Two Questions about European Unemployment

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Abstract

A general equilibrium search model makes layoff costs affect the aggregate unemployment rate in ways that depend on equilibrium proportions of frictional and structural unemployment that in turn depend on the generosity of government unemployment benefits and skill losses among newly displaced workers. The model explains how, before the 1970s, lower flows into unemployment gave Europe lower unemployment rates than the United States; and also how, after 1980, higher durations have kept unemployment rates in Europe persistently higher than in the U.S. These outcomes arise from the way Europe's higher firing costs and more generous unemployment compensation make its unemployment rate respond to bigger skill losses among newly displaced workers. Those bigger skill losses also explain why U.S. workers have experienced more earnings volatility after 1980 and why, especially among older workers, hazard rates of gaining employment in Europe now fall sharply with increases in the duration of unemployment.

KEY WORDS: Job, search, skills, obsolescence, turbulence, unemployment, unemployment insurance, employment protection, discouraged worker.

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"A growing body of evidence points to the fact that the world economy is more variable and less predictable today than it was 30 years ago.... [there is] more variability and unpredictability in economic life." Heckman (2003, pp. 30–31)

1 Introduction

Our first question is: Why during the 1950s and 1960s was unemployment systematically *lower* in Europe than in the U.S.? Our answer is that Europe had stronger employment protection (EP in the language of Mortensen and Pissarides (1999)) despite also having had more generous government supplied unemployment compensation (UI in the language of Mortensen and Pissarides (1999)). Our second question is: Why for two and a half decades after 1980 has unemployment been systematically *higher* in Europe than in the United States?[1] We repeat our first answer: Europe has continued to have stronger EP and more generous UI than the U.S. A change in the microeconomic environment, modeled as a change in the human capital technology that captures forces that James Heckman highlighted in the epigraph above, enables us to attribute opposite outcomes before and after 1980 to an unchanging pattern of differences in EP and UI institutions across continents. We model the altered microeconomic environment as an increase in the risk of instantaneous human capital depreciation that workers experience at moments of involuntary job losses. Our model tells us that Europe's generous UI exposed it to structural unemployment when microeconomic turbulence emerged world wide after 1980. Though it reduced frictional unemployment in the 1950s and 1960s, after 1980 EP increased structural unemployment. Structural unemployment is synonymous to long-term unemployment in our analysis that reproduces the fact that hazard rates of gaining employment in Europe fall sharply with increases in the duration of unemployment, especially among older workers. After showing how the model's microeconomic environment affects aggregate outcomes, we describe how it implies panels of workers' earnings with features that resemble those observed in the U.S.

2 The facts

2.1 Facts about unemployment, UI, and EP

We ask the reader to accept the following well documented facts about unemployment outcomes in the two continents:[2]

[1] Krugman (1987) posed these two questions.

[2] For a detailed account, see Layard et al. (1991, p. 4) who succinctly summarize that "[t]he 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." Machin and Manning (1999, p. 3093) show that "[i]n all countries there is a higher incidence of [long-term unemployment] among older workers and a lower rate among young workers."

1. In the 1950s and 1960s, unemployment rates were persistently *lower* in Europe than in the U.S. The difference was accounted for by a *higher* inflow rate into unemployment in the U.S.

2. After the 1970s, unemployment became persistently *higher* in Europe.

3. Inflow rates into unemployment were roughly constant across periods within both Europe and U.S.

4. In Europe, average durations of unemployment were low in the 1950s and 1960s, but became high after the 1970s. Average duration in U.S. stayed low.

5. In Europe, since the late 1970s, hazard rates of leaving unemployment fall with increases in the duration of unemployment.

6. In Europe, since the late 1970s, older workers experience long-term (i.e., 'structural') unemployment with particularly high incidence.

The institutional features that differ between continents in our model are designed to represent the following facts about UI and EP in Europe and the United States:[3]

1. In both periods, government supplied unemployment insurance payments were generous with long durations in Europe, but they were stingy with short durations in the U.S.

2. Government mandated employment protection was stronger in Europe throughout both periods.

3 Our model

We answer the two questions posed in section 1 by extending the McCall (1970) search model of Ljungqvist and Sargent (1998) to include the following features:[4] (a) workers age and behave differently at different ages; (b) a job offers a Markov process of wages per unit of human capital; and (c) the government offers employment protection by imposing a tax on all separations except retirements. Feature (a) allows us to distinguish effects of labor market institutions on workers of different ages. Feature (b) endogenizes most separations. At a setting for a key human-capital-loss parameter that captures the environment before the 1980s, features (b) and (c) interact to let high layoff costs push unemployment rates

[3] OECD (1994, chap. 8) documents generous UI in Europe well before the outbreak of high unemployment and, as a result, there was a negative correlation between benefit levels and unemployment in the 1960s and early 1970s. As an early observer of trans-Atlantic differences in EP, Myers (1964, pp. 180–181) points to the relative ease of American employers to lay off workers while "specific laws, collective agreements, or vigorous public opinion [in Europe] protect the workers against layoffs except under the most critical circumstances."

[4] Some of these features were contained in the models in Ljungqvist and Sargent (1995) and Ljungqvist (2002).

down by reducing frictional unemployment, thereby allowing us to explain the lower European unemployment of the 1950s and 1960s. As mentioned above, a big part of our story is how accompanying responses in equilibrium proportions of frictional and structural unemployment reverse that effect when we reset the human capital loss parameter to its 1980s level.

3.1 The economy

There is a continuum of workers with geometrically distributed life spans. Births equal 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. With probability $\pi(s_t)$, next period an 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 exogenously 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 exogenously laid off. In the event of an exogenous layoff, the transition probability is $\mu_l(h, h')$. After the initial period coinciding with an exogenous 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.

At the beginning of a period, a worker observes his new age and skill level 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 or unemployment compensation at time $t + i$ net of disutility of searching. (The variable y_{t+i} assumes the value zero after retirement.)

Workers who have been 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 $e(I)$ be the government stipulated 'suitable earnings' of a laid off worker whose last earnings were I.

The 'suitable earnings' criterion determines also whether or not a worker who quits his job is entitled to unemployment compensation. That is, an employed worker whose earnings in the previous period were I, is entitled to unemployment compensation after quitting his job if and only if the foregone market earnings fall short of $e(I)$. A quitter who is entitled to unemployment compensation receives government funds according to the same rules as does 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 $b(I)$ and $e(I)$, 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.

3.2 Bellman equations

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 option to work at the wage w. The value associated with being unemployed and eligible for unemployment compensation benefits is $V_b(a,h,I)$, a function of the unemployed worker's age a, skill level h, and last earnings I. In the value function for 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:[5]

$$(1) \quad V(a,h,w,I) = \max\Big\{ \Omega(a,h,w)\,, \; D(h,w,I)V_b(a,h,I) + \Big[1 - D(h,w,I)\Big] V_o(a,h) - K \Big\},$$

$$(2) \quad V_b(a,h,I) = \max_s \Big\{ -c(s) + (1-\tau)b(I) + \beta \sum_{a'} \alpha(a,a') \sum_{h'} \mu_u(h,h')$$

[5]We have omitted lump-sum transfers to workers of the government's proceeds from the tax on job destruction. Since utility is linear in consumption, such lump-sum transfers would not affect workers' decision rules for reservation wages and search intensities.

$$
\begin{aligned}
& \cdot\Big[\big(1-\pi(s)\big)V_b(a',h',I)+\pi(s) \\
& \cdot\Big(\int_{w<e(I)/h'} \max\Big\{\Omega(a',h',w),V_b(a',h',I)\Big\}dF(w) \\
& + \int_{w\geq e(I)/h'} \max\Big\{\Omega(a',h',w),V_o(a',h')\Big\}dF(w)\Big)\Big]\Big\},
\end{aligned}
$$

$$
\begin{aligned}
(3) \qquad V_o(a,h) \;=\; & \max_s\Big\{-c(s)+\beta\sum_{a'}\alpha(a,a')\sum_{h'}\mu_u(h,h')\Big[(1-\pi(s))\,V_o(a',h') \\
& +\pi(s)\int\max\Big\{\Omega(a',h',w),V_o(a',h')\Big\}dF(w)\Big]\Big\},
\end{aligned}
$$

where $\Omega(a,h,w)$ is the value of accepting a wage w for a worker of age a with skill level h, and if that worker was employed last period with earnings I, the indicator function $D(h,w,I)$ is equal to one if he would be eligible for unemployment compensation upon rejecting such an offer and zero otherwise;

$$
\begin{aligned}
\Omega(a,h,w) \;\equiv\; & (1-\tau)wh+\beta\sum_{a'}\alpha(a,a')\Big[\lambda\sum_{h'}\mu_l(h,h')V_b(a',h',wh)-\lambda K \\
& +(1-\lambda)\sum_{h'}\mu_e(h,h')\int V(a',h',w',wh)\,dG(w'|w)\Big], \\
D(h,w,I) \;=\; & \begin{cases} 1 & \text{if } wh<e(I)\,; \\ 0 & \text{otherwise.} \end{cases}
\end{aligned}
$$

Associated with the solution of equations (1)–(3) are two policy functions, $\overline{s}_b(a,h,I)$ and $\overline{w}_b(a,h,I)$, describing 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 $\overline{w}_o(a,h)$, describing 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 $\overline{w}_e(a,h,I)$, describing a reservation wage for an employed worker of age a and skill level h with last period's earnings I.

3.3 Human capital evaporates after layoffs but not after quits

We have distinguished 'being laid off' from 'quitting': the former refers to exogenous layoffs that occur with probability λ and the latter to endogenous separations. We assume that workers experience no depreciation of human capital when they *quit*, even in turbulent times; but if they are exogenously *laid off*, they acquire a possibly lower new skill level drawn from the transition probabilities for skills after such layoffs, $\mu_\ell(h,h')$. This specification captures our vision that there are two types of job separations – orderly and potentially disruptive ones. Orderly separations include both real-world quitters who are secure in their skills and inspired to change jobs to make better use of their current skills and also workers who are laid off from faltering firms but who can with relative ease find comparable employment opportunities with other firms. We have labeled all of the lucky people who experience orderly separations 'quitters'. The unlucky people are the victims of exogenous layoffs who face the risk of impending skill obsolescence. Formally, the shocks drawn from $G(w'|w)$ and $\mu_e(h, h')$ that propel quits affect the future earnings of quitting workers less adversely than do events associated with exogenous layoffs.[6]

3.4 Broader interpretation of immediate skill loss

While we have modeled an increase in turbulence in terms of immediate negative shocks to laid off workers' earning potentials, the multi-dimensional character of employment means that in truth workers' job opportunities can deteriorate in other ways. We think that our specification also captures the situations confronting such workers who have encountered unfavorable labor market conditions in one way or another and who are entitled to generous benefits so long as they remain unemployed.[7]

4 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.

[6] Den Haan et al. (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.

[7] A proper account of unemployment would include a wider group of people than those officially counted as unemployed. OECD (2003, chapter 4) reports comprehensive measures of benefit dependency: "Some countries have now reached a position where most of the working-age population that is neither employed nor participating in education has an income-replacement benefit. . . . Benefit recipients are a very heterogenous group. Some of them may want to work, or can be 'activated' . . . The largest categories in 1999 were disability, unemployment and [early retirement] . . . a near-universal rise in the aggregate benefit dependency rate among the population of working age between 1980 and 1990, with Japan and the United States being the only exceptions."

There are 11 different skill levels evenly partitioning the interval $[1, 2]$. All newborn workers start with the lowest skill level equal to one. We calibrate the skill transition probabilities $\mu_e(h, h')$ and $\mu_u(h, h')$ during employment and unemployment spells, respectively, as follows. 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 on 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 of 0.1 that the worker's skills decrease by one level; otherwise they remain unchanged.[8] The lowest skill level reached through depreciation is also an absorbing state until the unemployed worker gains employment.

To represent economic turbulence in form of the skill transition probability $\mu_l(h, h')$, we follow Ljungqvist and Sargent (1998) in positing that a newly involuntarily displaced worker is exposed to the risk of an instantaneous reduction in his human capital, which we model as drawing a new human capital level 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) can the worker be sure of not experiencing any skill loss when laid off.

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

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

The exogenous wage offer distribution $F(w)$ is 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 $G(w'|w)$ 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 $[0, 2]$.

[8] We make the same assumptions about skill accumulation and skill depreciation as Ljungqvist and Sargent (1998), except that here we have chosen a coarser partition of the skill space in order to economize on the state space. We justified our parameter values partly by referring to Keane and Wolpin (1997). We thank Daniel Hamermesh for conversations about his data explorations of wage-experience profiles. Our assumption that work experience alone can double a worker's earnings seems to line up well with data for full-time male workers in the U.S. manufacturing industry. But the time required to attain such earnings gains are longer than we assume. Note that the speed of skill accumulation in our model pertains to both inexperienced new workers and workers who have suffered skill loss and want to regain their earnings potential.

We compare two alternative government policy regimes. Our laissez-faire (LF) economy has no government intervention, i.e. neither unemployment compensation nor employment protection, while our welfare state (WS) economy has both institutions as follows. For purposes of awarding unemployment compensation, the government in the WS economy divides the earnings interval $[0, 2]$ evenly into 20 earnings classes; let the upper limits of these classes 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 $e(I)$ are such that a laid off worker faces a 'replacement rate' 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.[9] Recall that quitters' entitlement to unemployment compensation is governed by the same suitable earnings criterion. 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.

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

5 Model outcomes

5.1 Tranquil times

Table 1 displays 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. In these tranquil times (denoted by an index of turbulence equal to T00), Table 2 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

[9] While unemployment insurance is typically of limited duration, Layard et al. (1991) emphasize that further benefits are often available in Europe for an indefinite period after unemployment compensation has been exhausted. Hunt (1995) describes the German policy in 1983 when unemployment compensation ('Arbeitslosengeld') replaced 68% of an unemployed worker's previous earnings and could be collected for at most 12 months. After those benefits were exhausted, means-tested unemployment assistance ('Arbeitslosenhilfe') paid a replacement rate of 58% for an indefinite period. Unemployed workers were obliged to accept jobs deemed suitable for their qualifications, and after an unemployment spell had lasted longer than 4 months, a person was even obliged to accept jobs beneath his or her qualifications. The penalty for refusing an offer unjustifiably was a loss of benefits for 12 weeks. Repeat offenders lost their benefits completely. For additional evidence on generous replacement rates and long benefit durations in Europe, see Martin (1996), who also considered housing benefits.

rate than the WS economy.[10]

Figure 1 depicts reservation wages per unit of skill 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. The U-shaped relationship between the reservation wage and 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 the worker's emphasis shifts to 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 2, 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 upper bound of unity.

Lower reservation wages of *employed* workers account for the lower unemployment rate in the WS economy. Figure 3 depicts the reservation wages of employed workers in age group 20–45 in the WS economy. The layoff tax makes employed workers reluctant to quit their jobs and this makes 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 4 exhibit some similarities with Figure 3 except that reservation wages are much higher in Figure 4. 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 difficult to find and the generous benefits make it less costly to remain unemployed, Figure 5 shows that an unemployed worker in these circumstances invests less in search by choosing a relatively low search intensity. Figures 6 and 7 show that these adverse incentive effects of generous benefits are most pronounced in the highest age group 55–60.

Fortunately, in tranquil economic times there are hardly any unemployed workers with low skills who are entitled to high benefits based on high last earnings, so the WS economy

[10] Mortensen and Pissarides (1999) also note that the UI and EP institutions have offsetting effects on the unemployment rate. In our calibration of very generous UI in Europe, the 'suitable earnings' criterion is needed to bring the unemployment rate of the WS economy below that of the LF economy. Specifically, if this criterion is relaxed so that the unemployed can reject all jobs paying less than their last earnings without loss of benefits, the steady-state unemployment rate of the WS economy in tranquil times is equal to 5.9%, i.e., almost the same as that of the LF economy. But instead of using the 'suitable earnings' criterion, we could also have lowered the relative unemployment rate of the WS economy by increasing the layoff tax above its current value of about 3 months of an average worker's productivity.

sustains a low equilibrium unemployment rate in Table 1.

5.2 Turbulent times

When the turbulence parameter increases in Table 3, the WS economy posts an ever higher unemployment rate while unemployment is practically flat (with some drift downward) in the LF economy. Generous unemployment benefits and high layoff costs both contribute to the emergence of high and long-term unemployment in the WS economy. The explanation is how increased turbulence increases the incidence of structural unemployment in the WS economy.

It is noteworthy that the decision rules of unemployed workers under high turbulence are qualitatively the same as under low turbulence. We can therefore use Figures 4 through 7 to describe how the adverse incentive effects of unemployment compensation in the WS economy are heightened in turbulent times. Turbulence creates a substantial group of laid off workers who suffer large instantaneous skill losses and therefore choose high reservation wages within the region of "rising slopes" in Figures 4 and 6. Because these workers' depreciated skill levels are low relative to their recent earnings history, unemployment benefits, based as they are on last earnings, look very attractive relative 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 discouraged and choose low search intensities, as depicted by the deepest "precipice" in Figures such as 5 and 7. 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. These adverse incentive dynamics are absent from the LF economy. Because past earnings are not a state variable for unemployed workers, a laid off worker in the LF economy who experiences an instantaneous skill loss will quickly adjust to the new situation by searching diligently for a new job.

5.3 Why layoff costs increase unemployment in turbulent times

Table 2 shows the reversal of the sign of the effects of high EP on equilibrium unemployment that underlies our answers to the two questions posed in section 1. Within a McCall (1970) search model, Ljungqvist (2002) showed that higher layoff costs lower the unemployment rate by reducing frictional unemployment. Table 2 confirms that finding when turbulence is low. The reason for Ljungqvist's finding is that in his McCall search model, all unemployment is 'frictional', consisting of workers who can expect to find work reasonably quickly using their optimal reservation wage strategies. Notice that table 2 shows that when turbulence is high, higher layoff taxes cause equilibrium unemployment to increase. The reason is that turbulence imparts a *structural* component to the unemployment pool in addition to the frictional one present without it. The structural component is comprised of unemployed workers who, after some bad luck early in their current unemployment spell, have become so discouraged that they choose low search intensities and high reservation wages. In turbulent times, both higher turbulence and the higher layoff cost discourage long-term unemployed workers from doing what it takes to land a new job by making their job prospectives less attractive relative to the government UI benefits that they receive. Without those generous government UI benefits, not working would be a much less attractive option. Table 2 thus shows that 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 (and even though it *isn't* such a robust feature of the WS economy).

5.4 Artificial panels

We have used our model as a tool to interpret aspects of earnings dynamics described by Gottschalk and Moffitt (1994) and Jacobson et al. (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 9.a and 9.b as our counterparts to their Figures 2 and 4 (reproduced here in our Figures 8.a and 8.b). 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. That the distribution of permanent earnings in Figure 9.a 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 9.b 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.

For a panel formed from artificial data for our LF economy with economic turbulence indexed by T20, we produced Figure 10, a counterpart of Figure 1 of Jacobson et al. (1993). Their figure showed earnings losses experienced by displaced workers in Pennsylvania in the first quarter of 1982. The figure for our artificial agents looks very much like theirs for those early 1980s residents of Pennsylvania.[11]

5.5 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

[11] To form our graph, we averaged earnings histories 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.

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 4 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 11a depicts the distribution of those earnings losses in age group 55–60 for both economies.

The lower panel of Table 4 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 11b.

5.6 Long-term unemployment in the WS economy

Figure 12 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.

Table 5 confirms that long-term unemployment is more common in higher age groups. Older workers actually have a lower *inflow* rate into unemployment but it is not sufficiently lower to offset their lower hazard rates of accepting jobs. The lower inflow rates into unemployment for older workers come from these workers' greater willingness to remain in 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. Thus, given the same skill levels, employed older workers have lower reservation wages than younger employed workers.

5.7 Other government-subsidized withdrawals from work

When studying the higher incidence of long-term unemployment among older workers in Table 5, we recommend remembering that labor force participation is not variable in our model. But it is well known that early retirement and enrollments in disability insurance programs have both increased dramatically among older workers in several European countries since the 1980s. See the country studies compiled by Gruber and Wise (2004). We think that our model of stochastic skill depreciation represents some of the adverse events that have prompted many of these workers to "bail out" into the social safety net.[12] Thus, the unemployment numbers in Table 5 can be thought of as reflecting both open unemployment and hidden unemployment in form of excessive enrollment in welfare programs such as early retirement and disability insurance.

5.8 Heterogeneity not duration dependence accounts for falling hazard

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 the sense that unemployed workers with high re-employment rates leave unemployment first, or whether it reflects *duration dependence*, in the sense that the passage of time reduces the chances for a particular unemployed worker to secure employment. In our model, the sources of *duration dependence* are a worker's aging and skill level deterioration within an unemployment spell. Sources of *heterogeneity* are the cross section distributions of age, skills, and entitlements to unemployment benefits for newly terminated workers. For a stationary equilibrium of our model, we can assess the relative importance of heterogeneity and duration dependence by constructing an adjusted hazard rate that holds fixed the age, skills, and entitlements to unemployment compensation for each worker throughout an unemployment spell, thereby assigning all of the variation in hazard rates to heterogeneity. Figure 13 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

[12]For example, referring to highly correlated numbers of recipients of disability insurance and unemployment insurance in different geographic regions of Sweden, Edling (2005) concludes that disability insurance is to a large extent used to conceal unemployment, especially among older workers in age group 55-64. Autor and Duggan (2003) argue that adverse demand shifts for the skills of high school dropout in the United States and less stringent screening in the disability insurance program have led to a higher propensity among these workers to exit the labor force and seek disability benefits after adverse shocks. The reasoning is the same in these two studies but the magnitudes are different. According to Autor and Duggan, 3.7% of Americans in ages 25-64 received disability insurance benefits in 2001 while Edling (2005) reports for the Swedish population in ages 20-64 that these benefit recipients comprised 10% in 2004 while another 2.4% had received sick insurance benefits for more than a year in 2003.

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 14 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 Tables 1 or 3). 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 lower search intensities and raise reservation wages per unit of skill . 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 on 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 a half years 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 14 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.

6 Concluding remarks

Our model interprets European unemployment rates that were lower than that in the United States in the 1950s and 1960s, but higher after 1980, as equilibrium responses to a common change in the dynamics of skill depreciation. Equilibrium outcomes differed because government mandated employment protection and government unemployment compensation differed systematically across continents but were stable across time within continents. To explain differences over time in labor market outcomes in the U.S. and Europe, we have varied a key parameter, called T for turbulence. We have denoted alternative values of T by Txx where xx is the variance of a truncated left half of a normal distribution that governs the percentage decrement of a worker's human capital at the time of an involuntary job loss. To explain both aggregate and individual workers' labor market outcomes, we have focussed on how variations in T interact with layoff costs and rules for compensating unemployed workers. We calibrated T so that values T00 and T03 approximate outcomes in the 1950s and 1960s, T05 and T10 captures the 1970s, and T20 portrays the 1980s and 1990s. 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 outcomes of our model mimic 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 1960s.

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. Similar overall unemployment rates in Europe and the U.S. in the 1970s 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 WS economy with T20 predicts that long-term unemployment has become a serious problem for older workers, an outcome that agrees with European outcomes summarized by Machin and Manning (1999). 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 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.

We have answered the two questions posed in section 1 in terms of how our extended McCall search model makes the effects of high EP on equilibrium unemployment depend on equilibrium fractions of frictional and structural unemployment, and how the amount of economic turbulence represented as skill depreciation at moments of involuntary separations affects those fractions. In Ljungqvist and Sargent (2006b), we show that the same effects prevail in two other types of models of frictional unemployment that incorporate features that our model omits, for example, bargaining over wages or wages determined in competitive markets or precautionary savings motives, namely, a search-island model in the tradition of Lucas and Prescott (1974) and several matching models in the Diamond-Mortensen-Pissarides tradition (see e.g. Pissarides (2000)). However, its high labor supply elasticity and lack of frictional unemployment prevent our story from being told within a representative family model, as we show in Ljungqvist and Sargent (2006a).

6.1 Has turbulence increased?

Our theory of the European unemployment experience hinges on an increase in the turbulence experienced by individual workers in the 1980s and 1990s as compared to the 1950s and 1960s. We have used studies of displaced workers and earnings volatility by Jacobson et al. (1993) and Gottschalk and Moffitt (1994), respectively, to motivate and to validate our theory. We acknowledge that the substantial earnings losses experienced by displaced U.S. workers since the 1980s by themselves say nothing about *increased* turbulence between the 1950s-1960s and the post 1980s, since that would require evidence from similar displaced worker studies from the 1950s and 1960s, which unfortunately do not exist. Perhaps the lack of interest among both academic researchers and the popular press suggests that worker displacements where less disruptive in those days, but we do not know that. Instead, we have drawn support for our story about increased turbulence indirectly from time series studies like that of Gottschalk and Moffitt (1994), whose findings Katz and Autor (1999) show to be robust across a variety of studies and data sets.

Our view that turbulence has increased in the last few decades is not universally accepted. One skeptical voice is that of Layard et al. (1991, p. 46), who used measures of 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. However, we think that their definition of turbulence is not the appropriate from the perspective of individual workers. The restructuring of the U.S. steel industry in the 1980s can serve as an example. While the decline and subsequent recovery of that industry might have left a small imprint on measures of sectoral reallocation, the consequences for workers initially employed in that industry were dramatic. As studied by Shaw (2002), the restructuring led to new hiring standards that meant that workers laid off at older, declining steel mills were not considered for employment at the newer steel mills.

The central question is whether disruptive labor market experiences have become more common in the last decades. Evidence that they have is provided by Kambourov and Manovskii (2005), who document a substantial overall increase in occupational and industry mobility in the U.S. over the period 1968–1997. Citing an earlier study by Rosenfeld (1979), who showed that occupational mobility was constant in the 1960s, Kambourov and

Manovskii argue that a more turbulent economic environment is a phenomenon of the last 30 years. They suggest that the next quest should be to discover the reasons that have prompted American workers to undertake more transitions between occupations in the last decades. To that, we would recommend adding a quest for the reasons that have prompted Europeans in alarming numbers to seek shelter in disability insurance, unemployment insurance and early retirement schemes.

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Table 1: Steady state values for the WS and LF economies with no (T00) 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 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 for all jobs at a point in time. 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, where both rates are expressed as percentages of the labor force.

Table 2: Unemployment rates (%) for the WS and LF economies with different economic turbulences and layoff costs.

	WS economy			**LF economy**		
Economic	Layoff costs			Layoff costs		
turbulence⋆	0	5	10	0	5	10
T00	5.85	4.77	3.83	5.70	4.43	3.51
T03	5.65	4.74	4.18	5.24	4.14	3.23
T05	5.76	5.03	5.06	5.18	4.06	3.16
T10	6.01	5.92	6.75	5.11	4.03	3.19
T20	6.31	7.00	8.76	5.07	4.00	3.19
T99	6.60	8.08	10.95	5.02	3.98	3.24

⋆ A higher index of economic turbulence denotes a higher variance of skill losses at layoffs.

Table 3: Steady state values for WS economies and LF economies with different amounts 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 employed[a]	WS	1.442	1.371	1.346	1.317	1.300	1.281
	LF	1.503	1.422	1.395	1.365	1.347	1.327
Average job tenure[b] (in years)	WS	7.26	7.11	7.16	7.22	7.26	7.33
	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] (% per month)	WS	2.06	2.05	2.03	2.00	1.99	1.97
	LF	3.39	3.33	3.30	3.27	3.25	3.23
Average duration of unempl.[d] (in weeks)	WS	7.73	8.53	10.52	14.47	19.34	25.00
	LF	7.13	6.64	6.63	6.59	6.57	6.56
Percentage of unemployed with spells so far $\geq$ 12 months	WS	0.08	9.67	23.53	41.10	54.14	62.64
	LF	0.02	0.01	0.01	0.01	0.01	0.01

* A higher index of economic turbulence denotes a higher variance of skill losses at layoffs.
$^{a-d}$ See corresponding footnotes in Table 1.

Table 4: Earnings losses and unemployment in a cohort of workers who were laid off one year ago in a high (T20) turbulence economy.[a]

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

Table 5: Unemployment by age group in high turbulence T20 WS economy.)

	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 (one year and over) unemployed in the total labor force.

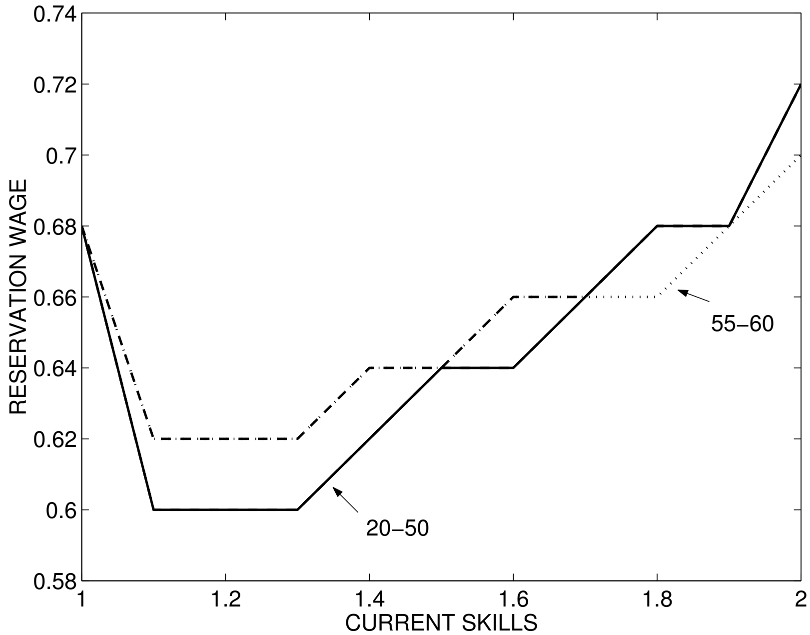


Figure 1: Reservation wage of employed and unemployed workers in low turbulence (T00) LF economy.

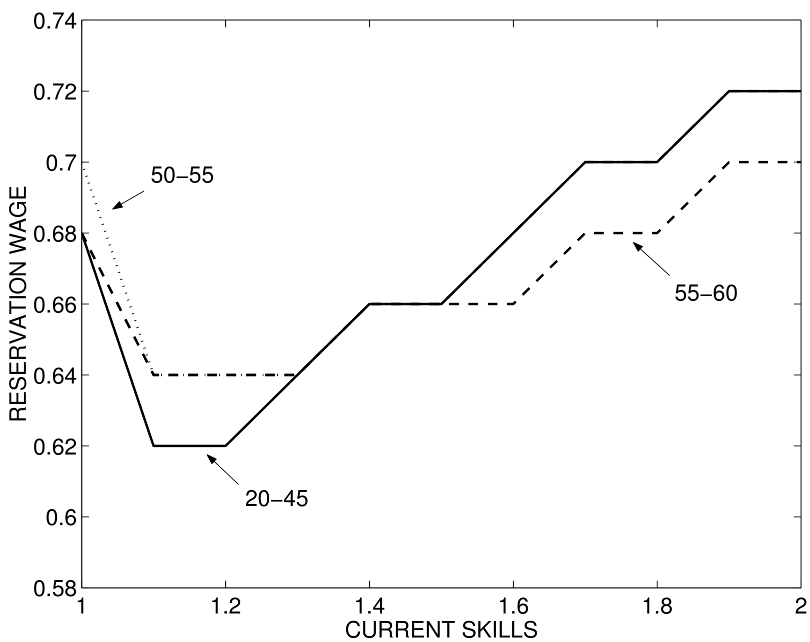


Figure 2: Reservation wage of unemployed workers who are not eligible for unemployment compensation in low turbulence (T00) WS economy.

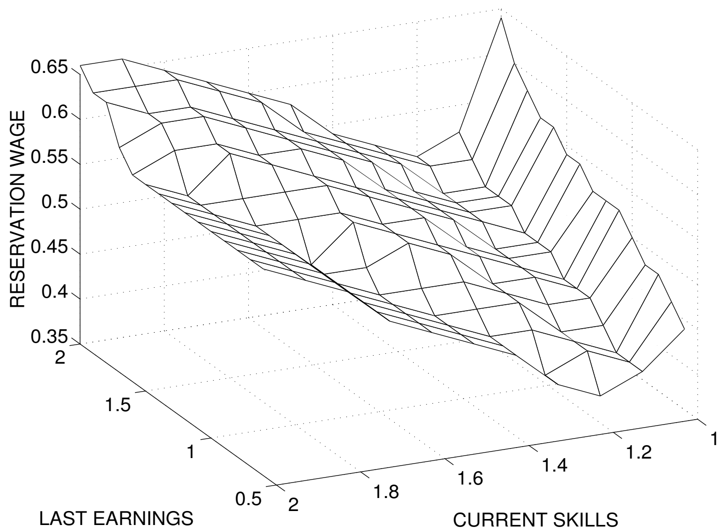


Figure 3: Reservation wage of employed workers in age group 20–45 in low turbulence (T00) WS economy.

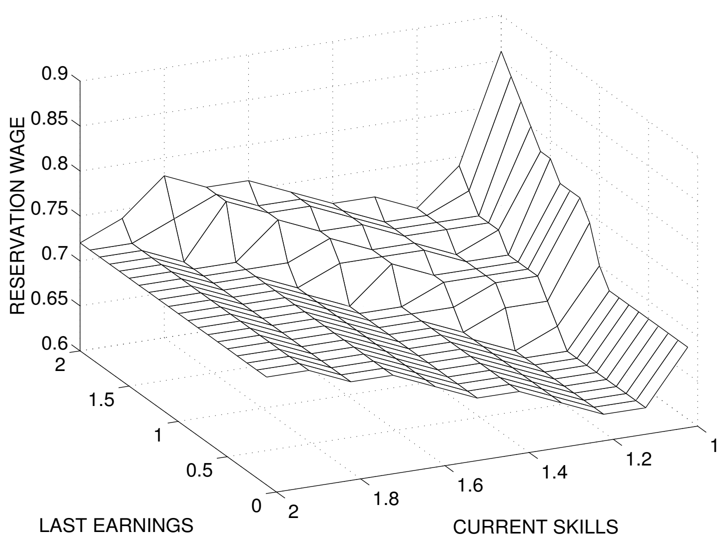


Figure 4: Reservation wage of unemployed workers in age group 20–45 who are eligible for unemployment compensation in low turbulence (T00) WS economy.

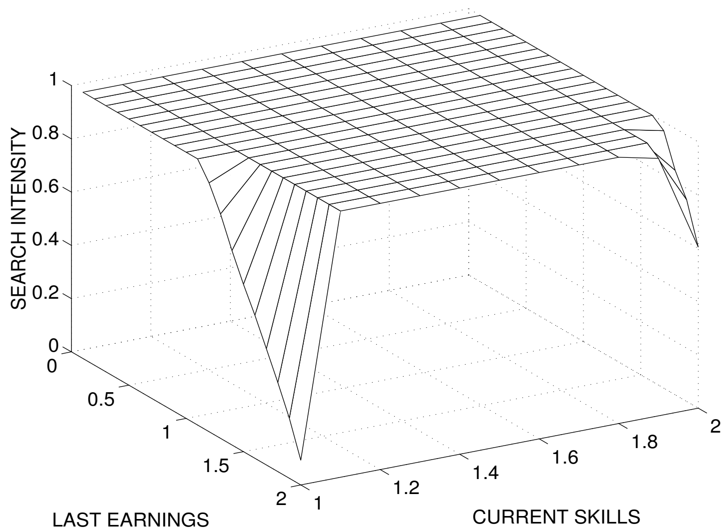


Figure 5: Search intensity of unemployed workers in age group 20–45 who are eligible for unemployment compensation in low turbulence (T00) WS economy.

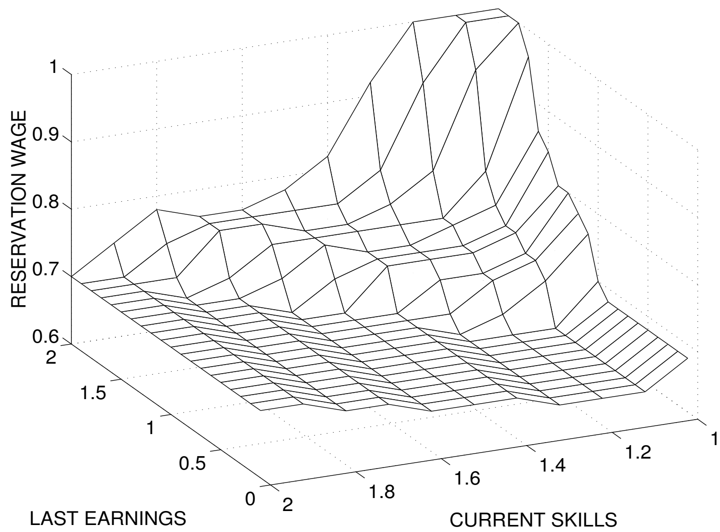


Figure 6: Reservation wage of unemployed workers in age group 55–60 who are eligible for unemployment compensation in low turbulence (T00) WS economy.

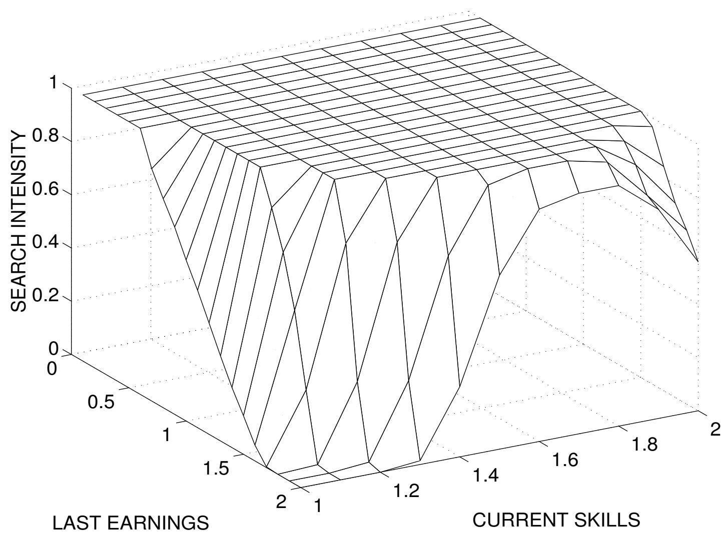
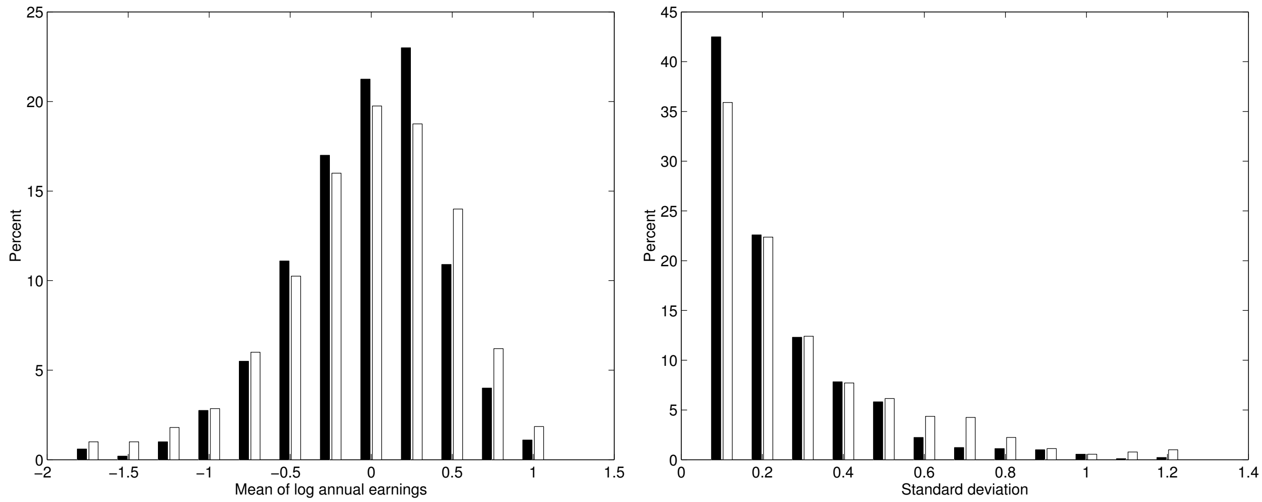


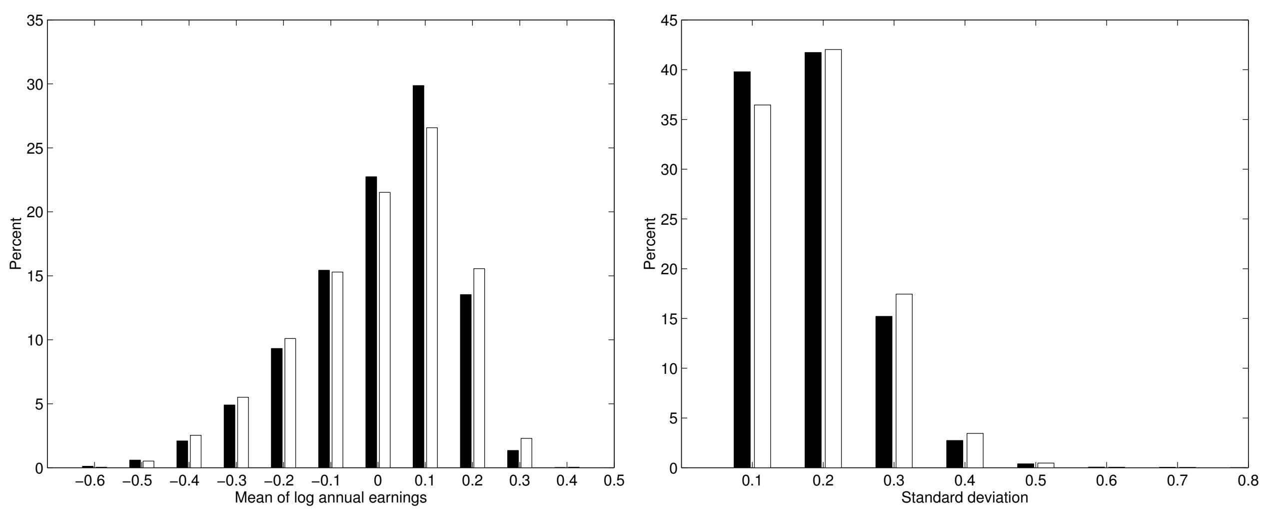
Figure 7: Search intensity of unemployed workers in age group 55–60 who are eligible for unemployment compensation in low turbulence (T00) WS economy.



(a) Distribution of permanent earnings

(b) Distribution of standard deviations of individuals' transitory earnings

Figure 8: Reproduction of Gottschalk and Moffitt's (1994) Figures 2 and 4 in panels (a) and (b), respectively. The black bars correspond to 1970-78, the white bars to 1979-87.



(a) Distribution of permanent earnings

(b) Distribution of standard deviations of individuals' transitory earnings

Figure 9: Laissez-faire economy. The black bars and the white bars correspond to economic turbulence indexes T10 and T20, respectively.

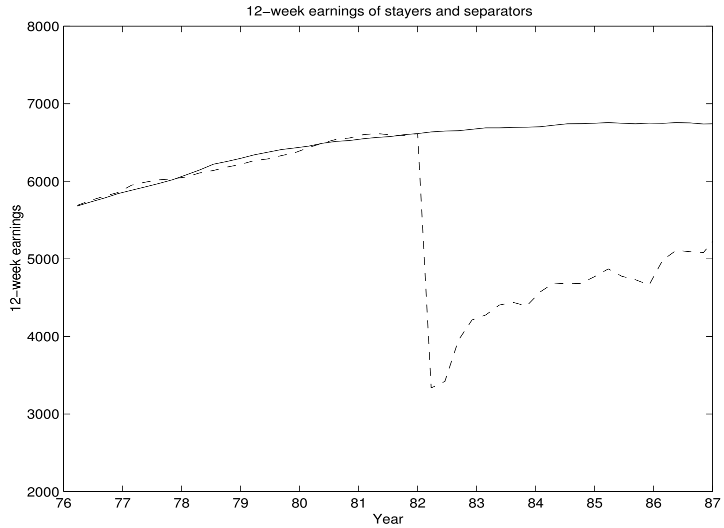


Figure 10: 12-week earnings of high-attachment workers separating in the first 12-week period of 1982 with skill losses exceeding 30% and workers staying through 1986. The solid line refers to stayers, the dashed line separators. The simulation is based on the LF economy with economic turbulence indexed by T20. The earnings numbers are multiplied by a factor of 700 to facilitate comparison with the empirical study by Jacobson et al. (1993).

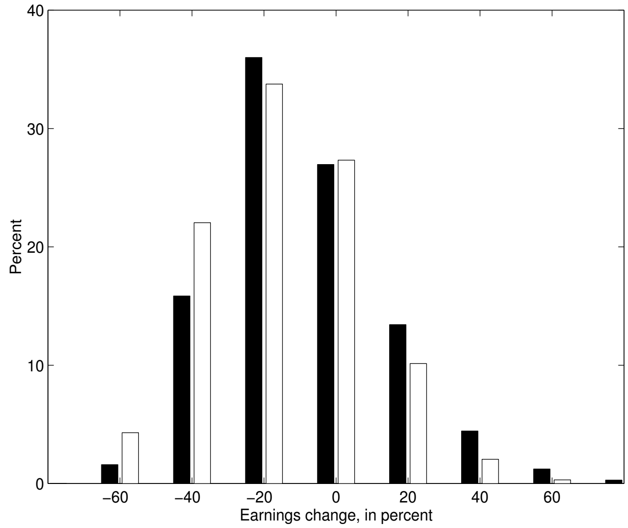


Figure 11a: Earnings losses experienced by re-employed workers one year after being laid off. Prior to the layoffs, the cohort belonged to age group 55–60 and was distributed across skills and wages according to the stationary distribution for that age group. The black bars are the WS economy, and the white bars are the LF economy. Turbulence is indexed by T20.

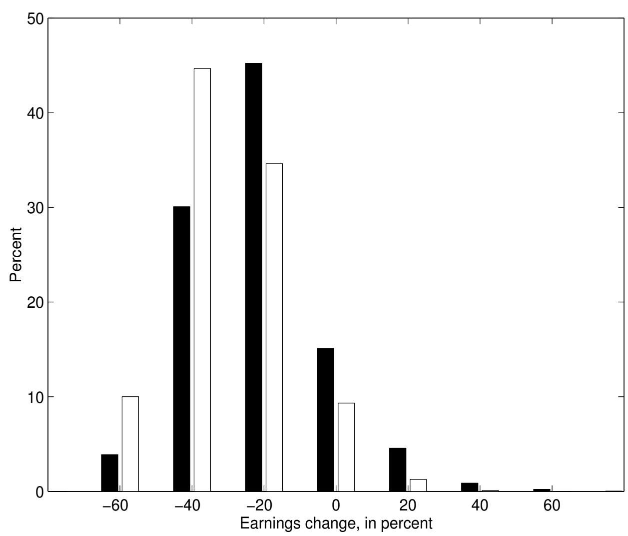


Figure 11b: Earnings losses experienced by re-employed workers one year after being laid off, conditional on an immediate skill loss of at least 20 % at the time of the layoffs. Prior to the layoffs, the cohort belonged to age group 55–60 and was distributed across skills and wages according to the stationary distribution for that age group. The black bars are the WS economy, and the white bars are the LF economy. Turbulence index is T20.

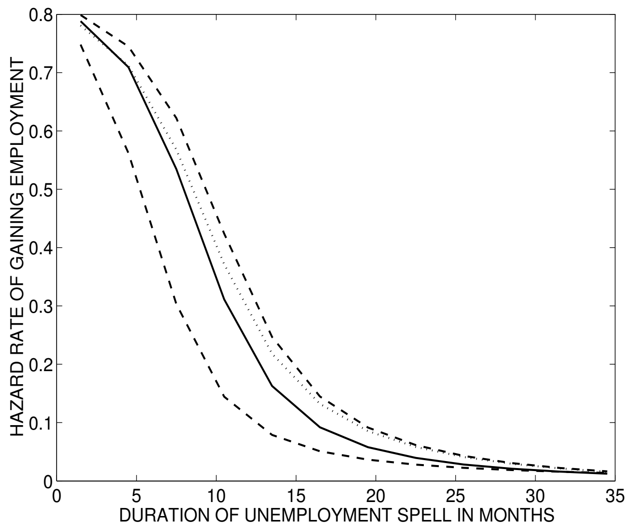


Figure 12: Quarterly hazard rates of gaining employment for all workers (solid line), age group 20–45 (upper dashed line) and age group 55–60 (lower dashed line) in the WS economy. The dotted line is the adjusted hazard rate for age group 20–45 when the cohort entering unemployment has the same distribution of skills and entitlements to unemployment compensation as the one for age group 55–60. Turbulence index is T20.

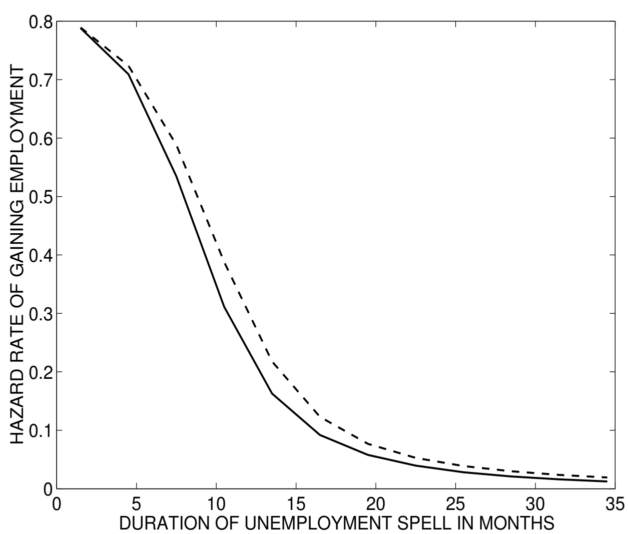


Figure 13: Heterogeneity vs. duration dependence. Quarterly hazard rates of gaining employment for all workers (solid line) in the WS economy. The dashed line is the adjusted hazard rate when age, skills and entitlements to unemployment compensation are held constant during the unemployment spell. Turbulence index is T20.

Figure 14: 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. Turbulence index is T00.