of the U.S. labor market's institutional structure appear more flexible, in the sense of our model, than their European counterparts. The relative flexibility of the U.S. labor market with respect to its European counterpart has been questioned by Allen and Freeman (1994), who point out some elements of greater rigidity, or perhaps just the lack of greater flexibility, in the recent evolution of the U.S. labor market. As to Europe, there are indications of increasing flexibility in several countries during the last decade, and in Britain since the early 1980s (see Bertola and Ichino, 1995). Yet, Europe and the United States still have a long way to go before the former becomes more flexible than the latter from an institutional point of view. In this section, we argue that the performance of U.S. and European labor markets can at least qualitatively be interpreted in light of our stylized model's twin solutions—which, of course, should not be taken literally: the rigid model, in particular, certainly offers an extreme and unrealistic picture of "rigidity," as even in Europe workers are difficult but not impossible to fire, quit with positive probability, and to some extent do move across occupations, sectors, and regions.

We first address empirical issues from a long-run perspective, focusing on the steady-state implications of the class of models we consider for mobility-cost-induced wage dispersion and for equilibrium (frictional, or long-run) employment. Then, we discuss how different labor-market institutions may explain the divergent reaction of U.S. and European labor markets to exogenous developments over the 1970s and 1980s.

4.1 INSTITUTIONS, MOBILITY, AND LABOR INCOMES

The model of Section 3 is quite vague as to what might be the real-life counterpart of its "firms." A geographic interpretation is certainly possible, however, and may throw some light on the institutional determinants of the wage-dispersion and regional-dynamics evidence reviewed in Section 2. The relative lack of workers' mobility across regions in Europe has been widely documented. At least during the 1970s and 1980s, labor appears scarcely mobile even within each European state, and certainly less mobile than across American states (see, e.g., *OECD Employment Outlook,* 1990, p. 85). Available migration data, in most cases, lump together workers and out-of-the-labor-force migrants, and evidence from such low-quality data should perhaps be discounted to some extent. Indirect evidence on patterns of regional labor-market adjustments after a shock affords similar conclusions, however: as is apparent from the simple indicators considered in Section 2.2 above, European regional unemployment rates regress much more slowly to a common mean (and fluctuate much less around each other) than their U.S. counterparts. More careful empirical analyses of migration, labor-force, and employment data suggest that European workers would rather exit from the labor force or remain unemployed than move geographically after a negative shock to local labor demand.[13]

Of course, one might want to explain regional labor immobility in Europe by exogenous tastes and technology: European workers might be inclined to stay where they are rather than face the relatively high mobility costs imposed by sharply differentiated local cultures and strong family ties. These features are certainly important, especially for understanding why labor mobility should be even lower across European national borders than across regions within them.[14] But mobility costs across regions of each European nation, however high, can hardly

13. See, for example, Pissarides and McMaster (1990) on Great Britain, Ichino (1994) on Italy, Jimeno and Bentolila (1995) on Spain, and Decressin and Fatàs (1994) for comparative evidence on various countries.

14. See Flanagan (1993) and Eichengreen (1993). Across the borders of European nations, in fact, purchasing-power-adjusted wage differentials are actually larger than across U.S. states (Erickson, 1993). Since there is as yet no institutional pressure towards nominal- or real-wage equalization across national borders within the European Union, such findings could be interpreted along the lines of the "flexible" model of Section 3.1 if the substantial cultural differences across European nationalities (a large k) are contrasted with the more homogeneous United States (where, at least, the same language is spoken everywhere).

explain the lack of mobility at the level of geographical disaggregation considered in Figure 4 (regional units at the NUTS 3 level of the REGIO databank have average population of less than a million, and their area is comparable to that of counties in the United States).

The model of Section 3 suggests a different point of view on European regional immobility. In the dynamic equilibrium of the flexible market, labor mobility from "bad" towards "good" firms (or regions) leads to relative-wage adjustments, up to the point where labor mobility costs are just consistent with wage differentials. In Europe, on the other hand, wage equalization is largely a result of centralized collective wage settlements aimed at reducing wage differentials across regions.[15] If wage equality is institutionally enforced, only different employment probabilities can provide incentives for individual workers to move across regions. In the "rigid" model of Section 3.2, wage compression is combined with perpetual job security—which reduces turnover to (at most) substitution of voluntarily retiring workers, and essentially wipes out incentives for worker mobility. Reality is certainly less extreme than our simple model would make it, but, to the extent that wages are similar across regions and hiring probabilities are uniformly low, European workers do not have strong incentives to move from a region hit by a negative shock to a more fortunate area, and low worker mobility induces high persistence of unemployment rates across European regions.

Little reliable wage information is available for Europe at the regional level, and lack of individual wage datasets makes it very difficult to control for worker characteristics in geographic comparisons.[16] Available U.S. data, however, conform well to a geographical interpretation of the alternative, "flexible" paradigm illustrated in Section 3—where regional wage differentials persist in equilibrium to trigger labor mobility between regions subject to idiosyncratic shocks. Like Blanchard and Katz's (1992) evidence on aggregate state-level wage dynamics (see Section 2.1), Topel's (1986) work on individual worker data finds that wages initially increase in areas which receive positive labor-demand shocks. This increase attracts migration flows to the region, and this process

15. In Italy, for example, removal of nominal wage differences ("gabbie salariali," or *wage cages*) was and still is an explicit goal of unions, and is enforced by law for most components of the compensation package. Cost-of-living adjustment clauses ("scala mobile") always specified identical nominal wage increases for all regions independently of local differences in inflation. French minimum-wage legislation has much the same effect, namely that of preventing job characteristics from being reflected in wages (and wage differentials).

16. Jimeno and Bentolila (1995), using national-income accounting data and urban price indices, do find that labor compensation does not vary across Spanish regions in response to unbalanced shocks.

continues until wage differentials are arbitraged away, i.e, they are too small to offset mobility costs. In fact, for more mobile workers (e.g., young workers), regional wage differentials are largely eliminated by migration inflows, while for less mobile workers (e.g., older workers) regional wage differentials are not fully arbitraged away, and tend to persist in equilibrium to compensate their higher mobility costs. Finally, for all workers, Topel (1986) finds that larger differentials trigger mobility if shocks are expected to be less persistent.

This evidence is consistent with the predictions of models in the class represented by the "flexible" paradigm of Section 3. We can also consider other, nongeographic implications of relative labor market "rigidity" or "flexibility" in U.S. and European evidence. Even within the same regional unit, of course, earnings inequality for observationally equivalent workers is much more pronounced in the United States than in Europe. From the flexible model's vantage point, this could at least partly reflect reallocation-cost-induced wage differentials across sectors, plants, or occupations, or cross-classifications according to these and other job (rather than worker) characteristics.

In a flexible market's dynamic equilibrium, in fact, point-in-time wage heterogeneity corresponds to time-series fluctuations of labor income for individual workers, who face wage and employment uncertainty as a result of "firm"-level dynamic developments. There is plentiful evidence that U.S. workers laid off by firms hit by negative shocks indeed suffer severe income losses and substantial periods of unemployment.[17] This is qualitatively consistent with the model of Section 3, where workers employed in highly productive firms suffer income losses if a negative shock to their employer's labor demand forces them to choose between remaining in the current job, at a *lower* wage, or incurring the mobility cost entailed by the transitions towards more productive firms. In equilibrium, both movers and stayers earn lower labor income. Symmetrically, the employees of "bad" firms earn *higher* wages, without bearing mobility costs, if their employer receives a positive labor-demand shock and hence pays higher wages both to his existing employees and to the new ones he attracts.

Empirical work on U.S. individual wage data does not usually try to assess the extent to which point-in-time wage dispersion reflects high volatility of individual labor-income profiles. But the evidence of Gottschalk and Moffitt (1994) indicates that a third to a half of historical U.S. wage inequality (and of its recent increase, which we discuss below) reflects longitudinal instability of workers' labor income, whether at un-

17. See, for example, Jacobson, LaLonde, and Sullivan (1993) and Farber (1993).

changed jobs or upon job changes, rather than (or as well as) different mean earnings for workers with different unobservable characteristics. These empirical estimates imply that our modeling perspective may indeed be relevant for a large portion of U.S. wage inequality. Unfortunately, no European longitudinal data sets are suitable for comparative empirical work on such issues. Other well-known and readily available evidence, however, is quite supportive of the implications of our "rigid" view of Europe. In particular, the high incidence of youth and long-term unemployment in Europe is qualitatively consistent with situations where turnover is largely limited to replacement of retiring workers by young ones, who have been unemployed since entering the labor market.

Another potentially fruitful direction for empirical research would build on the work and data of Davis and Haltiwanger (1991) and on similar data sets for other countries where larger and more profitable firms are found to pay higher wages to similar workers. Davis and Haltiwanger find evidence that many plant characteristics other than size have explanatory power for within-group wage inequality. In other words, *job* characteristics matter for the wages of otherwise identical workers—and this is what models of costly worker mobility across jobs could rationalize. Firm-level wage differentials certainly have more than one explanation, of course, but it is interesting to recognize explicitly that size and profitability are not given once and for all in a static setting, but vary over time: inasmuch as mobility towards recently improved firms is costly for workers, equilibrium wage (differentials) may offer dynamic compensation for such costs. The evolution of the distribution of plant size is indeed found by Davis and Haltiwanger to be associated with the evolution of the wage structure, and it would be very interesting to obtain comparable evidence from similar European data sets as they become available.

4.2 ONE EXPLANATION FOR U.S. AND EUROPEAN DYNAMICS

Extrapolating the long-run comparative evidence above, it is tempting to try and bring the stylized theoretical analysis of Section 3 to bear on the recent evolution of European and U.S. labor markets. If European workers are increasingly jobless, and U.S. workers increasingly penniless (Krugman, 1994), can these phenomenon be interpreted as different "waves" caused by a stone falling in "lakes" whose institutional characteristics have long been and largely remain quite different?

From the perspective of the stylized models of Section 3, increasing inequality and increasing unemployment can indeed be viewed as "more of the same" for each labor market: if U.S. within-skill wage inequality reflects workers' mobility costs (and U.S. unemployment is frictional in nature), then exogenous developments can explain higher inequality if they make mobility issues more relevant to the flexible market's equilibrium; if European institutions force wage equalization and low mobility, then the persistent unemployment resulting from noncompetitive wage-setting practices may be increased by exogenous developments which magnify the efficiency and labor-demand effects of job-security provisions.

Our framework of analysis suggests that a simple and plausible change in the economic environment may be responsible for more sharply divergent outcomes in "flexible" and "rigid" (but otherwise similar) labor markets: increased instability, as indexed by the frequency p of labor-demand shocks, enhances the relevance of the dynamic aspects analyzed in Section 3—or, as Allen and Freeman (1994) put it, "makes flexibility a more important determinant of outcomes than in the past." Allen and Freeman dismiss this explanation and, without developing a formal model, lean towards institutional changes leading to more flexibility in Europe and less flexibility in the United States as potential explanations of the evidence. In the simple models of Section 3, however, the effects of higher uncertainty on labor-market outcomes are strikingly consistent with the evidence. A higher p requires more wage inequality across standardized labor units in the equilibrium of a model where wage differentials finance costly labor reallocation (Figure 5), as larger immediate gains are needed to induce labor mobility when they are more likely to disappear in the near future: this may well rationalize the increasing within-skill U.S. wage inequality documented in Section 2 above. Symmetrically, we see in Figure 6 that a higher p reduces steady-state employment for any given (rigid) wage level, as higher instability of notional labor demand gives more weight to future negative shocks in optimal forward-looking labor demand policy: for any given wage, higher volatility is consistent with higher levels of wait (rather than frictional) unemployment among new entrants and at the aggregate level.

These theoretical results match the parallel developments of U.S. and European labor markets, suggesting that increasing volatility of labor demand over the last two decades may be the common cause of diverging developments of institutionally different labor markets across the Atlantic. By saying so, of course, we may well be giving a fancy name to our ignorance, since forcing processes and their volatility are not easy to identify and measure. However, it is reasonable to suppose that the intensity of reallocation-inducing shocks has been strongly correlated across the Atlantic throughout the 1970s and 1980s, given the similar technological structure of the U.S. and Europe and given the strict trade and financial linkages between their economies. The end of the postwar reconstruction period, the demise of the Bretton Woods system of fixed exchange rates, changes in the structure of raw-material markets, and erratic and poorly coordinated macroeconomic policies all arguably destabilized labor-market forcing processes, along with increasing openness to trade and technological progress—i.e., with the structural changes invoked by conventional skill-based theories of wage determination.

If (potential) "reallocation energy" did increase in the recent past, it had to be conserved in equilibrium, and its outlet may very well have been different in different institutional environments. A more volatile environment requires larger wage differentials across identical workers in a flexible labor market, as the expectation of higher wages compensates the movers for mobility costs incurred when leaving firms (sectors, regions) hit by negative shocks to reach firms (sectors, regions) hit by positive ones. In a rigid economy, conversely, a more volatile environment induces more caution in hiring and, for a given wage, leads to a higher overall rate of unemployment. The dynamic perspective we propose can arguably explain a portion (though certainly not all) of the observed evolution of U.S. wages and European unemployment rates. The remainder of this section lays out and discusses some of its less obvious empirical implications, which have not attracted as much attention as the motivating facts of Section 2.

4.2.1 Wage Instability A crucial and unambiguous empirical implication of models where wage differentials reflect worker mobility costs is that higher idiosyncratic labor-demand volatility should have led to more unstable labor-income profiles in the U.S. labor market, especially for older and/or less mobile workers. Gottschalk and Moffitt (1994) find not only that a substantial portion of cross-sectional wage inequality at a point in time indeed is explained by within-individual dynamics, but also that the "transitory" (almost i.i.d.) and "permanent" components of individual wage differentials have both widened in the 1980s, and for "movers" as well as for "stayers"—which, as noted above, is quite consistent with the flexible model's theoretical implications in the face of higher labor-demand volatility. Further relevant empirical work should perhaps try to discriminate between an essentially static view of wage determination, where wage heterogeneity increases only if an individual's skills are priced differently *once time variation is removed*, and the dynamic perspective we propose—where cross-sectional inequality would increase even if all relevant conceivable worker characteristics were appropriately controlled for, as a result of greater time-series instability of a given individual's labor income.

Real-life datasets, unfortunately, feature a changing collection of intrinsically heterogeneous workers in perpetually changing labor markets, and make it difficult to evaluate an individual's *ceteris paribus* earning potential. Inasmuch as higher volatility of one's future outlook makes inaction more attractive, the basic qualitative message of our model's "flexible" equilibrium would presumably be valid in realistic models which allow for entry and exit of workers and firms in nonstationary technological environments. Without a complete specification of forcing processes' dynamics, however, it is hard to see how long-run (static) and temporary (dynamic) components might be best disentangled from raw levels and changes of individual wages. In their work, Gottschalk and Moffitt find that temporary wage movements have become increasingly pronounced around both moving-average and random-walk estimates of an individual's earning potential. Further research along these lines may well confirm that dynamic features are an important component of U.S. inequality trends.

4.2.2 Job-Based and Geographic Effects Of course, not all wage-dispersion phenomena may be appropriately explained by our theoretical perspective. People do not usually choose or change their sex for economic reasons; hence gender earning gaps cannot be rationalized by adjustment costs and forward-looking worker behavior (and male–female wage differentials are probably the only decreasing ones in recent U.S. experience; see, e.g., Katz and Murphy, 1992). To the extent that one's education level can be (at a cost) chosen or changed, conversely, increasing education premia might be partly explained by higher uncertainty about future employment prospects. Of course, however, the most natural interpretation of a mobility-cost-based view of wage differentials is a geographical one. Accordingly, we reconsider the evidence in this respect, with an eye to assessing whether the recent evolution of regional wage differentials and unemployment persistence is consistent with increased forcing-process instability.

Figure 7 illustrates the evolution of geographic wage differentials across American states. Panel (a) plots the coefficient of variation of raw manufacturing wages: regional wage inequality decreased in the 1970s (probably reflecting geographic variation of supply and demand factors, which are *not* controlled for in this figure), but has increased very strongly since 1980.[18] The evidence displayed in panel (b), which con-

18. The 1970s evidence is consistent with long-term trends towards convergence of per capita incomes across U.S. states, documented by Barro and Sala-i-Martin (1991). A long-term perspective, however, hides the remarkable fact that, in the 1980s, U.S. wage dispersion increased along the regional dimension as well as along those emphasized by empirical labor economists.

Figure 7 DISPERSION OF WAGES ACROSS STATES OF THE UNITED STATES

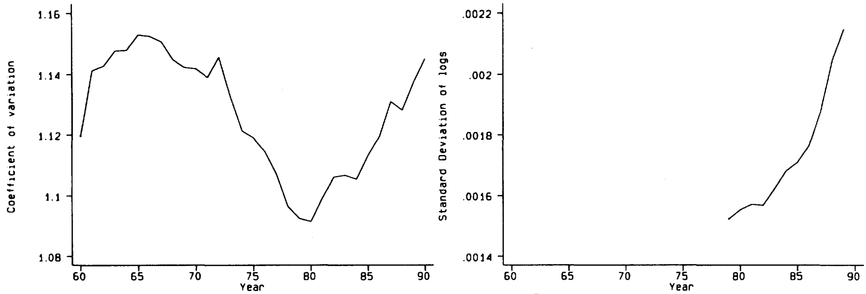


Fig.7A: Hourly wages, manufacturing

Fig.7B: Residual hourly wages, manufacturing

Notes: (a) Coefficient of variation of BLS establishment-based average hourly earnings of manufacturing production workers. (b) Population-weighted standard deviation of state-specific residual means from cross-sectional regression of CPS log hourly wages on an experience polynomial and a variety of controls. For details and sources, see Blanchard and Katz (1992).

trols for individual characteristics and is only available for the 1979–1990 period, is more directly relevant to our point. Similar workers' wage dispersion increases strongly across U.S. states, supporting a geographical interpretation of the "flexible" model's implications in the face of higher labor-demand instability. Rigid European labor markets, conversely, display patterns of constant or declining regional wage dispersion over the 1980s (see *OECD Employment Outlook*, 1990, p.89).

Europe, once again, lacks reliable wage information. Indications of higher instability may, however, be found in the evolution of regional unemployment persistence: even in a "rigid" market, if not in the extreme characterization of Section 3.2, labor does move towards regions where unemployment is relatively low. If the identity of these regions changes more frequently over time, then migration flows change direction more often and we should observe less persistence (stronger mean reversion) of regional unemployment rates. Similar reasoning applies, even more clearly, to a "flexible" equilibrium with frictional unemployment in the sending and receiving regions. Table 2 reports statistics similar to those of Table 1, for two subperiods. These short data series may not contain much information, of course. Taken at face value, however, the simple statistics of Table 2 conform to what the theoretical models of Section 3 would predict in response to higher volatility: both in the relatively "flexible" U.S. and in the more "rigid" European economies, unemployment appears less geographically persistent in the more recent periods.

Table 2 EVIDENCE OF INCREASING REGIONAL TURBULENCE

Country	*Coefficient* 1983–1987[a]	1988–1992[a]
U.S.	−.50	−.70
	(.12)	(.06)
Great Britain	−.01	−.47
	(.05)	(.05)
France	.04	−.07
	(.06)	(.05)
Italy	.36	−.11
	(.08)	(.04)

[a]For the United States the periods are 1982–1986 and 1987–1991.

Note: Coefficients of OLS cross-sectional regressions for each country and for each subperiod. Regional units as in Table 1. The dependent variable is the variation of the unemployment rate, and the coefficient shown is that of the initial unemployment rate (standard errors in parentheses). The constant (not shown) absorbs the effects of aggregate unemployment changes.

4.2.3 On Quantity-Based Volatility Measures Other pieces of evidence on the recent evolution of U.S. labor markets are only apparently inconsistent with our dynamic interpretation of wage inequality. Allen and Freeman (1994) note that, in the 1960s, "unemployment rates in the U.S. were between 5 and 6%—two to three times larger than unemployment rates in Europe, which ran between 1 and 2%," and they use more recent evidence to argue that labor-market flexibility has not increased in the recent U.S. experience despite the increased importance of trade-induced shocks (and, we may add, the wide swings of U.S. real exchange rates during the 1970s and 1980s). However, the stylized model outlined in Section 3 tells us that nothing prevents a rigid system from delivering full employment if wages are set low enough (though even in this case workers would be inefficiently allocated across production sites): if there is unemployment in a rigid labor market, it is persistent rather than frictional, and it may be either higher or lower than in an otherwise similar flexible system. Institutions do change over time, of course, but it is not necessary to invoke such changes to rationalize the U.S. and European unemployment experience from the 1960s to the present: even in the absence of institutional changes, increased idiosyncratic uncertainty (as in Figure 6) and insider wage pressure in rigid European economies may explain the observed reversal of the unemployment-rate ranking of the two systems.

Another lesson of Section 3's simple models is that it may be misleading to try to use quantity indicators to assess the relevance of idiosyncratic shocks in a "flexible" market, where wage differentials spur costly labor mobility. As the bottom panel of Figure 5 illustrates, a more volatile environment (as indexed by an increase of the frequency p of idiosyncratic labor-demand shocks) need not cause more labor reallocation per unit time or higher frictional unemployment: in our stylized model, when labor is reallocated more frequently out of or into a *given firm* (region, sector) then fewer labor units actually move upon realization of a shock. As the potential for reallocation increases with p, but actual reallocation is discouraged by the same increase in volatility, both the incidence of mobility on a *given worker* and the overall unemployment rate are ambiguously affected by higher volatility. Thus, the mild increase of overall U.S. unemployment is quite consistent with increased idiosyncratic uncertainty if the flexible market equilibria are located in the flat portion of the "unemployment Laffer curve" illustrated in the bottom panel of Figure 5 (or if p drifts up from about 22% to about 28% for the parameters of the figure).

In our steady-state model, an individual worker's average tenure length is inversely related to aggregate unemployment: hence, the evidence in Allen and Freeman (1994), Farber (1995), and Diebold, Neumark, and Polski (1995) that "lifetime jobs are not disappearing" in the U.S. is similarly far from being inconsistent with higher labor-demand variability. These empirical findings are not uncontroversial (see, e.g., Gottschalk and Moffitt, 1994), and such supply-side phenomena as increasing female attachment to labor-force participation may partly hide the effects of greater uncertainty on the demand side. But conceptually straightforward extensions of the "flexible" labor-market model may rationalize other composition effects. Farber (1995) finds that young men are substantially less likely to be in long-term jobs today than they were twenty years ago, while the opposite is true for older workers, and this is consistent with models of equilibrium labor mobility where the likelihood of exit from the market is an increasing function of age: as a fixed cost discourages mobility more strongly for workers whose horizon is shorter, the distribution of unemployment and short-tenure jobs should be skewed towards shorter labor-market ages, possibly more strongly so for higher volatility of labor demand.

5. *Conclusions*

This paper's interpretation of U.S. and European unemployment and wage dispersion, while somewhat unconventional, is based on a stylized representation of standard labor-market models and is fully consistent with the common view that labor-market flexibility (or lack thereof) has become an increasingly important determinant of market performance in the last two decades. We certainly do not deny that biased technological progress or increased competition from developing countries worsened the wage and employment opportunities of low-skill workers in industrial countries; nor do we dismiss the obvious effect of high real wages and low aggregate demand on the aggregate unemployment rate of heavily unionized, inflation-fighting European countries. We emphasize, however, that higher labor-demand volatility may have contributed to increase within-skill wage dispersion in the United States and unemployment in Europe, through dynamic adjustment in laissez-faire markets and forward-looking behavior by employers in heavily regulated markets.

This perspective on labor-market issues suggests potentially fruitful directions for further empirical and theoretical research. The simple models discussed above are not meant to be fully realistic and could be complicated in a number of directions for empirical purposes. In particular, steady-state solutions conveniently eliminate aggregate dynamics, but, of course, the static and dynamic structure of industrial economies changes continuously and gradually over time. Transitional dynamics are important in reality, and, like the rest of the simple models above, the steady-state assumption is not meant to be taken literally. In particular, European employment and wages were presumably biased upwards in the 1970s, when elements of "rigidity" were introduced and prevented labor shedding, while the employment performance of many European economies appears particularly weak as institutional steps towards increased flexibility are taken in the 1980s and 1990s (Bertola and Ichino, 1995).

The deeper determinants of labor markets' institutional structures also deserve to be studied in future work. Like Dr. Jekyll, the stylized model of Section 3 has a double personality: given plausible differences in wage-setting and job-security institutions, it can explain different labor-market outcomes for technologically identical economies faced by similar changes in exogenous uncertainty. The competitive nature of a flexible market's equilibrium implies that the resulting allocation is constrained efficient, as the mobility decisions induced by equilibrium wage differentials appropriately maximize the total surplus produced in the market, net of mobility costs: thus, the rigid personality of the model is unambiguously Mr. Hyde if the model is solved, as we do, under the assumption of risk neutrality. Our entire analysis is based on the premise that the United States has a more flexible system than Europe, and, with the exception of the post-Thatcher British experience, this premise is confirmed by many empirical indicators. It is then natural to wonder why European governments would choose to decrease their economies' productive efficiency.

It may be possible to answer this question by considering that, if individuals are risk-averse, then maximization of aggregate production would still be an appropriate social objective only if financial markets and/or fiscal instruments made it possible to redistribute the production "pie" across individuals. But perfect financial markets would also allow market participants to specify appropriate (contingent) side payments so as to work around those regulations that hamper productive efficiency—for example, employers could offer bonuses to redundant employees and induce them to search for alternative employment opportunities rather than remain idly employed in their current jobs; or unemployed individuals could "buy" state-contingent jobs from prospective employers who fear future firing constraints (Lazear, 1990). The implications of labor-market institutions are more interesting and less clear-cut if insurance against labor-income risk is ruled out in light of realistic imperfect-information and contract implementation problems, which also prevent financial markets from undoing the effects of regulations. Existing markets clearly provide incomplete hedging opportunities against labor-income risk,[19] and intertemporal contingent contracts (especially those meant to circumvent regulation) are hardly enforceable in labor courts.

Thus, the welfare of risk-averse uninsured workers can be decreased ex ante by the same labor-income volatility that allows a flexible labor market to respond ex post quickly, if not costlessly, to exogenous demand and productivity developments. Inasmuch as a "rigid" market structure can have desirable labor-income stabilization effects, continental European institutions may well be inspired by a desire to shelter individual workers' welfare from idiosyncratic shocks, at the cost of dynamic inefficiencies in labor allocation. This perspective on European rigidities is complementary to that of Burda and Mertens (1994), who discuss European wage-setting institutions in the standard efficient-contracts framework: if workers are immobile for exogenous reasons, implicit or explicit wage contracts should optimally compress wage differentials; we assume exogenously compressed wages, and argue that this may contribute to lower worker mobility. Future research should try to model the tradeoff between desirable and undesirable effects of labor-

19. In the United States, in fact, consumption inequality has increased roughly in parallel with labor-income inequality, and poor people, in particular, appear to reduce their consumption in response to decreased labor income (Cutler and Katz, 1992)—as they should if low financial assets make even self-insurance impossible for them.

market rigidity, and evaluate the possibility that its position and slope may have been changed by technological developments and/or insider wage-setting mechanisms. If generalized instability has increased the returns to flexibility, as the wage and unemployment evidence would indicate, then rigid European institutions may have become too costly in terms of efficiency. Still, it is quite possible that a unified Europe should choose a common institutional framework that, while less rigid than previously, does not reach the American or British degree of flexibility.

To the extent that they do not result in across-the-board wage increases, aggregate demand policies might alleviate the unemployment consequences of labor market rigidities in Europe, although they would not reduce the inefficiencies due to the lack of labor-market reallocation in the presence of idiosyncratic shocks. As to the United States, if the volatility of idiosyncratic shocks can be blamed for at least part of the observed wage inequality, then measures aimed at reducing labor-demand volatility might help eliminate a possibly important source of wage inequality without costs in unemployment—whether moving along the efficiency–insurance frontier, or shifting it.

Appendix A. Equilibrium Wage Differentials under Costly Labor Mobility

Worker j's mobility choices must be such as to maximize the expected present value of labor income net of mobility costs between the present time t and the (random) time T when he leaves the market:

$$\max_{\{m^j\}} E_t\left[\sum_{i=0}^{T}(w_t^j - m_t^j k)\left(\frac{1}{1+r}\right)^{-i}\right] = \max_{\{m^j\}} E_t\left[\sum_{i=0}^{\infty}(w_t^j - m_t^j k)D^{-i}\right] \equiv W_t^j, \tag{A1}$$

where $D \equiv 1/[(1 + r)(1 + \delta)] \leq 1$; $w_t^j = w^G$ (if worker j is employed in a good firm at time t) or w^B (if employed in a bad firm at time t); and $m_t^j = 1$ if worker j moves at time t, or 0 otherwise.

In a steady-state equilibrium of our model, w^G and w^B are constant over time, and the present discounted value of worker j's labor income depends on a single state variable—namely, the productivity of his employer at the beginning of the period, as indexed by α_t^i: this takes two possible values, switching from one to the other with probability p, and so does the value of problem (A1). Denoting $W_t^j = W^G$ if j is employed by a good firm at t, and $W_t^j = W^B$ if j is employed by a bad firm at the beginning of period t, we have from (A1) the recursive relationships

$$W^G = w^G + D[(1 - p)W^G + pW^B] \tag{A2}$$

and

$$W^B = \begin{cases} w^b + D[pW^G + (1-p)W^B] & \text{if} \quad m_t^j = 0, \\ w^b - k + D[(1-p)W^G + pW^B] & \text{if} \quad m_t^j = 1. \end{cases} \tag{A3}$$

If mobility does take place in equilibrium, the expressions on the right-hand side of the second relationship in (A3) must be equal to each other: hence,

$$\begin{aligned} W^B &= W^G - \frac{k}{D(1-2p)} \\ &= W^G - \frac{k(1+r)(1+\delta)}{1-2p}. \end{aligned} \tag{A4}$$

Inserting the condition (A4) in (A2) and (A3), and solving, one obtains (6) in the main text. If k is too large (in light of wage volatility and discount rates) to ever induce low-wage employees to move, then labor allocation is history-dependent in steady state, and (A4) holds as an upper bound rather than with equality.

In the linear case, we have

$$l_t^G = \frac{\alpha^G - w^G}{\beta}, \qquad l_t^B = \frac{\alpha^B - w^B}{\beta} \tag{A5}$$

if firms equate wages and marginal revenue products. Under the hypothesis in the main text, that workers remain unemployed for one period when changing employers, for (7) to hold wages must be given by

$$\begin{aligned} w^B &= \frac{(1+p)(\alpha^G - \xi) + (1-p)\alpha^B}{2} - \beta L \\ &= \tilde{w} + \frac{p}{2}(\alpha^G - \xi - \alpha^B) - \frac{\xi}{2}, \\ w^G &= w^B + \xi \\ &= \tilde{w} + \frac{p}{2}(\alpha^G - \xi - \alpha^B) + \frac{\xi}{2}, \end{aligned} \tag{A6}$$

and employment levels by

$$l^G = L + \frac{1-p}{2\beta}(\alpha^G - \alpha^B - \xi),$$
$$l^B = L - \frac{1+p}{2\beta}(\alpha^G - \alpha^B - \xi). \tag{A7}$$

Appendix B. Optimal Labor Demand in a Rigid Labor Market

The solution for the general case where labor attrition is positive ($\delta > 0$) is conceptually straightforward, but analytically complex. If $\delta > 0$, however, solution is easy. Let V_t^j denote the marginal value of a labor unit employed by firm j at time t, i.e., the expected present value of the difference between the marginal employees' contribution to the firm's revenues and the wage rate:

$$V_t^j \equiv E_t \sum_{\tau=0}^{\infty} \left(\frac{1}{1+r}\right)^{\tau} (\alpha_t^j - \beta l_t^j - w). \tag{B1}$$

In the steady state we consider, employment is stable at every firm, and the marginal value of labor only depends on each firm's business conditions index: denoting $V_t^j = V^G$ if $\alpha_t^j = \alpha^G$, $V_t^j = V^B$ if $\alpha_t^j = \alpha^B$, and recalling the Markovian behavior of $\{\alpha_t^j\}$, we can write from (B1)

$$V^G = \alpha^G - \beta\bar{l} - w + \frac{1}{1+r}[(1-p)V^G + pV^B],$$
$$V^B = \alpha^B - \beta\bar{l} - w + \frac{1}{1+r}[(1-p)V^B + pV^G]. \tag{B2}$$

The hiring policy of the firm is straightforwardly described. With costless hiring, the marginal value of employment at each "good" firm must be zero, for with $\beta > 0$ a positive marginal value should be arbitraged away by further hiring (from the unemployment pool, or from other firms), and in steady state a negative value could only result from suboptimal hiring decisions in the past. Given that firing costs are prohibitive, however, the marginal value of labor can become negative, and the firm should take that into account when evaluating the forward-looking expression (B1) at times when it considers hiring additional employees.

Inserting $V^G = 0$ in (B2) and solving for endogenous variables yields

$$V^B = \frac{1 + r}{2p + r}(\alpha^B - \alpha^G) \leq 0 \tag{B3}$$

(the marginal value of labor is negative for "bad" firms, which would fire if that were allowed) and (8) in the main text.

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Comment

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The two issues addressed by Bertola and Ichino—widening wage differentials in the United States and increasing unemployment in Europe—are undoubtedly two of the most important labor-market phenomena of recent decades. Since both trends are possible symptoms of changes in the structure of labor demand, it seems natural to try, as do Bertola and Ichino, to find a common demand-side explanation for these two trends. The basic explanation they put forth is that greater instability in local labor demand (in the sense of less persistence of relative demand shocks) generates higher equilibrium levels of wage differentials in the United States, where wages adjust to allocate labor across areas in the presence of costly mobility. In Europe the decrease in persistence reduces the hiring of labor by currently high-demand firms, since institutional restrictions on employment reductions will prevent these firms from shedding labor when their labor demand declines.

The notion that common forces are driving the recent changes in the United States and Europe is extremely attractive. The fundamental demand-side forces of technical change and changes in the world market are likely to be similar on both sides of the Atlantic. Likewise, differences in the institutional structures of the U.S. and European economies seem like the most likely explanation for the observed contrasts in labor-market outcomes. While I am convinced by the basic structure of their analysis, I am less convinced that the particular structural changes or institutional factors that the authors emphasize are the most important reasons for what we have witnessed in the U.S. and European labor markets.

Evidence on wages and employment for the United States suggests that the rapid growth in wage inequality over the past two decades has resulted from substantial growth in the relative demand for skilled workers, or equivalently a substantial decline in the relative demand for low-skilled workers (see Katz and Murphy, 1992, or Juhn, Murphy, and Pierce, 1993 in the reference section above). Widening wage premia for more skilled workers in the face of a rising supply of more educated and more skilled workers over this time period, as well as more direct evidence on changes in the occupation and industrial distributions of employment, suggest a substantial rise in skill demand in the United States. The authors pick up on a piece of this evidence by pointing out that inequality within education and experience categories and inequality in individual wages over time have increased as well. They interpret this evidence of increased individual and individual-time specific variation in wages as evidence that the volatility of labor demand has increased. A key element in their interpretation of this evidence is that wage variation across individuals within skill categories and wage variation over time for individuals represent variation in the market value of fixed bundles of skills (i.e., something that must reflect short-run limitations on wage arbitrage across markets).

One must keep in mind that the evidence on wage inequality within skill categories looks at only very crude measures of skill such as years of education and years of potential labor-market experience. Taken together, these and other "human capital" variables explain only about 30% of the variation in individual wages. For example, using data from the March Current Population Survey, I find that the overall variance in the natural logarithm of wages for a sample of working males in the United States in 1991–1992 was 0.32, while the variance of the wage residuals from a standard human-capital earnings equation (controlling for education, experience, marital status, SMSA, and central-city residence and region) for this sample was 0.22. This is a very large amount of residual variation. A variance of 0.22 implies a standard deviation of individual wages within skill groups of 0.48. To get a feel for the magnitude of the variation in individual wages it is useful to note that the cross-sectional return to a year of education in 1991–1992 was about 0.08, while the standard deviation of individual log wage residuals is about 0.48 (equal to the return to 6 years of schooling). This implies that if one randomly chose two individuals with different levels of schooling, one would have to compare someone having 18 years of schooling with someone having just a first-grade education to be 95% certain that the person with more schooling actually had a higher hourly wage (i.e., $0.08 \times 17 = 1.36$ and $0.48 \times 1.96 \times 1.41 = 1.33$). Given the crudeness of the standard controls and the enormous magnitude of the residual wage variation, it seems likely to me that the bulk of the observed residual wage variation represents the return to unmeasured attributes of individuals and jobs and not transitory variation in market prices generated by fluctuating labor demand. In my opinion the increase in within-group variation is generated by the same forces leading to greater wage inequality across groups (i.e., the general growth in the demand for skill) and not by growth in the volatility of labor demand.

This does not limit the usefulness of the authors' model or their overall approach. The model they develop to analyze the impact of increased volatility could have been used to address the question of how the U.S. and European labor markets would have responded to growth in the demand for skill. My suspicion is that the implications would have been quite similar to what they predict using their current structure and quite similar to what we have observed, but it would be nice to see if they could tease out some way to evaluate whether growing skill demand or increased volatility is the key element (more on this later).

On the institutional side, the authors model the United States as an unregulated market with costly mobility and stress both institutional wage setting and limits on layoffs as the key elements of the European markets. Taking the United States as the competitive benchmark seems sensible. A more interesting question is whether it is the centralized wage setting (which will generate unemployment when wages are not set appropriately) or the limits on mobility that generate the U.S.–European contrast. For example, it is clear that simply having institutions that limit the downward adjustment of wages would generate unemployment for marginal labor-force groups in Europe in response to a skill demand shock, even without increased volatility. The need to consider the restrictions on mobility stems from the authors' desire to explain why a decreased persistence of shocks alone would lead to higher unemployment. While limits on mobility may be an important aspect of the European labor market, it seems to me that they may not be essential to understanding the European unemployment crisis, provided we consider the primary labor-market shock as one to the demand for the less skilled rather than simply an increase in the volatility of demand. A skill-demand shock with rigid wages provides a direct impact on employment without the need to appeal to limits on mobility.

The authors are also interested in explaining other features of European labor markets, such as why there is little mobility in response to relative demand shocks across areas and why unemployment is high among high-skill groups in Europe. The first of these questions I think remains a puzzle. Their explanation is that the institutional rigidities lead to wage compression across areas and hence reduce the incentive to migrate. However, by preventing wage adjustments, these same wage rigidities generate greater employment variations across regions and would therefore tend to increase the incentive to migrate to other regions where the expected duration of unemployment would be less. Hence, while wage differentials across regions will be small, employment differentials will not be so, and there may actually be a greater and not a lesser incentive to migrate. In fact my guess is that the durations of unemployment vary greatly across areas within Europe and therefore that any calculation of the economic incentive to migrate would prove those incentives to be high and not low.

The growth in unemployment for high-skilled workers in Europe I think fits quite nicely with the facts for the United States and the presence of wage rigidities. Again, in the United States we have seen changes in labor demand that have reduced wages for less-skilled groups relative to wages for high-skilled groups and reduced wages for the least skilled within each group relative to the most skilled. If institutions limit the ability of wages to adjust for different individuals within these groups just as they limit the ability of wages to adjust across groups, then some unemployment for the lowest skilled within each group is likely to occur. This would apply within high-skill groups and low-skill groups. Uniform wages for workers within skill categories generates a market where the marginal workers within those categories move in and out of employment with overall variations in the demand for those skill categories. The key notion here is that what we call within-group wage and employment variation is not variation in labor-market outcomes for identical workers. Rather, all of our observed groups are very heterogenous collections of workers with various skills and talents. Variation in wages and employment within these groups probably has much more to do with variations in individuals than market-level volatility.

Table 1 illustrates what I think is the most compelling evidence that

Table 1 STANDARD DEVIATIONS FOR LOG WAGES, LOG WAGE RESIDUALS, AND LOG WAGE CHANGES

Years	*Log Wage Levels*	*Log Wage Residuals*	*Log Wage Change*
1979–1980	.49	.42	.37
1986–1987	.56	.47	.40
1991–1992	.57	.47	.40

Note: Data are for males with 1–40 years of potential labor-market experience from the matched files of the March Current Population Surveys for 1980–1981, 1987–1988 and 1992–1993. The wage residuals are from a log wage equation that controls for education, experience, marital status, SMSA, and central-city location and region.

the rising price of skill accounts for the bulk of the rise in wage inequality within groups and even within individuals over time. The table gives the standard deviation of individual log wages, log wage residuals, and individual log wage changes for three pairs of years: 1979–1980, 1986–1987, and 1991–1992. The data are from matched records from the U.S. Current Population Survey and are for adult males that worked in both years. What I find amazing is that the time patterns for the three standard deviations are so similar. All of them increase substantially between the first two pairs of years and remain roughly constant between the second and third pairs. Moreover, the increases are all of similar magnitude. The differences, if anything, point to the smallest increases being in the within-group and within-individual components, since the largest percentage increase is for overall wage inequality, the next largest increase is in the across-individual component, and the smallest increase is for the within-individual component. The similarity of these increases in inequality is exactly what I would expect in response to an increase in the price of skill between the first two pairs of years and a stable price of skill between the last two pairs of years. All wage differentials would move together. More-skilled groups would gain on less-skilled groups, and more-skilled individuals would gain on less-skilled individuals within these groups.

What may seem odd to some is that the variation in individual wage changes has also increased as a result of the increase in skill prices. But one must remember that this too is consistent with a rise in the price of skill. Individuals get paid for what skills they currently employ and not the skills with which they are endowed. Much of the variation in individual wages is due to people changing jobs and moving up or down the skill ladder. When inequality is greater, the wage changes generated by moving up or down this ladder are correspondingly greater. This can be seen by looking at the occupational component of the variation in individual wages through time (defined as the individual's occupational effect in a wage equation). Again, using the same CPS data, I find that 98% of the variation in individual wages accounted for by occupation is accounted for by individuals changing occupation, while only 2% is accounted for by changes in the occupational wages themselves (i.e., individual variation in wages is generated much more by people changing occupations than by changing wages for the occupations that they are currently in). This evidence is why I think that the skill-demand aspect and European wage rigidities rather than the volatility of labor demand and restrictions on mobility are the key driving forces behind the U.S. and European experiences. This does not reduce the applicability of Bertola and Ichino's model, but simply suggests that they may want to change the forces and labor-market features that they emphasize as most important.

Finally, Bertola and Ichino's model stresses reduced persistence rather than an increase in the magnitude of demand shocks as the source of the growth in volatility. My only comment on this point is that I have seen no evidence for the United States that wage differences across individuals have become less persistent. Although (as Table 1 shows) the standard deviation of wage changes has increased, the correlation of individual wages through time actually rises somewhat over the time period covered by Table 1.

Comment

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This is an interesting paper. The authors undertake the ambitious task of presenting a unifying explanation for two patterns that have attracted the attention of many economists in recent years: rising unemployment in Europe and rising wage inequality in the United States. As I argue below, their model also offers an explanation for the slowdown in productivity growth that has been common to Europe and the United States over the last two decades. The authors' approach is to explain these developments as the consequence of a change which is common to all countries but which produces different responses across countries due to differences in labor-market institutions. The change in fundamentals that they put forward is an increased transience in the economic situation faced by individual production units. My comments focus to a large extent on laying out what I believe to be the leading alternative explanation, which is some form of skill-biased technological change.

Consider first the analysis of developments in the U.S. economy. Many authors have documented changes in relative wages during the last thirty years, e.g., Katz and Murphy (1992), Murphy and Welch (1992), and Davis and Haltiwanger (1993). There are three facts from this literature that are relevant to my comments:

Fact 1. The differential between high-school and college graduates increased in the sixties, decreased in the seventies, and has increased steadily since the late seventies.

Fact 2. The variance of wages within age and schooling groups has increased since the late sixties.

Fact 3. For nonproduction workers in manufacturing, the increased within-group variance in wages is largely accounted for by increases within manufacturing plants rather than across manufacturing plants.

Fact 1 is widely cited and can easily be explained by skill-biased technological change. This paper is motivated largely by Fact 2 to look for alternatives to skill-biased technological change. The authors argue that if observationally identical workers are receiving increasingly different wages, then it must be that something else is at work. In my view, the authors have gone too far in their interpretation of this fact. It leads them to create a model in which truly identical workers receive different wages and in which these differences grow over time. However, because the available worker characteristics in the relevant data sets are quite limited, workers can be very different and yet be observationally identical from the perspective of the data set. In fact, I argue that given the presence of unobserved skill differences among workers, skill-biased technological change leads naturally to an explanation for both Fact 1 and Fact 2, so that Fact 2 does not call for an alternative to skill-biased technological change.

The following simple static model can be used to illustrate this argument. There are two dimensions along which workers differ: ability and educational attainment. We assume for simplicity that there are only two levels for each characteristic, resulting in four types of workers:

Group A: High ability, high educational attainment.
Group B: High ability, low educational attainment.
Group C: Low ability, high educational attainment.
Group D: Low ability, low educational attainment.

The labor supplied by each group is differentiated in the production function. Additionally, within each group, individual worker i is endowed with ϵ_i units of efficiency labor of that type, where ϵ_i is uniformly distributed on an interval symmetric about 1. (This is just a convenient way to get heteroegeneity of wages within each group.) Here I simply take as given the distribution of workers across groups. Presumably there is some correlation between ability and educational attainment, but this does not affect the argument unless some of the groups contain no workers. Technology is given by

$$y = f\left(K, \lambda_A \sum_{A} e_i + \lambda_B \sum_{B} e_i + \lambda_C \sum_{C} e_i + \lambda_D \sum_{D} e_i \right),$$

where the λ's are relative productivity weights, K is physical capital, and the summations are over workers in each group. A natural assumption on the λ's might be $\lambda_A > \lambda_B > \lambda_C > \lambda_D$. This technology is not sufficiently rich to capture all the patterns found in the data, but it serves to illustrate the main point of the argument.

I assume that only education and not ability is observed. It is relatively straightforward to show that an increase in λ_A results in greater wage variance within the high-educational-attainment group as well as across educational attainment groups. Similarly, a decrease in λ_D leads to increased wage variance within the low-educational-attainment group as well as across educational attainment groups. It is therefore easy to see how skill-biased technological change which manifests itself as changes in relative productivities of labor types can explain both Fact 1 and Fact 2. (I note that to capture the reversal in relative wages referred to in Fact 1 it is necessary to adopt a production function which allows for less substitutability across labor types.)

I find this kind of story to be a rather compelling explanation for Fact 1 and Fact 2. The rising return to college education strongly suggests greater relative productivity of workers with certain characteristics, and it is extremely unlikely that educational attainment would be a perfect indicator of how these skills were distributed across the population. At least qualitatively, a story based on skill-biased technological change explains both facts. On the other hand, the story of increased transience in economic conditions put forward by Bertola and Ichino can explain Fact 2 but does not seem to readily explain Fact 1. Hence, it does not really offer a true alternative to skill-biased technological change.

Fact 3 is also an important piece of information for distinguishing between the two stories. In the model of Bertola and Ichino all differences in wages are accounted for by differences in wages across firms. As Fact 3 indicates, however, this cannot be the whole story, since within-plant wage variance is the dominant factor in explaining the increased variance of wages for nonproduction workers. It is not difficult, however, for versions of the skill-biased technological change to match this finding.

I should point out that the story of skill-biased technological change that I have outlined above is not really complete. One issue is that firms presumably are able to choose the technologies that they operate, and hence it is not appropriate to take this technological change as exogenous. A slightly different story but with similar implications has been examined by Krusell, Ohanian, Rios-Rull, and Violante (1995). They argue that if skilled labor is complementary with physical capital, and unskilled labor is substitutable with physical capital, then the declining price in physical capital that has been documented implies an increasing relative demand for skilled workers.

While I think the above facts favor skill-biased technological change over increasing transience, it does not follow that the latter may not be an important phenomenon, and thus it is still of interest to examine the alternative that the authors have put forward in this paper. This leads us to look for other implications of the authors' model that we can examine for evidence of increasing variability in the economic environment faced by individual firms, or, in the authors' notation, increases in the parameter p. One is led naturally (although, as it turns out, incorrectly) to look for increases in the reallocation of workers across establishments, i.e., increases in the rates of job creation and destruction. There is no evidence to suggest an increase in these rates for the United States over the last twenty years. However, the model predicts an inverted-U relationship between job creation (or destruction) and the parameter p, so that constancy of these rates is at least consistent with the U.S. economy being near the peak of this curve.

There are several other implications of increases in p that could be checked against the available evidence:

1. There should be increased dispersion in plant-level productivities.
2. Newly created or destroyed jobs should be less persistent.
3. Plant-level productivity should be less persistent.
4. The plant-size wage differential should increase.

Davis, Haltiwanger, and Schuh (1994) show that statement 2 is not true, at least for manufacturing. On the other hand, statement 4 is shown to be true for manufacturing in Davis and Haltiwanger (1993). I am not aware of any definitive evidence for points 1 and 3, but some of the findings in Baily, Hulten, and Campbell (1992) and Dwyer (1994) indicate some support for 1 though not for 3. Clearly a more extensive analysis of these factors is called for.

I mentioned earlier that the authors' model also predicts slower productivity growth in the face of increases in p. As p increases there is less incentive for workers to move from currently low-productivity units to currently high-productivity units, because the increase in p makes it less worthwhile to incur the moving cost. As a result, as p increases, the allocation of labor at a point in time becomes worse from the perspective of maximizing current output. This should show up as a decrease in productivity.

One of the nice features of the analysis for the case of the United States is that the model makes strong predictions which can be examined using available data. The analysis that pertains to European labor markets is much less rich in this sense. By assumption, all workers receive the same wage in that model. Obviously, how unemployment responds to shocks will depend very much on how this wage rate responds to shocks, and hence any story of changes in European unemployment must at least take some stand on how wages are determined. Over the last twenty years wages have continued to rise in Europe, so it is not accurate to simply assume that rigid wages are the problem.

I raise three other points concerning the analysis of developments in Europe. First, note that given the assumptions characterizing the operation of European labor markets, it is also true that skill-biased technological change would give rise to higher unemployment. Second, a slight variation on the wage-compression story for Europe is that it is minimum wages which are the constraint in adjusting to the increase in p, rather than the average level of wages. Third, it would also be of interest to see to what extent the facts about wage variance are true for a larger sample of European countries.

In summary, I think that the authors do a good job of laying out a new unified explanation for some very important developments that have occurred in the last two decades. While their explanation holds some promise, however, they have yet to demonstrate that it outperforms what seems to be the leading alternative.

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Discussion

Bertola responded to Murphy's and Rogerson's comments on the ability of the model to explain the stylized facts. He stressed that the model had been made intentionally simple in order to focus on the effects of differences in labor-market institutions. The hope was that this model would be useful in explaining the component of wage inequality which had been most difficult to rationalize by more conventional approaches. In particular, Bertola noted that detailed empirical work by Davis and Haltiwanger, as well as other research mentioned by the discussants, had stressed the importance of job-specific (as opposed to worker-specific) uncertainty; job-specific uncertainty is the type captured by the Bertola–Ichino model. On the other hand, Bertola said, the increasing idiosyncratic uncertainty which they postulate (i.e., increases in the model parameter p) need not be completely unrelated to stories stressing skill-biased technological progress, etc.; increasing idiosyncratic uncertainty might itself be a result of broader changes in the market environment, technology, or trade patterns.

Bob Hall observed that there were a number of possible schemes which would effectively vitiate the European antifiring laws. For example, the worker and the firm could draw up an agreement at hiring time that gives either party the right to initiate a separation. If this is impractical or illegal, then the firm could try to find a new job for a redundant worker at another firm and thus avoid the penalty imposed for firing a worker. A third possibility is for the firm to diversify either by entering an industry which requires employment growth or by acquiring growing firms. Hall asked if any of these tactics were illegal in Europe.

Bertola responded that it is illegal to draw up an agreement at the time of hiring by which the worker gives up his right not to be fired. A separation agreement signed at the time of firing would not be very useful, since at that point the worker could extract the full value of his tenure rights with the firm. Bertola agreed that diversification would be a sensible way of avoiding the no-firing constraint. However, there are factors working against diversification; for example, if a poorly performing firm joins with a profitable firm, the former will lose the public subsidies that European governments often extend to companies in dire straits. Overall, Bertola agreed that market pressures and political changes were moving European labor markets toward greater flexibility (the authors explore this point in a related paper), but he argued that labor-market institutions remain generally more rigid in Europe than in the U.S.

Kevin Murphy suggested that the important part of the authors' story about Europe was the wage floor and not the no-firing constraint. He argued that—as in cities with binding rent controls, where people rarely move because of the difficulty of finding another apartment—the low worker mobility in the rigid version of the Bertola–Ichino model arises because firms are less willing to hire than in the flexible version of the model. He noted that the homogeneous-worker assumption made by the authors eliminates an important distortion of a European-style system, which is that low rates of job shopping lead to poor matches between specific workers and jobs. In other words, the wage floor leads not only to the wrong number of workers being allocated to each sector—the point emphasized by this paper—but it also creates inefficiencies in who gets allocated where.

Ben Bernanke suggested that in future work the authors should write down and explicitly solve the model assuming risk-averse (rather than risk-neutral) agents; although intuitively the European system seems more risk-averse than the American system, because of its inefficiencies it is far from obvious that the European system is optimal or near-optimal even with risk-averse workers. He also suggested that the authors should use their setup to address the issues of capital formation and capital "shortage" in Europe.

Jan Eberly picked up on the capital-accumulation issue and pointed out that, by extending their analysis to include capital accumulation, the authors might be able to develop some corroborating evidence for their approach. In particular, since according to their model labor is a more fixed factor in Europe than in the United States, in the face of rising uncertainty European firms should have a greater propensity to switch out of labor into capital. Therefore, it might be worthwhile to compare capital formation data in Europe and the United States over the recent period. Bertola said they would try this, but noted that the interpretation of the results would depend significantly on whether capital and labor are thought to be complements or substitutes.

John Shea cited some recent studies that show that the degree of mobility in the income distribution is not going up, and for less-educated workers is even going down. Less-educated people today are more likely to remain at their initial position in the income distribution than were similarly educated people in the 1960s. Is this observation consistent with increasing idiosyncratic uncertainty?

Daron Acemoglu observed that the ratio of unskilled to skilled unemployment in Europe should be higher than in the United States, given the imposed rigidity of relative wages. However, there is very little evidence that this ratio is in fact higher in Europe. Bertola responded that this observation might be true for the conventional skill-based story, but their model does not predict any specific difference in this ratio.

Walter Wasserfallen felt that it was not useful to refer to Europe as if it were a single entity. The legal and institutional frameworks are quite different across European states. At the same time, the fact of very low labor mobility relative to the United States seems to hold for all European countries. Bertola responded by suggesting that the intra-European variation in institutional frameworks, while real, is much smaller than the difference between Europe and the United States.

Larry Kotlikoff asked if European firms provide bonuses to workers for early retirement. Bertola answered that they could and that some firms had adopted this practice. However, he noted that bonus programs were sufficiently expensive that there was not much difference to the firm between inducing an early retirement and keeping the worker around for a few more years. Bob Hall noted that there would be a huge difference from a social perspective if the inefficient continuation of employment could be resolved by writing an efficient contract. Bertola agreed, but he expressed the view that European workers are less likely to start a second career after an early retirement than are American workers.