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ABSTRACT

The European Employment Experience*

Similar durations but lower flows into unemployment gave Europe lower unemployment rates than the United States until the 1970's. But since 1980, higher durations have kept unemployment rates in Europe persistently higher than in the US. A general equilibrium search model with human capital explains how these outcomes arise from the way Europe's higher firing costs and more generous unemployment compensation make its unemployment rate respond to a parameter that measures a worker's loss of human capital after an involuntary job loss. An increase in that parameter between the 70s and the 80s made workers face more turbulence in labour market outcomes and allows our model to match features of a number of empirical studies showing that workers experienced more earnings volatility after 1980. Our model also explains why, especially among older workers, hazard rates of gaining employment in Europe fall off sharply with the duration of unemployment, and why displaced workers in Europe experience smaller earnings losses and lower re-employment rates than those in the United States. The effects of lay-off costs on unemployment rates depend on the proportions of frictional and structural unemployment and therefore on the generosity of unemployment benefits and the amount of microeconomic turbulence facing workers.

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The European Employment Experience

1. Introduction

Until the second half of the 1970s, unemployment was significantly lower in Europe than in the United States (see Figure 1). American observers saw Europe's labor market as a success. The President's Committee to Appraise Employment and Unemployment Statistics (1962), appointed by President John F. Kennedy, studied unemployment data across countries and concluded from an international comparison carried out by the Bureau of Labor Statistics that divergence in statistical methods and definitions did not explain the observed differences in unemployment rates. That confirmation of lower unemployment in Europe prompted Deputy Commissioner Robert J. Myers (1964, p. 172–173) at the Bureau of Labor Statistics to write:

> "From 1958 to 1962, when joblessness in [France, former West Germany, Great Britain, Italy and Sweden] was hovering around 1, 2, or 3 per cent, [the U.S.] rate never fell below 5 per cent and averaged 6 per cent.
>
> The difference between [the U.S.] unemployment rate and the average for these European countries was only a little more than 3 percentage points. But, if we could wipe out that difference, it would mean 2 million more jobs, and perhaps $40 to $50 billion in Gross National Product. We can surely be excused for looking enviously at our European friends to see how they do it. We have profited much in the past from exchange of ideas with Europe. It would be short-sighted indeed to ignore Europe's recent success in holding down unemployment."

But things have changed since Commissioner Myers wrote that. Europe has for the last two decades experienced persistently high unemployment while Figure 1 shows that the American unemployment rate has continued to fluctuate around its post-World War II average. The increase in European unemployment was not caused by a larger fraction of workers becoming unemployed but rather by a lengthening of the average duration of unemployment spells. As noted by Layard, Nickell and Jackman (1991, p. 4),

> "The rise in European unemployment has been associated with a massive increase in long-term unemployment. In most European countries the proportion of workers entering unemployment is quite small: it is much lower than in the USA and has risen little. The huge difference is in the duration of unemployment: nearly half of Europe's unemployed have now been out of work for over a year."

Table 1 shows that long-term unemployment is the essence of the European unemployment problem. Hazard rates of escaping unemployment in Europe fall off sharply with increases in the length of unemployment spells. So although most Europeans leave unemployment relatively quickly, a significant fraction of workers become trapped in long-term unemployment and have little chance of finding jobs that they want. This situation had not prevailed in earlier decades. A study by Sinfield (1968) established that, except for Belgium, long term unemployment was not much of a problem in Europe in the 1960s. Defining 'long-term' as six months and over, Sinfield concluded that long-term unemployment typically affected half a percent of a country's labor force. In countries such as the former West Germany and the Scandinavian countries, it was less than two tenths of a percent.

Long-term unemployed workers in Europe today are diverse. They represent all age groups, as shown in Table 2. Machin and Manning (1999, p. 3093) describe some patterns in the incidence of long-term unemployment (LTU) in various groups of unemployed workers.

> " In all countries there is a higher incidence of LTU among older workers and a lower rate among young workers.
>
> Differences in the incidence of LTU by education are less marked. Most countries seem to have a higher incidence among less-educated but the differences are often small."

During the 1980s, the OECD (1992, p. 67) observed that "former manufacturing workers tend to be overrepresented among the long-term unemployed, reflecting the impact of structural adjustment in industry." An early and stark example of high long-term unemployment in the wake of structural change was Belgium, the sole country singled out by Sinfield (1968) to have had a problem with long-term unemployment in the 1960s.

Possible explanations

Blanchard, Dornbusch, Drèze, Giersch, Layard and Monti (1986) offered an early discussion of several potential explanations of the European unemployment problem. They argued that many factors contributed to the problem, but it was their "opinion that a sharp decrease in aggregate demand is indeed the proximate cause of the rise in unemployment in the EC [European Communities] since 1980." But because high European unemployment persisted longer than what could plausibly be attributed to insufficient demand, attention turned to mechanisms that could propagate high unemployment. For example, Blanchard and Summers (1986) and Lindbeck and Snower (1988) converted the employed workers into insiders and the unemployed into outsiders. An economic shock that increases unemployment reduces the number of insiders. The insiders are assumed to have enough bargaining power to force up the real wage after the drop in employment. That higher real wage then curtails firms' labor demand, leaving more outsiders unemployed.

Layard et al. (1991) emphasized hysteresis and nominal inertia in wage and price setting when theorizing about the European unemployment problem, but they also argued that the

> "unconditional payment of benefits for an indefinite period is clearly a major cause of high European unemployment."

An OECD study (Martin, 1996) supported this characterization of the generosity of European social safety nets. For the average 40-year-old worker with a long period of previous employment, Table 3 describes net welfare benefits after tax and housing benefits. It shows that a single-earner household with a dependent spouse in Europe has a replacement rate of around 70% even five years into an unemployment spell, which contrasts with 14% in the United States. The typical U.S. worker faces a sharp drop in welfare benefits after unemployment compensation expires. The duration of unemployment benefits in the United States is generally restricted to 26 weeks with replacement rates before that ranging from 50 to 70 percent.

Bentolila and Bertola's (1990) study of firing costs also attributes the European unemployment problem to welfare state institutions. However, a widespread criticism of all such attempts to pin the problem on welfare state institutions is that there were no major changes in those institutions when high European unemployment erupted. As Krugman (1987, p. 68) put it:

> "The main difficulty with the Eurosclerosis hypothesis is one of timing. Although details can be debated, no strong case exists that Europe's welfare states were much more extensive or intrusive in the 1970s than in the 1960s, and no case at all exists that there was more interference in markets in the 1980s than in the 1970s. Why did a social system that seemed to work extremely well in the 1960s work increasingly badly thereafter?"

In the case of generous benefits, OECD (1994, chap. 8) pointed out that empirical studies failed to find any cross-country correlation between unemployment benefits and aggregate unemployment for data prior to the European unemployment crisis of the 1980s. In fact, there was even a negative correlation between benefit levels and unemployment in the 1960s and early 1970s.

The stability of European labor market institutions throughout these decades leads us to consider the possibility that changes in the economic environment interacted with those institutions to unleash persistently high unemployment. Thus, we shall pursue Blanchard and Wolfers' (2000) theme about the *interaction* of shocks and institutions, but with a twist. Unlike researchers who look for macroeconomic shocks, we shall focus on *microeconomic* shocks concealed within slow moving macroeconomic averages.

Aggregate shocks or microeconomic turbulence?

The oil-price increases of 1973 and 1979 are commonly cited causes of the outbreak of high European unemployment, see e.g. Layard et al. (1991, chap. 8). In Phelps's (1994, chap. 18) account, these oil price shocks are later supplanted by high real interest rates due to growing world public debt: " by 1986 or 1987 the real price of oil was back to its level of the early 1970s. So it was largely the high real interest rates lasting over most of the decade that account for the high equilibrium unemployment rates in the late 1980s." In addition to high real interest rates, Blanchard and Wolfers' (2000) empirical work suggests that two more aggregate shocks have explanatory power – declining total factor productivity growth in Europe since the early 1970s and a decreasing labor share of output since the 1980s.

Rather than focusing on *aggregate* shocks, both Bertola and Ichino (1995) and Ljungqvist and Sargent (1998) cited *microeconomic* evidence of increasing volatility in worker's earnings during and after the 1980's. They referred to a study by Gottschalk and Moffitt (1994) who provided evidence for growing instability in earnings of U.S. workers over the 1970s and 1980s. Gottschalk and Moffitt divided data for white males in the Michigan Panel Study of Income Dynamics (PSID) into two nine-year periods, 1970–78 and 1979–87. After adjusting for age-earnings profiles, for each individual within each period they calculated the mean of log earnings over all nine years and the deviation of log earnings from mean in each year. They computed the "permanent variance" of log earnings for each nine-year period as the variance of the means across individuals, whereas they defined the "transitory variance" to be the variance of the nine annual transitory components separately for each individual and by then averaging them across individuals.

Table 4 contains Gottschalk and Moffitt's calculations. The first row shows that the permanent and transitory variances of log annual earnings both rose by approximately 40% between the two subperiods. Since the transitory variance is roughly half as large as the permanent variance and the two variances sum to the total cross-sectional variance, the findings indicate that one-third of the widening of the earnings distribution has resulted from a rise in the instability of earnings.[1] To examine whether the rise in transitory variance merely reflected an increase in the instability of employment, the next two rows in Table 4 decompose annual earnings into weekly wages and weeks worked during the year. The calculations show that roughly half of the increase in the variance of transitory annual earnings is a result of an increase in the variance of weekly wages.

Bertola and Ichino (1995) interpreted Gottschalk and Moffitt's findings of greater earnings instability as reflecting more volatile local demand shocks since the 1980s. Given a rigid wage and the high firing costs that prevail in Europe, they showed that a higher likelihood of negative shocks in the near future decreases labor demand by hiring firms. Then so long as the wage rate does not fall, the equilibrium unemployment rate would rise.

[1] Gottschalk and Moffitt (1994) did the same calculations for different subgroups classified by education and age, and found that the variance of permanent and transitory earnings increased for all subgroups.

Ljungqvist and Sargent (1998) imputed part of the increased earnings variability to shocks to individual workers' human capital. Human capital is accumulated on the job but can be lost during spells of unemployment and also at the time of an involuntary job loss. According to our 1998 model, generous benefits produce high long-term unemployment in Europe because the last couple of decades saw an increased probability of human capital loss at the time of an involuntary job displacement. This is our way of modelling increased economic turbulence facing individual workers. Before extending our 1998 model to capture additional important features of the data that it neglected, we summarize more evidence that earnings variability has increased.

Increased earnings variability

Gottschalk and Moffitt's discussants, Dickens (1994) and Katz (1994), were both intrigued by their documentation of the increased earnings instability that had until then only been the subject of speculation by the public and media. These discussants also called for further study to shed light on this finding and to check its robustness. Additional research has supported and extended the initial results. Katz and Autor (1999, p. 1495) summarize the state of knowledge in the Handbook of Labor Economics:

> "A consistent finding across studies and data sets is that large increases in both the permanent and transitory components of earning variation have contributed to the rise in cross-section earnings inequality in the United States from the late 1970s to early 1990s. The increase in the overall permanent component consists of both the sharp rise in returns to education and a large increase in the apparent returns to other persistent (unmeasured) worker attributes. The rise in cross-sectional residual inequality for males (controlling for experience and education) in the 1980s seems to consist of approximately equal increases in the permanent and transitory factors."

For household data on consumption and income from Britain, Blundell and Preston (1998) used the cross-equation restrictions from a permanent income model to infer variations over time in variances of innovations to both permanent and transitory components of earnings. Over the period 1968–1992, they found substantial growth in inequality coming from the transitory part. They also found that at the end of their sample period younger cohorts faced substantially larger permanent innovation variances than older cohorts had at similar ages.

Our concept of economic turbulence differs from another common definition based on sectoral reallocation. Layard et al. (1991, p. 46) had in mind sectoral reallocation when they asked and answered the question: "has turbulence increased since the 1960s in a way that could help to explain increased unemployment? The answer is a clear no." They computed the proportions of jobs in each industry in adjacent years and then took the changes in each proportion. After summing the positive changes to get a measure of the proportion of employment switching industries, they found that turbulence had not increased enough to explain the emergence of high European unemployment.

But individual workers can experience turbulence in our sense without changes in the economy's sectoral composition. As reported by Davis, Haltiwanger and Schuh (1996), about one in ten manufacturing jobs disappears in the United States in an average year, and a comparable number of new manufacturing jobs is created. Two-thirds of this job creation and job destruction are concentrated at plants that expand or contract by 25 per cent in one year. Workers who are laid off in the process of job destruction might not necessarily qualify for new jobs created in the same industry. A case in point is provided by Shaw (2002) who studies the introduction of new technologies in the U.S. steel industry and their effects on employment. She documents that the restructuring of the steel industry has led to new hiring standards that emphasize independent thinking, ability to solve mechanical problems, and communication skills. As a result, many of the less skilled workers laid off at older, declining steel mills are not considered for employment at the newer steel mills. We now turn to some evidence about how displaced workers fare in terms of lost earnings.

Earnings losses of displaced workers

Another line of empirical inquiry that addresses economic turbulence in labor markets is the study of displaced workers, individuals with established work histories who have involuntarily separated from their jobs. Jacobson, LaLonde and Sullivan (1993) studied the earnings losses of displaced workers in Pennsylvania during the early and mid-1980's.

From administrative data they identified displaced workers with 6 or more years of tenure on the predisplacement job, and compared their earnings with those of workers who kept their jobs throughout the period 1974–86.

Like earlier researchers, Jacobson et al. found that high-tenured workers incurred large losses at the time of separation, but their data also reveal a consistent intertemporal response to these losses. Displaced workers' relative earnings already begin to decline three years prior to their displacement, drop sharply when they actually lose their jobs, and then rise rapidly during the next six quarters. After that point, however, these workers' earnings recover very slowly, so that five years after separating from their former firms, their losses still amount to 25 percent of their predisplacement earnings. Figure 2 reproduces Jacobson et al.'s figure 1, which dramatically shows the disparate expected earnings patterns of high-tenured workers who were displaced in the first quarter of 1982 compared to workers who remained employed throughout the period. Schoeni and Dardia (1996) found similar long-run earnings losses of 17 to 25 percent for workers separating from declining firms in California in the early 1990's.[2]

European studies of displaced workers have only begun to appear. A common finding seems to be that earnings losses *and* reemployment probabilities of displaced workers are both smaller in Europe than in the United States. For Germany, Burda and Mertens (2001) remark:

> "As only around 80% of all displaced workers [in Germany in 1986] are observed in socially insured employment even 4 years afterwards, it seems that lower displacement wage losses in Germany come at the cost of lower reemployment probabilities."

Our modelling strategy

Our tool for understanding the data is a general equilibrium model. We first calibrate the model's parameters to fit some observations, then check how various quantitative predictions from the model line up with dimensions of the data not used in the calibration

[2] For surveys on displacement studies in the United States, see Hamermesh (1989), Fallick (1996), and Kletzer (1998).

stage. Our model incorporates several features from our earlier work (Ljungqvist and Sargent (1995, 1998) and Ljungqvist (2001)) and adds important new elements that enrich our predictions.

The closest antecedent of the present model is our study of two decades of high European unemployment (Ljungqvist and Sargent (1998)). In that paper, we focused on how institutions for compensating unemployment interact with microeconomic shocks impinging on workers' human capital. We captured adverse incentive effects of arrangements that link generous unemployment compensation to past earnings by modelling geometrically lived (ageless) workers in an environment where unemployed workers must search for jobs and where human capital increases during employment spells and decreases during unemployment spells. A key parameter measured the human capital lost at the beginning of an involuntary spell of unemployment. An increase in that parameter captured the increased volatility of earnings outcomes observed in the U.S. during the 1980's and also implied a substantial increase in the equilibrium unemployment rate under European rules governing unemployment compensation. However it implied no increase under stingy U.S. rules. The model thus explained the rise in Europe's unemployment rates relative to America's in the 1980s.

But our 1998 model missed some important aspects of European unemployment. Because we assumed that workers do not age, our model could not confront the fact that long-term unemployment in Europe is especially high among older workers. Also, our model did not explain why during the 1950s and 1960s Europe's unemployment rates were actually *lower* than those in the U.S. despite Europe also having generous rules then for compensating unemployed workers.

This paper makes three significant modifications to our model that enable us to understand these features of the data: (a) workers now belong to different age classes, age stochastically, and behave differently at different stages of life; (b) there are costs of firing workers; and (c) a job offers a Markov process of wages per unit of human capital. Feature (a) allows us to study the differential effects of labor market institutions on workers of different ages. At our pre-1980s setting for the key human-capital-loss parameter, features (b) and (c) interact to let high firing costs push unemployment rates *down* by reducing frictional unemployment, thereby allowing us to explain the lower European unemployment of the 1950s and 1960s. That effect is reversed when the human capital loss parameter is set at its 1980s level. Thus, the effects of layoff costs on the unemployment rate depend on the proportions of frictional and structural unemployment.

2. The Economy

There is a continuum of workers with geometrically distributed life spans, indexed on the unit interval with births equaling deaths. Each worker passes through a finite number of age classes, indexed by $a = 1, 2, \ldots, A$, with transition probability from age class a to a' denoted by $\alpha(a, a')$. Aging occurs sequentially, i.e., $\alpha(a, a') = 0$ if $a' \neq a, a+1$; and all workers reach retirement, i.e., $\alpha(a, a) + \alpha(a, a+1) = 1$ for $a = 1, 2, \ldots, A-1$. Hence, the probability of retirement from the highest age class A is equal to $1 - \alpha(A, A)$.

An unemployed worker in period t chooses a search intensity $s_t \geq 0$ at a disutility $c(s_t)$ that is increasing in s_t. Search yields a probability of a job offer in the next period. With probability $\pi(s_t)$, next period the unemployed worker will receive one wage offer from the distribution $F(w) = \text{Prob}(w_{t+1} \leq w)$. With probability $(1-\pi(s_t))$, the worker will receive no offer in period $t+1$. We assume that $\pi(s_t) \in [0, 1]$ and that it is increasing in s_t. Accepting a wage offer w_{t+1} means that the worker earns that wage (per unit of skill) in period $t+1$, and thereafter receives a Markov wage process $G(w'|w) = \text{Prob}(w_{t+i+1} \leq w'|w_{t+i} = w)$ for each period he has not retired, has not been laid off, and has not quit his job. The probability of being laid off at the beginning of a period is $\lambda \in [0, 1]$.

Employed and unemployed workers experience stochastic accumulation or deterioration of skills, respectively. There is a finite number of skill levels with transition probabilities from skill level h to h' denoted by $\mu_u(h, h')$ and $\mu_e(h, h')$ for an unemployed and an employed worker, respectively. That is, an unemployed worker with skill level h faces a probability $\mu_u(h, h')$ that his skill level at the beginning of next period is h', contingent on not retiring. Similarly, $\mu_e(h, h')$ is the probability that an employed worker with skill level h sees his skill level change to h' at the beginning of next period, contingent on not being laid off. In the event of a layoff, the transition probability is $\mu_l(h, h')$. After this initial period of a layoff, the stochastic skill level of an unemployed worker is again governed by the transition probability $\mu_u(h, h')$. All newborn workers begin with the lowest skill level.

A worker observes his new age and skill level at the beginning of a period before deciding to accept a new wage offer, choose a search intensity, or quit a job. Each worker maximizes the expected value $E_t \sum_{i=0}^{\infty} \beta^i y_{t+i}$, where E_t is the expectation operator conditioned on information at time t, β is the subjective discount factor, and y_{t+i} is the worker's after-tax income from employment and unemployment compensation at time $t+i$ net of disutility of searching.[3] (The variable y_{t+i} assumes the value zero after retirement.)

Workers who were laid off are entitled to unemployment compensation benefits that depend on their last earnings. Let $b(I)$ be the unemployment compensation to an unemployed worker whose last earnings were I. Unemployment compensation is terminated if the worker turns down a job offer with earnings that are deemed to be 'suitable' by the government in view of the worker's past earnings. Let $I_u(I)$ be the government determined 'suitable earnings' of a laid off worker whose last earnings were I.

A worker quitting his job is entitled to unemployment compensation only if the foregone earnings falls short of a 'suitable earnings' criterion based on the worker's earnings in the previous period. Let $I_e(I)$ be the government determined 'suitable earnings' of an employed worker whose earnings in the previous period were I. A quitter who is entitled to unemployment compensation falls under the same rules as a laid off worker. Newborn workers are not qualified for unemployment compensation.

Income from employment and unemployment compensation are both subject to a flat rate income tax of τ. In equilibrium, the government policy functions $b(I)$, $I_u(I)$ and $I_e(I)$ and the tax parameter τ are set so that income taxes cover the expenditures on unemployment compensation.

An additional policy instrument is a tax on job destruction. Each worker who is laid off or quits his job has to pay a tax K. It is irrelevant for the analysis of employment whether this tax constitutes a deadweight loss or whether the tax proceeds are handed back lump sum to all workers.

Workers' optimization behavior

Let $V(a, h, w, I)$ be the value of the optimization problem for a worker of age a and skill level h, who was employed in the previous period with income I and today has the

[3] We discuss the justification of the linear utility specification in a section below.

option to work at the wage w. The value associated with being unemployed and eligible for unemployment compensation benefits is $V_b(a,h,I)$, which is a function of the unemployed worker's age a, skill level h, and last earnings I. In the case of an unemployed worker who is not entitled to unemployment compensation, the corresponding value $V_o(a,h)$ depends only on the worker's age and skill level. The Bellman equations are:[4]

$$\text{(1)}\quad V(a,h,w,I) \;=\; \max_{\text{accept,reject}} \Big\{ \Omega(a,h,w)\,, \\ D(h,w,I)V_b(a,h,I) \;+\; \Big(1-D(h,w,I)\Big)V_o(a,h) \;-\; K \Big\}\,,$$

$$\text{(2)}\qquad V_b(a,h,I) \;=\; \max_s \Bigg\{ -c(s) \;+\; (1-\tau)b(I) \;+\; \beta \sum_{a'} \alpha(a,a') \sum_{h'} \mu_u(h,h') \\ \cdot \Bigg[\big(1-\pi(s)\big)V_b(a',h',I) \;+\; \pi(s) \\ \cdot \Bigg(\int_{w<I_u(I)/h'} \max_{\text{accept,reject}} \Big\{ \Omega(a',h',w)\,, V_b((a',h',I) \Big\} dF(w) \\ + \int_{w\geq I_u(I)/h'} \max_{\text{accept,reject}} \Big\{ \Omega(a',h',w)\,, V_o((a',h') \Big\} dF(w) \Bigg) \Bigg]$$

$$\text{(3)}\qquad V_o(a,h) \;=\; \max_s \Big\{ -c(s) \;+\; \beta \sum_{a'} \alpha(a,a') \sum_{h'} \mu_u(h,h') \Bigg[(1-\pi(s))\, V_o(a',h') \\ + \; \pi(s) \int \max_{\text{accept,reject}} \Big\{ \Omega(a',h',w)\,, V_o((a',h') \Big\} dF(w) \Bigg]\,,$$

where

$$\Omega(a,h,w) \;\equiv\; (1-\tau)wh \;+\; \beta \sum_{a'} \alpha(a,a') \Big[\lambda \sum_{h'} \mu_l(h,h') V_b(a',h',wh) \;-\; \lambda K \\ + \; (1-\lambda) \sum_{h'} \mu_e(h,h') \int V(a',h',w',wh)\, dG(w'|w) \Big]\,,$$

[4] We have left out any lump-sum transfers to workers of the government's proceeds from the tax on job destruction. Such lump-sum transfers would not affect workers' decision rules for reservation wages and search intensities.

$$D(h,w,I) \;=\; \begin{cases} 1, & \text{if } wh < I_e(I); \\ 0, & \text{if } wh \geq I_e(I). \end{cases}$$

Associated with the solution of equations (1)–(3) are two functions, $\overline{s}_b(a,h,I)$ and $\overline{w}_b(a,h,I)$, giving an optimal search intensity and reservation wage of an unemployed worker of age a and skill level h with last earnings I, who is eligible for unemployment compensation benefits; two functions, $\overline{s}_o(a,h)$ and $\overline{w}_o(a,h)$, giving an optimal search intensity and a reservation wage of an unemployed worker of age a and skill level h, who is not entitled to unemployment compensation; and one function $\overline{w}(a,h,I)$, giving a reservation wage for an employed worker of age a and skill level h with last period's earnings I.

Linear utility focuses attention on incentives

To focus our analysis on the incentive effects of unemployment compensation on labor supply under different economic environments, we have made the one-period payoff linear in after-tax income. The linear utility specification makes workers choose their labor supplies by comparing the different present values of the after-tax incomes, net of search costs, that are associated with the options confronting them.

Of course, we recognize that the assumption of linearity in after-tax payoffs precludes rationalizing unemployment compensation as a socially desirable insurance program for workers who cannot otherwise insure themselves, either through explicit insurance against job losses or through precautionary savings that sustain some self-insurance. Normative analyses of unemployment insurance, such as Shavell and Weiss (1979) and Hopenhayn and Nicolini (1997), impute concave one-period utility functions to workers and make a worker's consumption both observable and controllable by an insurance agency. To rationalize experience-rated unemployment compensation schemes, those analyses also cut workers off from all other insurance and storage opportunities, and this affects the analysis sensitively. As Ivan Werning (2002) emphasizes, if the Shavell-Weiss setting is altered to let workers borrow and lend at a gross risk free rate of interest equal to β^{-1}, then the scope for a social insurance scheme is substantially circumscribed; when they have access to borrowing and lending arrangements, workers' evaluations of the present values of alternative labor-market options become paramount (an insight also present in Allen (1985) and Cole and Kocherlakota (2001)).

Thus, in settings in which workers can save or borrow through market or nonmarket (e.g., family) arrangements, the dominant incentive effects of government supplied unemployment insurance occur through the present values of alternative options. By using linear utility, we intend to spotlight these incentive effects.

In the case of Europe, one could also argue that the focus of our analysis is justified by the very high levels of government provided insurance. Benefits with high replacement rates and indefinite duration drastically reduce the consumption risk faced by individual workers leading us to focus on the incentive effects of those insurance schemes. Therefore, our decision to abstract from risk aversion and not to model private risk sharing arrangements does not seem to be too confining in the European context. Rather, our simpler framework gains in transparency and brings out economic forces that would also be present and drive the results in a richer model with concave utility functions and asset accumulation. In the case of the United States, relaxing our assumption of linear utility would if anything strengthen our result that the U.S. unemployment rate does not rise sharply in turbulent economic times. Risk averse agents faced with stingy government insurance would be compelled to adjust their reservation earnings in response to negative shocks and return to work relatively quickly to earn a living. It should be noted that unemployed workers in the United States seem to achieve substantial consumption smoothing. Gruber (1997) estimates that unemployed workers without unemployment benefits experience consumption declines of 22 percent. Thus, a linear utility specification might not be such a bad approximation even for the kind of labor market outcomes observed in the United States.[5]

Human capital evaporates after layoffs but not after quits

An important aspect of our specification is that workers experience no depreciation of human capital when they *quit*, even in turbulent times; but if they are *laid off*, they acquire a possibly lower new skill level drawn from the transition probabilities for skills

[5] We are thankful to Robert Hall for this insight.

after layoffs, $\mu_\ell(h, h')$. This specification captures our vision that victims of layoffs, not quitters, are the unlucky ones. We see quitters as people who are secure in their skills and inspired to change jobs to make better use of their current skills. The shocks drawn from $G(w'|w)$ and $\mu_e(h, h')$ that propel quits do not so adversely affect the future earnings of quitting workers as do the events associated with layoffs.[6]

3. Calibration

We set the model period to be two weeks. We set the discount factor $\beta = 0.9985$, making the annual interest rate 4.0 percent. There are four age classes with probabilities of remaining within an age class equal to 0.9985 for the first age class and 0.992 for each of the other three age classes. The time spent in an age class is then geometrically distributed with an expected duration of 25.6 years in the first age class and 4.8 years in each of the other three age classes. We label the four age classes as age groups '20–45', '45–50', '50–55' and '55–60', respectively.

The probability of being laid off is $\lambda = 0.006$. Given that the worker has not quit or retired, the average time before being laid off is 6.4 years.

There are 11 different skill levels evenly partitioning the interval $[1, 2]$. All newborn workers start with the lowest skill level equal to one. After each period of employment that is not followed by a layoff, with a probability of 0.05 the worker's skills increase by one level (0.1 units of skill), and with probability .95 they remain unchanged. Employed workers who have reached the highest skill level retain those skills until becoming unemployed. As a point of reference, someone who starts working with the lowest skill level will on average reach the highest skill level after seven years and eight months, conditional upon no job loss. The stochastic depreciation of skills during unemployment is twice as fast as the accumulation of skills. That is, after each period of unemployment, there is a probability

[6] Den Haan, Haefke, and Ramey (2001) make the alternative assumption that quitters are subject to the same risk of instantaneous skill loss as workers being laid off. With that assumption, they show that in their model, an increase in economic turbulence reduces the unemployment rate because workers fear the potential skill losses that are associated with both voluntary and involuntary job separation, depressing the inflow rate into unemployment.

of 0.1 that the worker's skills decrease by one level; otherwise they remain unchanged.[7] The lowest skill level reached through depreciation is also an absorbing state until the unemployed worker gains employment.

To represent economic turbulence, we use the theoretical construct of Ljungqvist and Sargent (1998) in which a newly involuntarily displaced worker experiences an instantaneous reduction in his human capital modelled as a draw from a truncated left half of a normal distribution with specified variance. We use this specification to study six different degrees of economic turbulence (with the variance of the underlying normal distribution in parenthesis): T00 (var. 0), T03 (var. 0.03), T05 (var. 0.05), T10 (var. 0.1), T20 (var. 0.2) and T99 (uniform distribution). Only during tranquil times (T00) does the worker retain his skill level from the latest period of employment when laid off.

The disutility from searching and the function mapping search intensities into probabilities of obtaining a wage offer are assumed to be

$$c(s) = 0.25\, s\,,$$
$$\pi(s) = 0.5 s^{0.3}\,, \qquad \text{where } s \in [0,1]\,.$$

The exogenous wage offer distribution $F(w)$ is assumed to be a normal distribution with a mean of 0.7 and a variance of 0.02 that has been truncated to the unit interval and then normalized to integrate to one. The Markov wage process on the job is as follows. With probability 0.98, the wage will be the same as in the previous period, and with probability 0.02, the wage is drawn from the distribution $F(w)$. The average time between wage draws on the job (given that the worker has not quit or retired) is 1.9 years. Since a worker's earnings are the product of his wage and current skill level, it follows that observed earnings fall in the interval $[0,2]$.

For purposes of awarding unemployment compensation, the government divides the earnings interval $[0,2]$ evenly into 20 earnings classes; let the upper limits of these classes

[7] The assumptions on skill accumulation and skill depreciation are taken from Ljungqvist and Sargent (1998), except that we have here chosen a coarser partition of the skill space in order to economize on the state space. For a motivation of the parameter values, see our earlier argument based on empirical work by Keane and Wolpin (1997).

be denoted I_i, for $i = 1, 2, ..., 20$. A laid off worker with last earnings belonging to earnings class i receives unemployment compensation of $0.6 \cdot I_i$ in each period of unemployment. However, the benefit is terminated if the worker does not accept a job offer associated with earnings greater than or equal to $0.7 \cdot I_i$. That is, the government policy functions $b(I)$ and $I_u(I)$ are such that a laid off worker faces a 'replacement ratio' equal to 60% and a 'suitable earnings' criterion equal to 70% of the upper limit of the earnings class containing his own last earnings before being laid off. Concerning quitters' entitlement to unemployment compensation, the suitable earnings criterion is the same so that $I_e(I) = I_u(I)$ for all I. Thus, a quitter receives unemployment compensation only if he would have earned less than 70% of the upper limit of the earnings class containing his last earnings before quitting.

We set the layoff tax $K = 10$, making it equivalent to 14 weeks of the average productivity of all employed workers.

4. Analysis

Tranquil economic times

Table 5 displays the steady states of the WS economy and the LF economy when there is no economic turbulence. The WS economy has significantly lower unemployment than the LF economy because of a lower inflow rate into unemployment while the average duration of unemployment is similar across the two economies. As a result, lower unemployment in the WS economy is accompanied by much longer average job tenures than in the LF economy.

Table 6 shows that the layoff cost in the WS economy is responsible for the lower unemployment rate. If the LF economy were to impose the same layoff cost, it would have an even lower unemployment rate than the WS economy.

Figure 3 depicts reservation wages in the LF economy. In the absence of unemployment compensation and layoff taxes, employed and unemployed workers share the same policy functions for the reservation wage as a function of age and skill level. A positive relationship between the reservation wage and skill level except for the lowest skill level emerges from the technology for accumulation and depreciation of skills. On the one hand, before a worker has reached the highest skill level, the potential for further skill accumulation that can be actualized by accepting a job favors a relatively low reservation wage. But at higher skill levels, the potential for further skill accumulation becomes smaller and emphasis shifts towards searching for higher wages, i.e., the reservation wage curve tends to slope upward. On the other hand, a worker's choice of reservation wage is tempered by the risk of skill depreciation while unemployed. This downward pressure on the reservation wage is smaller at lower skill levels because there are fewer skills to be lost. These forces coalesce to produce a reservation wage policy that is U-shaped in the skill level.

The reservation wages of unemployed workers who are not eligible for unemployment compensation in the WS economy, shown in Figure 4, lie slightly above those in the LF economy. An unemployed worker without benefits in the WS economy takes into account the potential future benefits from the unemployment compensation program. These are an increasing function of the worker's earnings. The optimal search intensity of these workers and the unemployed workers in the LF economy equals the highest value of one.

The reservation wages of *employed* workers yield the lower unemployment rate in the WS economy. Figure 5 depicts the reservation wages of employed workers in age group 20–45 in the WS economy. Because of the layoff tax, employed workers are reluctant to quit their jobs, making reservation wages lower than in the LF economy.

The reservation wages of *unemployed* workers with benefits in age group 20–45 in the WS economy in Figure 6 exhibit some similarities with Figure 5 except that reservation wages are much higher in Figure 6. This is especially apparent for those unemployed workers with low skills who are entitled to high benefits based on their high last earnings. Moreover, because these high reservation wages are hard to find and the generous benefits make it less costly to remain unemployed, Figure 7 shows that an unemployed worker in these circumstances invests less in search by choosing a relatively low search intensity. Figures 8 and 9 show that these adverse incentive effects of generous benefits are accentuated in the highest age group 55–60.

Fortunately, in tranquil economic times there will hardly be any unemployed workers with low skills who are entitled to high benefits based on high last earnings, so the WS economy sustains a low equilibrium unemployment rate in Table 5.

Economic turbulence

When the economic turbulence parameter is increased in Table 7, the WS economy posts an ever higher unemployment rate while unemployment is practically flat (with some drift downward) in the LF economy. The emergence of high, long-term unemployment in the WS economy is due to both generous unemployment benefits and high layoff costs.

The decision rules of unemployed workers in turbulent economic times are qualitatively the same as in times of tranquility. We can therefore use Figures 6 through 9 to illustrate how the adverse incentive effects of unemployment compensation in the WS economy are exacerbated in turbulent times. Because of turbulence there will be laid off workers who suffer significant amounts of instantaneous skill loss, and they will choose high reservation wages belonging to the "rising slopes" in Figures such as 6 and 8. Since these workers' depreciated skill levels are low relative to their recent earnings history, unemployment benefits based on last earnings look very attractive compared to their current labor market prospects. Therefore, they demand a high wage per unit of remaining skill before giving up those generous benefits. Moreover, such high wages are hard to come by so workers under these circumstances tend to become disillusioned and choose low search intensities, as depicted by the deepest "precipice" in Figures such as 7 and 9. Older laid off workers have a shorter horizon until retirement and therefore less time for any accumulation of new skills, so they are even choosier than younger workers before accepting a job and giving up their benefits. All these adverse incentive dynamics are absent from the LF economy because past earnings are not a state variable for unemployed workers. In other words, any laid off worker in the LF economy who experiences an instantaneous skill loss, will immediately adjust to the new situation and search diligently for a suitable job given the change in circumstances.

We now briefly examine the effects of layoff costs in the WS economy – a discussion that we will pursue more in a section below.

Ljungqvist (2001) showed that in a search model like ours, higher layoff costs lower the unemployment rate by reducing frictional unemployment. However, Table 8 shows that in turbulent times the effect is reversed in the WS economy because in turbulent times unemployment has both frictional and *structural* components. The structural component contains the long-term unemployed who have chosen to become less active in the labor market. In turbulent times, when agents think about withdrawing from the labor market, both the higher turbulence and the higher layoff cost make labor market participation less attractive. But in the absence of generous benefits, not participating in the labor market is not a viable option. Table 9 thus shows how the negative relationship between layoff costs and unemployment is a robust feature in the LF economy even in the face of variations in the degree of economic turbulence (even though it *isn't* such a robust feature of the WS economy).

Replication of empirical studies

We can use our model as a laboratory to replicate aspects of earnings dynamics described by Gottschalk and Moffitt (1994) and Jacobson, LaLonde, and Sullivan (1993).

Using the LF economy with economic turbulence indexed by T10 and T20, we generate artificial versions of Gottschalk and Moffitt's PSID panels for 1970–78 and 1979–87, respectively. After applying their method for decomposing each panel's earnings into permanent and transitory components, we arrive at Figures 11a and 11b as our counterparts to their Figures 2 and 4 (reproduced here in our Figures 10a and 10b). Evidently, an increase in our turbulence parameter spreads the distributions of both components of the Gottschalk-Moffitt decomposition in the direction observed. However, there are differences in the ranges of the distributions. The fact that our distribution of permanent earnings in Figure 11a spans a smaller range than the Gottschalk-Moffitt data is not surprising. Our artificial panel contains a group of homogeneous individuals who are *ex ante* identical, while the PSID used by Gottschalk and Moffitt comprises a diverse group of American males with different educational backgrounds. It is also noteworthy that the increased earnings variability in the more turbulent period in our Figure 11b occurs at lower standard deviations than Gottschalk and Moffitt's. In this respect, the increase in economic turbulence in our parameterization for the 1980's falls short of the changes documented for the U.S.

As discussed in the introduction, our Figure 2 depicts Jacobson et al.'s (1993) Figure 1 of earnings losses experienced by displaced workers in Pennsylvania in the first quarter of 1982. Using artificial data from the LF economy with economic turbulence indexed by T20, we produce a counterpart of their graph in Figure 12. The surprisingly good fit here is obtained for our subsample of separators who have experienced skill losses of at least 30%. These separators constitute roughly one third of all separators in our artificial data set.

Displaced workers in the WS economy versus the LF economy

Empirical studies of displaced workers in Europe have started to appear (see for example Burda and Mertens (2001)). A common finding seems to be that European workers experience both smaller earnings losses on average and lower re-employment rates than their American counterparts. We now examine whether there are such differences between our WS economy and LF economy. From hereon, we let economic turbulence be indexed by T20.

We follow two cohorts of workers who were laid off in age groups 45–50 and 55–60, respectively. Prior to the layoffs, these workers were distributed across skills and wages according to the stationary distribution for the employed in each age group. Table 10 reports that these cohorts fare similarly in the LF economy with mean earnings losses of around 15% among the re-employed workers one year after the layoffs, and an unemployment rate of about 4%. In comparison, the re-employed workers in the WS economy suffer smaller earnings losses but have a higher incidence of unemployment. This is especially true for the higher age group 55–60, where the average earnings loss is less than 9% but the unemployment rate exceeds 11% one year after the layoffs. Figure 13a depicts the distribution of those earnings losses in age group 55–60 for both economies.

The lower panel of Table 10 shows how the employment performance of the WS economy further deteriorates when looking at the subgroup of laid-off workers who suffered skill losses of at least 20% at the time of the layoffs. But it remains true that the re-employed workers of the WS economy suffer significantly lower earnings losses than the LF economy. The distribution of those earnings losses in age group 55–60 is depicted in Figure 13b.

Long-term unemployment in the WS economy

Figure 14 portrays the problem of long-term unemployment in the WS economy by showing hazard rates of gaining employment when economic turbulence is indexed by T20. The hazard rate declines dramatically with the length of an unemployment spell. There are also significant differences across age groups. In particular, the figure shows that the hazard rate of workers in age group 20–45 does not fall off as fast as the one for older workers in age group 55–60. To demonstrate that the disparity is mainly due to the *age effect*, the figure also displays an adjusted hazard rate for age group 20–45 when the cohort entering unemployment has the same distribution of skills and entitlements to unemployment compensation as the one for age group 55–60. Adjusting the hazard rate does little to bridge the difference in hazard rates between the two age groups.

As we would then expect, in Table 11 long-term unemployment is more common among the unemployed in higher age groups. Older workers do have a lower inflow rate into unemployment but it is not sufficient to counter their less favorable hazard rates of accepting jobs so that the unemployment rate is also higher among older workers. The lower inflow rate into unemployment for older workers comes from these workers' greater willingness to hold onto jobs that have suffered poor productivity draws. Older workers have less time left in the labor market, so it makes less sense for them to quit jobs and invest in search for better job opportunities. That is, employed older workers have lower reservation wages than younger employed workers, given the same skill level.

Heterogeneity versus duration dependence

A question that has attracted much attention is whether the negative relationship between hazard rates and the length of unemployment spells is due to *heterogeneity*, in that unemployed workers with high re-employment rates leave unemployment first, or whether it reflects *duration dependence*, by which the passage of time reduces the chances for any unemployed worker to gain employment. Our model has aging and skill level deterioration as sources of duration dependence for each individual. Our model's sources of heterogeneity are in the cross section distribution of age, skills, and entitlements to unemployment benefits at the time of quits and layoffs. For our model, we can evaluate the relative importance of heterogeneity and duration dependence by constructing an adjusted hazard rate where age, skills, and entitlements to unemployment compensation are held constant for each worker throughout an unemployment spell. Figure 15 shows that the adjusted hazard rate is only marginally higher at each point in time, so that we can conclude that in our model under economic turbulence indexed by T20, the falling hazard rate is caused almost entirely by *heterogeneity*. That is, already at the time of quits and layoffs, the unemployed are heterogeneous with respect to reemployment probabilities because of different choices of reservation wages and search intensities that are motivated by a worker's age, current skill level, and his entitlement to unemployment benefits. In turbulent times, there are laid off workers with large instantaneous skill losses, who with high probability at the very start of their unemployment spells are already destined for long-term unemployment.

It is instructive to present the hazard rate and its adjusted version in tranquil economic times (indexed by T00). Figure 16 shows that the average hazard rate in the economy plummets towards the end of the second year of an unemployment spell, and that the high hazard rate until then explains why the average duration of unemployment spells is only around two months and thus why there is hardly any long-term unemployment in tranquil economic times (see Table 5 or 7). Moreover, duration dependence is now the sole explanation for why the hazard rate falls over time. Workers age and lose skills during an extended period of unemployment, and both of these factors eventually raise reservation wages per unit of skill and lower search intensities. Recall that skills are assumed to decay gradually during unemployment, and it takes on average three years and ten months for someone to lose all his skills conditional upon having attained the highest skill level prior to the layoff. This slow of rate of skill depreciation in tranquil economic times explains why the adverse incentive effects manifested as a falling average hazard rate does not set in until at least one and one half year into an average unemployment spell. And since there is no instantaneous skill loss at layoffs in tranquil times, the construction of the adjusted hazard rate arrests *all* skill depreciation of workers losing their jobs. The virtually constant adjusted average hazard rate in Figure 16 then implies that all unemployed workers with their earnings potential intact, are equally unhappy with a 60% replacement rate and prefer to return to work, i.e., they exhibit similar reemployment probabilities.

Heterogeneity versus a representative family

Our model emphasizes an important feature of the data that many other models ignore, namely, the diversity of unemployment experiences across individuals. Some individuals face very low hazard rates of escaping unemployment, but the reemployment probabilities of other workers appear to be high. A fairly diverse group of unlucky European workers, including disproportionately many older workers, experience protracted spells of long-term unemployment and seem unable to find acceptable jobs. The spells of long-term unemployment frequently end with transitions into disability insurance or early retirement. As noted by Layard, Nickell, and Jackman (1991) and others, an explosion in these adverse labor market dynamics caused the dramatic increase in European unemployment after 1980. Therefore, we believe that any explanation of the European unemployment problem should confront why hazard rates of gaining employment fall sharply with the length of unemployment spells and should explain the incidence and distribution of long-term unemployment.

However, most macroeconomic models of the European unemployment problem ignore the observed heterogeneity in individuals' labor market experiences. For example, the frequently used matching framework makes the aggregate pool of unemployed a critical determinant of the rate at which any particular unemployed worker gets matched with a vacancy, with the implication that hazard rates of escaping unemployment remain constant over the duration of unemployment spells, and that an increase in long-term unemployment amounts to an equal lengthening of the average duration for all unemployment spells. Mortensen and Pissarides (1999a) loosen this outcome by introducing separate matching functions for unskilled and skilled workers. They attribute the European unemployment problem to skill-biased technological change that causes the unemployment rate to increase for unskilled workers and to fall for skilled workers. In particular, an absolute decline in the productivity of unskilled workers makes the constant value of home production relatively more attractive, so if measures of labor market tightness were to remain unchanged, the unskilled workers would reap a larger relative share of the production result when bargaining with employers. That disturbs the equilibrium unemployment rate. In order to restore the profitability of employers, the equilibrium unemployment rate of unskilled workers must increase – both to reduce the average time and cost to fill vacancies and to weaken the bargaining strength of unskilled workers. The implication for skilled workers with increasing productivity is exactly the opposite, and their unemployment rate should fall. While it does introduce some heterogeneity across workers, this theory of the European unemployment problem still predicts constant hazard rates of escaping unemployment for broad groups of workers.

The neoclassical growth model with homogeneous labor and a stand-in household, a.k.a. the real business cycle model, is void of all the individual labor market dynamics that make up the core of our analysis. Prescott (2002) has recently used the growth model to explain among other things the economic performance of the French economy. Prescott argues that "France is depressed by 30 percent relative to the United States because the French labor factor is 30 percent lower. The difference in the labor factors is due to differences in the tax systems." In particular, using estimates of marginal tax rates on labor income and consumption, Prescott shows that the Euler equation of the stand-in household can rationalize that market time is about 30 percent lower in France than it is in the United States. He avoids the issue of decomposing the aggregate labor input into employment and average hours of work per employed by invoking aggregation results behind the stand-in household utility function. Specifically, in the presence of indivisibilites in hours of work per employed, Rogerson (1988) and Hansen (1985) have established that employment lotteries are welfare enhancing and would be operational in a complete-market world. Individual households would trade probabilities of working and rely on contingent claim markets to insure away any unwanted consumption risk associated with those lotteries.

Besides downplaying idiosyncracies on the level of individual workers, these alternative frameworks offer a sharply different view of the equilibrium forces that sustain high European unemployment. In a matching model, all of the unemployed constitute a "reserve army" that is needed in order for firms to break even. If unemployment were to be exogenously perturbed downward, the probability of filling a vacancy would drop and the bargaining strength of employed workers would increase, so that European firms would not be able to recover the expected vacancy costs associated with hiring new workers. Alternatively, in a model with employment lotteries, a high unemployment rate in Europe reflects the fact that the populations of Europe have substituted leisure for consumption by engaging in transactions that randomly assign workers to "long-term leisure" and the consumption risks associated with these lottery outcomes are somehow shared collectively, possibly, through generous unemployment compensation schemes. Hence, the market forces would undo any exogenous downward perturbation in unemployment by in effect furlowing some workers in order to bring the stand-in household's marginal rate of substitution between leisure and consumption into line with the ratio of the marginal after-tax wage rate to the price of consumption including any consumption tax. In our search model, there are no such equilibrium forces that would cause an immediate reversal of an exogenous reduction in unemployment. Instead, a temporary exogenous arrival of acceptable job opportunities would have a persistent effect on employment. Europe would enjoy an exogenous downward perturbation in unemployment until idiosyncratic shocks in the future would eventually deteriorate labor market prospects for individual workers and cast them into long-term unemployment, which would then move the European unemployment rate back up to its high steady-state level.

Given the different equilibrating forces in each framework, it is not surprising that the employment effects of layoff costs also differ between the models. Our search model attributes the low European unemployment rate in the 1950s and 1960s to policies making layoffs very costly. In contrast, an employment-lottery model has the exactly opposite implication with employment falling with higher layoff costs, as shown by Hopenhayn and Rogerson (1993). The explanation for this is that the private economy perceives higher layoff costs as equivalent to a less productive technology so the stand-in household substitutes away from consumption towards leisure by choosing a lower probability of working in the lotteries over employment.[8] Millard and Mortensen (1997) arrive at the same positive relationship between layoff costs and unemployment in a matching model that they use to study American and British labor market policies. As explained by Ljungqvist (2001), their finding hinges critically upon the assumption that the layoff costs are already imposed upon an employer in its very first encounter with a job seeking worker. That is, the layoff cost adversely shifts an employer's threat point in wage bargaining and

[8] The substitution effect prevails over the income effect because to a first-order approximation the latter effect is neutralized, since layoff costs are assumed to be a layoff tax where the tax revenues are handed back lump-sum to the agents.

therefore the worker's relative share of the match surplus increases with the layoff cost. To restore the profitability of firms, the equilibrium unemployment rate must increase so that the average time and cost to fill vacancies are reduced and the worker's bargaining strength is thereby weakened. However, if layoff costs are not assumed to affect threat points but only enter negatively in the match surplus, then the matching model with its standard Nash-bargaining formulation produces a negative relationship between layoff costs and unemployment, as demonstrated by Mortensen and Pissarides (1999b).[9]

The negative employment effects of layoff costs in what we can call the standard matching model and in our search model, agree with the insight developed by Deputy Commissioner Myers (1964, p. 180–181) when trying to answer his own query about what explained the low European unemployment rate in the 1950s and 1960s, as quoted in our introduction. His cautious warning about the efficiency losses of instituting a policy of layoff costs is also born out in our analysis.

> "One of the differences [between the United States and Europe] lies in our attitude toward layoffs. The typical American employer is not indifferent to the welfare of his work force, but his relationship to his workers is often rather impersonal. The interests of his own employers, the stockholders, tend to make him extremely sensitive to profits and to costs. When business falls off, he soon begins to think of reduction in force . . .
>
> In many other industrial countries, specific laws, collective agreements, or vigorous public opinion protect the workers against layoffs except under the most critical circumstances. Despite falling demand, the employer counts on retraining his permanent employees. He is obliged to find work for them to do. . . .
>
> These arrangements are certainly effective in holding down unemployment. But they involve a very heavy cost. They partly explain the traditionally

[9] For a detailed discussion of the employment implications of layoff costs in different frameworks, see Ljungqvist (2001).

lower productivity and lower income levels in other countries. Here is something we can learn from our neighbors, therefore, but are we quite sure we want to learn it? Are there not better ways to reduce unemployment?"

Something that Myers did not anticipate (and neither did we at the outset of this inquiry) is that the employment effects of layoff costs can be reversed in a welfare state with generous benefits when economic turbulence increases. According to our analysis, Europe has had both frictional unemployment and a substantial amount of *structural* unemployment during the last two decades of economic turbulence. By structural unemployment we mean to refer to those long-term unemployed workers who have to a large degree withdrawn from labor market participation. Layoff costs increase the incidence of such transitions into inactivity because these costs reduce the payoff to work and therefore make labor market participation less attractive. Hence, in turbulent times our search model with generous benefits becomes similar to the employment-lottery model. As mentioned, the negative employment effects of layoff costs in the latter framework emerge because employment lotteries and complete insurance markets combine to produce a high labor supply elasticity, making employment fall in response to layoff costs because of the implied lower private return to work. In our search model, workers who experience significant skill losses in turbulent times and are eligible for generous benefits also consider choosing unemployment. A lower payoff to work tips the scale toward withdrawing from labor market participation. The fact that layoff costs combined with generous benefits can have different employment effects depending on the degree of economic turbulence adds a dimension of complexity to evaluating labor market policies. Coe and Snower (1997) have emphasized the presence of strong complementarities between different policies. Our analysis suggests that the nature of those complementarities can differ between tranquil and turbulent times.

Our search model says that the European employment experience has been shaped by two factors – policies that hinder labor mobility and entitle unemployed workers to generous benefits based on past earnings, and an economic environment that has changed from a state of tranquility to one of persistent turbulence. European labor market policies are well documented and our characterization of them should not be controversial. But our perspective that there has been a fundamental change in the economic environment is currently a subject of great debate that has received much attention by both macroeconomists and microeconomists in theoretical and empirical studies. To just mention one example, Greenwood and Yorukoglu (1997) used the suggestive title "1974" when attempting to date the start of a new industrial revolution based on the introduction of information technologies. For our purposes, we can be pragmatic about the *sources* of economic turbulence. We only require that the turbulence pertains to individual workers' earnings potentials. Formally, we model turbulence as persistent shocks to workers' human capital, but it could also be other things such as losses of union wage premia. For example, Beeson, Shore-Sheppard, and Shaw (2001) report that the restructuring of the U.S. steel industry has been associated with wages for steelworkers falling from a level of approximately 35 percent above the wages of other manufacturing workers in 1979 to just 5 percent higher in 1991. They identify a reduction in the union wage premium as one explanatory factor. In the introduction, we referred to Shaw's (2002) observation that the restructuring of the steel industry has been accompanied by changing hiring standards that render some workers no longer employable in that industry. From the perspective of our analysis it makes little difference whether a laid off worker faces lower future earnings because of having to change industry or whether the worker still remains employable in his original industry that has now lost its union wage premium. In either case, generous benefits based on past earnings would make the worker reluctant to accept such earnings losses and there would be adverse unemployment dynamics as predicted by our model.

A message of our analysis is that the *aggregate* unemployment rate in Europe can be explained only by focusing on the idiosyncracies of individual workers. Any aggregation of unemployed workers into a stand-in household or a small number of static groups such as educational attainment misses the kind of individual labor market dynamics that we think is the key to understanding the European employment experience. In our view, it should be of high priority to conduct more empirical work on individual labor market histories. An interesting recent study is by Kambourov and Manovskii (2002) who document a substantial overall increase in occupational and industry mobility in the United States over the period 1968–1993. The next quests are to discover the reasons that prompt American workers to undertake more transitions between occupations and industries in the 1980s and 1990s, and that cause individual European workers to enter into long-term unemployment.

Earnings distribution

The workers of our model can be thought of as self-employed. The Bellman equations above state that an individual worker receives labor income and bears all layoff costs. As a tool to help interpret observed earnings distributions, we now consider a contractual arrangement that shields the worker both from fluctuations in his productivity arising from the Markov process $G(w'|w)$ and from the payment of the layoff cost K. Let there be financial intermediaries that offer the following contract to a worker of age a and skill level h who has found a job with initial productivity w. In exchange for the production generated by the job, the intermediary promises to pay the worker $\hat{w}(a,h,w)$ per unit of skill until the job is terminated just as it would be under self-employment. That is, job termination is triggered when the productivity per unit of skill falls below the reservation value that solves Bellman equation (1) or when the worker experiences an exogenous layoff or retirement.[10] At the time of a quit or layoff, the financial intermediary absorbs the layoff cost. The worker's obligation under the contract is to stay with the job until it is terminated by one of the stated events.

In a competitive equilibrium with free entry of intermediaries, the equilibrium contract satisfies

$$\hat{w}(a,h,w) = \frac{wh + E\Big[\sum_{t=1}^{\infty} D_t^a \beta^t \Big\{ D_t^e w_t h_t + (D_t^e - D_{t-1}^e)K \Big\} \;\Big|\; \Psi_0 \Big]}{h + E\Big[\sum_{t=1}^{\infty} D_t^a \beta^t D_t^e h_t \;\Big|\; \Psi_0 \Big]} \tag{4}$$

where

$$\Psi_0 \equiv \{a_0 = a, h_0 = h, w_0 = w, D_0^e = 1\},$$

[10] We assume that workers who enter these contracts would receive the same unemployment benefits as they would in the economy without those contracts, given their state at the time of termination. Thus, workers cannot manipulate benefit levels by entering into contractual arrangements with financial intermediaries.

$$D_t^a \equiv D^a(a_t) = \begin{cases} 1, & \text{if } a_t \le A; \\ 0, & \text{otherwise;} \end{cases} \qquad \text{for } t \ge 1,$$

$$D_t^e \equiv D^e(a_t, h_t, w_t, w_{t-1}h_{t-1}, D_{t-1}^e)$$

$$= \begin{cases} 1, & \text{if } w_t \ge \bar{w}(a_t, h_t, w_{t-1}h_{t-1}) \text{ and } D_{t-1}^e = 1; \\ 0, & \text{otherwise;} \end{cases} \qquad \text{for } t \ge 1.$$

Job finders and intermediaries are both indifferent between accepting and rejecting the contract; job finders attain the same expected utility as under self-employment and intermediaries break even. The equilibrium contract is sustainable since the intermediary and the worker will never mutually agree to renegotiate a signed contract.

Introducing insurance contracts in an economy with risk-neutral agents cannot change production outcomes. However, these contracts give rise to an alternative measure of labor income, which we denote "adjusted earnings." To compare the equilibrium values of workers' productivities ($w_t h_t$) and their adjusted earnings ($\hat{w}_t h_t$), we follow a cohort of workers that entered the WS economy and the LF economy at some time $t = 0$. Figure 17a and 17b depict the mean and standard deviations of employed workers' productivities. As we would expect, the mean productivity in the WS economy is lower than in the LF economy because it has a less efficient allocation of labor. But in terms of standard deviations there is little difference between the two economies. Figure 19 provides a snap shot of the productivity distribution at the 20-year horizon.

In contrast, Figures 18a and 18b show that the adjusted earnings of employed workers have both a lower mean and a lower standard deviation in the WS economy than in the LF economy. In Figure 20, we see how the adjusted earnings distribution at the 20-year horizon is truncated at the upper end relative to the LF economy. Because job terminations are more efficient, workers who have found good job opportunities in the LF economy are awarded higher adjusted earnings than similar job finders in the WS economy, whose jobs last longer on average but might therefore also entail lower productivities in the future.

Layoff costs can be said to accomplish a lower dispersion of adjusted earnings at the cost of a lower mean.

5. Conclusion

The European employment experience through the lens of the model

To explain differences over time in labor market outcomes in the U.S. and Europe, we have varied a key parameter, T for turbulence. We have denoted alternative values of T by Txx where .xx is the variance of a truncated normal distribution that governs the percentage decrement of a worker's human capital at the time of an involuntary job loss. We have focussed on how variations in T interact with layoff costs and rules for compensating unemployed workers to explain both aggregate and individual workers' labor market outcomes. We calibrated T so that values T00 and T03 approximate outcomes in the 1950s and 60s, T05 and T10 captures the 70s, and T20 portrays the 80s and 90s. To match outcomes from our model to the data, we think of Europe as having the welfare state (WS) arrangements for compensating unemployed workers and for making layoffs costly, and America as having laissez faire (LF) arrangements.

With little or no turbulence, T00 or T03, the equilibrium of our model mimics the 1950s and 1960s when Europe had significantly lower unemployment than the United States. As with the data, the model attributes the lower European unemployment to lower rates of flow into unemployment in the presence of similar average durations of unemployment spells. The model therefore also implies longer job tenures in Europe. With these parameter settings, long-term unemployment is not a problem in the WS equilibrium, just as it was not a problem in Europe in the 1950s and 60s.

Model outcomes associated with turbulence T05 remind us of Europe in the 1970s, when unemployment had drifted upwards to reach American levels. The model outcomes for this 1970s parameter setting contain a bad omen about the future: long-term unemployment has reared its head in the WS, as shown by our decomposition of the unemployment rate into a frictional component due to ongoing labor reallocation and a structural component consisting of the long-term unemployed. The similar overall unemployment rates in Europe and the U.S. in the 70s conceal a long-term unemployment problem that looms on the horizon for Europe.

The problem of long-term European unemployment comes out of hiding in the 1980s in the data and in our model for T20. As with data from Europe since the 1980s, in the model half of all unemployed are long-term unemployed. The model is thus consistent with the observation emphasized by Layard et al. (1991) that the employment problem in Europe is not associated with changes in the inflow into unemployment but rather with a higher average duration of unemployment spells. But the model also reproduces the observation that the length of job tenures does not seem to have changed over time.

Turning to outcomes for individual workers and using values of turbulence of T10 and T20 to represent the 1970s and the 1980s, respectively, the model replicates earnings dynamics documented by Gottschalk and Moffitt (1994), and Jacobson et al. (1993). Further, the distribution of long-term unemployed across age groups in the model compares favorably to OECD data. Long-term unemployment is a serious problem for older workers in the data and in our model for T20. The model's hazard rates of gaining employment also resemble estimates reported by Layard et al. (1991). Consistent with observations from Europe, older workers in the model with T20 have lower hazard rates of gaining employment. Moreover, the analysis suggests that the negative relationship between hazard rates and the length of unemployment spells is mainly due to heterogeneity among the unemployed rather than so-called duration dependence.

The model also captures important features documented by recent studies of displaced workers in Europe. In particular, the model predicts that displaced workers in the WS economy suffer smaller earnings losses but also face lower re-employment rates than in the LF economy.

Finally, we constructed a measure of adjusted earnings that we used to think about differences in earnings distributions between the U.S. and Europe. With our measure of earnings, the model with T20 implies that earnings are more equally distributed under WS than with LF, an outcome that matches the compression of Europe's earnings distribution relative to America's.

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Table 1: Unemployment and long-term unemployment in OECD

	Unemployment (Per cent)			**Long-term unemployment of six months and over** (Per cent of total unemployment)		
	1974–79[a]	1980–89[a]	1995[b]	1979[c]	1989[d]	1995[e]
Belgium	6.3	10.8	13.0	74.9	87.5	77.7
France	4.5	9.0	11.6	55.1	63.7	68.9
Germany[g]	3.2	5.9	9.4	39.9	66.7	65.4
Netherlands	4.9	9.7	7.1	49.3	66.1	74.4
Spain	5.2	17.5	22.9	51.6	72.7	72.2
Sweden	1.9	2.5	7.7	19.6	18.4	35.2
United Kingdom	5.0	10.0	8.2	39.7	57.2	60.7
United States	6.7	7.2	5.6	8.8	9.9	17.3
OECD Europe	4.7	9.2	10.3	...	...	...
Total OECD	4.9	7.3	7.6	...	...	...

a) Unemployment in 1974–79 and 1980–89 is from OECD, Employment Outlook (1991), Table 2.7.

b) Unemployment in 1995 is from OECD, Employment Outlook (1996), Table 1.3.

c) Long-term unemployment in 1979 is from OECD, Employment Outlook (1984), Table H.; except for the OECD aggregate figures that are averages for 1979 and 1980 from OECD, Employment Outlook (1991), Table 2.7.

Table 1 (continued)

	Long-term unemployment of one year and over (Per cent of total unemployment)			
	1970[f]	1979[c]	1989[d]	1995[e]
Belgium	...	58.0	76.3	62.4
France	22.0	30.3	43.9	45.6
Germany	8.8	19.9	49.0	48.3
Netherlands	12.2	27.1	49.9	43.2
Spain	...	27.5	58.5	56.5
Sweden	...	6.8	6.5	15.7
United Kingdom	17.6	24.5	40.8	43.5
United States	...	4.2	5.7	9.7
OECD Europe	...	31.5	52.8	...
Total OECD	...	26.6	33.7	...

d) Long-term unemployment in 1989 is from OECD, Employment Outlook (1992), Table N.; except for the OECD aggregate figures that are from OECD, Employment Outlook (1991), Table 2.7.

e) Long-term unemployment in 1995 is from OECD, Employment Outlook (1996), Table Q.

f) Long-term unemployment in 1970 is from OECD, Employment Outlook (1983), Table 24.

g) Except for year 1995, data refer to former West Germany only.

Table 2: Distribution of long-term unemployment (one year and over) by age group in 1990

	Distribution of long-term unemployment (per cent of total long-term unemployment)		
	15–24 years	25–44 years	45+ years
Belgium	17	62	20
France[a]	13	63	23
Germany	8	43	48
Netherlands	13	64	23
Spain[a]	34	38	28
Sweden	9	24	67
United Kingdom	18	43	39
United States[a]	14	53	33

a) Data for France, Spain and the United States refer to 1991.

Source : OECD, Employment Outlook (1993), Table 3.3.

Table 3: Net unemployment benefit replacement rates[a] in 1994 for single-earner households by duration categories and family circumstances

	Single			With dependent spouse		
	First year	Second & third year	Fourth & fifth year	First year	Second & third year	Fourth & fifth year
Belgium	79	55	55	70	64	64
France	79	63	61	80	62	60
Germany	66	63	63	74	72	72
Netherlands	79	78	73	90	88	85
Spain	69	54	32	70	55	39
Sweden[b]	81	76	75	81	100	101
United Kingdom[b]	64	64	64	75	74	74
United States	34	9	9	38	14	14

a) Benefit entitlement on a net-of-tax and housing benefit basis as a percentage of net-of-tax earnings.

b) Data for Sweden and the United Kingdom refer to 1995.

Source : Martin (1996), Table 2.

Table 4: Variances of permanent and transitory real annual earnings, real weekly wages and annual weeks worked, United States 1970–89[a] (in logarithms)

	Permanent variance			**Transitory variance**		
Variable	*1970–78*	*1979–87*	*Change*	*1970–78*	*1979–87*	*Change*
Annual earnings	0.201	0.284	41%	0.104	0.148	42%
Weekly wages	0.171	0.230	35%	0.075	0.101	35%
Weeks worked	0.014	0.020	43%	0.046	0.063	37%

Source: Gottschalk and Moffitt (1994, tables 1 and 2), who base calculations on the PSID from the U.S.

a) Earnings and wages are deflated to 1988 dollars.

Table 5: Steady state values for the WS economy and the LF economy (under no economic turbulence)

	WS	**LF**
GNP per capita[a]	1.387	1.417
Average productivity of employed[a]	1.442	1.503
Average wage of employed	0.768	0.803
Average skill level in the population	1.874	1.866
Average job tenure[b]	7.26 years	4.53 years
Unemployment rate	3.83 %	5.70 %
Inflow into unemployment per month[c]	2.06 %	3.39 %
Average unemployment duration[d]	7.73 weeks	7.13 weeks
Percentage of unemployed with with spells so far $\geq$ 6 months	2.87 %	1.73 %
Percentage of unemployed with spells so far $\geq$ 12 months	0.08 %	0.02 %

[a] GNP and average productivity are computed for the 2-week period.

[b] The average job tenure is computed for all jobs at a point in time, and each job's tenure is the expected duration until termination due to a future layoff, quit or retirement.

[c] The monthly inflow into unemployment is expressed as a percentage of employment.

[d] The average unemployment duration is computed by dividing the unemployment rate by the inflow rate, when both rates are expressed as percentages of the labor force.

Table 6: Unemployment effects of layoff costs (under no economic turbulence)

	Layoff cost		
	0	5	10
Unemployment rate (%)			
WS economy	5.85	4.77	3.83
LF economy	5.70	4.43	3.51

Table 7: Steady state values for the WS economy and the LF economy with different degrees of economic turbulence

		Index of economic turbulence*					
		T00	T03	T05	T10	T20	T99
Tax rate (%)	WS	1.46	1.97	2.82	4.42	6.32	8.46
Average productivity of	WS	1.442	1.371	1.346	1.317	1.300	1.281
employed[a]	LF	1.503	1.422	1.395	1.365	1.347	1.327
Average job tenure[b]	WS	7.26	7.11	7.16	7.22	7.26	7.33
(in years)	LF	4.53	4.54	4.56	4.58	4.59	4.61
Unemployment rate (%)	WS	3.83	4.18	5.06	6.75	8.76	10.95
	LF	5.70	5.24	5.18	5.11	5.07	5.02
Inflow into unemployment[c]	WS	2.06	2.05	2.03	2.00	1.99	1.97
(% per month)	LF	3.39	3.33	3.30	3.27	3.25	3.23
Average duration of unempl.[d]	WS	7.73	8.53	10.52	14.47	19.34	25.00
(in weeks)	LF	7.13	6.64	6.63	6.59	6.57	6.56
Percentage of unemployed with	WS	0.08	9.67	23.53	41.10	54.14	62.64
spells so far $\geq$ 12 months	LF	0.02	0.01	0.01	0.01	0.01	0.01

* A higher index of economic turbulence is associated with a higher variance of skill losses at layoffs.

$^{a-d}$ See corresponding footnotes in Table 1.

Table 8: Unemployment effects of layoff costs in the WS economy with different degrees of economic turbulence

	Layoff cost		
	0	5	10
Index of turbulence			
T00	5.85	4.77	3.83
T03	5.65	4.74	4.18
T05	5.76	5.03	5.06
T10	6.01	5.92	6.75
T20	6.31	7.00	8.76
T99	6.60	8.08	10.95

Table 9: Unemployment effects of layoff costs in the LF economy with different degrees of economic turbulence

	Layoff cost		
	0	5	10
Index of turbulence			
T00	5.70	4.43	3.51
T03	5.24	4.14	3.23
T05	5.18	4.06	3.16
T10	5.11	4.03	3.19
T20	5.07	4.00	3.19
T99	5.02	3.98	3.24

Table 10: Earnings losses and unemployment in a cohort of workers that were laid off one year ago.[a] (The economic turbulence is indexed by T20.)

	Age group 45–50		Age group 55–60	
	WS	LF	WS	LF
Unconditional of skill loss				
Mean earnings loss[b] (%)	-10.43	-15.10	-8.82	-15.12
Unemployment[c] (%)	5.93	3.84	11.52	3.91
Conditional upon skill loss $\geq$ 20%				
Mean earnings loss[b] (%)	-24.68	-30.96	-21.95	-30.55
Unemployment[c] (%)	10.11	3.34	21.71	3.33

[a] Prior to the layoffs, workers were distributed across skills and wages according to the stationary distribution for the employed in age group 45–50 and 55–60, respectively.

[b] Earnings losses among re-employed workers, one year after the layoffs.

[c] Unemployment rate among non-retired workers, one year after the layoffs.

Table 11: Unemployment by age group in the WS economy (with economic turbulence indexed by T20)

	Age group				
	20–45	45–50	50–55	55–60	All
Unemployment rate[a]	7.29	8.66	10.96	14.55	8.76
Inflow into unemployment per month[b]	2.12	1.86	1.80	1.58	1.99
Percentage of unemployed with spells so far $\geq$ 12 months[c]	43.45	54.59	64.37	74.72	54.14
Distribution of all long-term unemployed across age groups[d]	42.7	11.96	17.85	27.49	100.00

All numbers are expressed in per cent.

[a] Percentage of the labor force in each age group.

[b] Percentage of employment in each age group.

[c] Percentage of unemployed in each age group.

[d] Percentage of all long-term unemployed (one year and over) in the total labor force.

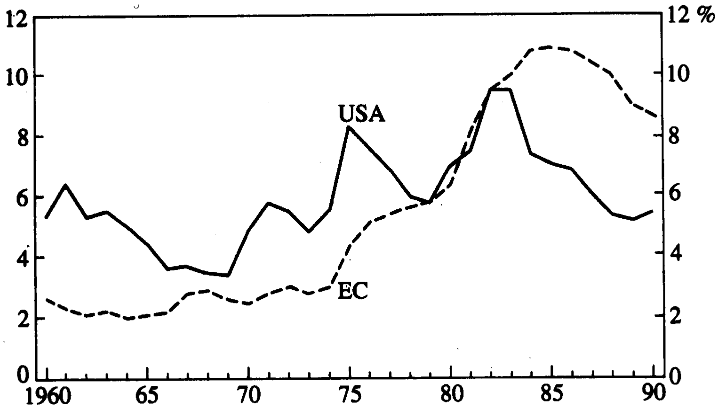

Figure 1. Unemployment rates in the European Community (EC) and in the United States. Reproduction of Layard, Nickell and Jackman's (1991, p. 2) Figure 1a.

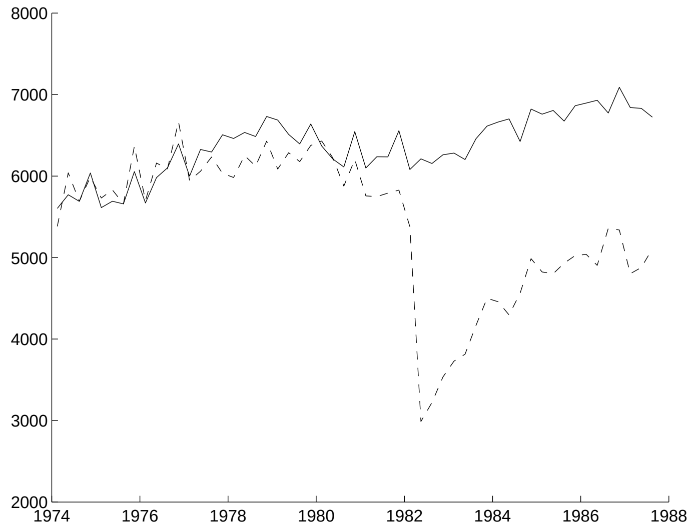

Figure 2. Quarterly earnings of high-attachment workers separating in the first quarter of 1982 and workers staying through 1986. The solid line refers to stayers, the dashed line separators. Reproduction of Jacobson et al.'s (1993) Figure 1, omitting their last observation because it was based on an insufficient sample.

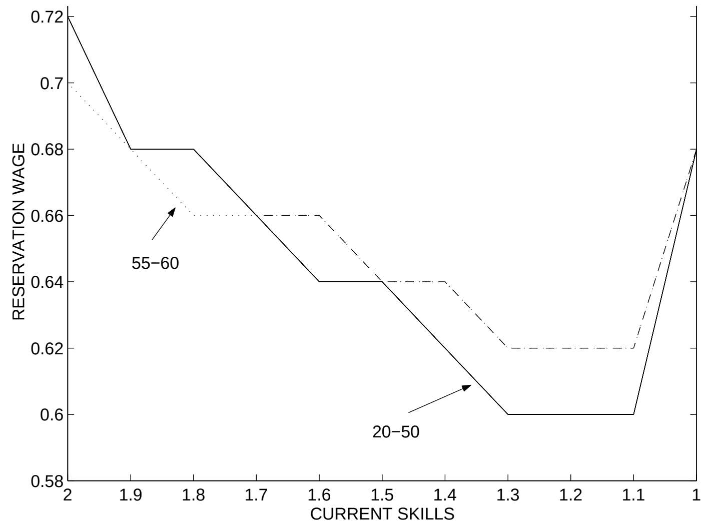

Figure 3. Reservation wage of the employed and the unemployed in the LF economy (under tranquil economic times).

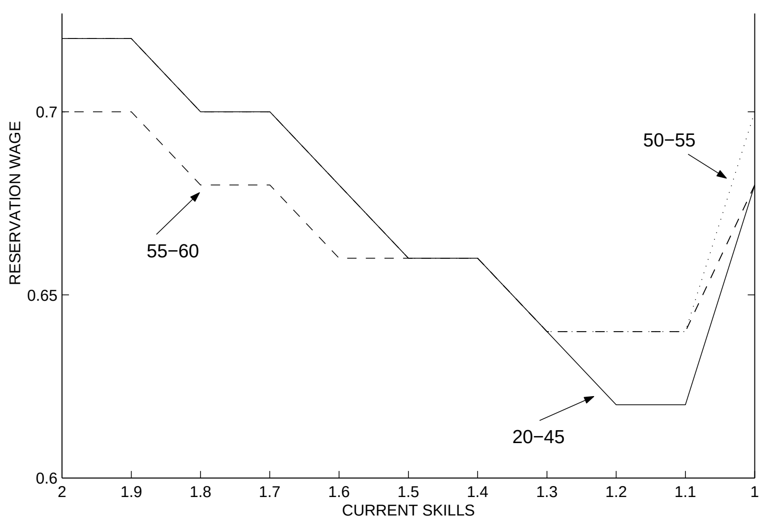

Figure 4. Reservation wage of the unemployed who are not eligible for unemployment compensation in the WS economy (under tranquil economic times).

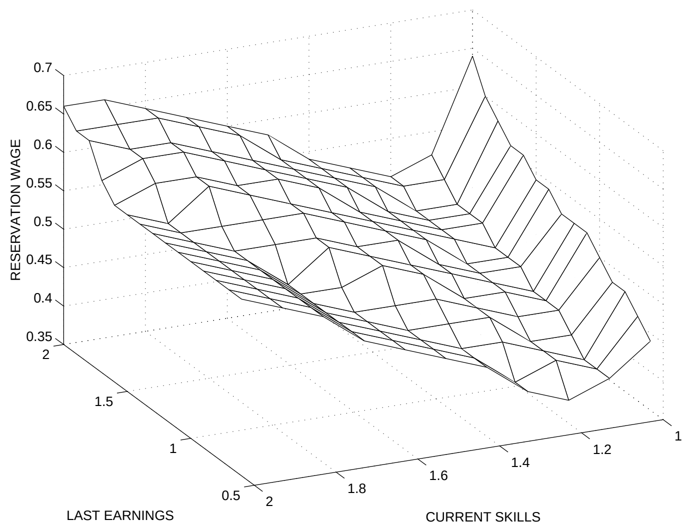

Figure 5. Reservation wage of the employed in age group 20–45 in WS economy (under tranquil economic times).

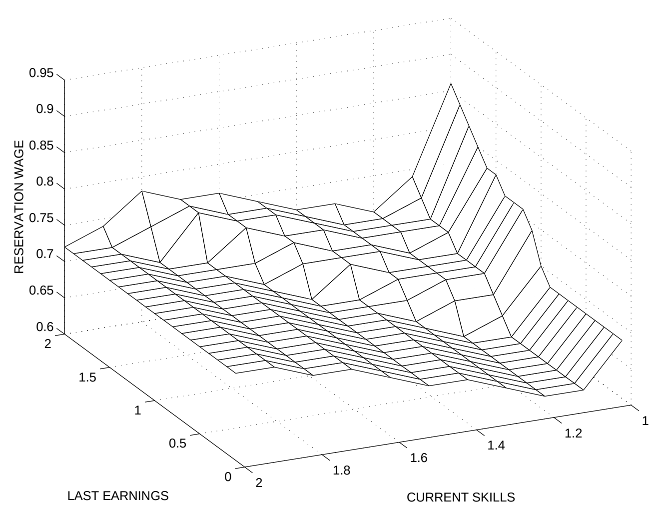

Figure 6. Reservation wage of the unemployed in age group 20–45 who are eligible for unemployment compensation in the WS economy (under tranquil economic times).

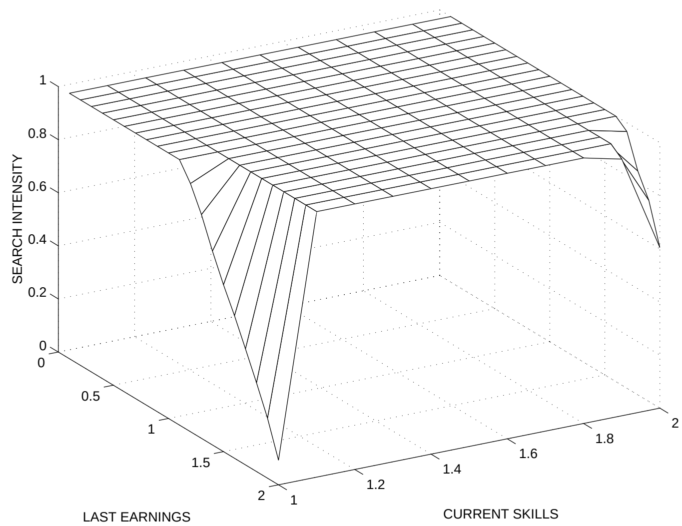

Figure 7. Search intensity of the unemployed in age group 20–45 who are eligible for unemployment compensation in the WS economy (under tranquil economic times).

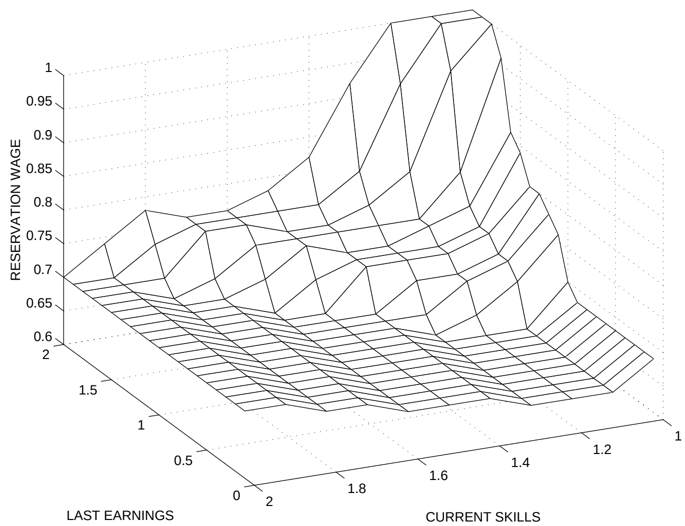

Figure 8. Reservation wage of the unemployed in age group 55–60 who are eligible for unemployment compensation in the WS economy (under tranquil economic times).

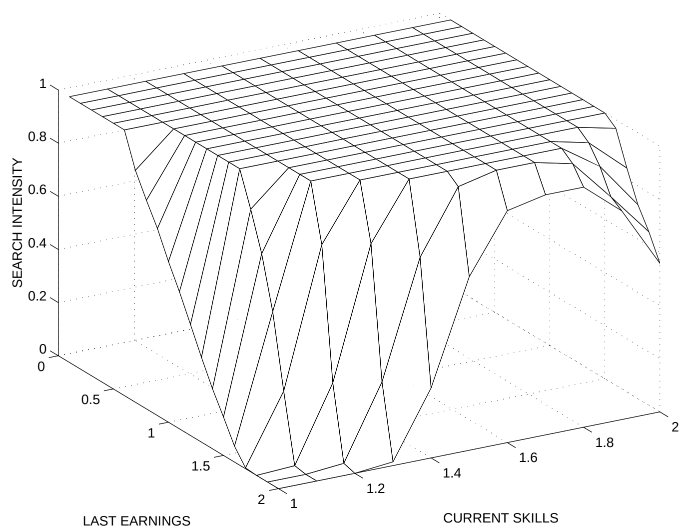

Figure 9. Search intensity of the unemployed in age group 55–60 who are eligible for unemployment compensation in the WS economy (under tranquil economic times).

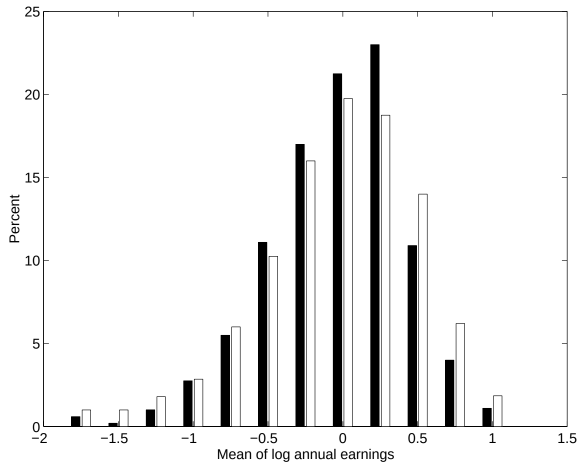

Figure 10a. Distribution of permanent earnings, 1970-78 and 1979-87. Reproduction of Gottschalk and Moffitt's (1994) Figure 2. The black bars correspond to 1970-78, the white bars to 1979-87.

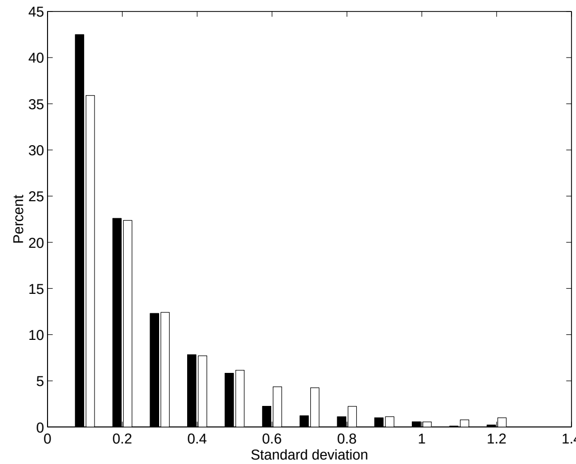

Figure 10b. Distribution of standard deviations of individuals' transitory earnings, 1970-78 and 1979-87. Reproduction of Gottschalk and Moffitt's (1994) Figure 4. The black bars correspond to 1970-78, the white bars to 1979-87.

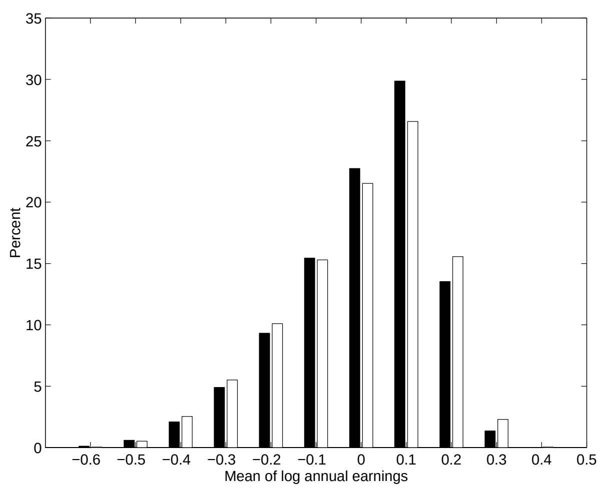

Figure 11a. Distribution of permanent earnings in the laissez-faire economy. The black bars and the white bars correspond to degrees of economic turbulence indexed by T10 and T20, respectively.

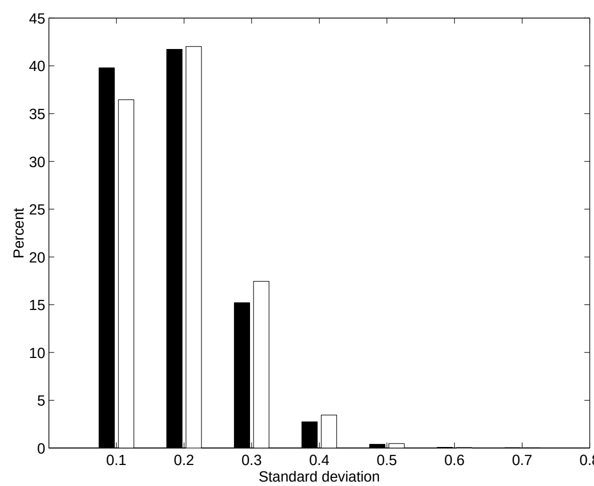

Figure 11b. Distribution of individuals' standard deviations of transitory earnings in the LF economy. The black bars and the white bars correspond to degrees of economic turbulence indexed by T10 and T20, respectively.

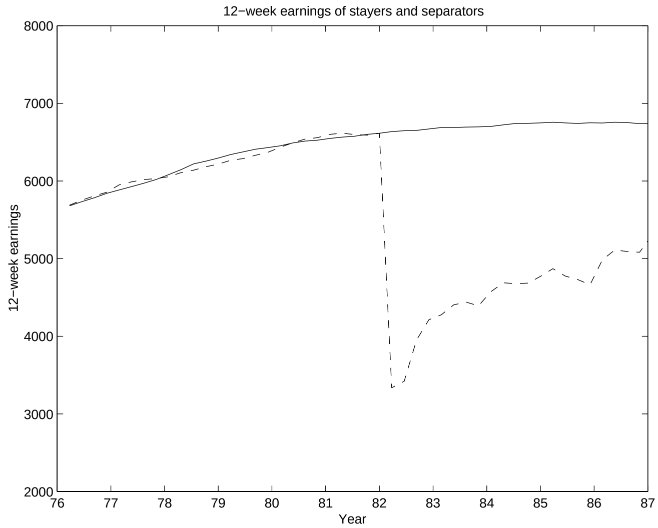

Figure 12. 12-week earnings of high-attachment workers separating in the first 12-week period of 1982 with skill losses exceeding 30% and workers staying through 1986. The solid line refers to stayers, the dashed line separators. The simulation is based on the LF economy with economic turbulence indexed by T20. (The earnings numbers are multiplied by a factor of 700 to facilitate comparison with the empirical study by Jacobson et al. (1993).)

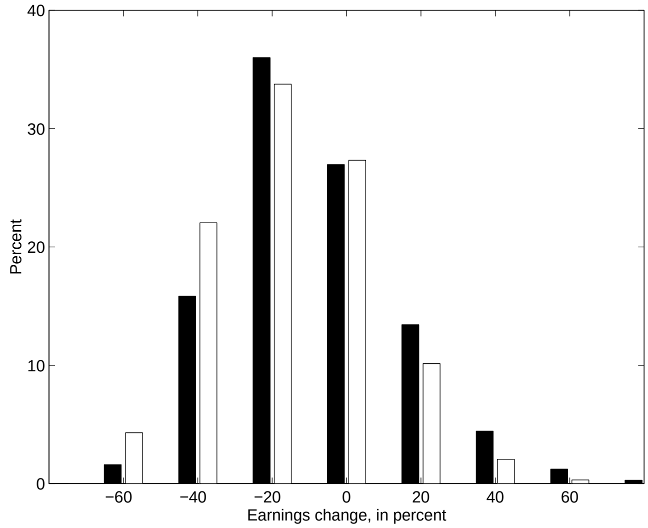

Figure 13a. Earnings losses experienced by re-employed workers one year after being laid off. Prior to the layoffs, the cohort belonged to age group 55–60 and was distributed across skills and wages according to the stationary distribution for that age group. The black bars are the WS economy, and the white bars are the LF economy. (The economic turbulence is indexed by T20.)

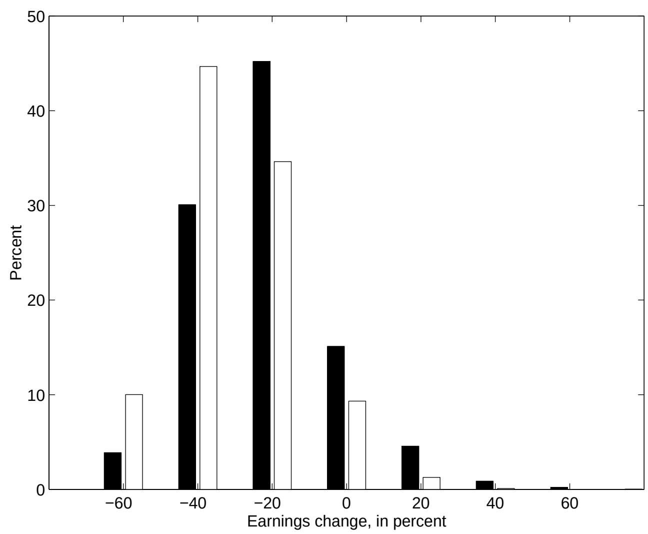

Figure 13b. Earnings losses experienced by re-employed workers one year after being laid off, conditional upon an immediate skill loss of at least 20 % at the time of the layoffs. Prior to the layoffs, the cohort belonged to age group 55–60 and was distributed across skills and wages according to the stationary distribution for that age group. The black bars are the WS economy, and the white bars are the LF economy. (The economic turbulence is indexed by T20.)

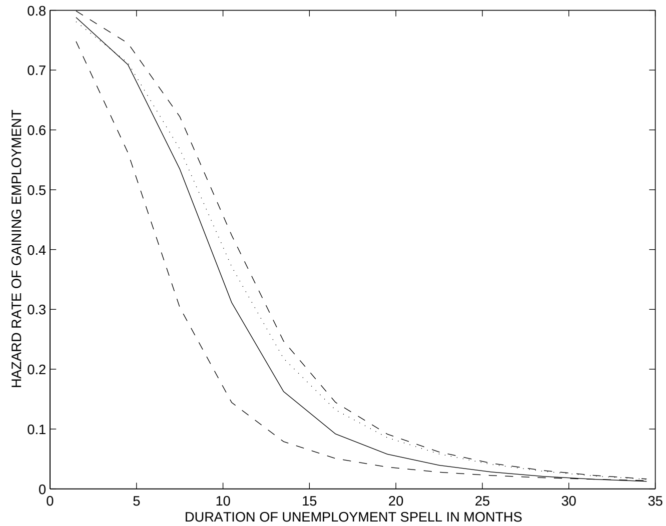

Figure 14. Quarterly hazard rates of gaining employment for all workers (solid line), age group 20–45 (upper dashed line) and age group 55–60 (lower dashed line) in the WS economy. The dotted line is the adjusted hazard rate for age group 20–45 when the cohort entering unemployment has the same distribution of skills and entitlements to unemployment compensation as the one for age group 55–60. (Economic turbulence is indexed by T20.)

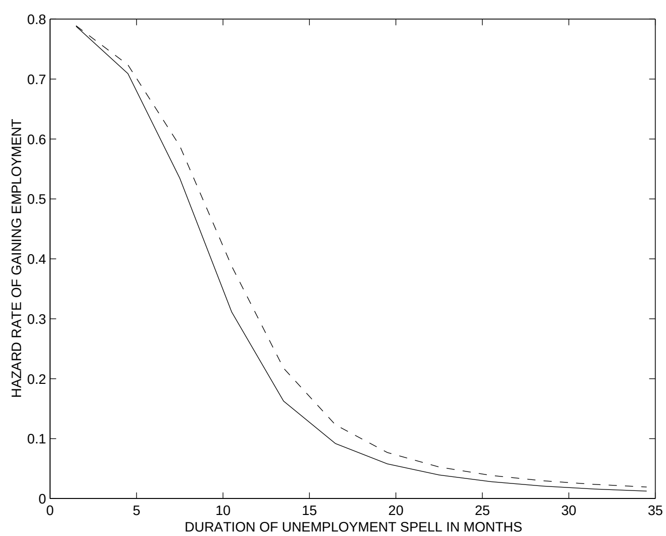

Figure 15. Heterogeneity vs. duration dependence. Quarterly hazard rates of gaining employment for all workers (solid line) in the WS economy. The dashed line is the adjusted hazard rate when age, skills and entitlements to unemployment compensation are held constant during the unemployment spell. (Economic turbulence is indexed by T20.)

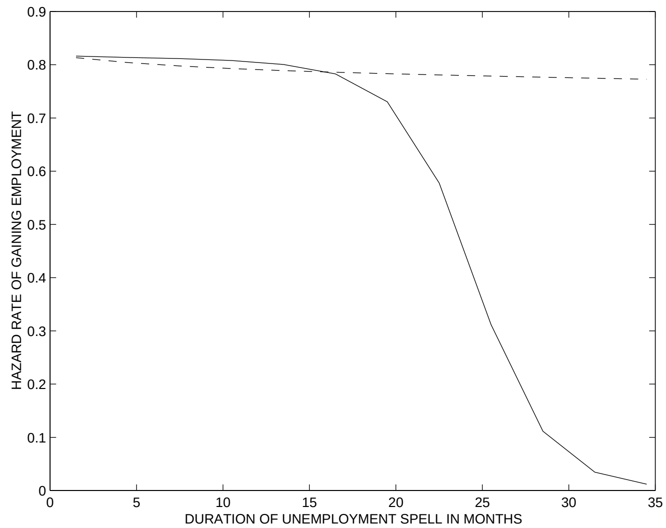

Figure 16. Heterogeneity vs. duration dependence. Quarterly hazard rates of gaining employment for all workers (solid line) in the WS economy. The dashed line is the adjusted hazard rate when age, skills and entitlements to unemployment compensation are held constant during the unemployment spell. (Economic turbulence is indexed by T00.)

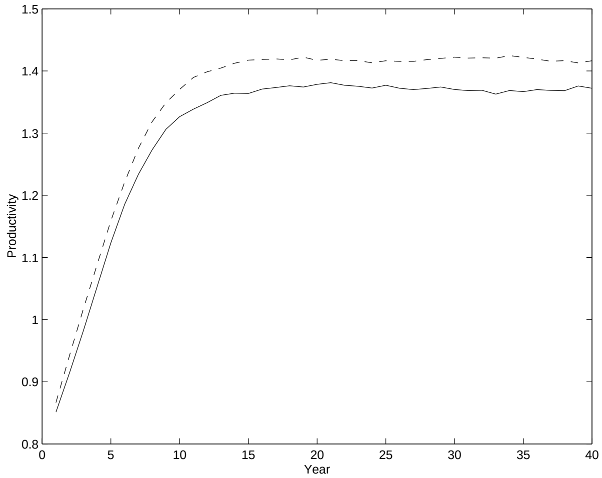

Figure 17a. Mean productivity of employed workers in a cohort that entered the labor force in period 0. The solid line is the WS economy, and the dashed line is the LF economy. (The economic turbulence is indexed by T20.)

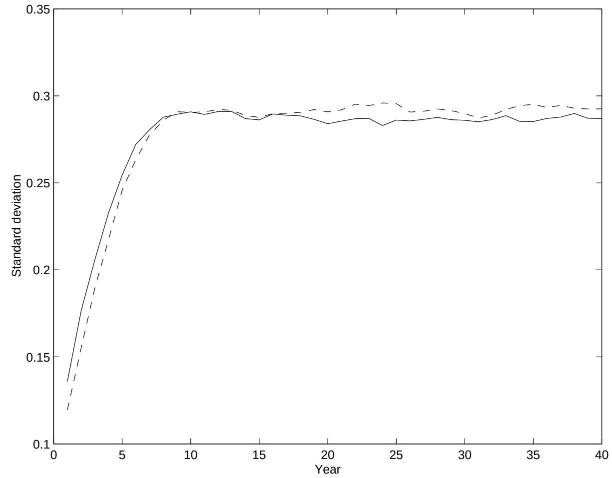

Figure 17b. Standard deviation of productivities of employed workers in a cohort that entered the labor force in period 0. The solid line is the WS economy, and the dashed line is the LF economy. (The economic turbulence is indexed by T20.)

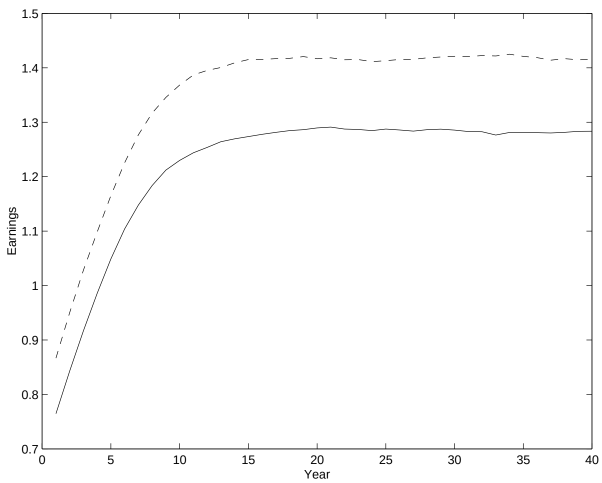

Figure 18a. Mean adjusted earnings of employed workers in a cohort that entered the labor force in period 0. The solid line is the WS economy, and the dashed line is the LF economy. (The economic turbulence is indexed by T20.)

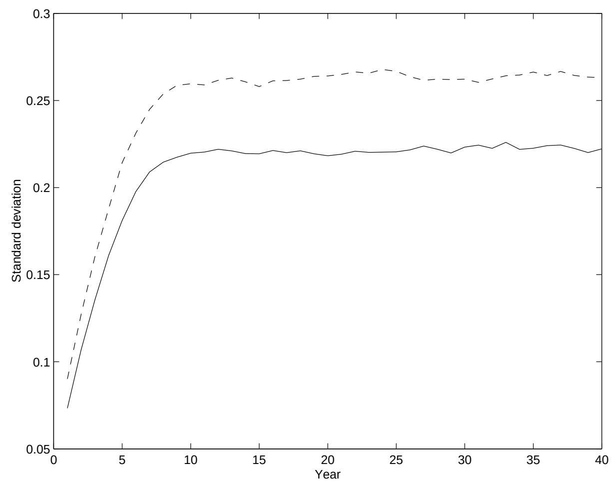

Figure 18b. Standard deviation of adjusted earnings of employed workers in a cohort that entered the labor force in period 0. The solid line is the WS economy, and the dashed line is the LF economy. (The economic turbulence is indexed by T20.)

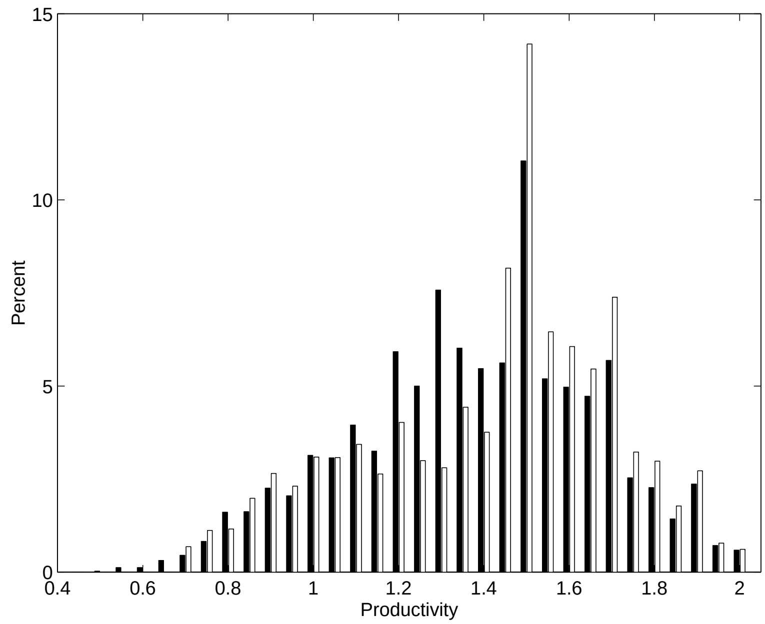

Figure 19. Distribution of productivities of employed workers in a cohort with 20 years in the labor force. The black bars are the WS economy, and the white bars are the LF economy. (The economic turbulence is indexed by T20.)

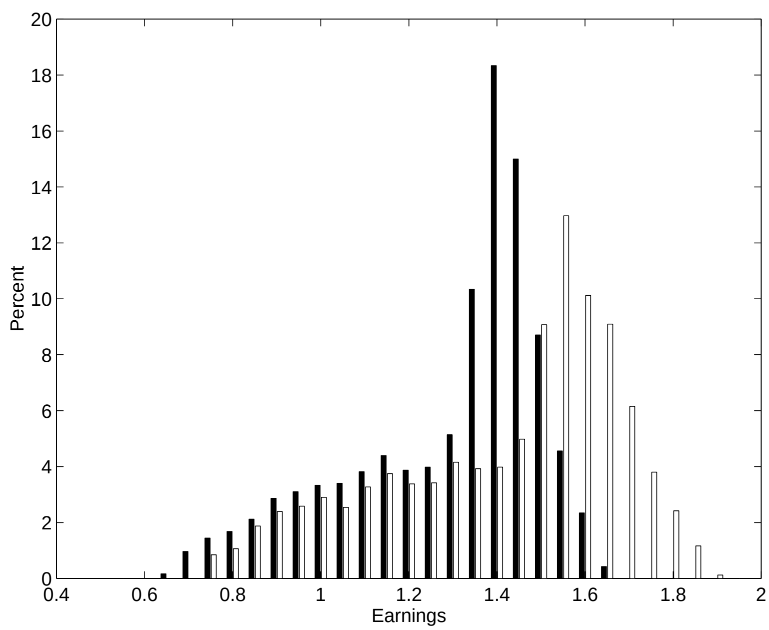

Figure 20. Distribution of adjusted earnings of employed workers in a cohort with 20 years in the labor force. The black bars are the WS economy, and the white bars are the LF economy. (The economic turbulence is indexed by T20.)