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Age and the U-Shaped Cost of Job Loss

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Job displacement causes large and persistent earnings losses. We document that these losses exhibit a U shape over the life cycle: young and old workers experience greater drops than mid-career workers. We develop a simple search model with human capital accumulation and deterioration that rationalizes this pattern. Losing a job early in the career is particularly costly because it implies missing out on fast wage growth opportunities. For older workers, specific human capital and firms' reluctance to hire explain most of the drop in earnings. Recessions affect the young disproportionately and exacerbate the U-shaped cost of job loss. (JEL E24, J24, J63)

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1 Introduction

Job displacement causes large, persistent, and countercyclical earnings losses. These facts are supported by an extensive body of empirical research and hold across time, countries, occupations, and skill levels.[1] Yet in this vast literature, less is known about the profile of earnings losses over the life cycle. A widely-held belief among labor economists is that the cost of job loss increases with age.[2] This comes from the observation that young workers tend to start with few specific skills and low wages relative to their older peers. As workers progress in their career, they accumulate firm-specific human capital. This capital is typically lost with displacement, causing older workers to face worse reemployment prospects and sharper wage declines than their younger counterparts.

In this paper, we document that the cost associated with job loss is not monotonic in age but rather exhibits a U shape. That is, after displacement, earnings of workers in their twenties fall more than earnings of workers in their thirties, in present value. In turn, earnings of workers in their forties and fifties drop more than earnings of workers in their thirties. Figure 1 shows this for three large countries, the United States, Germany, and Brazil. The available evidence suggests this phenomenon is robust across advanced and emerging economies. This novel fact conveys an important message: the early stage of the career is crucial for lifetime earnings. Being displaced at young age has detrimental consequences in the long run.

What explains the high cost of job loss for the young? Existing theories of the labor market are either silent on age or imply that the cost increases linearly in age. We lay down a simple life-cycle search model with human capital accumulation and deterioration. The model generates earnings losses that first decrease, then increase, with age. The intuition is as follows. Early in the career, workers have unstable jobs, earn low wages, but enjoy fast earnings growth. Losing a job at this critical stage of life is harmful to long-term earnings because it implies missing out on frequent and steep raises — a big dynamic loss. Old workers, by contrast, command stable and high-paying jobs with little or no wage growth. Losing a job entails a large, immediate fall in income coupled with limited employment opportunities — a big static loss. In between, middle-age workers have already benefited from most of their wage growth but still face good job prospects. These workers therefore do better after displacement.

We discipline the model on US data by matching key moments of the labor market, including wages, unemployment rates, and job finding rates, for workers of different age. We

[1] See, for example, Ruhm (1991); Jacobson, LaLonde, and Sullivan (1993); Couch and Placzek (2010); Davis and von Wachter (2011); Schmieder, von Wachter, and Heining (2023); Bertheau et al. (2023).

[2] As Kletzer (1998) puts it, "Due largely to the presumption that inexperienced workers have little firm-specific human capital to lose, long-term studies have overlooked young workers." More recently, Michelacci and Ruffo (2015) write that "wage losses upon displacement ... increase substantially with age as is documented in Davis and von Wachter (2011) and Johnson and Mommaerts (2011)." Jung and Kuhn (2019) state that "earnings losses are almost linear in age, so that the effect at the mean and the mean effect are identical."

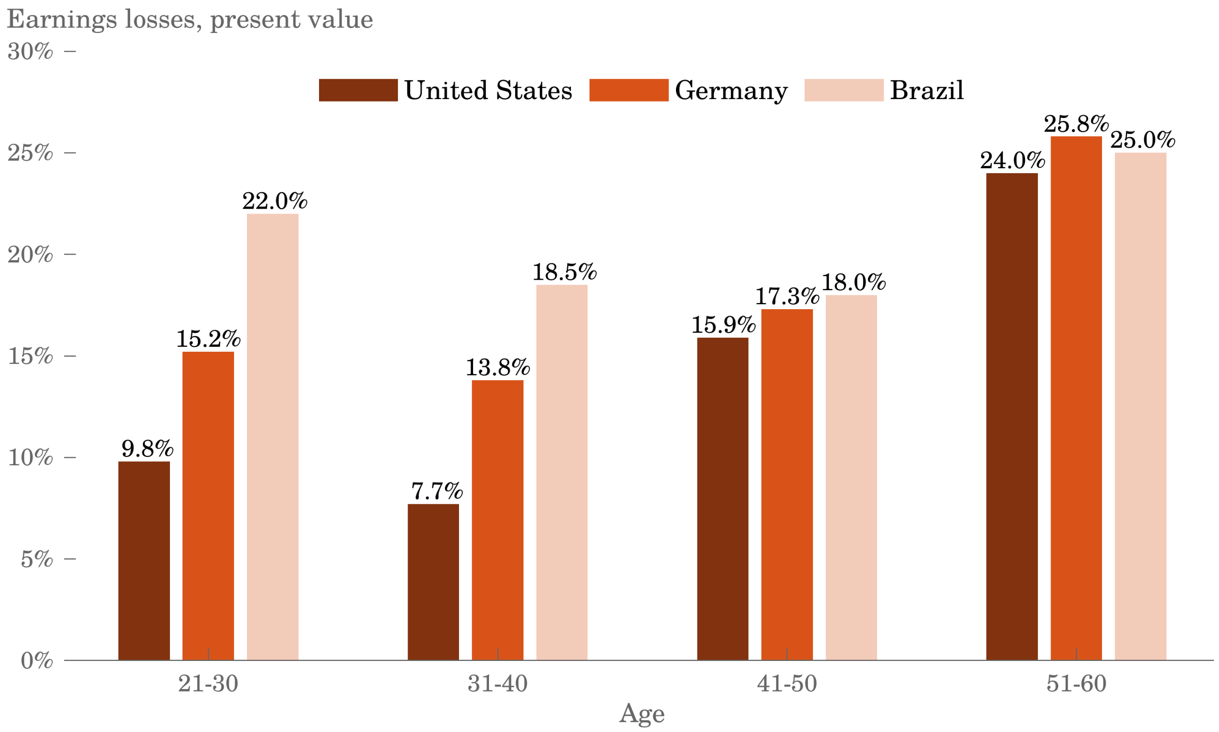

Figure 1: The U-Shaped Cost of Job Loss

Notes: This figure reports long-term earnings losses after mass-layoff events, expressed in percentage of present-value earnings of non-displaced workers. Values for US data are from Davis and von Wachter (2011). Treatment and control groups are workers with at least three years of job tenure at the time of displacement (one year for Brazil). Workers in the control group remain within the same firm an additional two years after displacement (one year for Brazil). Periods of non-employment provide zero earnings. Future earnings are discounted at a 5 percent annual rate. Present discounted values are computed over a 10-year horizon for all ages, except for the US, where the horizon for workers aged 21-30, 31-40, 41-50, and 51-60 is 20, 20, 15, and 10 years, respectively.

show that a U-shaped pattern of earnings losses emerges naturally as an equilibrium outcome. In particular, workers aged 25 lose up to 15 percent in long-term earnings, workers aged 35 only lose 10 percent, and workers aged 45 and 55 lose 17 and 25 percent, respectively. These magnitudes are consistent with the data for all four age groups. To our knowledge, our study is the first to reproduce the observed nonlinear profile of post-displacement earnings over the life cycle.

We perform a decomposition exercise to highlight the driving channels of earnings losses. Three forces account for the high cost of the young: i) fast wage growth early in the career; ii) job instability early in the career; iii) human capital depreciation while out of work. Since workers enter the labor market with little human capital, they face a relatively high probability of being laid off. Unemployment spells hurt earnings because they delay the accumulation of skills and the rapid wage growth that comes with it. They also cause skills to depreciate, thereby maintaining workers in low-paying, high-turnover jobs for longer periods of time. The story for older workers is different. As workers age, an increasing share of accumulated human capital becomes obsolete, ie cannot be redeployed to a new job in a new firm. In addition, employers' expected profit from opening vacancies falls as workers near retirement. These two forces contribute to drastically decreasing the job finding probability of older workers as well as their wage upon reemployment, thereby raising the cost of displacement. To sum up, our analysis reveals that the sources of earnings losses depend on the stage of workers' career. One explanation does not fit all ages.

Previous work emphasizes how business-cycle downturns amplify earnings losses from displacement.[3] We simulate a recession in our model by feeding it shocks that lower the job finding rate and increase the job separation rate. The result is a magnified U-shaped cost of job loss, with the curve shifting curve upward but also tilting leftward. In other words, during recessions, young workers' earnings decline disproportionately more than their older peers'. For instance, being displaced in a downturn at age 25 increases the loss to almost 25 percent of long-term earnings. These implications of the model are consistent with the empirical evidence. Our simple framework is thus capable of matching earnings losses simultaneously over the life cycle and the business cycle.

Related Literature.—This paper contributes to the empirical literature on the cost of job displacement. Early studies looking at earnings losses by age all find that losses increase with age and tenure (Topel 1990; Carrington 1993; Farber 1993, 1997; Jacobson, LaLonde, and Sullivan 1993, 2005; Couch 1998; Couch and Placzek 2010). These results, however, are partly confounded by the fact that older workers earn more. Davis and von Wachter (2011) propose a method to properly assess the cost associated with displacement. They compute the present discounted value (PDV) of annual earnings losses over a given time horizon and express this as a percentage of PDV counterfactual earnings in the absence of displacement. Using the same measure, we document how a U-shaped cost of job loss arises over the life cycle.[4] The high cost borne by young workers speaks to a line of research showing how the timing of graduation matters for long-term earnings (Kahn 2010; Oreopoulos, von Wachter, and Heisz 2012; Guo 2018; von Wachter 2020).

We also add to the theoretical literature on the drivers of earnings losses. As mentioned above, researchers either abstract from age (Krolikowski 2017; Burdett, Carrillo-Tudela, and Coles 2020; Huckfeldt 2022; Jarosch 2022; Audoly, De Pace, and Fella 2022) or develop models where the cost of job loss increases with age (Michelacci and Ruffo 2015; Cozzi and Fella 2016; Jung and Kuhn 2019). We propose a new, yet simple, mechanism to explain why the young suffer large drops in earnings. Since most productivity and wage gains occur early in the working life, being displaced during this critical phase implies falling behind and rarely catching up. Thus, the life cycle is not a side show. Modeling workers at different stages of the career sharpens our understanding of the labor market and helps us uncover

[3]See Farber (1997); Davis and von Wachter (2011); Huckfeldt (2022); Schmieder, von Wachter, and Heining (2023).

[4]In fact, the U-shaped cost job is apparent in Table 2 of Davis and von Wachter (2011), but the authors do not comment on this finding, as their paper focuses on a different set of issues.

new sources of earnings losses caused by displacement.

Outline.—The rest of the paper proceeds as follows. Section 2 describes the model. Section 3 illustrates the key novel mechanism in a stripped-down version of the model that we can solve analytically. Section 4 calibrates the model and presents our main quantitative results. Section 5 concludes.

2 A Simple Life-Cycle Model

We present a simple life-cycle model of the labor market with search and matching frictions, human capital accumulation, and human capital deterioration.

Environment.—Time is discrete and runs forever. The economy is populated by workers and firms. Each period, a new generation of workers is born and lives for T periods. Thus, at any given time, T generations overlap. Workers are endowed with one unit of labor and derive utility from earning income. They differ along three dimensions: age t, human capital h, and employment status, either employed or unemployed. Workers accumulate human capital on the job through learning by doing and lose human capital when out of work (Ljungqvist and Sargent 1998; Huckfeldt 2022). This deterioration takes two forms. First, skills gradually depreciate as long as individuals remain unemployed. Second, upon dismissal, workers' stock of knowledge may become obsolete, ie cannot be redeployed to another firm. This specification captures both general and firm-specific human capital. We assume obsolescence is increasing and convex in age. Overall, since workers are employed most of the time, wages increase over the life cycle, as we observe in the data.

A continuum of firms open vacancies specifying the conditions under which they hire workers. Firms operate a constant return-to-scale technology that turns the labor unit of a worker with human capital h into h units of output. Firms pay wage αh, where $\alpha \in (0, 1)$ is an exogenous piece rate.

Unemployed workers and firms meet and match on the labor market according to a matching function $M(u, v)$, where u represents the number of unemployed workers and v is the number of vacancies. The market is segmented, as in Menzio, Telyukova, and Visschers (2016). There is one submarket for each pair of age and human capital. An unemployed worker of age t and human capital h necessarily searches in submarket (t, h). Workers are not allowed to search on the job. Let $\theta(t, h) = v(t, h)/u(t, h)$ denote tightness in submarket (t, h). Both the job finding rate $p(\theta(t, h)) = \frac{M(u(t,h),v(t,h))}{u(t,h)}$ and the vacancy filling rate $q(\theta(t, h)) = \frac{M(u(t,h),v(t,h))}{v(t,h)}$ are functions of submarket tightness. We assume free entry in each submarket to endogenize vacancy postings.

Timing.—The timing of events is as follows. After production takes place, job separation shocks realize. If a match is not dissolved, an accumulation shock hits. This shock either upgrades or keeps constant the level of human capital of the employed worker. If a match is dissolved, the worker becomes unemployed. At this point, an obsolescence shock hits. This shock either deteriorates or keeps constant the level of human capital of the unemployed worker. In each subsequent period of unemployment, a depreciation shock occurs. This shock either downgrades or keep constant the level of human capital of the unemployed worker.

Value Functions.—Let x' denote the next-period value of variable x. Workers discount the future at rate $\beta \in (0, 1)$. The value function of an employed worker with state (t, h) reads

$$W_t(h) = \alpha h + \beta \mathbb{E}_{h'} \left\{ [1 - \delta_t(h)] W_{t+1}(h') + \delta_t(h) U_{t+1}(h') \right\}, \tag{1}$$

where $\delta_t(h)$ denotes the separation rate and $U_t(h)$ is the value function of an unemployed worker. Notice the separation rate depends on human capital. This enables us to capture an important reality of the labor market: job stability increases with age and earnings. With this assumption, getting fired not only leads to an income drop but also decreases job security upon reemployment. The value function of unemployed workers is given by

$$U_t(h) = b + \beta \mathbb{E}_{h'} \left\{ p(\theta(t+1, h')) W_{t+1}(h') + [1 - p(\theta(t+1, h'))] U_{t+1}(h') \right\}, \tag{2}$$

where b is the value of being unemployed. In period $T+1$, workers exit, $W_{T+1}(h) = U_{T+1}(h) = 0$. The firm's value of a filled job in submarket (t, h) is

$$J_t(h) = (1 - \alpha) h + \beta \mathbb{E}_{h'} \left\{ [1 - \delta(h)] J_{t+1}(h') \right\}, \tag{3}$$

Since there is no market at time $T + 1$, $J_{T+1}(h) = 0$. The firm's value of a vacancy is

$$V_t(h) = -\kappa + q(\theta(t, h)) J_t, \tag{4}$$

where κ is the cost of posting vacancies, common to all submarkets. Free entry in submarket (t, h) equalizes the expected profit with the cost of posting a vacancy

$$q(\theta(t, h)) J_t(h) = \kappa. \tag{5}$$

Conditions (3) and (5) together pin down the job finding rate, independently of workers' actions.

Equilibrium.—Given the law of motion of idiosyncratic shocks, an equilibrium consists for each pair (t, h) of worker value functions (1)–(2), firm value functions (3) and firm free entry conditions (5). The equilibrium exists and is unique.

3 Intuition

This section focuses on a special, simplified case of the model presented above. Our purpose is to derive analytical results that isolate the key mechanism by which earnings losses may decrease with age. Consider the model in Section 2 and set a unit finding rate, $p_t =$

1, together with a zero separation rate, $\delta_t = 0$. That is, unemployed workers find a job with certainty in the next period, while employed workers never lose their job. The value functions of employed and unemployed workers simplify to

$$W_t(h) = \alpha h + \beta W_{t+1}(h') \tag{6}$$

$$U_t(h) = \beta W_{t+1}(h). \tag{7}$$

Next, suppose the level of human capital h of employed workers evolves linearly as follows. In period $t = 0$, workers of age $t = 0$ start with $h = \underline{h}$. In any subsequent period $t < T$,

$$h_t = \underline{h} + \Delta t, \quad \Delta > 0. \tag{8}$$

Equation (8) implies that the *growth rate* of human capital is positive and decreasing. Under these assumptions, the following proposition establishes that younger workers who find themselves out of work for a given period of time experience greater losses in earnings than older workers in the same situation.

Proposition 1: *Consider the model of Section 2 and set $\delta_t = 0$ and $p_t = 1$ for all t. Assume the growth rate of human capital is positive but decreases over time. Then the cost of job loss decreases with age.*

Proof. Let t be the worker's age at displacement, T be the retirement age, and $\tilde{T}$ be the time horizon over which the cost of displacement is computed. Provided $t + \tilde{T} \leq T$, the value of being continuously employed between t and $\tilde{T} - 1$ reads

$$W_t = \alpha h_t + \beta \alpha h_{t+1} + \beta^2 \alpha h_{t+2} + \cdots + \beta^{\tilde{T}-2} \alpha h_{t+\tilde{T}-2} + \beta^{\tilde{T}-1} \alpha h_{t+\tilde{T}-1}. \tag{9}$$

The value of being continuously employed except in period t is

$$U_t = 0 + \beta \alpha h_t + \beta^2 \alpha h_{t+1} + \cdots + \beta^{\tilde{T}-1} \alpha h_{t+\tilde{T}-2}. \tag{10}$$

Denote by C_t the cost associated with being out of work during one period only relative to a continuously-employed worker. The cost is given by

$$C_t = \frac{W_t - U_t}{W_t} = 1 - \frac{U_t}{W_t}. \tag{11}$$

Substitute (9) and (10) into (11)

$$\begin{aligned} C_t &= 1 - \frac{\beta \alpha h_t + \beta^2 \alpha h_{t+1} + \cdots + \beta^{\tilde{T}-1} \alpha h_{t+\tilde{T}-2}}{\alpha h_t + \beta \alpha h_{t+1} + \cdots + \beta^{\tilde{T}-1} \alpha h_{t+\tilde{T}-2} + \beta^{\tilde{T}-1} \alpha h_{t+\tilde{T}-1}} \\ &= 1 - \frac{\beta}{1 + \dfrac{\beta^{\tilde{T}-1} h_{t+\tilde{T}-1}}{h_t + \beta h_{t+1} + \cdots + \beta^{\tilde{T}-2} h_{t+\tilde{T}-2}}}. \end{aligned} \tag{12}$$

Let $A_t \equiv \dfrac{h_{t+\tilde{T}-1}}{h_t + \beta h_{t+1} + \cdots + \beta^{\tilde{T}-2} h_{t+\tilde{T}-2}}$. Whether the cost increases or decreases with age t depends on the sign of the derivative of A_t with respect to t

$$\frac{\partial C_t}{\partial t} < 0 \quad \text{if} \quad \frac{\partial A_t}{\partial t} < 0.$$

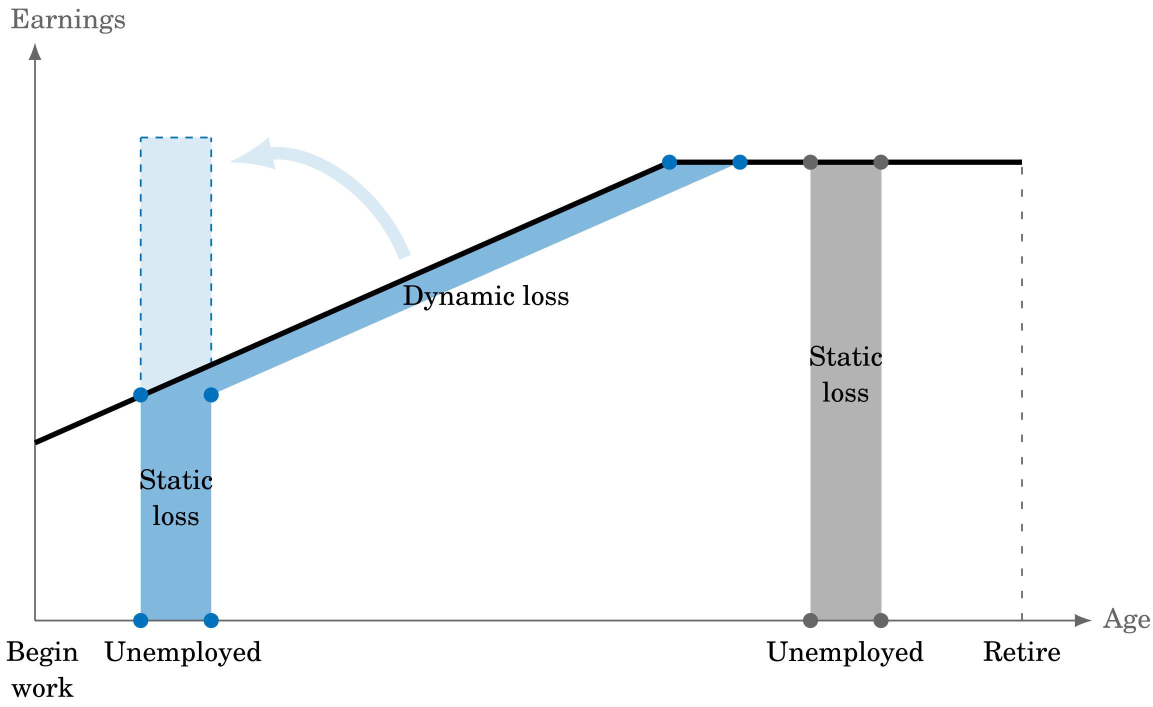

Figure 2: Earnings Losses, Young vs Old

Rewrite A_t using the law of motion of human capital (8)

$$A_t = \frac{\underline{h} + \Delta(t + \tilde{T} - 1)}{(\underline{h} + \Delta t) + \beta[\underline{h} + \Delta(t+1)] + \cdots + \beta^{\tilde{T}-2}[\underline{h} + \Delta(t + \tilde{T} - 2)]}. \tag{13}$$

Derive A_t with respect to t

$$\frac{\partial A_t}{\partial t} = \frac{\Delta \times D_t - \Delta(1 + \beta + \cdots + \beta^{\tilde{T}-2})[\underline{h} + \Delta(t + \tilde{T} - 1)]}{D_t^2}, \tag{14}$$

where $D_t \equiv (\underline{h} + \Delta t) + \beta[\underline{h} + \Delta(t+1)] + \cdots + \beta^{\tilde{T}-2}[\underline{h} + \Delta(t + \tilde{T} - 2)]$ is the denominator of (13). The sign of $\partial A_t / \partial t$ depends on the sign of the numerator of (13), call it N_t

$$\begin{aligned} N_t &= \Delta \times D_t - \Delta(1 + \beta + \cdots + \beta^{\tilde{T}-2})[\underline{h} + \Delta(t + \tilde{T} - 1)] \\ &= (\underline{h} + \Delta t) + \beta[\underline{h} + \Delta(t+1)] + \cdots + \beta^{\tilde{T}-2}[\underline{h} + \Delta(t + \tilde{T} - 2)] - (1 + \beta + \cdots + \beta^{\tilde{T}-2}) \\ &\qquad \times [\underline{h} + \Delta(t + \tilde{T} - 1)] \\ &= \left[\underline{h} + \Delta t - \left(\underline{h} + \Delta(t + \tilde{T} - 1)\right)\right] + \beta\left[\underline{h} + \Delta(t+1) - \left(h + \Delta(t + \tilde{T} - 1)\right)\right] + \ldots \end{aligned} \tag{15}$$

Since $\Delta > 0$ and $\tilde{T} > 1$, it follows that $N_t < 0$ for all t. Therefore, $\partial A_t / \partial t < 0$. We conclude that for all t

$$\frac{\partial C_t}{\partial t} < 0.$$

■

Intuition.—The intuition for Proposition 1 is straightforward. Early in the working life, workers enjoy rapid human capital accumulation and therefore rapid wage growth. Being out of work in this dynamic phase of the career is detrimental to long-term earnings because it implies missing out on steep wage hikes. Mid-career workers, by contrast, have already benefited from most of their earnings growth. If they lose their job, they forego earnings during the time they are unemployed but they do not fall much behind their employed peers because everyone's wage is flatter at that stage of the career.

Figure 2 offers a graphical representation of the mechanism. To make the point starker, we draw a trajectory of life-cycle earnings that is linearly increasing at first, then flat. Young workers who are displaced suffer a relatively small *static* loss because their current wage is low (the vertical blue shaded region). However, they incur a large *dynamic* loss because their wage growth is high (the tilted blue shaded region). Older workers who are displaced for the same period of time sustain a large static loss because their current wage is high (the vertical gray shaded region). But they incur no dynamic loss because their wage growth is null. All in all, the blue shaded area is larger than the red shaded area, ie young workers experience greater losses in earnings than older workers following displacement.

Having illustrated the channel through which young workers may sustain higher losses than their older counterparts, we now turn to the full quantitative model, which incorporates other channels of displacement-induced losses and lets them interact with one another.

4 The U-Shaped Cost of Job Loss

This section presents our main results. We begin by discussing the parameterization of the model and the methodology to compute earnings losses. We then show that the calibrated model is able to replicate the observed profile of earnings losses by age, both qualitatively and quantitatively. Next, we delve into the different mechanisms that drive the nonlinear pattern of earnings losses. Finally, we discuss how recessions affect the cost of job loss.

4.1 Calibration

We calibrate the model on US data at quarterly frequency. Table 1 reports all parameter values. Workers are born unemployed at age 20, are active for 45 years ($T = 180$), then exit at age 65. We set the discount factor β to match an annual interest rate of 5 percent. We fix the piece rate α and the utility derived from not working b at 0.96 following Hagedorn and Manovskii (2008). The matching function is such that in each submarket (t, h), the job finding rate takes the form

$$p_t(h) = m_t[1 + \theta_t(h)^{-\gamma}]^{-1/\gamma},$$

where m_t is a matching efficiency coefficient and γ is the elasticity of the matching function. We fix $\gamma = 0.65$ as in Chaumont and Shi (2022). We assume that m_t is age-dependent in

Table 1: Calibration

Parameter		Value	Target/Source	Model	Data
Externally calibrated parameters					
Number of periods	T	180	45-year career, 20 to 65		
Discount factor	β	0.988	5-percent annual interest rate		
Piece rate	α	0.96	Wage to productivity ratio		
Home production	b	0.96	Hagedorn and Manovskii (2008)		
Matching function elasticity	γ	0.65	Chaumont and Shi (2022)		
Internally calibrated parameters					
Vacancy cost	κ	0.076	Hiring cost to wage ratio	0.045	0.045
Human capital increment	Δ	0.212	Mean wage 30-34 relative to 20	1.63	1.60
Maximum human capital	$\bar{h}$	2.13	Mean wage 45-49 relative to 20	1.97	1.93
Separation rate curvature	δ_0	0.88	Unemployment rate 21-24	0.098	0.104
Separation rate curvature	δ_1	4.59	Unemployment rate 25-34	0.055	0.058
Separation rate curvature	δ_2	0.026	Unemployment rate 35-44	0.044	0.046
Matching efficiency	m_0	1.2	Unemployment duration 21-30	17.17	17.10
Matching efficiency	m_1	-6e-3	Unemployment duration 31-40	20.25	20.20
Matching efficiency	m_2	2e-5	Unemployment duration 50-60	27.80	25.80

order to match the average duration of unemployment spells for various age brackets. In particular, $m_t = m_0 + m_1 t + m_2 t^2$. We calibrate the vacancy cost κ to match a hiring cost of 4.5 percent of quarterly wage, as estimated by Silva and Toledo (2009). Next, we define human capital over a grid $[\underline{h}, \overline{h}]$, where $\underline{h} = 1$. Human capital of employed workers accumulates as follows

$$h_{t+1}(h, W) = \begin{cases} h + \Delta & \text{with probability } 1/4, \\ h & \text{with probability } 3/4. \end{cases}$$

Thus, h increases by one increment Δ, on average, after a year of continuous employment. Following Ljungqvist and Sargent (1998), human capital during unemployment depreciates twice as fast as it accumulates during employment, that is

$$h_{t+1}(h, U) = \begin{cases} h - \Delta & \text{with probability } 1/2, \\ h & \text{with probability } 1/2. \end{cases}$$

We set Δ and $\overline{h}$ to discipline the wage profile over a worker's career. The increments controls earnings growth before 35 years old, by when roughly two thirds of lifetime wage growth is achieved. The parameter $\overline{h}$ sets an upper bound on the wage a worker can attain during a career.

In the data, the unemployment rate is at its highest for workers in their twenties, then halves for workers in their thirties, and remains flat afterwards. To fit this pattern, we specify an exponential function $\delta(h) = \delta_0 \exp(-\delta_1 h) + \delta_2$ and set δ_0, δ_1, and δ_2 to match the unemployment rates of workers of age 21-24, 25-34, and 35-44, respectively.

Measurement.—We compute displacement outcomes in the model following common practice the literature (Davis and von Wachter 2011). Workers in the treatment group are those

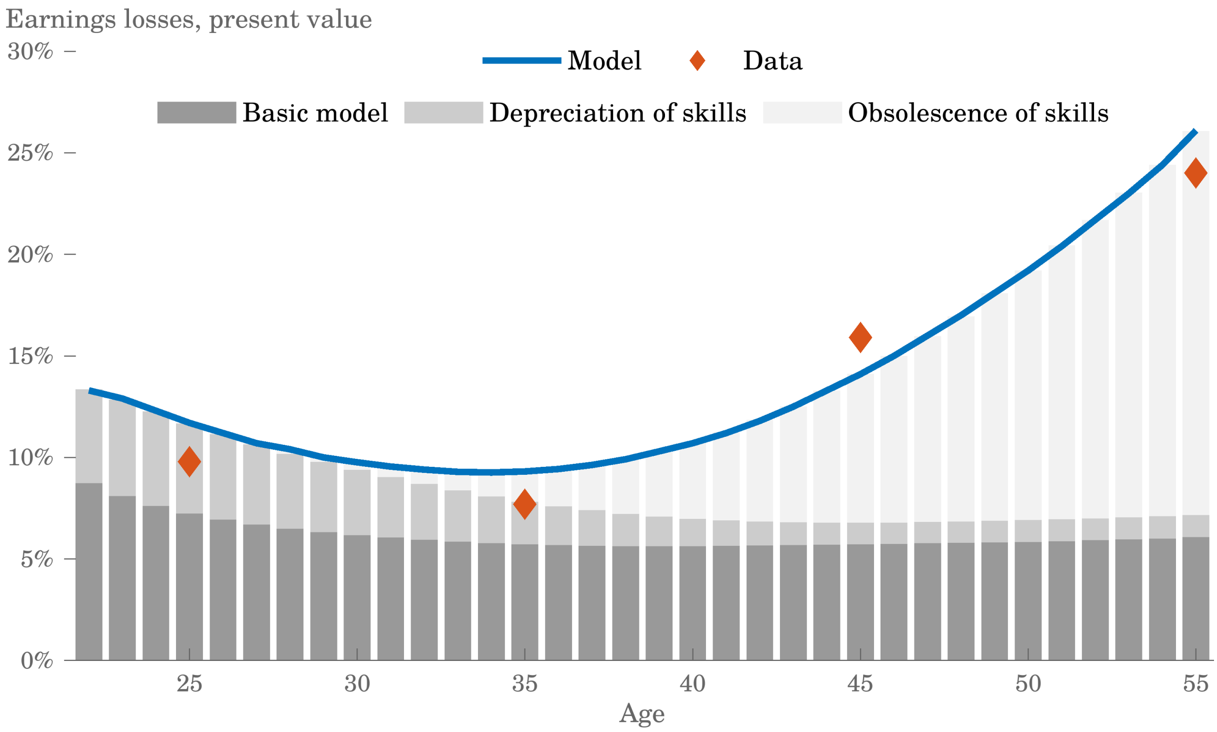

Figure 3: Cost of Job Loss, Model vs Data

Note: Data values are for the US and come from Davis and von Wachter (2011).

who are displaced with at least one year of job tenure at the time of displacement, where tenure means uninterrupted employment. Workers in the control group must have one year of tenure prior to displacement time and must remain with the same firm an additional two years. To measure the present discounted value of earnings losses, we simulate employment histories, select the workers who satisfy the above criteria, and recover their lifetime earnings. Periods of unemployment provide zero earnings. We then compute for each age t the lifetime cost as a percentage of present value counterfactual earnings. In order to get a consistent measure of present value losses across age groups, we use a ten-year horizon.

4.2 Main Results

Consider Figure 3. The solid blue line displays the PDV earnings losses at displacement, by age, as a percentage of PDV counterfactual earnings. The red diamonds indicate the corresponding values in US data for average workers aged 25, 35, 45, and 55 (as reported in Figure 1). Earnings losses form a clear U shape. Following displacement, workers in their twenties experience larger losses than workers in their thirties, who in turn, experience smaller losses than workers in their forties and fifties. The magnitude is large: losing a job early in the career wipes out up to 15 percentage points in long-term earnings. For mid-career workers, the figure is closer to 10 percentage points. To be sure, older workers, with

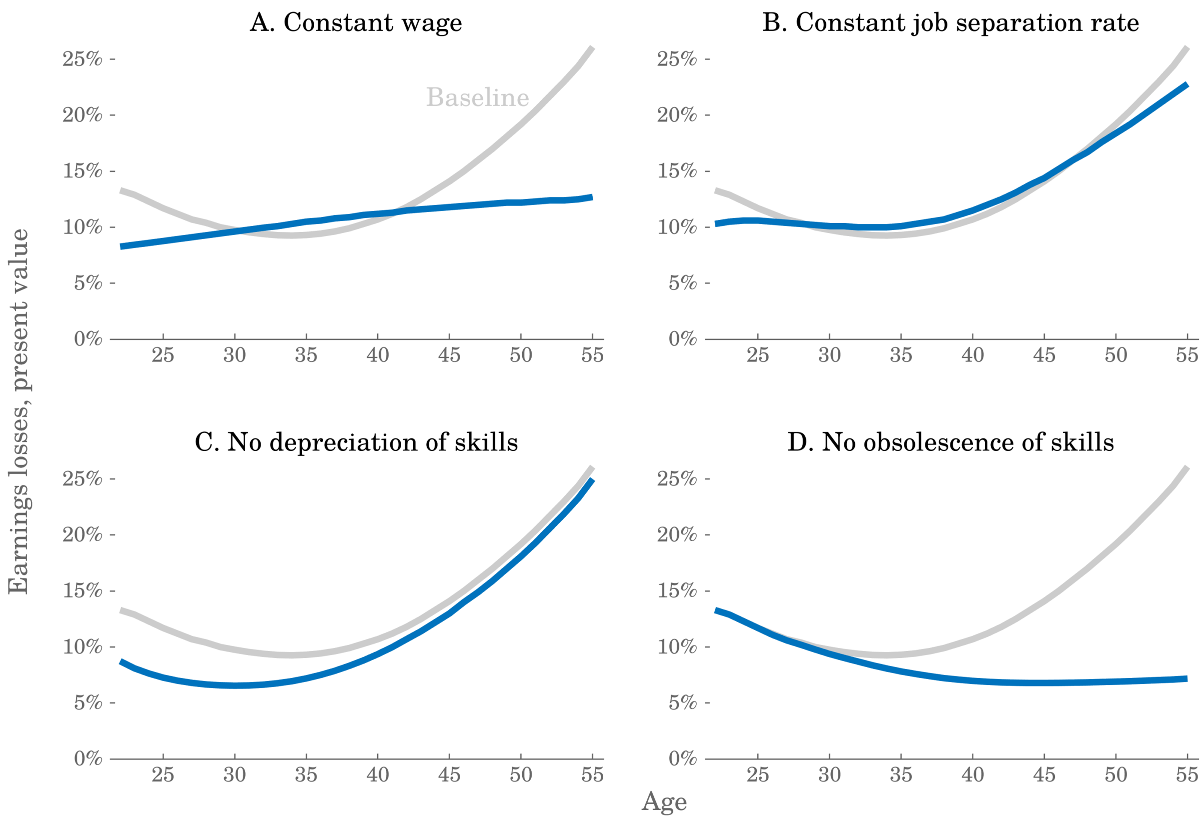

Figure 4: Isolating the Channels

up to 25 percentage points drop in earnings, are the biggest losers from displacement, a finding well documented in the literature. The values implied by the model are consistent with US data (Davis and von Wachter 2011). To our knowledge, this is the first paper that matches the cost of job loss over the life cycle — across all age groups.

4.3 Inspecting the Mechanisms

What explains the non-monotonic pattern of earnings losses? We switch off one element of the model at a time to expose the mechanisms at play. Figure 4 plots the results. In Panel A, we keep the level of human capital (and thus the wage) constant for all workers and set it to its mean. Earnings losses become linearly increasing in age. This is because older workers who are displaced have more trouble finding a job. As they near retirement, the profitability of a match from the employer's point of view decreases. Job creation for these workers falls. Thus, a standard life-cycle model without human capital can account partially for the large losses experienced by older displaced individuals. But it completely misses the fact that young workers lose more than middle-aged ones.

In panel B, we fix the job separation rate throughout. This flattens out the left part of the U, ie it reduces the cost of job loss for the young. Intuitively, workers start their career with a low level of human capital and gradually build up skills through learning by doing.

As they become more productive, the probability to lose their job falls. In other words, the job separation rate decreases with experience. By setting the separation rate to its mean, we remove an important source of earnings losses for young workers on the labor market — early career job instability.

In Panel C, we assume workers do not lose their skills while unemployed. The upshot is a J-shaped cost of job loss that makes the young better off. The reason is as follows. Young workers, as discussed, face more frequent unemployment spells than their older peers. During these unemployment spells, skills depreciate. A world where human capital does not depreciate while out of work favors the young disproportionately, thus removing an other important source of earnings losses for this age group.

Finally, Panel D displays an experiment with no obsolescence of skills. The cost of job loss now decreases monotonically with age. This highlights the main driving force behind the large earnings losses incurred by the old. As workers age, an increasing fraction of their accumulated human capital becomes obsolete, ie cannot be transferred to a new job in another firm. As a result, the wage upon reemployment falls drastically. On top of that, the job finding rate of old workers drops because low human capital (due to obsolescence) and high age make it less profitable for firms to hire these workers. Poor reemployment prospects are, of course, highly damageable to earnings.

To summarize, three forces account for the high cost of job loss *early* in the career: i) rapid human capital accumulation and wage growth; ii) job instability; iii) skill depreciation while out of work. In turn, two forces explain the high cost of job loss *late* in the career: i) firm-specific human capital, in the form of skill obsolescence; and ii) reduced employment prospects. Thus, the interaction between human capital dynamics and labor market transitions varies with age and helps generate the U-shaped profile of earnings losses over the life cycle.

4.4 Business Cycle Meets Life Cycle

A growing literature initiated by Davis and von Wachter (2011) documents how economic recessions magnify long-term earnings losses from displacement. What is perhaps less known is that young workers bear the brunt of the effects. Put differently, the U curve shifts up but also becomes steeper on its left half. In this subsection, we show that our simple model readily matches the behavior of earnings during downturns. We simulate a recession by doubling the average job separation rate and halving the average job finding rate over a period of two years, following Farber (2017). Then everything returns to normal. We compute PDV earnings losses with respect to non-displaced workers in the same way as before. Figure 5 depicts the outcome. Again, the red diamonds indicate the data values.

The model does a great job at capturing the observed upward shift in the U curve. When losing her job in a recession, an average 35 year-old worker experiences a 16 percentage point drop in long-term earnings, fully 60 percent more than in normal times. For young

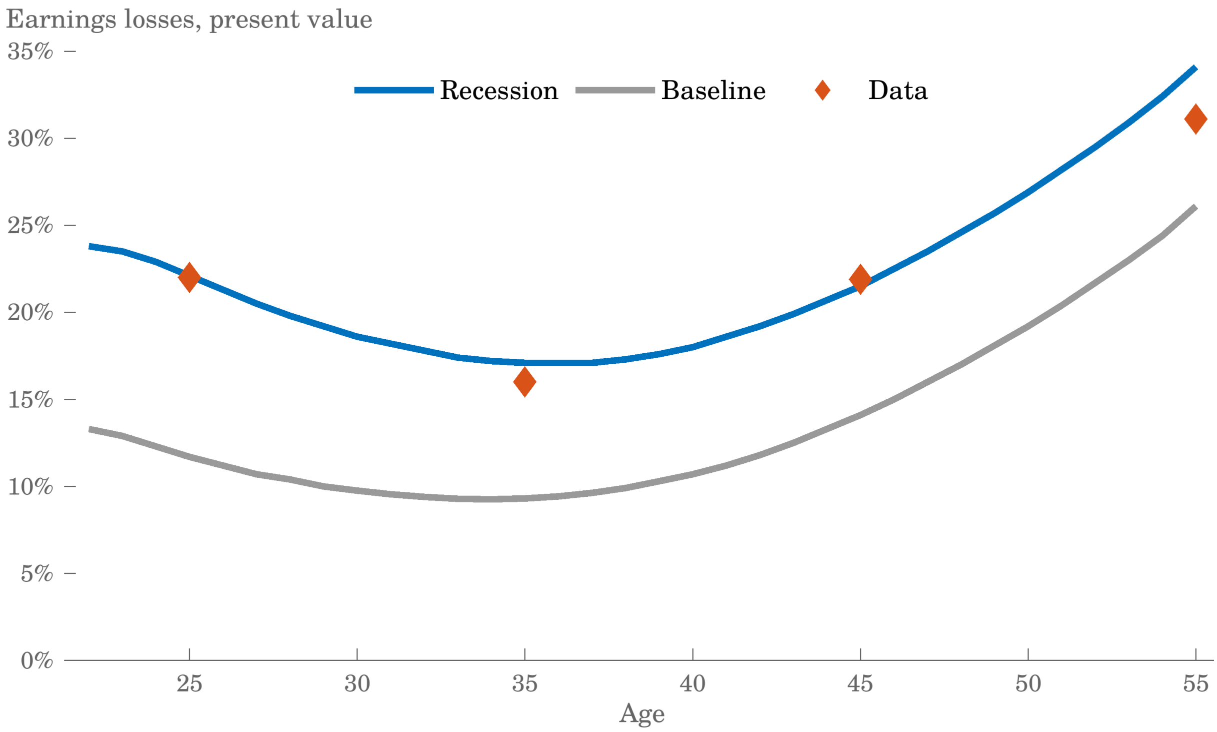

Figure 5: Cost of Job Loss in Recession

Note: Data values are for the US and come from Davis and von Wachter (2011).

workers, the absolute drop is even more pronounced: a displaced 25 year-old worker loses 22 percentage points in present value earnings. The figure makes clear that young workers suffer disproportionately more than their older peers.

What drives the increased loss in earnings? For one, a higher job separation rate means workers are laid off more often, dragging income down. In addition, as the job finding rate drops, displaced workers spend more time unemployed, searching for a job. This reduces labor income and entails a larger depreciation in human capital, which negatively impacts future wages and future job stability. Endogenous low job stability determined by human capital accumulation and depreciation turns out to be once again a key determinant of earnings losses for younger workers, in normal times as well as in recessions.

5 Conclusion

This paper revisits the profile of displacement-induced earnings losses over the life cycle. We document a new fact, namely that the cost of job loss is U-shaped in age. In particular, young workers who lose a job in their twenties experience a greater a drop in present-value earnings than workers who lose a job in their thirties. This finding may appear surprising at first glance, given that the young enter the labor market with little experience and low salaries relative to their older peers.

We offer an intuitive explanation for why job loss inflicts a high cost on the young. Most gains in earnings and productivity typically occur at an early stage of the career. Workers who are displaced in this dynamic phase of life forego the opportunity to quickly grow their human capital and reap the benefits of rapid wage hikes. By contrast, workers in their mid-thirties to forties have usually achieved most of their earnings growth, while remaining highly employable. This explains why these workers suffer less after displacement than their younger colleagues.

We develop a simple life-cycle search model in which this mechanism features prominently. The key ingredients are human accumulation on the job and human capital decumulation off the job, in the form of general depreciation and skill obsolescence. The model calibrated to the US data does a great job a reproducing the U-shaped pattern of earnings losses over the life cycle. In addition, we are able to match the higher cost of job loss in recessions, and emphasize that young workers are hit particularly bad when the economy contracts.

We keep our model simple deliberately. The key advantage is it makes very apparent the different forces that drive the non-monotonic profile of earnings losses. Recent work, however, shows that the change in firm quality before and after displacement accounts for part of the cost of job loss. It would be interesting to model heterogeneous firms with different piece rates and have unemployed workers direct their search to one firm or another. This would give workers the chance of working in lower-paying jobs instead of simply be unemployed and see their skills deteriorate. We leave the promising analysis of firm heterogeneity to future work.

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