Aging, Mobility, and the Erosion of Bargaining Power*

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Abstract

Workforce aging decreases labor mobility and weakens bargaining power by reducing outside-offer competition, even when older workers remain valuable hires, because they search less and are harder to poach. U.S. industry-level evidence shows that aging reduces employer-to-employer (EE) flows, job creation, labor share, and firm's vacancy creation, while individual-level evidence shows that wage gains from EE flows decline with age. In a general-equilibrium life-cycle search model with on-the-job search and endogenous bargaining, aging explains half the 1995–2015 decline in labor share. The shift in workforce composition toward older workers accounts for 40% of the demographic effect, while the remaining 60% reflects the resulting decline in vacancy creation. Vacancy subsidies and moderate unemployment-benefit cuts substantially restore the labor share.

JEL codes: J11, J62, E24

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1 Introduction

Population aging is one of the most profound structural changes facing the world. Since the early 1980s, for example, the average age of the U.S. workforce has risen steadily, and workforce aging is expected to continue as fertility declines and longevity increases.[1] Although the effects of population aging on economic growth, saving, and fiscal sustainability have been widely studied, a smaller literature examines its implications for labor-market dynamism and labor bargaining power.[2] In particular, little is known about how changes in workforce composition interact with firms' equilibrium vacancy-creation response to shape outside-offer competition, leading to changes in employer-to-employer (EE) flows and the labor share of output.

We study this interaction through on-the-job search, which directly connects labor mobility to bargaining power and the labor share. Workers benefit from outside offers because accepted offers generate EE flows, typically with wage gains (Topel and Ward, 1992), and offers matched by incumbent employers generate retention counteroffers.[3] Both EE flows and bargaining gains therefore depend on outside offers available to workers, which are jointly determined by workers' search behavior and firms' vacancy creation.

Workforce aging reduces these opportunities through two effects. First, older workers search less intensively and have lower EE flows, so aging shifts the employment composition toward workers with lower EE-flow rates. We call this the "composition effect." Second, an older workforce reduces the expected duration and value of newly formed matches, discouraging vacancy creation and thereby reducing outside-offer opportunities for workers of all ages. We call this the "vacancy-creation effect."[4] Together, these effects reduce EE flows and retention counteroffers, weaken workers' bargaining power, and lower the labor share.

We provide two sets of empirical evidence supporting this mechanism. First, we examine the

[1] Workforce aging has not been monotonic over a longer history of the United States. The entry of the large baby-boom cohorts into employment lowered the average age of the workforce during the 1960s and 1970s. This trend reversed in the early 1980s as the baby-boom cohorts aged and smaller cohorts entered the workforce.

[2] Closely related studies include Glover and Short (2023), Engbom (2019), and Furbach (2024). Glover and Short (2023) take age-specific offer-arrival rates as given, while Engbom (2019) studies interactions between worker and firm dynamics with exogenous relative search intensity. Furbach (2024) links age-dependent labor-supply elasticities to employer wage-setting power and spatial wage differences. Our model combines endogenous search, age-dependent rent portability, and firms' vacancy creation to examine how workforce aging affects worker rents and the aggregate labor share. See the literature review below for a detailed comparison.

[3] An EE flow is a direct move from one employer to another without an intervening period of nonemployment.

[4] Crucially, this effect does not require older employed workers to be intrinsically unattractive to firms. Greater human capital can raise a firm's surplus conditional on a successful hire, but lower search intensity, stronger incumbent matches, and shorter remaining horizons make profitable hiring opportunities less likely.

relationship between workforce aging, EE flows, labor rent, and the labor share.[5] At the aggregate level, the U.S. EE-flow rate has declined, partly because employment has shifted toward older workers with lower EE-flow rates. Age-specific EE-flow rates have also declined within every major age group. At the industry level, industries experiencing larger increases in average worker age also experience larger declines in the EE-flow rate, labor rent, and labor share.

To identify the causal effect of workforce aging at the industry level, we use a shift–share instrument that combines predetermined industry-level age distribution with subsequent national changes in the relative sizes of age groups. The 2SLS estimates imply that an instrumented increase in average industry age reduces the EE-flow rate, labor rent and labor share. Moreover, the decline in the labor share is nearly twice as large in industries with initially low EE-flow rates as in those with higher rates. This pattern suggests that workforce aging weakens workers' bargaining power most where outside-offer competition is already limited. On the firm side, an instrumented one-year increase in average workforce age reduces the gross job-creation rate, providing evidence consistent with the model's vacancy-creation mechanism. A complementary analysis using the JOLTS job-openings rate gives similar results.

Second, we use matched CPS data to examine how the wage-growth premium associated with employer switching varies with age. Workers aged 20–29 with an observed employer switch experience 2.1 log points more weekly-earnings growth and 1.2 log points more hourly-wage growth than comparable workers without an observed switch. The premium declines rapidly with age, becoming close to zero among workers in their 40s and negative among older workers.[6] A recent-switch measure, based on an employer switch between the final two consecutive monthly CPS interviews, produces an even steeper age gradient. Hence, the wage-growth premium associated with changing employers is substantial early in the career but becomes progressively smaller with age.

Motivated by this evidence, we develop an equilibrium life-cycle search model with on-the-job search, human-capital accumulation, firm heterogeneity, and endogenous bargaining share. Workers have finite working lives and choose their search intensity, while firms create vacancies subject to the free entry condition. Outside offers generate movements up the job ladder and in-

[5] Labor rent provides a measure of the portion of firm surplus captured by workers and is, therefore, informative about worker bargaining power (Stansbury and Summers, 2020).

[6] These estimates should be interpreted as associations rather than causal returns to employer switching. Switching is endogenous, and switchers may differ from non-switchers in unobserved characteristics. This concern may be especially important at older ages, when workers approaching retirement may value shorter hours, greater flexibility, lower job demands, or other nonpecuniary amenities and may therefore accept smaller wage gains or even wage reductions.

crease workers' bargaining power. Weak outside offers are rejected, intermediate offers induce retention counteroffers from incumbent firms, and sufficiently strong offers that incumbents cannot match generate EE flows.

The model generates the observed age gradients in the EE-flow rate and the employer-switch wage-growth premium through four life-cycle forces. First, as workers climb the job ladder and obtain better matches, fewer outside offers are attractive enough to induce an employer switch. Second, a shorter remaining working life reduces the return to job search, leading older workers to search less intensively. Third, accumulated rents are only partially portable across employers, and rent portability declines with age.[7] This reduces the incentive to switch employers and the wage gain from doing so, helping the model reproduce our second empirical finding. Finally, human-capital accumulation works in the opposite direction by raising productivity and wages. Together, these forces allow the model to generate a rising life-cycle wage profile alongside EE-flow rates and employer-switch wage-growth premiums that decline with age.

We calibrate the model to the U.S. economy around 1995. The age gradient in the EE-flow rate determines how search intensity changes over the life cycle, while the age gradient in the employer-switch wage-growth premium determines age-dependent rent portability. The calibrated model closely reproduces both gradients and the life-cycle wage profile. We then use the model to quantify the composition and vacancy-creation effects of workforce aging. Aging's effect on vacancy creation is therefore theoretically ambiguous. Greater human capital and lower rent portability can raise the firm's surplus conditional on a successful match, whereas lower search intensity, stronger incumbent matches, and shorter remaining careers reduce the frequency and duration of profitable matches. In the calibrated model, the combined negative forces dominate, and hence, align with the data, reducing vacancy creation and outside-offer competition and thereby amplifying the composition effect.

To quantify the aggregate effects of workforce aging, we conduct a demographic counterfactual that replaces the 1995 survival schedule and workforce age distribution with their 2015 counterparts, holding all other parameters fixed. This change raises the average workforce age from 38.4 to 42.0 years and reduces the aggregate EE-flow rate and equilibrium labor-market tightness. The labor share falls by 3.25 percentage points, aligning with empirical evidence and accounting for approximately half of its observed decline between 1995 and 2015. The composition effect ac-

[7] Rent portability summarizes firm- and occupation-specific know-how, and other employment attachments that make accumulated rents more difficult to preserve when changing employers.

counts for 43 percent of the model-generated decline, while the endogenous reduction in vacancy creation accounts for the remaining 57 percent. Despite the declines in EE flow and the labor share, GDP rises because the older workforce has accumulated more human capital.

Policy experiments underscore the central role of vacancy creation. A relatively modest vacancy subsidy of approximately 4.5 percent restores the labor share to its 1995 level, whereas achieving the same outcome through unemployment benefits requires a 40 percent reduction. Although the two policies operate through different margins, both increase the expected return to vacancy posting, raise labor-market tightness, and strengthen outside-offer competition. This contrast shows that aggregate worker bargaining power is highly sensitive to firms' incentives to create vacancies. The vacancy subsidy also raises GDP and worker welfare, whereas the welfare effect of reducing unemployment benefits depends on how the resulting fiscal savings are distributed.

By contrast, policies targeting older workers need not stimulate vacancy creation. Restoring the before-tax labor share requires closing 95 percent of the rent-portability gap. Moreover, the reform shifting surplus from firms to workers reduces vacancy profitability and GDP and may lower worker welfare after accounting for resource costs and tax financing. Subsidies raise older workers' contact rates but reduce firms' expected surplus and discourage vacancy creation, partially offsetting their direct benefits. Thus, policies that strengthen older workers' bargaining position may be partly undone in general equilibrium.

Literature review. Our paper contributes to the literature on demographic change and labor-market dynamics by examining how workers' outside opportunities interact with firms' recruiting incentives. On the worker side, Glover and Short (2023) emphasize the composition effect of older workers' exogenously lower offer-arrival rates, while Furbach (2024) links their lower labor-supply elasticities to greater employer wage-setting power. We show how aging also weakens outside opportunities for workers of all ages through reduced vacancy creation, generating a general equilibrium effect that is quantitatively comparable to the direct composition effect.

On the firm side, Hopenhayn, Neira and Singhania (2022) show that slower population growth shifts employment toward older, larger firms and lowers the aggregate labor share. We study a complementary channel through workforce age composition and outside-offer competition. Shimer (2001) connects workforce age composition to vacancy creation and unemployment, while Engbom (2019) shows how aging generates mutually reinforcing declines in worker mobility and

firm entry. In the framework of Engbom (2019), older workers have accumulated better matches and are consequently less likely to accept outside offers, while relative search intensity remains fixed. Our model allows search effort to respond to remaining working lives and the gains available from outside offers. It also incorporates age-dependent rent portability, which our evidence on the age gradient in employer-switch wage gains helps discipline.

These endogenous search intensity decisions provide an additional channel through which demographic change and mobility policies affect firms' recruiting incentives. Our industry-level evidence links aging to lower EE flows, worker rents, and gross job creation, with larger labor-share declines where initial mobility is low. We use the calibrated model to examine how policies affecting search costs, matching opportunities, and vacancy creation operate through these interactions.[8] In the baseline calibration, encouraging older workers' search or improving their matching opportunities can increase mobility while lowering the labor share through an adverse vacancy response. Vacancy subsidies instead strengthen outside-offer competition and raise the labor share. These exercises highlight how the distributional effects of mobility policies depend on the interaction between workers' search responses and firms' vacancy creation.

Our paper also contributes to research on labor-market dynamism and worker bargaining power. Davis and Haltiwanger (2014) document the secular decline in U.S. labor-market dynamism, while Moscarini and Postel-Vinay (2017) show that EE flows strongly predict aggregate wage growth. Cahuc, Postel-Vinay and Robin (2006) develop a framework in which on-the-job search and outside offers shape wage bargaining. Related work links weaker labor-market competition to lower wages and worker bargaining power: Benmelech, Bergman and Kim (2022) emphasize employer concentration, while Stansbury and Summers (2020) document a broader decline in worker power. We identify workforce aging as an additional, slow-moving source of weaker outside-offer competition and connect it to EE flows, labor rent, and the labor share. Finally, Córdoba, Isojärvi and Li (2023) show that falling labor-market tightness weakens workers' bargaining power and lowers the labor share. Our findings identify workforce aging as a source of weaker hiring incentives and competition, without an increase in vacancy costs. In our model, restoring tightness to previous levels does not fully restore labor's share, because aging also reduces the labor share at a given level of tightness.

Finally, we add a demographic mechanism to the literature on the decline in labor share. Ex-

[8] Gautier et al. (2018) provide related evidence on equilibrium spillovers: a Danish job-search assistance program for unemployed workers reduced nonparticipants' job-finding rates.

isting explanations emphasize production technology (Karabarbounis and Neiman, 2014), trade liberalization (Elsby, Hobijn and Şahin, 2013), product-market power (De Loecker, Eeckhout and Unger, 2020; Barkai, 2020), the reallocation of activity toward low labor-share firms (Autor et al., 2020; Kehrig and Vincent, 2021; Gouin-Bonenfant, 2022), and public-sector activity (Bridgman and Greenaway-McGrevy, 2022). For reviews, see Grossman and Oberfield (2022) and Karabarbounis (2024). We show that workforce aging lowers the labor share by reducing EE flows and weakening worker bargaining power. Quantitatively, it accounts for approximately one-half of the decline in the U.S. labor share between 1995 and 2015.

2 Evidence on Workforce Aging, EE Flow, and Labor Share

Aggregate EE flows have declined both because employment has shifted toward older workers and because EE flow has fallen within age groups. Across industries, increases in average worker age are associated with declines in EE flows, labor rent, and the labor share. A shift–share design, based on predetermined industry age composition and national cohort growth, supports a causal interpretation, with larger effects in industries where labor-market fluidity was initially low. Matched CPS evidence further shows that the wage-growth premium associated with employer switching declines sharply over the life cycle.

2.1 Data and measurement

Industry panel. The baseline industry analysis combines three sources of annual data. First, we use the Current Population Survey (CPS) to measure the age composition and EE-flow rate of each industry's workforce. Second, we use the labor-share and imputed labor-rent series constructed by Stansbury and Summers (2020). Third, we obtain the gross job-creation rate from the U.S. Census Bureau's Business Dynamics Statistics (BDS). We supplement these data with the job-openings rate from the Bureau of Labor Statistics' Job Openings and Labor Turnover Survey (JOLTS), which provides a more direct measure of vacancies for the shorter 2001–2016 period.

Industries in the baseline panel are harmonized using the classification in Covarrubias, Gutiérrez and Philippon (2020) and Stansbury and Summers (2020), a classification based primarily on BEA industry codes. The baseline panel covers 1994–2016 and includes CPS workers aged 16–64. Because the publicly available JOLTS series use substantially broader industry categories, the JOLTS analysis aggregates the CPS data into 16 private-industry groups.

For industry j in year t, AvgAge_{jt} is the employment-weighted mean age of employed CPS respondents. An EE flow occurs when a civilian worker is employed in the current wave of interviews and reports working for a different employer than in the previous wave. The industry EE-flow rate is the weighted number of these transitions divided by weighted industry employment. This construction follows the logic of Fallick and Fleischman (2004). Online Appendix A describes the CPS-to-industry crosswalk and the treatment of industry codes that map to multiple NAICS categories.

The labor share and labor rent capture distinct outcomes. The labor share is the fraction of industry income paid to labor. The imputed labor-rent series from Stansbury and Summers (2020) measures the portion of labor compensation above workers' estimated outside option. We adopt their use of labor rent as an industry-level proxy for the rents accruing to workers and, therefore, for worker bargaining power.

We use two complementary measures of firm outcomes. The BDS gross job-creation rate measures employment gains at expanding and entering establishments relative to average employment in the current and preceding years. We interpret it as a measure of realized employment expansion associated with vacancy creation rather than as a direct measure of vacancy posting. It excludes unfilled vacancies and replacement hiring that does not increase establishment employment.

The JOLTS job-openings rate provides a more direct measure of vacancies. JOLTS counts a position as open when work is available, the position could begin within 30 days, and the employer is actively recruiting outside the establishment. The job-openings rate is the number of openings divided by the sum of employment and job openings. We use the annual average rate for 2001–2016. Unlike BDS gross job creation, JOLTS captures unfilled positions and includes vacancies intended to replace departing workers. It nevertheless measures the stock of vacancies on the last business day of each month rather than the flow of newly posted positions. Its shorter time span and broader industry classification also limit its comparability with the baseline panel.

Individual-level wage sample. We then match CPS respondents across their two outgoing-rotation interviews, MISH 4 and MISH 8, which occur approximately one year apart. We restrict the sample to workers who are employed in both interviews, are aged 20–64 at MISH 4, report valid earnings, and have absolute twelve-month log wage growth of no more than 150 log points. Age groups are defined at MISH 4 and held fixed across interviews. We examine growth in both

weekly earnings and hourly wages. Hourly wages are calculated by dividing weekly earnings by usual weekly hours, with the directly reported hourly wage used when this measure cannot be constructed.

Our preferred switching indicator identifies workers who report a different employer in any observed month from MISH 5 through MISH 8; the comparison group consists of workers with valid employer-continuity information and no observed switch during this return spell. As robustness checks, we use a stricter recent-switch measure based on an employer change at MISH 8 relative to the preceding observed month and a broader job-change proxy that adds changes in industry or occupation between MISH 4 and MISH 8.

2.2 Motivating facts

Figure 1 shows the long-run evolution of workforce age. The entry of the baby-boom cohorts initially lowered the mean age of employed workers in the 1960s and 1970s. The trend reversed in the early 1980s, after which the workforce consistently aged. The reversal coincided with stronger labor-force attachment among older workers and the 1986 amendments to the Age Discrimination in Employment Act that eliminated most mandatory retirement. Figure 2 shows variation within industries. Increases in average worker age are associated with declines in both the labor share and the EE-flow rate.

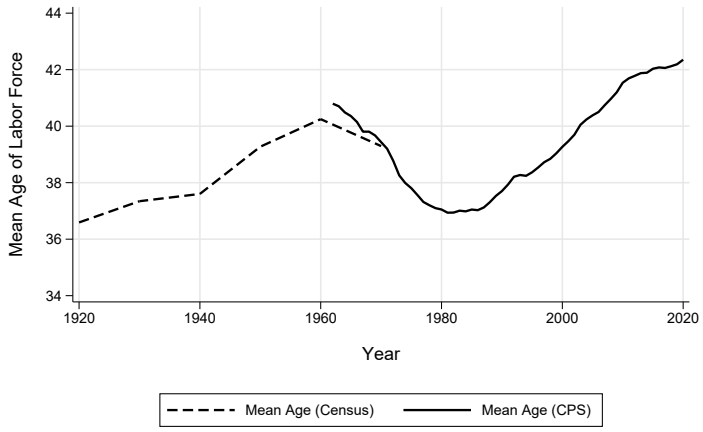


Figure 1: Average Age of the Labor Force

Notes: Sources: IPUMS USA, IPUMS CPS, and authors' calculations.

The aggregate decline in EE flow has between-group and within-group components. The left

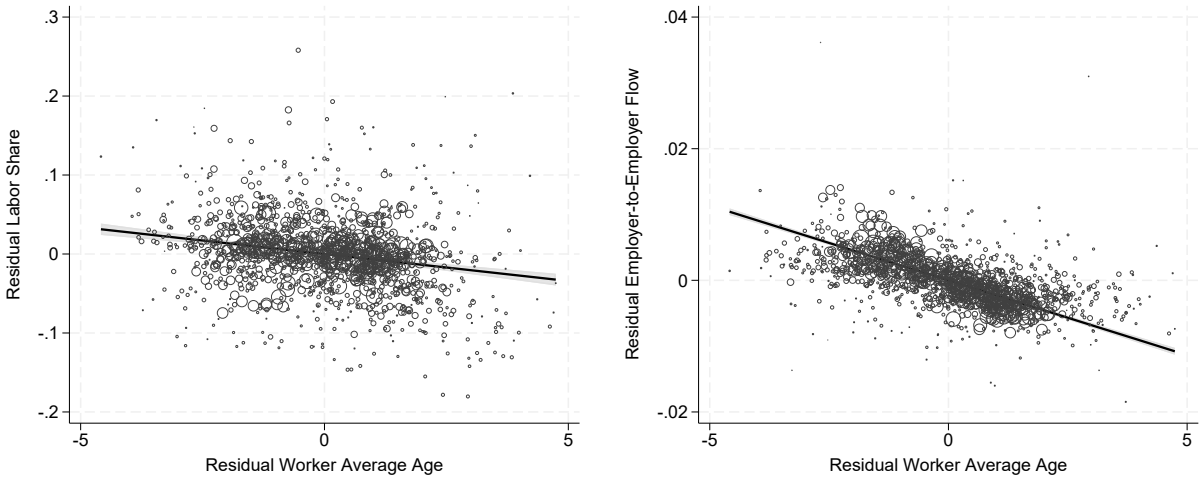


Figure 2: Industry-Level Correlations between Workforce Aging and Labor-Market Outcomes
Notes: Each point is an industry-year observation weighted by employment. The outcomes and average age are residualized with respect to industry fixed effects. Sources: CPS, U.S. Bureau of Labor Statistics, Stansbury and Summers (2020), and authors' calculations.

panel of Figure 3 shows that EE flows declined within every major age group. The right panel shows that employment shifted toward older groups with lower EE-flow rates. The composition effect of aging thus contributed to the aggregate EE flow decline, but does not account for the entire trend. This distinction matters in the quantitative analysis, where changing age weights and equilibrium search intensity across age groups are separate channels.

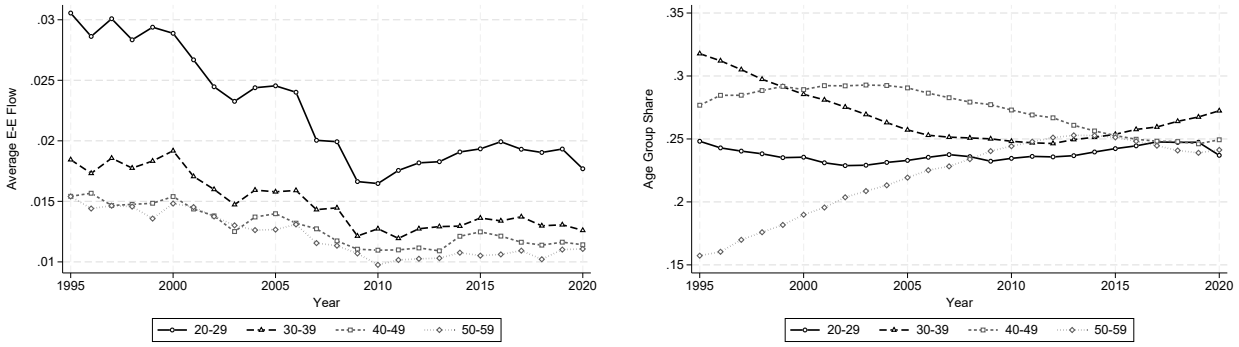


Figure 3: Employer-to-Employer Flow and Employment Shares by Age Group
Notes: The left panel plots EE-flow rates by age group. The right panel plots each group's share of employment. Sources: CPS and authors' calculations.

These patterns are consistent with a large literature documenting the secular decline in U.S. labor-market dynamism since the 1980s (Davis and Haltiwanger, 2014). EE flows are especially important because they generate outside offers, discipline incumbent firms, and support wage

growth, particularly early in the career (Topel and Ward, 1992). Lower EE flows therefore weaken workers' outside options and reduce the rents they obtain from employment, linking declining labor-market fluidity and the falling labor share.[9]

Glover and Short (2023) emphasize a demographic composition effect: as the workforce ages, aggregate EE flows and labor share fall because older workers face weaker outside options and larger earnings–marginal-product wedges. Our descriptive evidence is complementary, but it highlights an additional margin. The decline in EE flows is not only a reweighting of employment toward older, lower-mobility workers, as Figure 3 shows that EE flow also falls within every major age group. This distinction matters for the quantitative analysis. The model separates the mechanical reweighting of age groups from the equilibrium response of search incentives, vacancy creation, and outside-offer competition.

While these stylized facts are informative, they do not establish causality. Industry aging may be correlated with unobserved changes in productivity, technology adoption, labor demand, or market structure. In the next subsection, we therefore turn to a shift–share instrumental-variables strategy that isolates variation in industry-level workforce aging induced by predetermined industry age composition and national demographic change.

2.3 Industry-Level Evidence on Labor-Market Outcomes

This subsection uses industry-level shift-share variation to test whether workforce aging reduces EE flow and labor income, and whether these effects are stronger in industries that initially had lower EE flows. To this end, we relate industry outcomes to the industrial age composition. The baseline specification is

$$Y_{jt} = \beta \, \mathrm{AvgAge}_{jt} + \mu_j + \varepsilon_{jt}, \tag{1}$$

where Y_{jt} is the labor share, labor rent, or EE-flow rate in industry j and year t, AvgAge_{jt} is the average age of employed workers in the industry, and μ_j denotes industry fixed effects.[10] The estimation of the coefficient β therefore exploits variation in within-industry workforce age. A

[9] This interpretation complements evidence linking labor-market competition, worker rents, and the labor share. Stansbury and Summers (2020) document a close relationship between worker rents, labor share, and measures of labor-market power, while Autor et al. (2020) and Kehrig and Vincent (2021) emphasize how reduced competition and reallocation can shift surplus away from labor.

[10] Year fixed effects are omitted because national cohort aging is a substantive source of treatment variation in our analysis. Including them would absorb the aggregate demographic component. Identification requires that the cohort-driven variation in predicted workforce aging be uncorrelated with other unobserved changes affecting the outcomes, conditional on industry fixed effects and the included controls.

negative value of β means that an industry outcome falls as its workforce ages.

OLS estimates of equation (1) need not be causal. For example, persistent industry labor-demand shocks could both change the age composition of an industry and affect labor share, labor rents, or EE flow. We therefore construct an age-composition shift–share instrument that combines predetermined industrial age distribution with national changes in cohort size:

$$Z_{jt} = \sum_{a} s_{j,a,0}\, g_{a,t}\, \bar{a}, \tag{2}$$

where $s_{j,a,0}$ is age group a's employment share in industry j in the 1993 base year, $g_{a,t}$ is the national growth rate of that age group between $t-1$ and t, and $\bar{a}$ is the group's mean age. Industries that initially employed more workers from nationally expanding age groups receive a larger predicted increase in workforce age. The corresponding first stage is

$$\mathrm{AvgAge}_{jt} = \pi Z_{jt} + \mu_j + v_{jt}. \tag{3}$$

The exclusion restriction is that, conditional on industry fixed effects, baseline age exposure affects outcomes only through the industry aging induced by national demographic change. All regressions are weighted by CPS industry employment and cluster standard errors by industry.

Table 1 reports the baseline OLS and 2SLS estimates. The estimates are negative for all three outcomes. The first stages are strong, with high Kleibergen–Paap statistics. These results indicate that industries exposed to demographic aging experience lower labor income shares, lower worker rents, and lower EE-flow rates.

Table 1: Effects of Average Industry Age on Labor-Market Outcomes

	Labor share		Labor rent		EE flow	
	(1) OLS	(2) 2SLS	(3) OLS	(4) 2SLS	(5) OLS	(6) 2SLS
AvgAge_{jt}	-0.683^{**}	-1.362^{***}	-0.344^{***}	-0.301^{**}	-0.228^{***}	-0.305^{***}
	(0.272)	(0.377)	(0.079)	(0.123)	(0.025)	(0.029)
Observations	1,288	1,288	1,150	1,150	1,288	1,288
Industries	56	56	50	50	56	56

Notes: Labor share is the fraction of industry income paid to labor, and labor rent is the portion of labor compensation above workers' estimated outside options. EE flow is the employer-to-employer flow rate among employed CPS respondents aged 16–64. The 2SLS instrument uses 1993 baseline industry age-group employment shares and national age-group growth. Regressions are weighted by CPS industry employment and include industry fixed effects. Coefficients are percentage-point effects of a one-year increase in average industry age; industry-clustered standard errors are in parentheses. The reported Kleibergen–Paap F-statistics are heteroskedasticity robust. $^{*}p < 0.10$, $^{**}p < 0.05$, and $^{***}p < 0.01$.

We now consider whether the effects of workforce aging differ by an industry's initial EE flow. The motivation is that aging may be more damaging when workers already face fewer outside opportunities, as proxied by a low initial EE-flow rate. We define the initial EE flow as the employment-weighted average EE-flow rate over 1994–1996 and standardize it across industries in the estimation sample.[11]

Using the 1997–2016 sample, we estimate

$$Y_{jt} = \beta \, \mathrm{AvgAge}_{jt} + \delta \left(\mathrm{AvgAge}_{jt} \times \widetilde{\mathrm{EE}}_{j,0} \right) + \mu_j + \varepsilon_{jt}, \tag{4}$$

where Y_{jt} is either labor share or labor rent, $\widetilde{\mathrm{EE}}_{j,0}$ is the normalized EE flow and μ_j denotes industry fixed effects. Since initial EE flow is time-invariant, its main effect is absorbed by the industry fixed effects. The coefficient δ therefore captures whether the age effect differs between initially high- and low-EE-flow industries. The marginal effect of workforce aging is

$$\frac{\partial Y_{jt}}{\partial \, \mathrm{AvgAge}_{jt}} = \beta + \delta \widetilde{\mathrm{EE}}_{j,0}. \tag{5}$$

Table 2 reports the marginal age effect at the 25th, 50th, and 75th percentiles of initial EE flow. For labor share, the negative age effect is substantially larger in initially low-fluidity industries. In the IV specification,[12] a one-year increase in average age lowers the labor share by 2.1 percentage points at the 25th percentile of initial EE flow, compared with 1.1 percentage points at the 75th percentile. The high-minus-low difference is 1.0 percentage point and is statistically significant. The labor-rent estimates are negative throughout the initial-fluidity distribution, but the high-minus-low difference is smaller and not statistically significant.

Taken together, the industry results support two conclusions. First, workforce aging leads to lower labor income and lower EE flow. Second, the labor-share effect is more pronounced in industries that initially had lower EE flows.

[11] Specifically,

$$\mathrm{EE}_{j,0} = \frac{\sum_{t \in \mathcal{T}_0} \mathrm{Emp}_{jt} \, \mathrm{EE}_{jt}}{\sum_{t \in \mathcal{T}_0} \mathrm{Emp}_{jt}}, \qquad \mathcal{T}_0 = \{1994, 1995, 1996\},$$

and

$$\widetilde{\mathrm{EE}}_{j,0} = \frac{\mathrm{EE}_{j,0} - \overline{\mathrm{EE}}_0}{\sigma_{\mathrm{EE},0}},$$

where $\overline{\mathrm{EE}}_0$ and $\sigma_{\mathrm{EE},0}$ are the mean and standard deviation of initial EE flow across industries in the estimation sample.

[12] In the IV version, we instrument AvgAge_{jt} and $\mathrm{AvgAge}_{jt} \times \widetilde{\mathrm{EE}}_{j,0}$ with Z_{jt} and $Z_{jt} \times \widetilde{\mathrm{EE}}_{j,0}$, respectively, where Z_{jt} is the age-composition shift–share instrument.

Table 2: Age Effects by Initial EE-Flow Rate

Outcome	Model	Initial EE p25/p50/p75 (%)	Low EE	Median EE	High EE	High–Low	KP F	N	Industries
Labor share	OLS	1.47 / 1.81 / 2.26	-1.504^{***}	-1.186^{***}	-0.766^{**}	0.738^{*}	–	1,120	56
			(0.311)	(0.250)	(0.311)	(0.374)			
Labor share	IV	1.47 / 1.81 / 2.26	-2.074^{***}	-1.642^{***}	-1.072^{**}	1.001^{**}	45.5	1,120	56
			(0.408)	(0.329)	(0.419)	(0.501)			
Labor rent	OLS	1.47 / 1.81 / 2.24	-0.393^{***}	-0.362^{***}	-0.324^{***}	0.070	–	1,000	50
			(0.119)	(0.090)	(0.081)	(0.104)			
Labor rent	IV	1.47 / 1.81 / 2.24	-0.451^{**}	-0.386^{**}	-0.304^{**}	0.147	42.1	1,000	50
			(0.212)	(0.157)	(0.127)	(0.176)			

Notes: Entries are the marginal effect of one additional year of average industry age, evaluated at the 25th, 50th, and 75th percentiles of initial EE flow. Initial EE flow is the employment-weighted industry average over 1994–1996; estimation begins in 1997. Coefficients and standard errors are multiplied by 100, so share outcomes are in percentage points. High–Low is the difference between the marginal effects at the 75th and 25th percentiles. All specifications are weighted by CPS industry employment and include industry fixed effects only; year fixed effects are not included. Standard errors clustered by industry are in parentheses. In IV rows, average age and its interaction with standardized initial EE flow are instrumented by the age-composition shift–share instrument and its interaction with initial EE flow. KP F reports the Kleibergen–Paap first-stage diagnostic for the interacted IV specification. $^{*}p < 0.10$, $^{**}p < 0.05$, and $^{***}p < 0.01$.

2.4 Industry-Level Evidence on Firm-Side Outcomes

We examine the model's firm-side mechanism using two complementary outcomes. The first is the gross job-creation rate from the Census Bureau's Business Dynamics Statistics, merged with our CPS industry panel. BDS gross job creation measures employment gains at expanding continuing establishments and newly opened establishments relative to average employment. Because it does not observe vacancy postings directly, we interpret it as a measure of realized employment expansion associated with vacancy creation. Since BDS year $t+1$ measures employment changes from approximately March t to March $t+1$, we match gross job creation in $t+1$ to average workforce age in year t.

The second outcome is the annual average job-openings rate from the JOLTS. It provides a more direct measure of vacancies because it counts positions for which work is available, employment can begin within 30 days, and the employer is actively recruiting outside the establishment. It therefore includes both unfilled vacancies and vacancies created to replace departing workers. Its main limitations are that the public industry series begin only in 2001, cover 16 broad private-industry groups, and measure the stock of vacancies rather than the flow of newly posted vacancies. We match the annual job-openings rate in year t to average workforce age in the same year.

For each outcome, we estimate equation (1), weighting observations by CPS industry employment and including industry fixed effects. Standard errors are clustered by industry. In the 2SLS specifications, average workforce age is instrumented with the baseline age-composition shift–

share instrument defined in equation (2). The BDS specification uses 1993 industry age-group employment shares, whereas the JOLTS specification uses 1994 shares because the harmonized industry variable is unavailable in 1993.

Table 3 reports the results. For BDS, a one-year increase in average workforce age is associated with a 1.20-percentage-point decline in the gross job-creation rate in OLS. The corresponding 2SLS estimate implies a 2.05-percentage-point decline. These estimates indicate that workforce aging reduces realized employment expansion, consistent with weaker incentives to create vacancies. The JOLTS evidence offers a similar conclusion. The OLS estimate for the job-openings rate is close to zero. The 2SLS estimate is negative and statistically significant. These results are consistent with Shimer (2001), who links workforce age composition to job creation, and Engbom (2019), who shows that population aging reduces recruiting and firm dynamism.

Table 3: Effects of Average Industry Age on Firm-Side Outcomes

	Gross job-creation rate		Job-openings rate	
	(1) OLS	(2) 2SLS	(3) OLS	(4) 2SLS
AvgAge_{jt}	-1.198^{***}	-2.045^{***}	0.024	-7.283^{**}
	(0.133)	(0.235)	(0.070)	(2.831)
Observations	1,188	1,188	256	256
Industries	54	54	16	16

Notes: Gross job creation is the BDS rate of employment gains at entering and expanding establishments. Job openings are the annual average JOLTS rate for 16 private-industry groups over 2001–2016. The 2SLS instrument uses 1993 baseline age shares for BDS and 1994 shares for JOLTS. Regressions are weighted by CPS industry employment and include industry fixed effects. Coefficients are percentage-point effects of a one-year increase in average industry age; industry-clustered standard errors are in parentheses. The JOLTS 2SLS estimate should be interpreted cautiously because its first-stage F-statistic is 8.2 and it is not robust to year fixed effects. $^{*}p < 0.10$, $^{**}p < 0.05$, and $^{***}p < 0.01$.

2.5 Employer Switches and Wage Growth Over the Life-Cycle

The industry-level results show that workforce aging is associated with lower EE flows, labor rents, and labor shares. We now use individual-level CPS evidence to examine whether the payoff to an employer switch also declines with age. This exercise informs the quantitative model because the value of outside opportunities depends not only on how often workers switch employers, but also on the wage growth associated with those switches.

We link workers between their outgoing-rotation wage observations in the fourth and eighth CPS interviews, MISH 4 and MISH 8. For worker i, twelve-month wage growth is measured in 100 log points. We report results for both weekly earnings and hourly wages. Hourly wages are

constructed from weekly earnings divided by usual weekly hours, with reported hourly wages used as a fallback when needed.[13]

Our preferred measure identifies a worker as an employer switcher if the worker reports a different employer in any observed month from MISH 5 through MISH 8. The comparison group includes workers with at least one valid employer-continuity response during these months and no reported employer switch.

For each wage concept, we estimate

$$\begin{aligned}\Delta y_i = \alpha + \sum_a \beta_a \left(\text{Switcher}_i \times \mathbf{1}\{\text{AgeGroup}_i = a\}\right) \\ + \sum_a \pi_a \mathbf{1}\{\text{AgeGroup}_i = a\} + \lambda_{t(i)} + X_{i0}'\gamma + \varepsilon_i,\end{aligned} \tag{6}$$

where age groups are assigned at MISH 4 and kept fixed throughout the twelve-month window. The term $\lambda_{t(i)}$ denotes year-month fixed effects. The vector X_{i0} contains demographic controls. Standard errors are clustered by person. The coefficients β_a indicate the switcher premiums: the adjusted within-age differences in wage growth between switchers and non-switchers.

Table 4 shows a clear life-cycle gradient. For workers aged 20–29, an employer switch is associated with 2.1 log points higher weekly-earnings growth and 1.2 log points higher hourly-wage growth than for comparable non-switchers. The premium remains positive for ages 30–39, especially for hourly wages. By ages 40–49, the premium is close to zero, and for workers aged 50 and older the weekly-earnings premium becomes negative. The age gradient is sharper for weekly earnings than for hourly wages: among older workers, the hourly-wage premiums are smaller and less precisely estimated. This suggests that part of the later-career decline in the switching premium operates through hours, employment intensity, or movements into lower-earnings jobs, rather than through hourly wages alone. The estimates should be interpreted as conditional associations rather than causal returns to switching. Nevertheless, they show that EE flow is associated with higher wage growth primarily early in the career, while its earnings gain fades sharply with age, consistent with Topel and Ward (1992).[14]

[13] The wage construction keeps topcoded observations but removes missing, not-in-universe, nonpositive, and otherwise invalid wage codes.

[14] Appendix B reports robustness checks using a stricter recent-switch measure, which compares MISH 8 switchers to workers with no observed switch during MISH 5–8, and a broader job-change proxy that also classifies workers as movers if their industry or occupation changes between MISH 4 and MISH 8. Both checks preserve the main age gradient: the wage-growth premium associated with EE flow is concentrated among younger workers and becomes small or negative for older workers.

Table 4: Employer Switching and Wage Growth by Age

	Weekly earnings growth			Hourly wage growth			N_S/N_{NS}
Age group	Switcher	Non-switcher	Premium	Switcher	Non-switcher	Premium	
20–29	8.15	6.06	2.08^{***} (0.50)	6.19	4.98	1.21^{***} (0.42)	16,078 / 199,852
30–39	4.80	4.04	0.76^{*} (0.43)	4.73	3.52	1.21^{***} (0.40)	17,343 / 320,961
40–49	3.09	2.94	0.14 (0.45)	2.08	2.46	-0.38 (0.43)	16,625 / 365,674
50–59	0.89	1.98	-1.09^{**} (0.52)	1.08	1.90	-0.82^{*} (0.49)	12,610 / 299,386
60–64	-3.06	-0.18	-2.88^{**} (1.12)	-0.50	0.87	-1.37 (1.03)	3,099 / 75,945

Notes: The dependent variable is twelve-month wage growth measured in 100 log points. Switcher entries are the adjusted means from the estimated regression. Standard errors are reported in parentheses. Sample counts correspond to the weekly-earnings estimation sample. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

3 Model

We develop a discrete-time equilibrium life-cycle search model with on-the-job search, human-capital accumulation, heterogeneous match productivity, and endogenous surplus division. Building on Mortensen and Pissarides (1994), employed workers receive outside offers that generate sequential competition between incumbent and poaching firms (Cahuc, Postel-Vinay and Robin, 2006; Lise, Meghir and Robin, 2016). The model implies that, as the workforce ages, employment shifts toward workers with lower EE flows, while shorter expected match durations reduce firms' returns to vacancy creation. The resulting decline in labor-market tightness further weakens outside-offer competition and workers' ability to capture match surplus.

3.1 Environment, Demographics, and Timing

Time is discrete. At every date, the labor force has measure one; entrants replace workers who die or retire. There is free entry of vacancies with flow cost c. Workers and firms are risk neutral and discount future payoffs by the common factor $\beta \in (0, 1)$. Workers are indexed by age $a \in \{0, \ldots, T-1\}$, where $a = 0$ denotes entry into the labor market and age T is the terminal state. Periods beyond T yield zero worker continuation value. Let ℓ_a denote the unconditional probability of surviving to age a, with $\ell_0 = 1$ and $\ell_T = 0$. The conditional probability of surviving (survival schedule) from age a to age $a+1$ is then

$$s_a = \frac{\ell_{a+1}}{\ell_a}. \tag{7}$$

The cross-sectional labor-force age distribution is denoted by $\{\mu_a\}_{a=0}^{T-1}$. Its weights satisfy

$$\mu_a \geq 0, \qquad \sum_{a=0}^{T-1} \mu_a = 1.$$

We distinguish the survival schedule $\{s_a\}$, which governs an individual's remaining horizon, from the cross-sectional age distribution $\{\mu_a\}$, which determines the composition of the workforce.

A worker is either unemployed or employed. An unemployed worker's state is her human capital $h > 0$. An employed worker's state is (h, ε, η), where $\varepsilon > 0$ denotes the productivity of the current match and $\eta \in [\eta_0, 1]$ summarizes the worker's bargaining history. In particular, η records the contractual improvement generated by past competition between incumbent and poaching firms. A match formed from unemployment begins at the baseline state $\eta_0 \in (0, 1)$, before the worker has generated any outside-offer competition. Subsequent outside offers can raise η, either through a retention counteroffer or through an employer transition.

The bargaining index is a state variable rather than a wage or a share of output. A higher η represents a stronger contractual position, but the worker's enforceable share of match surplus also depends on the extent to which the bargaining gains represented by η are portable. As described in Section 3.4, the model maps η into an enforceable surplus share, which, together with the worker's and firm's continuation values, determines the wage.

Match productivity is independently drawn from the distribution G, with support $(0, \bar{\varepsilon}]$. Conditional on receiving an offer, every worker draws the prospective match productivity from the same distribution G. Contact rates may nevertheless differ by age and employment status.

Human-capital accumulation. All entrants are unemployed with human capital h_0. Thereafter, human capital evolves with the worker's realized employment transition. If an employed worker's match continues or she moves directly to another employer, next-period human capital is

$$H^E(h) = (1 - \delta_h)h + \Gamma h^{\rho_h}, \qquad \text{where} \quad \Gamma > 0, \quad \delta_h \in [0, 1), \quad \text{and} \quad 0 < \rho_h < 1. \tag{8}$$

If a worker begins the period unemployed, or if an employed worker separates, human capital evolves according to

$$H^U(h) = (1 - \delta_h)h. \tag{9}$$

The parameters Γ and ρ_h govern the scale and curvature of on-the-job learning, while δ_h governs depreciation.

Within-period timing. Within each period, workers observe their state and choose search intensity; current output, wages, and search costs are then realized. End-of-period labor-market transitions determine the next period's state. For an employed worker, the existing match may separate. If the match survives, the worker may receive an outside offer, which may be rejected, accepted to move to the offering firm, or used to renegotiate the incumbent contract through a sequential auction (discussed below). An unemployed worker may receive and decide to accept a job offer. Human capital is then updated using the laws defined above: a worker who begins unemployed has H^U, even if hired for the next period; an employed worker who continues or moves directly between employers uses H^E; and an employed worker who separates uses H^U. Finally, survival is realized and a survivor advances to age $a+1$. Search costs are therefore paid before the worker knows whether she survives to enjoy the resulting contract.

3.2 Production and Factor Prices

The final output is the numeraire. A competitive final-good firm rents physical capital K at the exogenous user cost $r_K + \delta_K$, where r_K is the net rental rate and δ_K is depreciation, and hires labor L at the price p per efficiency unit. It solves the static problem

$$\max_{K,L} \left\{ K^{\alpha_K} L^{1-\alpha_K} - (r_K + \delta_K)K - pL \right\},$$

where L is the total number of efficiency units supplied by employed workers. Its formal aggregation is given in Section C.5.

Denote $\varrho_K \equiv r_K + \delta_K$, the capital first-order condition gives

$$\varrho_K = \alpha_K \left(\frac{K}{L} \right)^{\alpha_K - 1}. \tag{10}$$

The labor first-order condition then determines the price of an efficiency unit:

$$k^* \equiv \frac{K}{L} = \left(\frac{\alpha_K}{\varrho_K} \right)^{1/(1-\alpha_K)}, \qquad p \equiv \frac{\partial Y}{\partial L} = (1-\alpha_K)(k^*)^{\alpha_K}. \tag{11}$$

Thus, p is the competitive factor price of one efficiency unit and is common across all matches.

Once ϱ_K is specified, equations (10) and (11) determine both k^* and p.[15]

A job filled with a worker with human capital h and match productivity ε supplies $h\varepsilon$ efficiency units to the final-good firm. The employing firm therefore receives the current labor-side revenue

$$R(h, \varepsilon) = ph\varepsilon. \tag{12}$$

The wage $w_a(h, \varepsilon, \eta)$ is the payment from the employing firm to the worker and is determined later by surplus sharing and outside-offer bargaining. The employer's current operating profit is therefore $ph\varepsilon - w_a(h, \varepsilon, \eta)$. Hence p is an economy-wide price determined by technology and the capital user cost, whereas w_a is a worker–match-specific contractual payment that also depends on, among other things, age and the bargaining state.

3.3 Search and Matching Technology

Workers choose search intensity $\zeta \in [0, 1]$. For employment status $x \in \{u, e\}$, the flow cost of search is

$$C_x(\zeta) = \frac{\sigma_x}{1+\sigma}\zeta^{1+\sigma}, \qquad \text{where} \quad \sigma_x > 0 \quad \text{and} \quad \sigma > 0, \tag{13}$$

and where σ_u and σ_e are the search-cost scales for unemployed and employed workers, respectively, and σ is the common curvature parameter. Let $\zeta_a^u(h)$ and $\zeta_a^e(h, \varepsilon)$ denote the corresponding optimal search intensity.

Aggregate effective search is

$$\begin{aligned} N^s = \sum_{a=0}^{T-1} \mu_a \Bigg[& \int u_a(h)\zeta_a^u(h)\, dh \\ & + \iiint e_a(h, \varepsilon, \eta)\zeta_a^e(h, \varepsilon)\, dh\, dG(\varepsilon)\, d\eta \Bigg], \end{aligned} \tag{14}$$

where $u_a(h)$ is the density of unemployed workers and $e_a(h, \varepsilon, \eta)$ is the density of employed workers. If v vacancies are posted, meetings are produced by the constant-returns matching technology

$$M(N^s, v) = A(N^s)^\alpha v^{1-\alpha}, \qquad \text{where} \quad A > 0, \quad 0 < \alpha < 1. \tag{15}$$

[15]There is no separate match-level capital optimization problem. Capital is chosen by the competitive final-good firm and is therefore not a state variable in the matching problem. Writing a second problem in which each match rents its own capital would deliver the same allocation under frictionless capital adjustment, but it is only an alternative decentralization and is unnecessary for the model.

Labor-market tightness is defined as vacancies per unit of effective search:

$$\theta = \frac{v}{N^s}. \tag{16}$$

The contact probability per unit of worker search and the contact probability per vacancy are, respectively,

$$\phi(\theta) = \frac{M(N^s, v)}{N^s} = A\theta^{1-\alpha}, \qquad q(\theta) = \frac{M(N^s, v)}{v} = A\theta^{-\alpha}. \tag{17}$$

Accordingly, a worker who chooses intensity ζ receives an offer with probability

$$\lambda(\theta, \zeta) = \zeta\phi(\theta). \tag{18}$$

We restrict parameters and equilibrium policies so that all discrete-time contact probabilities lie in $[0, 1]$. For later use, define

$$\lambda_a^u(h) = \lambda(\theta, \zeta_a^u(h)), \qquad \lambda_a^e(h, \varepsilon) = \lambda(\theta, \zeta_a^e(h, \varepsilon)). \tag{19}$$

Higher tightness raises workers' contact probability $\phi(\theta)$ but lowers the vacancy contact probability $q(\theta)$. This tradeoff is the source of the vacancy-creation effect.

3.4 Outside Offer, Bargaining, and Surplus Division

Let $U_a(h)$ denote the value of unemployment, $W_a(h, \varepsilon, \eta)$ denote the value to an employed worker, and $J_a(h, \varepsilon, \eta)$ denote the value to the incumbent firm. Finally, let V denote the value of an open vacancy.

Bargaining share and search. The index η summarizes the bargaining position supported by outside offers. A match formed from unemployment begins at η_0, and subsequent offers update η through the sequential auction defined below.[16]

For tractability, we impose

$$\zeta_a^e = \zeta_a^e(h, \varepsilon),$$

so employed search may vary with age, human capital, and current match productivity. Because h and ε affect both wages and match surplus, search can still covary with the current wage; the

[16]The index is a contract state, whereas $\bar{\eta}_a(\eta)$ is the worker's enforceable share of present-value match surplus, and w_a is the flow wage that implements that division.

restriction removes only the additional response to wage variation generated by outside-offer bargaining.

Canonical sequential-auction models typically take the raw arrival of outside offers to be independent of the worker's current wage contract (Postel-Vinay and Robin, 2002; Cahuc, Postel-Vinay and Robin, 2006). In Lise, Meghir and Robin (2016), the raw meeting technology can depend on the type of prospective opportunity, but it does not make the raw arrival rate respond directly to the worker's current negotiated wage.[17] By contrast, models of endogenous on-the-job search such as Christensen et al. (2005) allow search effort to respond directly to the value of the current wage. Our specification retains endogenous state-dependent search while excluding a separate response to η.

The restriction delivers tractability by making η a pure surplus-division state. Conditional on (a, h, ε), changing η leaves search costs, offer-arrival probabilities, production, human-capital accumulation, separation, and the efficient mobility decision unchanged. Worker and firm values therefore sum to the same total match surplus at every η:[18]

$$S_a(h, \varepsilon) = W_a(h, \varepsilon, \eta) + J_a(h, \varepsilon, \eta) - U_a(h) - V. \tag{20}$$

Bargaining share and surplus division. The bargaining share η records the gross bargaining position supported by employer competition. We allow the fraction of the associated incremental rents that the worker can enforce to vary with age. Motivated by the empirical findings that industries with older workforces have lower labor rents and that wage gains associated with employer changes decline over the life cycle, we allow this enforceable portion to decline with labor-market age. We specify the rent-portability factor as

$$m_a = \exp(-\kappa_m \tau_a), \qquad \kappa_m \geq 0, \tag{21}$$

where $\tau_a = \frac{a}{T}$. This factor captures the persistence of outside-offer rents within an incumbent match and their portability to a new match. It summarizes firm- or occupation-specific capital, seniority benefits, employer-linked amenities, location attachment, retraining costs, or imperfect

[17] In their notation, $s\kappa v(y')$ is the rate of meeting a prospective employer of type y': it combines search or contact efficiency with the availability of that prospective type, rather than the worker's current wage contract.

[18] Consequently, the model first solves $S_a(h, \varepsilon)$ on the lower-dimensional state space and then uses η to divide that surplus and determine wages. If search depended on η, total surplus would also depend on η, and the search policy, surplus recursion, and sequential auction would have to be solved jointly over the additional state.

enforceability of outside options.[19] In the quantitative analysis, the individual age gradient in the wage growth in Table 4 disciplines the strength of the rent-portability factor.[20]

The worker's enforceable share of present-value match surplus at age a is

$$\bar{\eta}_a(\eta) = \eta_0 + m_a(\eta - \eta_0). \tag{22}$$

The baseline η_0 is always enforceable, while m_a scales only the increment $\eta - \eta_0$ generated by bargaining history. Thus, η indexes the underlying history and $\bar{\eta}_a(\eta)$ is the share the worker can currently enforce. At $\eta = \eta_0$, the two coincide; for $\eta > \eta_0$, the enforceable portion of the accumulated gain declines with m_a. The present-value sharing rule is

$$\begin{aligned} W_a(h, \varepsilon, \eta) - U_a(h) &= \bar{\eta}_a(\eta) S_a(h, \varepsilon), \\ J_a(h, \varepsilon, \eta) - V &= [1 - \bar{\eta}_a(\eta)]\, S_a(h, \varepsilon). \end{aligned} \tag{23}$$

Consider an employed worker whose incumbent match has surplus $S = S_a(h, \varepsilon) > 0$ and who receives an offer from a firm with surplus $S' = S_a(h, \varepsilon')$. Define the first auction cutoff by

$$\underline{S}(\eta, S) \equiv \frac{\eta - \eta_0}{1 - \eta_0} S. \tag{24}$$

The post-offer productive state and bargaining-history state are given by

$$(\varepsilon^+, \eta^+) = \begin{cases} (\varepsilon, \eta), & S' \leq \underline{S}(\eta, S), \\ (\varepsilon, \eta_0 + (1 - \eta_0) S'/S), & \underline{S}(\eta, S) < S' \leq S, \\ (\varepsilon', \eta_0 + (1 - \eta_0) S/S'), & S' > S. \end{cases} \tag{25}$$

Thus, a weak offer is discarded, an intermediate offer raises the history state while the worker remains with the incumbent, and a strong offer induces an employer-to-employer move. After a move, η^+ can be lower than the worker's pre-move η even though the new match has higher total surplus and raises the worker's continuation surplus. The rent-portability factor m_a does not enter equation (25): the auction first updates the gross history state supported by employer competition, and m_a subsequently maps that state into the share currently enforceable.

[19] It does not represent the shorter remaining horizon, which already enters through s_a and the finite terminal age.

[20] It is worth-noting that while the job-ladder progression in the model allows us to have declining EE flows over the life cycle, it is not sufficient to match the declining switchers' wage growth without the age-specific portability factor.

The worker's post-offer surplus over unemployment is

$$\mathcal{W}_a(S, S', \eta) = W_a(h, \varepsilon, \varepsilon', \eta) - U_a(h) = \begin{cases} \bar{\eta}_a(\eta) S, & S' \leq \underline{S}(\eta, S), \\ \eta_0 S + m_a(1 - \eta_0) S', & \underline{S}(\eta, S) < S' \leq S, \\ \eta_0 S' + m_a(1 - \eta_0) S, & S' > S. \end{cases} \tag{26}$$

The three branches are ordered by offer strength: no contractual change, renegotiation with the incumbent, and EE flow to the prospective employer. Note that rent portability governs the employer competition component (the second term on the right hand side) at a given position on the job ladder.

The same three regions have a useful firm-side interpretation (see Online Appendix C.1). A weak offer leaves the incumbent's continuation value unchanged. In the retention region, the incumbent keeps the worker but concedes part of its match surplus: relative to the pre-offer contract, the firm's surplus value falls by

$$m_a \left[(1 - \eta_0) S' - (\eta - \eta_0) S \right],$$

which is precisely the increase in the worker's surplus. If $S' > S$, the incumbent loses the worker and returns to the vacancy value V, while the poaching firm receives the residual surplus generated by the new match. Thus, outside offers can redistribute surplus away from the incumbent even when no EE flow is observed; an observed transition occurs only when the outside match dominates the incumbent in total surplus.

3.5 Worker and Firm Optimization Problems

3.5.1 Unemployed workers

An unemployed worker receives flow value

$$b(h) = b_0 p h, \qquad b_0 \geq 0, \tag{27}$$

which includes leisure, home production, and unemployment benefits. Her value function is

$$U_a(h) = \max_{0\le\zeta\le 1}\Bigg\{ b(h) - C_u(\zeta) + \beta s_a\Bigg[\big(1-\lambda(\theta,\zeta)\big)U_{a+1}(H^U(h)) + \lambda(\theta,\zeta)\int \max\Big\{U_{a+1}(H^U(h)), W_{a+1}(H^U(h),\varepsilon',\eta_0)\Big\}\, dG(\varepsilon')\Bigg]\Bigg\}, \tag{28}$$

with terminal condition $U_T(h) = 0$. An offer is accepted if and only if the new match has positive surplus. Let $\zeta_a^u(h)$ denote the optimal policy. At an interior solution,

$$\sigma_u\big(\zeta_a^u(h)\big)^{\sigma} = \beta s_a \phi(\theta)\int \big[W_{a+1}(H^U(h),\varepsilon',\eta_0) - U_{a+1}(H^U(h))\big]_+\, dG(\varepsilon'), \tag{29}$$

where $[.]_+$ indicates $max\{0,.\}$. To make the survival effect transparent, define the expected next-period gain from an acceptable offer by

$$\Delta_{a+1}^u(h) \equiv \int \big[W_{a+1}(H^U(h),\varepsilon',\eta_0) - U_{a+1}(H^U(h))\big]_+\, dG(\varepsilon').$$

The interior policy is then

$$\zeta_a^u(h) = \left[\frac{\beta s_a \phi(\theta)\Delta_{a+1}^u(h)}{\sigma_u}\right]^{1/\sigma}, \qquad \left.\frac{\partial \log \zeta_a^u(h)}{\partial \log s_a}\right|_{\theta,\Delta_{a+1}^u} = \frac{1}{\sigma} > 0. \tag{30}$$

Thus, holding tightness and the gain from an offer fixed, search rises with the probability of surviving to enjoy the next-period contract. If survival falls with age, this creates a direct force toward lower search. It does not by itself prove that the full age profile is decreasing, because human capital and the continuation gain $\Delta_{a+1}^u(h)$ also vary with age. At the final working age, $s_{T-1} = 0$ and optimal search is zero under the assumed timing.

3.5.2 Employed workers and filled jobs

Let $\delta_s \in [0,1]$ denote the exogenous separation probability. An employed worker in state $(a, h, \varepsilon, \eta)$ receives wage $w_a(h, \varepsilon, \eta)$. Using the search intensity $\zeta_a^e(h, \varepsilon)$, her value satisfies

$$\begin{aligned} W_a(h,\varepsilon,\eta) = w_a(h,\varepsilon,\eta) - C_e\big(\zeta_a^e(h,\varepsilon)\big) \\ + \beta s_a \Bigg\{ \delta_s U_{a+1}(H^U(h)) \\ + (1-\delta_s)\Bigg[\big(1-\lambda_a^e(h,\varepsilon)\big) W_{a+1}(H^E(h),\varepsilon,\eta) \\ + \lambda_a^e(h,\varepsilon)\int \widetilde{W}_{a+1}(H^E(h),\varepsilon,\varepsilon',\eta)\, dG(\varepsilon')\Bigg]\Bigg\}. \end{aligned} \tag{31}$$

At an interior solution, the employed-search policy evaluated at the new-match contract satisfies

$$\begin{aligned} \sigma_e\big(\zeta_a^e(h,\varepsilon)\big)^{\sigma} = \beta s_a(1-\delta_s)\phi(\theta) \\ \times \int \Big[\widetilde{W}_{a+1}(H^E(h),\varepsilon,\varepsilon',\eta_0) - W_{a+1}(H^E(h),\varepsilon,\eta_0)\Big]_+ dG(\varepsilon'). \end{aligned} \tag{32}$$

Holding the expected gain in the integral and tightness fixed, the employed policy has the same direct survival elasticity, $\partial \log \zeta_a^e / \partial \log s_a = 1/\sigma$, at an interior solution.

The sharing rule in equation (23) and the worker Bellman equation jointly determine the current wage. In particular, the equilibrium wage can be written compactly as

$$\begin{aligned} w_a(h,\varepsilon,\eta) = U_a(h) + \bar{\eta}_a(\eta) S_a(h,\varepsilon) + C_e\big(\zeta_a^e(h,\varepsilon)\big) \\ - \beta s_a \Bigg\{ \delta_s U_{a+1}(H^U(h)) \\ + (1-\delta_s)\Bigg[\big(1-\lambda_a^e(h,\varepsilon)\big) W_{a+1}(H^E(h),\varepsilon,\eta) \\ + \lambda_a^e(h,\varepsilon)\int \widetilde{W}_{a+1}(H^E(h),\varepsilon,\varepsilon',\eta)\, dG(\varepsilon')\Bigg]\Bigg\}. \end{aligned} \tag{33}$$

Appendix C.3 derives an expanded expression that writes the wage entirely in terms of current surplus and next-period auction outcomes.[21]

[21] Physical capital does not appear as a separate state in the filled-job problem because it has already been rented and optimized out in Section 3.2. A match supplying $h\varepsilon$ efficiency units receives $ph\varepsilon$, which is net of the competitive capital rental bill, and then pays the worker's wage. This relies on frictionless within-period capital adjustment.

The value of the incumbent firm is

$$\begin{aligned} J_a(h,\varepsilon,\eta) = {} & ph\varepsilon - w_a(h,\varepsilon,\eta) \\ & + \beta s_a \Bigg\{ \delta_s V + (1-\delta_s) \Bigg[\big(1-\lambda_a^e(h,\varepsilon)\big) J_{a+1}(H^E(h),\varepsilon,\eta) \\ & \qquad + \lambda_a^e(h,\varepsilon) \int \widetilde{J}_{a+1}(H^E(h),\varepsilon,\varepsilon',\eta)\, dG(\varepsilon') \Bigg] \Bigg\} + \beta(1-s_a)V. \end{aligned} \tag{34}$$

Accordingly, the first line is net flow profit. If the match separates or the worker dies, its rented capital is released and the job returns to the vacancy state. A counteroffer compresses the incumbent firm's continuation value, whereas a successful poach destroys the incumbent match.[22]

3.5.3 Vacancy creation and free entry

An open vacancy has a flow cost of $c > 0$. Let $\Omega(\theta)$ denote the expected gain from a match relative to remaining vacant, conditional on one unit of effective search being matched. The vacancy Bellman equation is thus

$$V = -c + \beta V + \beta q(\theta)\Omega(\theta). \tag{35}$$

Free entry implies

$$V = 0, \qquad c = \beta q(\theta)\Omega(\theta). \tag{36}$$

Given the vacancy cost c, equation (36) determines equilibrium tightness. If the expected value of contacting the search pool falls at a given θ, vacancy creation falls until free entry is restored. For details, refer to Online Appendix C.3.

3.6 Stationary Equilibrium

Given $\{s_a, \mu_a\}_{a=0}^{T-1}$ and the model primitives, a stationary cross-sectional equilibrium consists of the value and policy functions

$$\left\{U_a, W_a, J_a, S_a, w_a, \zeta_a^u, \zeta_a^e, u_a, e_a\right\}_{a=0}^{T-1},$$

together with (V, v, N^s, θ), such that

[22] Appendix C.2 obtains the explicit total-surplus recursion by adding worker and incumbent values and subtracting unemployment and vacancy values. It also identifies precisely where bargaining-state-independent search is needed for $S_a(h,\varepsilon)$ to remain independent of η.

1. factor prices, matching probabilities, and tightness satisfy equations (10)–(12) and (14)–(19);
2. worker and firm values, search policies, surplus division, wages, and auction transitions satisfy equations (20)–(34);
3. the distributions satisfy transition rules based on policy functions; and
4. vacancy creation satisfies the free-entry condition (36).

3.7 Aging Workforce and Labor Market Dynamics

Outside offers generate a job ladder. Superior offers induce EE flows, whereas intermediate offers induces retention offers without a change of employers. Measured EE flows therefore capture only the extensive margin of outside-offer competition.

The life-cycle evolution of this job ladder reflects four forces. A shorter remaining horizon lowers the return to search and the duration of any new match; better incumbent matches narrow the set of outside offers capable of inducing a move; declining portability m_a weakens the enforceability of accumulated bargaining gains; and human-capital accumulation raises match output. Importantly, these forces affect worker mobility and firm vacancy incentives differently. Greater human capital and lower rent portability can raise a firm's surplus conditional on a successful move. However, the older workers' lower search intensity reduces their weight in the effective-search pool, while better incumbent matches and shorter remaining horizons make profitable matches less likely or less durable. Consequently, the expected value of a vacancy contact, Ω, and hence the return to vacancy posting through $q(\theta)\Omega$, can fall even when the surplus conditional on a successful match remains high.

To separate workforce composition from individual longevity, compare economies Y and O with identical primitives, survival schedules, and entrant states but different age weights. Economy O has an older workforce if

$$\sum_{j=0}^{a} \mu_j^O \leq \sum_{j=0}^{a} \mu_j^Y \qquad \text{for every } a < T, \tag{37}$$

with strict inequality for at least one a. This is first-order stochastic dominance toward older ages.

Proposition 1 (Horizon effect)**.** *For an interior search policy, holding tightness and the expected gain*

conditional on an offer fixed,

$$\begin{aligned} \frac{\partial \log \zeta_a^x}{\partial \log s_a} &= \frac{1}{\sigma}, \qquad x \in \{u, e\}, \\ \frac{\partial \log[s_a(1-\delta_s)\lambda_a^e]}{\partial \log s_a} &= 1 + \frac{1}{\sigma}. \end{aligned} \tag{38}$$

Proof. See Appendix C.6. □

A shorter horizon therefore directly reduces search intensity and the probability of surviving to receive a useful outside offer. This result, however, does not imply that search declines monotonically with age, because human capital, incumbent match quality, and expected offer gains also evolve over the life cycle.

A change in the age distribution affects aggregate outcomes through two channels. At a fixed θ, changing $\{\mu_a\}$ reweights age-specific employment, search, productivity, and wages without changing the problem solved by a worker of a given age. We refer to this as the composition effect.

The same demographic shift also operates through the vacancy-creation effect. Before tightness adjusts, an older effective-search pool changes the expected value of a vacancy contact, Ω. The shorter remaining duration of a match with an older worker tends to reduce this value. This force may be offset because older workers differ in human capital, incumbent and prospective match surplus, portability, bargaining position, and search intensity; search intensity also determines under which worker states a vacancy is most likely to be contacted.

Let $\mathrm{d}\log\Omega|_\theta$ denote the demographic change in the expected contact value holding labor-market tightness fixed.

Proposition 2 (Vacancy-creation effect)**.** *For a marginal demographic shift, differentiation of the free-entry condition gives*

$$\mathrm{d}\log\theta = \frac{\mathrm{d}\log\Omega|_\theta}{\alpha - \dfrac{\partial \log \Omega(\theta)}{\partial \log \theta}}. \tag{39}$$

If the denominator is positive, as required for local free-entry stability, then

$$\mathrm{d}\log\Omega|_\theta < 0 \quad \Longrightarrow \quad \mathrm{d}\log\theta < 0.$$

For a worker of a fixed state, holding survival and the gain conditional on an offer fixed, the policy-induced

contact probability satisfies

$$\frac{\partial \log \lambda_a^x}{\partial \log \theta} = (1-\alpha)\left(1+\frac{1}{\sigma}\right) > 0, \qquad x \in \{u, e\}. \tag{40}$$

Proof. See Appendix C.6. □

Thus, if aging lowers Ω at a fixed θ, free entry reduces vacancy posting and equilibrium tightness. Lower tightness, in turn, reduces the probability that a worker receives an outside offer, holding the worker's state and conditional offer gain fixed. EE flow and retention counteroffers therefore become less frequent, weakening the bargaining component of wages, all else equal.

4 Quantitative Analysis

4.1 Specification and Calibration

There are 20 parameters in the model. We preset some of them from the literature and jointly calibrate the rest to moments in the U.S. economy from around 1995. Table 5 summarizes the parameter values.

The model period is monthly, and the working life spans 45 years (540 periods). The discount factor β is 0.9967, consistent with an annual discount rate of 4 percent. The interest rate and the depreciation rate of physical capital are set to the monthly equivalent of an annual rate of 5%. The capital share α_K is set to 0.3, following the estimates by Vollrath (2024). The matching elasticity α is set to 0.5, a standard value in the literature (Petrongolo and Pissarides, 2001). Finally, the unemployed-search cost scale is normalized to $\sigma_u = 1$.

We jointly calibrate the remaining structural parameters $(b_0, h_0, \delta_h, \Gamma, \rho_h, \sigma_\varepsilon, \bar{\varepsilon}, \delta_s, \eta_0, A, \sigma_e, \sigma, \kappa_m, c)$ based on the U.S. economy in 1995. Although all parameters are jointly determined, particular moments are especially informative about specific parameters. We therefore describe the moments that primarily determine each parameter below.

The first calibration block concerns the value of nonemployment and the accumulation of human capital over the life cycle. It contains five parameters $(b_0, h_0, \Gamma, \rho_h, \delta_h)$, which are primarily determined by five moments: the unemployment-value ratio, the wage at age 20, and the wage ratios at ages 30, 40, and 50 relative to age 20. The flow value of unemployment is given by $b(h) = b_0 ph$, so b_0 is primarily determined by an unemployment-value ratio of 0.4, following

Table 5: Calibrated parameter values

Parameter	Description	Value	Target/source
β	Monthly discount factor	0.997	Annual discount rate of 4%
r_K	Monthly interest rate of capital	0.00407	Annual interest rate of 5%
δ_K	Monthly depreciation rate of capital	0.00427	Annual depreciation rate of 5%
α_K	Output elasticity of capital	0.300	Vollrath (2024)
α	Matching elasticity	0.500	Petrongolo and Pissarides (2001)
σ_u	Unemployed-search cost scale	1.000	Normalized
b_0	Nonemployment flow-payoff scale	0.415	Nonemployment replacement ratio
h_0	Initial human capital	2.188	Wage at age 20
δ_h	Monthly human-capital depreciation rate	0.020	Relative wages
Γ	Learning scale	0.038	Relative wages
ρ_h	Learning curvature	0.668	Relative wages
σ_ε	Firm-productivity dispersion	0.005	Standard deviation of log wages
$\bar{\varepsilon}$	Productivity upper bound	1.417	Average EE wage gain
δ_s	Exogenous separation probability	0.019	Unemployment rate
η_0	New-match bargaining share	0.568	Labor share in 1995
A	Matching efficiency	0.501	Monthly job-finding rate
σ_e	Employed-search cost scale	0.594	Monthly EE transition rate
σ	Search-cost curvature	14.889	EE-rate age ratio
κ_m	Rent-portability curvature	0.246	EE wage-growth premium slope
c	Vacancy flow cost	0.165	Labor-market tightness

Notes: Monthly units are used where applicable.

Shimer (2005). Initial human capital, h_0, determines the wage level at labor-market entry and is therefore primarily determined by the wage at age 20.

Employed human capital evolves according to equation (8). The scale parameter Γ governs the rate of human-capital accumulation, ρ_h determines how quickly this accumulation slows as human capital rises, and δ_h governs human-capital depreciation. These parameters jointly shape the life-cycle wage profile and are primarily determined by the wage ratios at ages 30, 40, and 50 relative to age 20.

The second calibration block concerns heterogeneity in firm productivity. It contains two parameters $(\sigma_\varepsilon, \bar{\varepsilon})$, which are primarily determined by two moments: the cross-sectional standard deviation of log wages and the average wage gain associated with an EE flow. Firm productivity follows a truncated lognormal distribution whose mean is normalized to zero. The dispersion parameter σ_ε governs overall productivity heterogeneity and the upper bound $\bar{\varepsilon}$ limits potential outside offers. They are, therefore, jointly identified by wage dispersion and the average wage gain among workers who change employers.

The third calibration block concerns aggregate labor-market flows and the division of match surplus. It contains three parameters (δ_s, A, η_0), which are primarily determined by three moments: the unemployment rate, the monthly job-finding rate, and the labor share in 1995. The exogenous separation probability δ_s governs flows from employment into unemployment and is therefore primarily determined by the unemployment rate. Matching efficiency A determines contact rates at a given level of labor-market tightness and is primarily determined by the job-finding rate. Finally, the new-match bargaining index η_0 governs the share of match surplus captured by workers and is primarily determined by the labor share given all other parameters.

The fourth calibration block concerns employed search and EE flow. It contains three parameters $(\sigma_e, \sigma, \kappa_m)$, which are primarily determined by three moments: the average EE-flow rate, the ratio of the EE-flow rate at age 40 to that at age 20, and the age gradient in the EE wage-growth premium. The on-the-job-search cost scale σ_e governs the overall level of employed search and is therefore primarily determined by the average EE-flow rate. Search-cost curvature σ determines how strongly search responds to age-related differences in the expected gain from an outside offer and is primarily determined by the age-40-to-age-20 EE-flow-rate ratio. Finally, κ_m governs the decline in rent portability with age and is primarily determined by the age gradient in the EE wage-growth premium. The target gradient is -4.33, measured in 100 log points, and is computed from the age gradient of weekly-earnings gain.

The final calibration block concerns vacancy creation. The vacancy flow cost c is determined by the 1995 labor-market tightness. It is calibrated to satisfy the free-entry condition exactly in the baseline economy.

Taken together, these blocks provide a mapping between parameters and moments, although the calibration is joint: each moment may affect several parameters. For each candidate parameter vector, we solve the monthly life-cycle problem, construct the implied cross-sectional distribution, and compute the corresponding model moments. The nonlinear least-squares routine minimizes the square of weighted distance between the model and data moments, with additional weight placed on the labor-share target because it is central to the counterfactual analysis.

Table 6 compares the targeted moments in the model and the data. The model reproduces the principal features of the U.S. economy in 1995: all targeted moments are matched within approximately 3.5 percent difference, while labor-market tightness is matched exactly through the calibration of the vacancy flow cost.

The life-cycle profiles provide an additional assessment of the calibration. Figure 4a compares

Table 6: Model Fit: Targeted Moments in the Data and Model

Moment	Data	Model
Replacement ratio	0.400	0.400
Wage at age 20	7.288	7.255
Age-30 wage relative to age-20 wage	1.799	1.736
Age-40 wage relative to age-20 wage	2.147	2.129
Age-50 wage relative to age-20 wage	2.263	2.340
Average weekly-earnings growth among switcher	4.388	4.401
Standard deviation of log wages	0.569	0.555
Unemployment rate	0.049	0.050
Labor share	0.682	0.676
Labor-market tightness, θ	0.500	0.500
Monthly job-finding rate	0.345	0.353
Monthly EE-flow rate	0.029	0.029
EE-flow rate at age 40 relative to age 20	0.324	0.319
Age gradient in the EE wage gain	-4.330	-4.322

Notes: Wage gains and the age gradient in the EE wage gain are expressed in 100 log points. The age gradient is estimated over ages 20–59. The labor-market tightness target determines the vacancy flow cost c and is matched exactly through the free-entry condition.

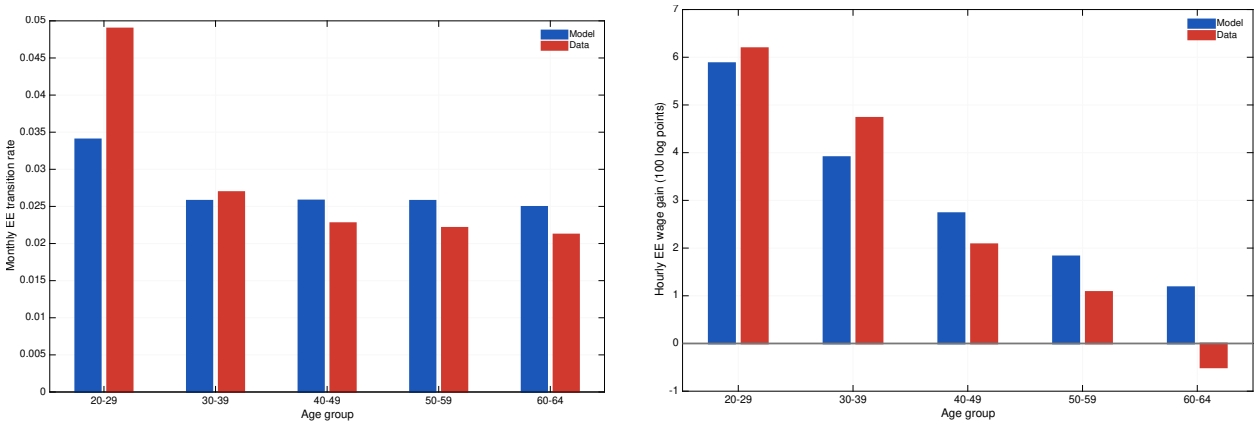
EE-flow rates across age groups in the model and the data. The model reproduces the pronounced decline in EE flow over the life cycle. Figure 4b presents the corresponding age profile of the EE wage growth profile. The model also captures the strong negative age gradient in the gains associated with changing employers.[23] Together, these profiles show that the calibration captures the two life-cycle patterns that are most important for the employed search and rent-portability mechanisms.

Labor Share Over the Life Cycle Figure 5 shows how the labor share changes with worker age in the model. It declines from 0.78 for workers at age 20 to 0.61 at age 60. With the aging employment distribution, this entails a compositional effect on the labor share which we will quantify in the next subsection.

4.2 Demographic Change and the Labor Share

We next use the calibrated model to quantify the effect of the actual demographic change that occurred between 1995 and 2015. For each year, we convert the observed mortality rates into

[23]The oldest age group experiences a negative wage growth in the data, which the model does not reproduce. This pattern may reflect selection if older workers who change employers tend to have lower productivity or are making transitions associated with reduced hours or partial retirement.



(a) EE-flow rates

(b) EE wage gains

Figure 4: Life-Cycle EE Flow Rate and Wage Growth by Age Group

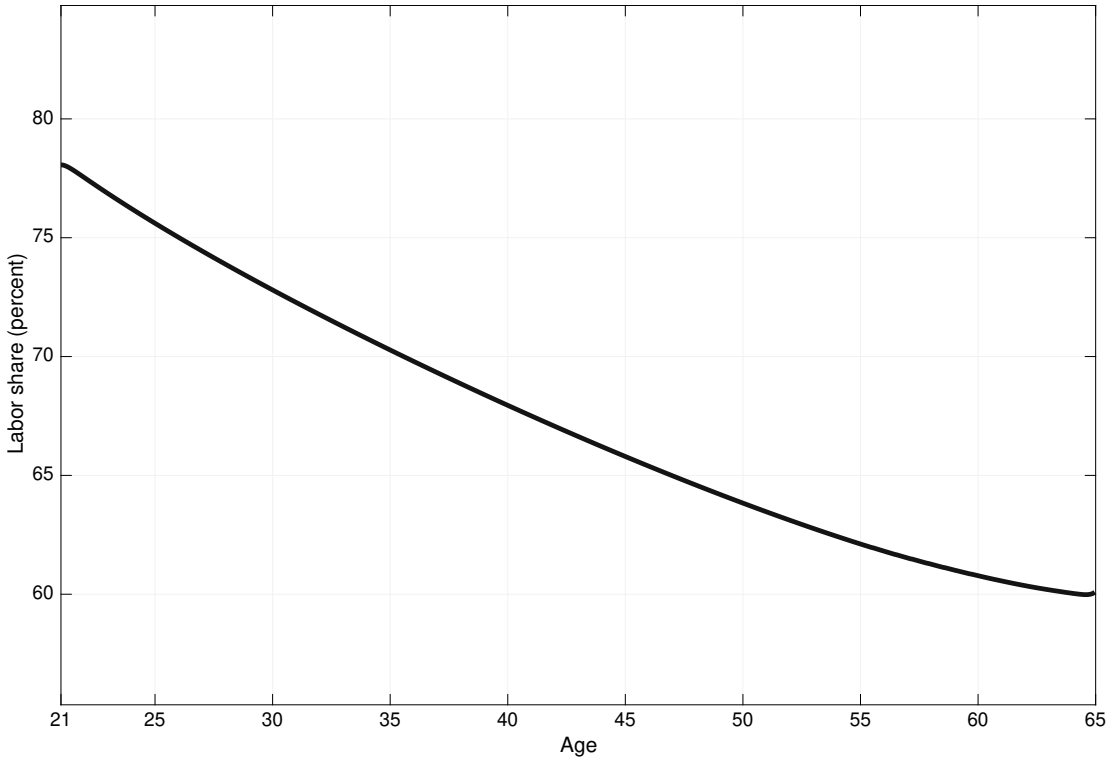


Figure 5: Life-Cycle Labor Share

Notes: This figure shows the labor share in the baseline model.

monthly survival probabilities and construct the corresponding age distribution. We then hold all structural parameters fixed and solve for the free-entry equilibrium under that year's demographic distribution. Thus, all changes in the simulated outcomes are driven by demographic changes alone.

Figure 6 shows the resulting labor-share path. The solid line with connected circles represents

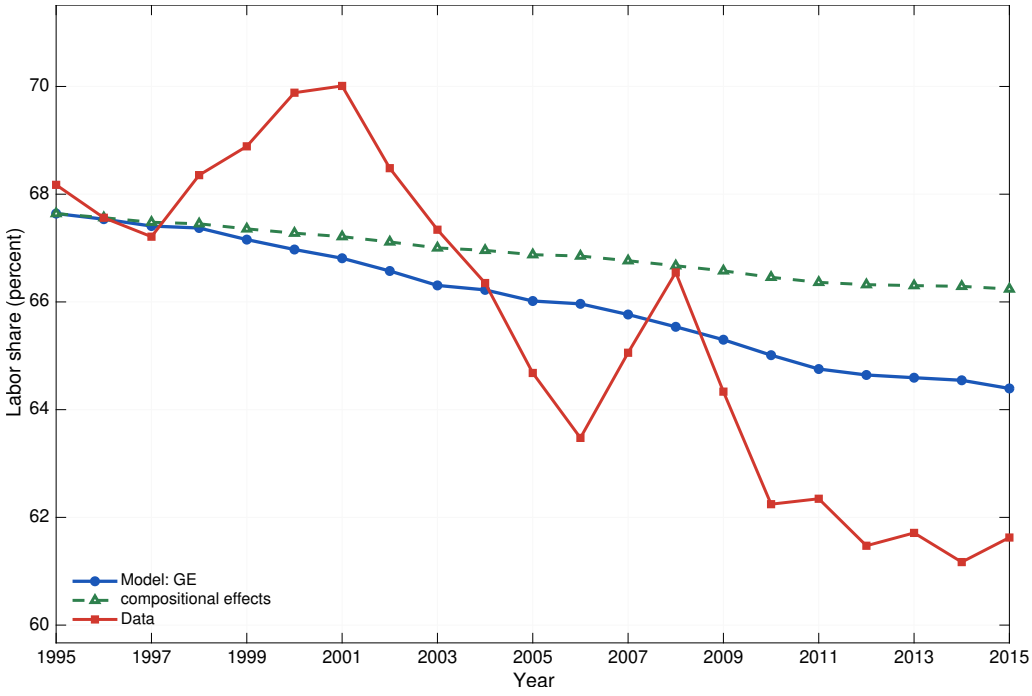


Figure 6: Empirical Labor Share and Demographic Counterfactuals

the full general-equilibrium model. The dashed connected line holds labor-market tightness, θ, fixed at its 1995 value of 0.5, thereby isolating the direct effect of the changing age composition. The solid line with connected squares shows the empirical labor share. The endpoint comparison measures how much of the cumulative decline between 1995 and 2015 can be attributed to demographic change.

In the 1995 baseline equilibrium, the labor share is 0.676 and labor-market tightness is 0.500. Replacing the 1995 demographic distribution with its 2015 counterpart reduces tightness to 0.488, a modest 2.4 percent decline.[24] It also lowers the monthly EE-flow rate from 0.0286 to 0.0275 and reduces the labor share to 0.644. Overall, as shown in Table 7, the model generates a 3.25 percentage point decline in the labor share, accounting for 49.6 percent of the decline observed in the data.

The magnitude of the model-generated decline is consistent with the industry-level evidence. The implied average response above is $\frac{-3.25}{42.0-38.4} = -0.90$ percentage point for each additional year of workforce age. This magnitude lies between the corresponding OLS and 2SLS estimates in Table 1, which imply declines of 0.68 and 1.36 percentage points, respectively, for a one-year increase in average industry age.

[24] In the model, over the same period, vacancy has declined by 2.19%, which is comparable to the 1.82% estimated from the data with a log-linear trend.

Table 7: Decomposition of the 1995–2015 Labor-Share Decline

Component	Value	Share of actual decline	Share of model decline
Actual decline	0.0655	1.000	–
Total demographic effect	0.0325	0.496	1.000
Composition effect	0.0140	0.214	0.431
Vacancy-creation effect	0.0185	0.282	0.569

When tightness is held fixed at its 1995 value, the labor share falls only to 0.662. This fixed-tightness experiment attributes 1.40 percentage points, or 43.1 percent of the model-generated decline, directly to the changing age composition. The remaining 1.85 percentage points, or 56.9 percent, arise from the general-equilibrium response of vacancy creation and labor-market tightness. Thus, although the direct composition effect is substantial, the vacancy-creation effect accounts for the majority of the model's demographic effect.

The composition effect reflects the shift in employment toward older workers, who search less intensively, receive fewer outside offers, and can carry less of their rents to a new employer. Outside offers therefore generate smaller wage gains and provide less bargaining leverage, reducing labor compensation relative to output.

The general-equilibrium effect should not be interpreted as evidence that older workers are poorer targets. Their greater human capital and lower rent portability can increase a firm's residual surplus conditional on a successful move. However, older workers search less, tend to hold stronger incumbent matches, and have shorter remaining careers, so profitable matches are less likely and shorter-lived. In the calibrated demographic counterfactual, the combined effect lowers the expected value of a vacancy. Free entry then reduces labor-market tightness, weakening outside-offer and retention-counteroffer competition throughout the labor market and producing the additional 1.85-percentage-point decline in the labor share.

5 Policy Analysis

We now use the calibrated model to examine how alternative policies affect the labor share and other aggregate outcomes. The main analysis focuses on a vacancy subsidy, a bargaining-power support program, and a reduction in the unemployment benefit.[25]

For each experiment, we report the effects on the before-tax labor share, job-finding rate,

[25]Online Appendix E considers policies targeting older workers, including an earnings supplement, a subsidy for on-the-job search, and improved matching efficiency.

GDP, and utilitarian worker welfare. Policies that require government financing are implemented through the progressive income tax schedule and the after-tax income is

$$w^{\text{after}} = \min\left\{\kappa_\tau \left(w^{\text{before}}\right)^{1-\tau}, w^{\text{before}}\right\}.$$

Following Guner, Lopez-Daneri and Ventura (2016), we set $\tau = 0.053$ and choose κ_τ to balance the government budget. In the policy that reduces the unemployment benefit, the resulting fiscal savings are returned to workers as lump-sum transfers. Welfare is measured by the age-distribution-weighted average of workers' values.

5.1 Vacancy Subsidy

The vacancy subsidy directly targets the decline in vacancy creation that amplifies the effect of workforce aging. A subsidy at rate τ_v reduces the private flow cost of a vacancy from c to $(1-\tau_v)c$. The subsidy is financed through the progressive income tax described above.

The subsidy operates by encouraging firms to create vacancies. The lower vacancy cost makes entry more profitable. Firms therefore post more vacancies, raising labor-market tightness until the free-entry condition is restored. The tighter labor market increases workers' job-finding rates and their opportunities to receive outside offers. These offers strengthen workers' bargaining positions and generate more frequent wage increases, thereby raising the labor share.

Figure 7 reports the effects of the subsidy. At a 10 percent subsidy, the before-tax labor share rises from 0.64 to 0.72. Job-finding prospects improve as labor-market tightness increases from 0.49 to 0.53 and the unemployment rate falls from 5.1 to 4.9 percent. The monthly EE-flow rate increases from 2.75 to 2.78 percent, GDP rises by 0.65 percent.

A subsidy of approximately 4.5 percent is sufficient to restore the labor share to its 1995 model level. At the 10 percent subsidy, worker welfare rises by 11.8 percent because the improvement in labor-market opportunities outweighs the additional tax burden in the model. The large estimated welfare gain indicates that vacancy creation is a quantitatively important policy margin in the calibrated economy.

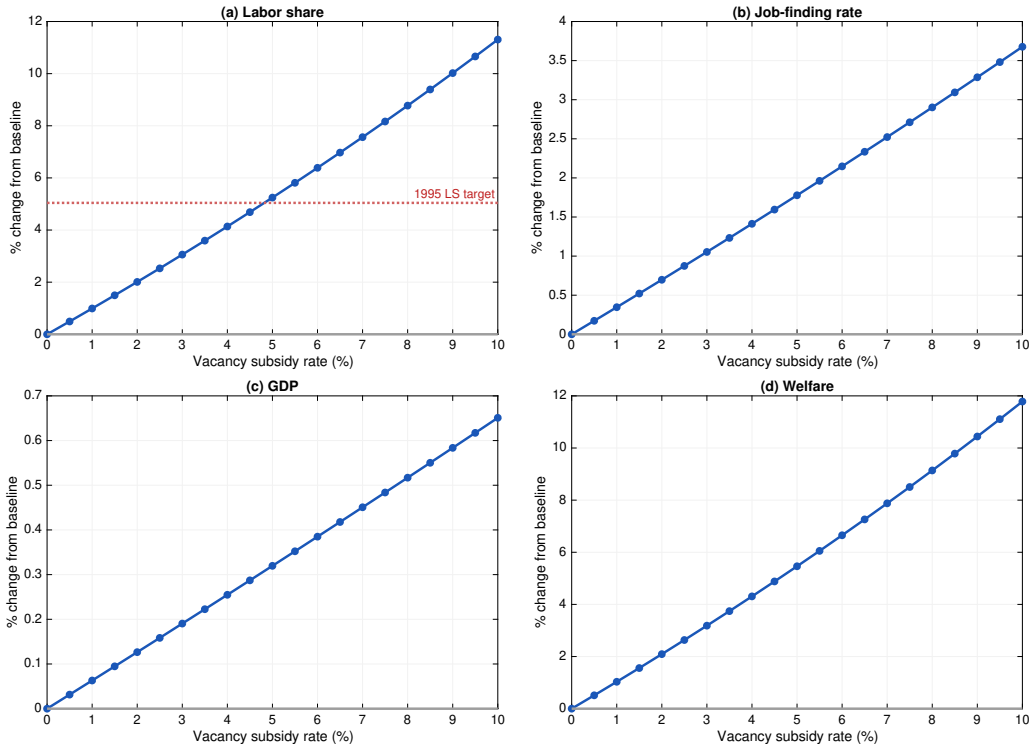


Figure 7: Effects of a vacancy subsidy financed by progressive income taxation

5.2 Bargaining-power Support

We next consider a policy that allows older workers to retain more of their accumulated employment rents when moving to another employer.[26] For workers aged 50 and older, the policy closes a fraction r of the gap between the baseline portability index, m_a, and full portability:

$$m_a^R = m_a + r(1 - m_a).$$

Greater portability allows older workers to preserve more of their accumulated rents when changing employers. Outside offers consequently generate larger wage gains and provide greater bargaining leverage with current employers. Although greater portability shifts bargaining power toward workers, the expected value of a vacancy contact nonetheless rises slightly once the resulting changes in search behavior and match surplus are taken into account. Vacancy creation

[26]One institutional analogue is Austria's 2003 severance pay reform. Under the previous system, severance benefits increased with tenure but were generally forfeited when workers voluntarily left their employer. The reform replaced this arrangement with employer contributions to individual accounts whose accumulated balances remain with workers when employment ends. It therefore converted a firm-specific, tenure-related entitlement into portable compensation and reduced the cost of changing employers. The scheme applies to all workers and does not literally make match rents portable, but it illustrates how compensation tied to continued employment with one firm can be made portable.

therefore increases modestly.

Figure 8 reports the results. Restoring the labor share to its 1995 model level requires closing approximately 95 percent of the portability gap. At this policy intensity, the labor share rises to 0.68, labor-market tightness increases modestly from 0.488 to 0.491, and unemployment falls slightly.

The policy raises worker welfare by 1.39 percent but reduces GDP by 3.83 percent. Because the experiment does not increase human capital or productivity directly, the higher labor share primarily reflects a redistribution of match surplus toward workers and the associated equilibrium responses. Thus, restoring the labor share through greater rent portability comes with a sizable output loss in the calibrated model.

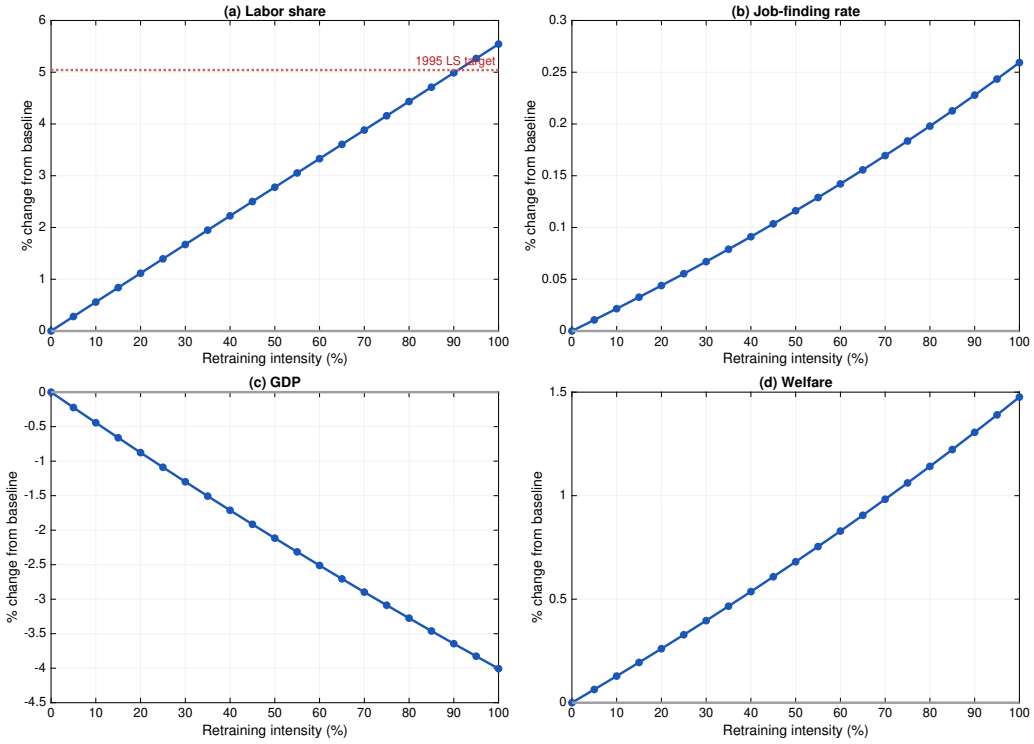


Figure 8: Effects of greater rent portability for older workers

5.3 Unemployment Benefits

We next vary the unemployment benefit, $b(h)$. Benefit increases are financed through the progressive income tax described above. Benefit cuts generate fiscal savings, which are returned to workers uniformly as lump-sum transfers.[27]

[27] We obtain the same qualitative results if we use uniform lump-sum adjustments for both benefit increases and cuts.

Figure 9 shows that the labor share has a U-shaped relationship with the unemployment benefit. A 40 percent benefit cut restores the labor share to its 1995 model level of 0.68. At this policy level, labor-market tightness rises from 0.49 to 0.51, the job-finding rate increases from 0.35 to 0.36, unemployment falls to 0.05, and GDP rises by 0.34 percent. Worker welfare increases by 5.36 percent.

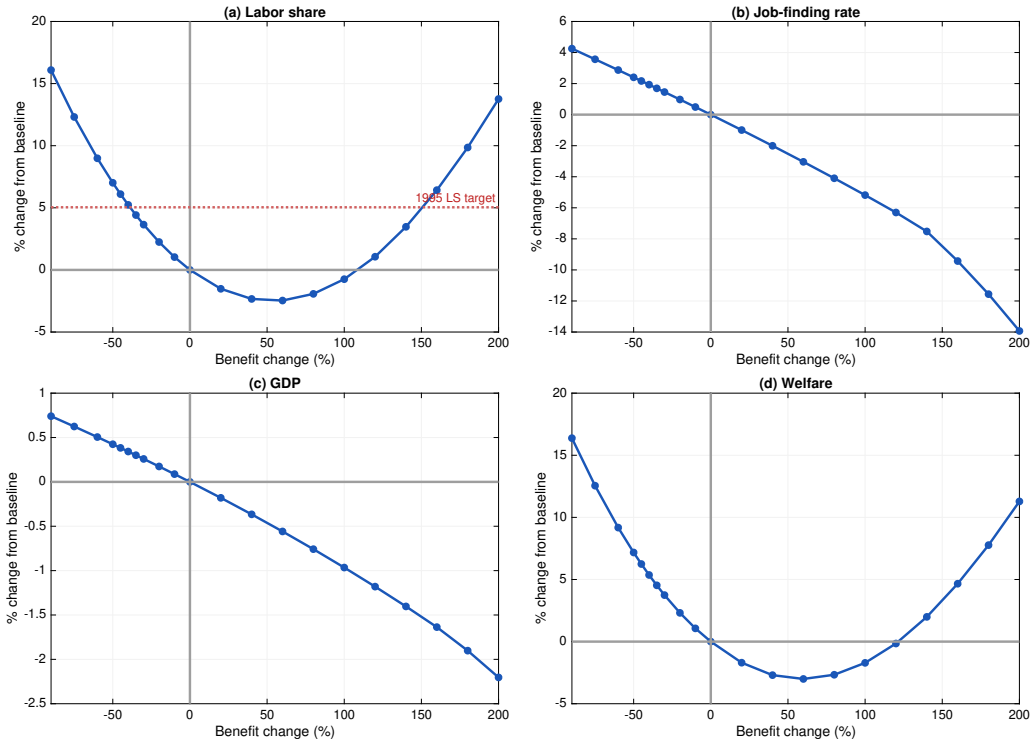


Figure 9: Effects of changes in unemployment benefits

Two opposing forces determine the wage response to a benefit cut. Holding labor-market conditions fixed, lower benefits weaken unemployed workers' outside options and reduce the wages they are willing to accept. In equilibrium, however, lower benefits increase firms' surplus from hiring unemployed workers. Firms respond by creating more vacancies, raising labor-market tightness, job-finding opportunities, and the arrival of competing offers. In the calibrated model, this general-equilibrium response more than offsets the direct effect of a weaker unemployment option on the aggregate wage bill. The lump-sum transfer further raises worker welfare without reducing firms' incentives to create vacancies.

Benefit increases raise the labor share through a different mechanism. A stronger unemployment option directly raises workers' wage demands and provides additional insurance. At the same time, it discourages vacancy creation, reduces job finding and output, and requires addi-

tional tax revenue. The labor share can therefore rise following either a benefit cut or an increase, but for different reasons. For the policy that restores the 1995 labor share, the main mechanism is the increase in vacancy creation and outside-offer competition generated by a moderate benefit cut.

5.4 Discussion

The policy experiments highlight two distinct ways to raise the labor share. Vacancy subsidies and reductions in the unemployment benefit operate primarily by encouraging vacancy creation and strengthening outside-offer competition. Greater rent portability, alternatively, increases the wage gains and bargaining leverage generated by outside offers. Although these channels can restore the labor share, they have different implications for mobility, output, welfare, and policy financing.

Two findings stand out. First, policies that directly stimulate vacancy creation most directly reverse the vacancy-creation effect through which workforce aging lowers the labor share. Both the vacancy subsidy and a moderate reduction in the unemployment benefit restore the 1995 labor share while raising labor-market tightness, the job-finding rate, and GDP. By contrast, greater rent portability restores the labor share mainly by shifting match surplus toward older workers and is accompanied by a sizable decline in output.

Second, policies that increase older workers' search effort or matching efficiency need not improve aggregate labor-market conditions. These interventions raise the targeted workers' effective contact opportunities, but they also change the composition and value of the search pool encountered by vacancies. In the experiments, the expansion in effective search is concentrated among employed older workers, reducing the unemployed share of vacancy contacts. This lowers the expected contact value because an employed-worker contact produces a profitable match only when the prospective match dominates the incumbent match, whereas an unemployed-worker contact can create a new match whenever its surplus is positive. In the search-subsidy experiment, additional mobility also moves older workers further up the job ladder, making subsequent poaches less likely and less valuable. Together with the shorter duration of matches formed later in the career, these forces reduce the expected value of a vacancy contact and equilibrium tightness, partly offsetting the policies' direct gains.[28]

[28] Online Appendix E.5 shows that the policies shift vacancy contacts away from unemployed searchers and toward employed searchers and documents an additional decline in employed-worker match opportunities through the job ladder.

6 Conclusion

This paper shows how workforce aging can reduce labor mobility and weaken workers' share of output. At the industry level, a shift–share design based on predetermined exposure to cohort aging yields negative effects on EE flows, labor rents, and labor shares, with larger labor-share effects in industries that were initially less fluid. An increase in average workforce age reduces the gross job-creation and job-opening rates, providing evidence consistent with the model's vacancy-creation mechanism. Matched CPS evidence shows that the wage-growth premium associated with employer switching declines with age. Together, these findings connect workforce aging to both the frequency and the value of outside opportunities.

We develop a general-equilibrium life-cycle search model to quantify this mechanism and its implications for the division of match surplus. The framework distinguishes two effects of workforce aging: a composition effect, which operates through the shift toward workers with lower mobility and bargaining power at a given level of tightness, and a general-equilibrium effect, which operates through firms' vacancy-posting decisions and equilibrium tightness. We find that replacing the 1995 demographic distribution with its 2015 counterpart reduces the labor share by about half of the decline observed in the data, of which vacancy creation accounts for more than half. Workforce aging therefore does more than reweighting workers with different mobility and bargaining profiles. By reducing the expected value of a vacancy contact, it discourages vacancy creation and weakens outside-offer competition for workers of all ages.

A broader lesson is that worker value and recruitability need not move together. Older employed workers can remain productive and profitable to firms conditional on a successful move, yet lower search intensity, stronger incumbent matches, and shorter horizons make such hires harder to realize. Workforce aging can therefore reduce vacancy creation even without making older workers intrinsically unattractive to firms.

The policy experiments reveal an important tension between policies' direct effects at a given level of tightness and their vacancy-creation effects. Subsidizing older workers' search or improving their matching efficiency directly increases their contact opportunities, but the resulting response of vacancy creation can reduce equilibrium tightness and offset these gains. By contrast, a vacancy subsidy and a reduction in the unemployment benefit accompanied by a lump-sum rebate restore the model labor share while raising tightness and output. Policies intended to strengthen worker bargaining power should therefore be evaluated not only by their direct ef-

fects on targeted workers, but also by their general-equilibrium effects on vacancy creation and outside-offer competition.

Several extensions would deepen the analysis. Introducing richer worker heterogeneity and endogenous labor-force participation and retirement would help separate the composition effect of demographic change from selection into late-career employment and could shed light on the weekly-earnings losses experienced by some older job switchers. Direct evidence on rent portability, incumbent counteroffers, and the costs and effectiveness of portability-enhancing policies would further discipline the model's central mechanisms. Finally, embedding demographic change alongside technological adoption, product-market power, labor-market institutions, and geographic or occupational reallocation in a unified transition framework would clarify how these forces interact and how their welfare consequences vary across age and income groups.

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Online Appendix of "Aging, Mobility, and the Erosion of Bargaining Power"

A Data appendix

A.1 Industry classification and crosswalk

Target industry classification. The industry-level analysis combines CPS measures of workforce age and EE flow with the labor-share and imputed labor-rent series constructed by Stansbury and Summers (2020). We therefore express all variables in the common industry classification used by Covarrubias, Gutiérrez and Philippon (2020) and Stansbury and Summers (2020), which is based primarily on BEA industry groups.

The CPS reports industry using classification systems that change over time. We begin with the harmonized 1990 Census industry code, `IND1990`, map it to three-digit NAICS categories using the Census Bureau industry code lists and crosswalks, and then collapse the NAICS categories to the final analysis industries.[29] Most `IND1990` codes map uniquely to one final analysis industry. When several candidate NAICS categories collapse to the same final industry, the mapping is also treated as unique at the level used in the regressions.

One-to-many mappings. Some `IND1990` codes correspond to multiple three-digit NAICS categories that belong to different final analysis industries. This occurs because the older Census classification is coarser than NAICS; it does not mean that an individual worker is employed in several industries. Let c index an `IND1990` code and let $\mathcal{J}(c)$ denote the set of final industries to which it can map. Using the 2003 CPS bridge sample, in which the newer industry classification is observed, we estimate the employment-weighted mapping share

$$\widehat{\pi}_{cj} = \frac{\sum_{i \in \mathcal{B}} \omega_i \mathbf{1}\{c_i = c\}\mathbf{1}\{j_i = j\}}{\sum_{i \in \mathcal{B}} \omega_i \mathbf{1}\{c_i = c\}}, \qquad j \in \mathcal{J}(c), \tag{41}$$

where $\mathcal{B}$ is the bridge sample, ω_i is the CPS sampling weight, and j_i is the final industry obtained from the observed NAICS code. By construction, $\sum_{j \in \mathcal{J}(c)} \widehat{\pi}_{cj} = 1$. For a unique mapping, $\widehat{\pi}_{cj} = 1$.

For observations from years in which the detailed NAICS category cannot be recovered, we use these shares as fractional crosswalk weights. An observation i with source code $c_i = c$ contributes

[29] The Census Bureau's industry code lists and crosswalks are available at `https://www.census.gov/topics/employment/industry-occupation/guidance/code-lists.html`.

to every $j \in \mathcal{J}(c)$ with analysis weight

$$\widetilde{\omega}_{ij} = \omega_i \widehat{\pi}_{cj}. \tag{42}$$

The weights assigned to that observation sum to its original CPS weight. This replaces each observation's stochastic contribution to industry totals with its conditional expectation; industry-year ratios are then formed from the expected numerator and denominator. The procedure therefore avoids dependence on a particular random seed and adds no simulation noise to the moments.

For example, `IND1990` code 810 (miscellaneous entertainment and recreation services) can map to NAICS 711 (performing arts, spectator sports, and related industries) or NAICS 713 (amusement, gambling, and recreation industries). Suppose their estimated 2003 shares are 0.31 and 0.69, respectively. A pre-2003 observation with CPS weight ω_i then contributes $0.31\omega_i$ to the analysis industry containing NAICS 711 and $0.69\omega_i$ to the industry containing NAICS 713. The observation is not randomly assigned to only one of the two categories.

Construction of industry-year outcomes. Let E_{it} indicate that worker i is employed in month t, and let D_{it}^{EE} indicate that the worker is employed in the current month and reports a different employer than in the preceding month. We assign an EE transition to the worker's current-month industry. For industry j and year t, average workforce age and the EE-flow rate are

$$\mathrm{AvgAge}_{jt} = \frac{\sum_{i \in t} \widetilde{\omega}_{ij} E_{it} \, \mathrm{Age}_{it}}{\sum_{i \in t} \widetilde{\omega}_{ij} E_{it}}, \tag{43}$$

$$\mathrm{EE}_{jt} = \frac{\sum_{i \in t} \widetilde{\omega}_{ij} D_{it}^{EE}}{\sum_{i \in t} \widetilde{\omega}_{ij} E_{it}}. \tag{44}$$

Thus, employment is the denominator of the EE-flow rate. The same fractional weights enter its numerator and denominator, as well as all other CPS-based industry-year statistics. We then merge these statistics with the labor-share and labor-rent series using the final common industry identifier.

B Robustness of employer-switch wage-growth gradients

This appendix reports two robustness checks for the individual-level wage-growth exercise. The first uses a stricter *recent-switch* definition. The switch indicator equals one only if the worker reports a different employer at MISH 8 relative to the previous observed month. To keep the

comparison group clean, non-switchers are again restricted to workers with no observed employer switch from MISH 5 through MISH 8. Workers who switch earlier in the return spell but do not report a switch at MISH 8 are excluded. The second robustness check uses a broader job-change proxy and is included only as a descriptive comparison.

Table B.1: Employer switching and wage growth by age: recent switch at MISH 8

	Weekly earnings growth			Hourly wage growth		
Age group	Switcher	Non-switcher	Premium	Switcher	Non-switcher	Premium
20–29	9.10	6.54	2.56^{***} (0.85)	6.77	5.43	1.34^{*} (0.70)
30–39	3.10	4.22	-1.12 (0.77)	3.73	3.74	-0.00 (0.70)
40–49	2.51	2.63	-0.12 (0.82)	2.04	2.16	-0.11 (0.77)
50–59	0.16	2.07	-1.91^{**} (0.97)	0.75	1.81	-1.06 (0.90)
60–64	-6.51	-0.77	-5.74^{***} (2.05)	-1.21	0.49	-1.70 (1.82)

Notes: Wage growth is measured over twelve months and expressed in 100 log points. The recent-switch indicator equals one if the worker reports a different employer at MISH 8 relative to the previous observed month. The comparison group has no observed employer switch from MISH 5 through MISH 8. Earlier return-spell switchers who do not switch at MISH 8 are excluded. Switcher entries are adjusted means from the switcher-only regressions. Standard errors, clustered by person, are in parentheses. Entries are rounded independently. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

The recent-switch estimates reinforce the life-cycle pattern. Switchers in their 20s experience substantially faster wage growth than non-switchers. From age 30 onward, this advantage disappears, and recent switchers aged 50–64 experience considerably weaker weekly-earnings growth than comparable non-switchers. The differences are smaller for hourly wages, indicating that changes in hours contribute to the sharper age gradient in weekly earnings. These patterns are consistent with later-career transitions being more likely to involve displacement, reduced hours, partial retirement, or movement to less remunerative jobs rather than upward movement along the wage ladder.

Table B.2: Wage growth by age: broad job-change proxy

	Weekly earnings growth			Hourly wage growth		
Age group	Job changer	Non-changer	Premium	Job changer	Non-changer	Premium
20–29	6.79	4.16	2.63^{***} (0.20)	5.66	4.07	1.59^{***} (0.18)
30–39	3.92	3.76	0.16 (0.15)	3.52	3.69	-0.17 (0.15)
40–49	3.00	2.85	0.16 (0.15)	2.47	2.64	-0.17 (0.15)
50–59	1.85	2.03	-0.18 (0.17)	1.79	2.07	-0.27 (0.17)
60–64	-0.49	-0.30	-0.19 (0.35)	0.65	0.93	-0.29 (0.34)

Notes: Wage growth is measured over twelve months and expressed in 100 log points. The broad job-change proxy equals one if the worker reports an employer switch during MISH 5–8, an industry change between MISH 4 and MISH 8, or an occupation change between MISH 4 and MISH 8. This descriptive measure is not used as the paper's preferred measure of EE flow. Job-changer entries are adjusted means from the changer-only regressions. Standard errors, clustered by person, are in parentheses. Entries are rounded independently. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

The broad job-change proxy produces the same central result. Job changes are associated with substantially faster weekly-earnings and hourly-wage growth among workers in their 20s, but the premium is close to zero thereafter. Thus, the concentration of wage-enhancing mobility early in the career is not specific to the employer-switch definition.

C Model appendix

This appendix collects derivations and technical results that support the model in Section 3. The main text states the economic environment, the outside-offer protocol, the worker and firm problems, the equilibrium conditions, and the aggregate model counterparts. The appendix derives the sequential-auction cutoffs and firm payoffs, obtains the total-surplus and wage recursions, gives the full distributional law of motion, and proves the comparative-static results used in the main text.

C.1 Sequential auction: derivation and properties

Consider a worker of age a in an incumbent match with surplus $S > 0$. An outside offer would create surplus S'. Let $\eta \in [\eta_0, 1]$ be the worker's bargaining index. It summarizes the contract position supported by outside offers and is not itself a surplus share. Define the currently enforceable

share of present-value match surplus by

$$\bar{\eta}_a(\eta) \equiv \eta_0 + m_a(\eta - \eta_0), \qquad 0 \leq m_a \leq 1. \tag{45}$$

The current worker surplus over unemployment is $\bar{\eta}_a(\eta)S$. This object is a present value; it is distinct from both current match revenue and the current flow wage.

The first cutoff. Suppose first that the incumbent remains the higher-surplus match, $S' \leq S$. If the outside offer is used in bargaining, the index supported by that offer is

$$\eta^{\text{stay}} = \eta_0 + (1 - \eta_0)\frac{S'}{S}. \tag{46}$$

The offer improves the contract's bargaining index if and only if $\eta^{\text{stay}} > \eta$. Rearranging this inequality gives

$$S' > \underline{S}(\eta, S), \qquad \underline{S}(\eta, S) \equiv \frac{\eta - \eta_0}{1 - \eta_0} S. \tag{47}$$

An offer below this cutoff is discarded. An offer between $\underline{S}(\eta, S)$ and S produces a counteroffer, leaves the worker at the incumbent firm, and updates the bargaining index according to equation (46).

The mobility cutoff. If $S' > S$, the outside match creates more total surplus and the worker moves. The losing incumbent supports the new match's bargaining index

$$\eta^{\text{move}} = \eta_0 + (1 - \eta_0)\frac{S}{S'}. \tag{48}$$

Combining the three regions, the post-offer match productivity and bargaining index are

$$(\varepsilon^+, \eta^+) = \begin{cases} (\varepsilon, \eta), & S' \leq \underline{S}(\eta, S), \\ (\varepsilon, \eta_0 + (1 - \eta_0)S'/S), & \underline{S}(\eta, S) < S' \leq S, \\ (\varepsilon', \eta_0 + (1 - \eta_0)S/S'), & S' > S. \end{cases} \tag{49}$$

The rent-portability factor does not appear in equation (49). The auction first updates the index supported by employer competition. The factor m_a then maps that index into the share currently enforceable. Notice that η^{move} can be below the pre-move η even though $S' > S$ and the

worker's continuation surplus rises. The index is normalized by the active match's surplus, so it is not an ordinal measure of worker bargaining power across matches with different S. Applying equation (45) gives

$$\bar{\eta}_a(\eta^+) = \begin{cases} \bar{\eta}_a(\eta), & S' \le \underline{S}(\eta, S), \\ \eta_0 + m_a(1-\eta_0)S'/S, & \underline{S}(\eta, S) < S' \le S, \\ \eta_0 + m_a(1-\eta_0)S/S', & S' > S. \end{cases} \tag{50}$$

Let $S^+ = S$ when the worker stays and $S^+ = S'$ when she moves. Her post-auction surplus over unemployment is therefore

$$\begin{aligned} \mathcal{W}_a(S, S', \eta) &\equiv \bar{\eta}_a(\eta^+)S^+ \\ &= \begin{cases} \bar{\eta}_a(\eta)S, & S' \le \underline{S}(\eta, S), \\ \eta_0 S + m_a(1-\eta_0)S', & \underline{S}(\eta, S) < S' \le S, \\ \eta_0 S' + m_a(1-\eta_0)S, & S' > S. \end{cases} \end{aligned} \tag{51}$$

The worker continuation value following the offer is $U_a(h) + \mathcal{W}_a(S, S', \eta)$.

Continuity, bounds, and limiting cases. At the first cutoff, substituting $S' = [(\eta - \eta_0)/(1-\eta_0)]S$ into the middle branch of equation (51) gives $\bar{\eta}_a(\eta)S$. At $S' = S$, the middle and moving branches both equal $[\eta_0 + m_a(1-\eta_0)]S$. The worker payoff is therefore continuous at both cutoffs. Moreover,

$$\eta^{\text{stay}} \in (\eta, 1] \quad \text{in the retention region,} \qquad \eta^{\text{move}} \in [\eta_0, 1) \quad \text{in the moving region.}$$

When $m_a = 1$, the entire outside-offer increment is enforceable and the formulas reduce to the standard sequential auction. When $m_a = 0$, changes in η no longer affect the enforceable share: the worker receives the baseline share η_0 of whichever match is active after the auction.

Firm payoffs. The incumbent firm's post-offer continuation value has the same three regions as the auction:

$$\widetilde{J}_a(h,\varepsilon,\varepsilon',\eta) = \begin{cases} J_a(h,\varepsilon,\eta), & S' \le \underline{S}(\eta,S), \\ J_a(h,\varepsilon,\eta^{\text{stay}}), & \underline{S}(\eta,S) < S' \le S, \\ V, & S' > S. \end{cases} \tag{52}$$

Using the sharing rule, the incumbent's post-offer surplus over vacancy is therefore

$$\widetilde{J}_a(h,\varepsilon,\varepsilon',\eta) - V = \begin{cases} [1-\bar{\eta}_a(\eta)]\,S, & S' \le \underline{S}(\eta,S), \\ (1-\eta_0)(S-m_aS'), & \underline{S}(\eta,S) < S' \le S, \\ 0, & S' > S. \end{cases} \tag{53}$$

Thus, a weak offer leaves the incumbent value unchanged. A counteroffer lowers the incumbent's value by

$$m_a\left[(1-\eta_0)S' - (\eta-\eta_0)S\right] \ge 0,$$

with a strict reduction when $m_a > 0$ and the offer lies strictly above the first cutoff. If $S' > S$, the incumbent loses the worker and returns to V.

The poaching firm's gain relative to remaining vacant is

$$\begin{aligned} J_a(h,\varepsilon',\eta^{\text{move}}) - V &= [1-\bar{\eta}_a(\eta^{\text{move}})]\,S' \\ &= (1-\eta_0)(S'-m_aS). \end{aligned} \tag{54}$$

For a contact with an unemployed worker, a positive-surplus match starts at η_0 because there is no incumbent–poacher competition, so the hiring firm's gain is

$$J_a(h,\varepsilon',\eta_0) - V = (1-\eta_0)[S_a(h,\varepsilon')]_+. \tag{55}$$

C.2 Total-surplus recursion

This subsection derives an explicit recursion for total match surplus. The derivation also shows why the surplus is independent of the bargaining index under bargaining-index-independent employed search.

Let

$$S^I_{a+1}(h,\varepsilon) \equiv S_{a+1}(H^E(h),\varepsilon),$$
$$S^P_{a+1}(h,\varepsilon') \equiv S_{a+1}(H^E(h),\varepsilon'),$$
$$S^{UE}_{a+1}(h,\varepsilon') \equiv S_{a+1}(H^U(h),\varepsilon').$$

For the current worker-incumbent coalition, define the continuation surplus after an employed-worker contact by

$$\mathcal{R}_a(S,S') = \begin{cases} S, & S' \le S, \\ \eta_0 S' + m_a(1-\eta_0)S, & S' > S. \end{cases} \tag{56}$$

If the worker stays, the auction merely redistributes the incumbent match surplus, so the coalition retains S. If the worker moves, the incumbent becomes vacant and the coalition retains the worker's auction surplus.

For compactness, define

$$\lambda^u_a(h) = \zeta^u_a(h)\phi(\theta), \qquad \lambda^e_a(h,\varepsilon) = \zeta^e_a(h,\varepsilon)\phi(\theta).$$

Evaluate the employed worker's value at the new-match contract η_0, add the incumbent firm's value, subtract the unemployment value, and impose free entry, $V = 0$. The resulting raw surplus is

$$\begin{aligned} S^{\text{raw}}_a(h,\varepsilon) = {} & ph\varepsilon - b(h) - C_e(\zeta^e_a(h,\varepsilon)) + C_u(\zeta^u_a(h)) \\ & + \beta s_a \Bigg\{ (1-\delta_s)\left[U_{a+1}(H^E(h)) - U_{a+1}(H^U(h))\right] \\ & \quad + (1-\delta_s)\Bigg[(1-\lambda^e_a(h,\varepsilon))\, S^I_{a+1}(h,\varepsilon) \\ & \qquad + \lambda^e_a(h,\varepsilon) \int \mathcal{R}_{a+1}\big(S^I_{a+1}(h,\varepsilon), S^P_{a+1}(h,\varepsilon')\big)\, dG(\varepsilon') \Bigg] \\ & \quad - \lambda^u_a(h)\eta_0 \int [S^{UE}_{a+1}(h,\varepsilon')]_+ \, dG(\varepsilon') \Bigg\}. \end{aligned} \tag{57}$$

The equilibrium surplus is

$$S_a(h,\varepsilon) = [S^{\text{raw}}_a(h,\varepsilon)]_+, \qquad S_T(h,\varepsilon) = 0. \tag{58}$$

The first line of equation (57) is current net match output relative to unemployment, including the difference in search costs. The first continuation term reflects the different human-capital laws under continued employment and unemployment. The second continuation term is the current coalition's value following no contact or an outside offer. The last term subtracts the option value that the worker would obtain by searching from unemployment.

Neither equation (56) nor equation (57) contains the current bargaining index. This invariance relies on the restriction $\zeta_a^e = \zeta_a^e(h, \varepsilon)$. With unrestricted privately optimal search, the policy would generally depend on η, and total surplus would inherit that dependence through search costs and contact probabilities.

C.3 Wage determination, vacancy values, and free entry

C.3.1 Expanded implementing wage

The sharing rule implies

$$W_a(h, \varepsilon, \eta) = U_a(h) + \bar{\eta}_a(\eta) S_a(h, \varepsilon).$$

This equation allocates present-value match surplus. The flow wage must offset current and continuation terms so that the worker's Bellman value satisfies the sharing rule. Substituting this expression into the employed-worker Bellman equation and then using the unemployment Bellman equation gives the expanded implementing wage

$$\begin{aligned} w_a(h, \varepsilon, \eta) = b(h) &+ C_e(\zeta_a^e(h, \varepsilon)) - C_u(\zeta_a^u(h)) + \bar{\eta}_a(\eta) S_a(h, \varepsilon) \\ &- \beta s_a \Bigg\{ (1 - \delta_s) \left[U_{a+1}(H^E(h)) - U_{a+1}(H^U(h)) \right] \\ &\quad + (1 - \delta_s) \Bigg[\left(1 - \lambda_a^e(h, \varepsilon)\right) \bar{\eta}_{a+1}(\eta) S_{a+1}^I(h, \varepsilon) \\ &\qquad + \lambda_a^e(h, \varepsilon) \int \mathcal{W}_{a+1}\big(S_{a+1}^I(h, \varepsilon), S_{a+1}^P(h, \varepsilon'), \eta\big)\, dG(\varepsilon') \Bigg] \\ &\quad - \lambda_a^u(h) \eta_0 \int [S_{a+1}^{UE}(h, \varepsilon')]_+ \, dG(\varepsilon') \Bigg\}. \end{aligned} \tag{59}$$

This formula is useful for implementation because every term is evaluated from objects already obtained in the backward-induction step. It also makes clear that capital is absent as a separate state because the competitive capital choice has already been optimized out: $ph\varepsilon$ is match revenue

net of the capital rental bill.

C.3.2 Expected value of a vacancy contact

Let N^s denote aggregate effective search and define the effective-search weights

$$\begin{aligned} \omega_a^u(h) &= \frac{\mu_a u_a(h)\zeta_a^u(h)}{N^s}, \\ \omega_a^e(h,\varepsilon,\eta) &= \frac{\mu_a e_a(h,\varepsilon,\eta)\zeta_a^e(h,\varepsilon)}{N^s}. \end{aligned} \tag{60}$$

Using equations (54) and (55), the expected gain from a vacancy contact is

$$\begin{aligned} \Omega(\theta) = &\sum_{a=0}^{T-1} \int \omega_a^u(h) s_a (1-\eta_0) \int [S_{a+1}^{UE}(h,\varepsilon')]_+ \, dG(\varepsilon') \, dh \\ &+ \sum_{a=0}^{T-1} \iiint \omega_a^e(h,\varepsilon,\eta) s_a (1-\delta_s)(1-\eta_0) \\ &\quad \times \int \left[S_{a+1}^P(h,\varepsilon') - m_{a+1} S_{a+1}^I(h,\varepsilon) \right] \\ &\quad \times \mathbf{1}\left\{ S_{a+1}^P(h,\varepsilon') > S_{a+1}^I(h,\varepsilon) \right\} \, dG(\varepsilon') \, dh \, dG(\varepsilon) \, d\eta. \end{aligned} \tag{61}$$

The first component is the value of meeting an unemployed worker and the second is the value of successfully poaching an employed worker. The factors s_a and $s_a(1-\delta_s)$ appear because the match must survive into the next-period contract. The functions ω_a^u and ω_a^e determine which worker states a vacancy is likely to contact.

The vacancy Bellman equation is

$$V = -c + \beta V + \beta q(\theta)\Omega(\theta), \qquad q(\theta) = A\theta^{-\alpha}. \tag{62}$$

Free entry implies

$$V = 0, \qquad c = \beta q(\theta)\Omega(\theta). \tag{63}$$

C.4 Conditional distributional law of motion

The main text describes the transition operator verbally. Here we provide its full weak-form representation, which is convenient for both proofs and implementation because it remains valid when the state distributions contain point masses.

At labor-market entry,

$$u_0 = \delta_{h_0}, \qquad e_0 = 0. \tag{64}$$

For any bounded test function ψ_u, the next-age unemployment distribution satisfies

$$\begin{aligned}\int \psi_u(\widetilde{h}) u_{a+1}(d\widetilde{h}) = & \int u_a(dh)\left[1 - \lambda_a^u(h) + \lambda_a^u(h) \int \mathbf{1}\{S_{a+1}^{UE}(h,\varepsilon') \le 0\} dG(\varepsilon')\right] \psi_u(H^U(h)) \\ & + \iiint e_a(dh, d\varepsilon, d\eta)\delta_s \psi_u(H^U(h)).\end{aligned} \tag{65}$$

For any bounded test function ψ_e, the next-age employment distribution satisfies

$$\begin{aligned}& \iiint \psi_e(\widetilde{h}, \widetilde{\varepsilon}, \widetilde{\eta}) e_{a+1}(d\widetilde{h}, d\widetilde{\varepsilon}, d\widetilde{\eta}) \\ = & \int u_a(dh)\lambda_a^u(h) \int \mathbf{1}\{S_{a+1}^{UE}(h,\varepsilon') > 0\} \psi_e(H^U(h), \varepsilon', \eta_0) dG(\varepsilon') \\ & + \iiint e_a(dh, d\varepsilon, d\eta)(1-\delta_s)\Bigg[\left(1 - \lambda_a^e(h,\varepsilon)\right) \psi_e(H^E(h), \varepsilon, \eta) \\ & \qquad + \lambda_a^e(h,\varepsilon) \int \psi_e\big(H^E(h), \varepsilon_{a+1}^+(h,\varepsilon,\varepsilon',\eta), \eta_{a+1}^+(h,\varepsilon,\varepsilon',\eta)\big)\, dG(\varepsilon')\Bigg].\end{aligned} \tag{66}$$

Here $(\varepsilon_{a+1}^+, \eta_{a+1}^+)$ is the transition in equation (49), evaluated using the next-age surpluses S_{a+1}^I and S_{a+1}^P.

Setting both test functions equal to one and adding equations (65) and (66) gives

$$\int u_{a+1}(dh) + \iiint e_{a+1}(dh, d\varepsilon, d\eta) = 1. \tag{67}$$

Survival does not appear in these conditional transitions because it depends only on age. The common survival factor cancels after conditioning on reaching age $a+1$. Unconditional cohort mass instead evolves according to $\ell_{a+1} = s_a \ell_a$. Cross-sectional state masses are obtained by multiplying the conditional measures by the supplied age weight μ_a.

C.5 Aggregation

Given the equilibrium distributions, aggregate effective labor is

$$L = \sum_{a=0}^{T-1} \mu_a \iiint h\varepsilon e_a(h,\varepsilon,\eta)\, dh\, dG(\varepsilon)\, d\eta. \tag{68}$$

Capital and output are

$$K = k^* L, \qquad Y = (k^*)^{\alpha_K} L. \tag{69}$$

The aggregate wage bill and labor share are

$$\begin{aligned} WB &= \sum_{a=0}^{T-1} \mu_a \iiint w_a(h,\varepsilon,\eta) e_a(h,\varepsilon,\eta)\, dh\, dG(\varepsilon)\, d\eta, \\ LS &= \frac{WB}{Y}. \end{aligned} \tag{70}$$

The aggregate unemployment and employment rates are

$$U = \sum_{a=0}^{T-1} \mu_a \int u_a(h)\, dh, \qquad E = 1 - U. \tag{71}$$

The job-finding rate, measured as the probability that a currently unemployed worker is employed next period, is

$$f^{UE} = \frac{1}{U} \sum_{a=0}^{T-1} \mu_a \int u_a(h) s_a \lambda_a^u(h) \int \mathbf{1}\{S_{a+1}^{UE}(h,\varepsilon') > 0\}\, dG(\varepsilon')\, dh, \tag{72}$$

where $S_{a+1}^{UE}(h,\varepsilon') \equiv S_{a+1}(H^U(h),\varepsilon')$ is surplus of a match formed from unemployment. The EE-flow rate is

$$\begin{aligned} f^{EE} = \frac{1}{E} \sum_{a=0}^{T-1} \mu_a \iiint & e_a(h,\varepsilon,\eta) s_a (1-\delta_s) \lambda_a^e(h,\varepsilon) \\ & \times \int \mathbf{1}\{S_{a+1}^{P}(h,\varepsilon') > S_{a+1}^{I}(h,\varepsilon)\}\, dG(\varepsilon')\, dh\, dG(\varepsilon)\, d\eta, \end{aligned} \tag{73}$$

where $S_{a+1}^{I}(h,\varepsilon) \equiv S_{a+1}(H^E(h),\varepsilon)$ is the surplus of the incumbent match if the worker remains employed with her current employer, and $S_{a+1}^{P}(h,\varepsilon') \equiv S_{a+1}(H^E(h),\varepsilon')$ is the surplus of a prospective poaching match. Thus, an outside offer that produces a counteroffer but not a move affects wages without appearing in f^{EE}.

C.6 Technical lemmas and proofs

For employed workers, the contact gain below is evaluated at the initial contract η_0. This implements the maintained restriction that a common policy $\zeta_a^e(h,\varepsilon)$ is chosen at the initial contract and then carried across values of the bargaining index. It is an optimum within that restricted policy

class; it is not the unrestricted optimum at every value of η.

Lemma 3 (Interior search policies under the restricted rule)**.** *Define the gains from a contact by*

$$\Delta^u_{a+1}(h) = \int \left[W_{a+1}(H^U(h), \varepsilon', \eta_0) - U_{a+1}(H^U(h))\right]_+ dG(\varepsilon'),$$
$$\Delta^e_{a+1}(h, \varepsilon) = \int \left[\widetilde{W}_{a+1}(H^E(h), \varepsilon, \varepsilon', \eta_0) - W_{a+1}(H^E(h), \varepsilon, \eta_0)\right]_+ dG(\varepsilon').$$

At an interior solution,

$$\zeta^u_a(h) = \left[\frac{\beta s_a \phi(\theta) \Delta^u_{a+1}(h)}{\sigma_u}\right]^{1/\sigma}, \tag{74}$$
$$\zeta^e_a(h, \varepsilon) = \left[\frac{\beta s_a (1-\delta_s) \phi(\theta) \Delta^e_{a+1}(h, \varepsilon)}{\sigma_e}\right]^{1/\sigma}. \tag{75}$$

With the constraint $\zeta \in [0, 1]$, each right-hand side is capped at one.

Proof. The contact probability is linear in search intensity, $\lambda(\theta, \zeta) = \zeta\phi(\theta)$, while $C'_x(\zeta) = \sigma_x \zeta^\sigma$. Equating the marginal search cost to the discounted, survival-weighted gain from a contact gives equations (74) and (75). □

Lemma 4 (Search and auction monotonicity)**.** *Holding tightness and the gain conditional on a contact fixed, both employed and unemployed interior search policies have elasticity $1/\sigma$ with respect to survival. The probability of surviving, avoiding separation, and receiving an employed-worker contact has elasticity $1+1/\sigma$. Moreover, the sequential auction never lowers the worker's surplus relative to the pre-offer contract.*

Proof. Log-differentiating equations (74) and (75) while holding θ and the conditional gain fixed gives

$$\frac{\partial \log \zeta^x_a}{\partial \log s_a} = \frac{1}{\sigma}, \qquad x \in \{u, e\}.$$

Multiplication by $s_a(1-\delta_s)\phi(\theta)$ adds one to the survival elasticity.

For the auction result, compare each branch of equation (51) with the pre-offer surplus $\bar{\eta}_a(\eta)S$. The difference is zero in the weak-offer region. In the counteroffer region it is

$$m_a \left[(1-\eta_0)S' - (\eta - \eta_0)S\right] > 0$$

by equation (47). In the moving region the difference is weakly positive at $S' = S$ and strictly increasing in S'. Hence an offer cannot reduce worker surplus. □

Lemma 5 (Free-entry pass-through)**.** *At a locally stable interior equilibrium, a marginal demographic change obeys*

$$d\log\theta = \frac{d\log\Omega|_\theta}{\alpha - \dfrac{\partial\log\Omega(\theta)}{\partial\log\theta}}. \tag{76}$$

At an interior search solution, holding survival and the gain conditional on a contact fixed,

$$\frac{\partial\log\lambda_a^x}{\partial\log\theta} = (1-\alpha)\left(1+\frac{1}{\sigma}\right), \qquad x\in\{u,e\}. \tag{77}$$

Proof. Log-differentiating $c = \beta A\theta^{-\alpha}\Omega(\theta)$, while allowing demographics to change Ω at fixed θ, gives

$$0 = -\alpha\, d\log\theta + \frac{\partial\log\Omega(\theta)}{\partial\log\theta} d\log\theta + d\log\Omega|_\theta.$$

Rearranging yields equation (76). Since $\phi(\theta) = A\theta^{1-\alpha}$, the search first-order conditions imply $\partial\log\zeta_a^x/\partial\log\theta = (1-\alpha)/\sigma$. Adding the elasticity of $\phi(\theta)$ gives equation (77). □

Proof of Proposition 1. Lemma 4 establishes the two elasticities reported in the proposition and shows that a reduction in survival lowers the expected worker surplus generated by outside offers, holding the conditional gain fixed. Evaluating the implementing wage at the post-auction contract maps the reduction in worker value into a lower bargaining component of the current wage when the productive state, outside option, search costs, and subsequent continuation terms are held fixed. The effect is strict when search is interior and a bargaining-improving offer occurs with positive probability. This is a partial comparative static; it does not sign the full age profile because human capital, incumbent match quality, and the conditional gain from an offer also vary with age.

Proof of Proposition 2. Equation (61) shows that the fixed-tightness effect of an older search pool on Ω is not signed without further restrictions. The direct duration force lowers the survival-weighted value of a successful contact, but age also changes human capital, incumbent and prospective match surpluses, rent portability, and the effective-search weights. Conditional on a negative fixed-tightness change in Ω, local stability and Lemma 5 imply a decline in tightness. Equation (77) then implies fewer worker contacts. By Lemma 4, fewer contacts weaken the bargaining gains generated by outside offers. The proposition leaves the total labor-share effect to the quantitative model because employment, human capital, match composition, wages, and output all adjust in general equilibrium.

D Computation Appendix

This appendix describes the algorithm used to solve the model equilibrium. Conditional on a parameter vector, a demographic environment, and labor-market tightness, we first solve worker values and policies by backward induction over age. It then constructs the conditional worker distributions by forward iteration and evaluates the free-entry condition. General equilibrium adds a scalar root search over labor-market tightness. Calibration places this equilibrium solver inside a nonlinear least-squares routine.

The state space is discretized as follows. Age has $T = 540$ monthly cells covering ages 20 through 64, with age 65 as the terminal state. Human capital has N_h nodes on $[0.5, 20]$, with relatively more nodes near low human capital. Firm productivity has N_ε nodes. We divide the truncated lognormal distribution on $[0, \bar{\varepsilon}]$ into probability cells, evaluate the inverse CDF at each cell midpoint, and use the cell probabilities as quadrature weights. Outside offers are independent draws from G. The recorded bargaining share has N_η equally spaced nodes on $[\eta_0, 0.995]$. Theoretical bargaining-share updates above the highest grid point are assigned to that endpoint.

The human-capital laws in (8) and (9) generally map to points between grid nodes. For each current h_j, we record the two adjacent nodes and the associated linear-interpolation weights. The same procedure is used when the bargaining-share updates in (46) and (48) map to points between nodes on the η grid. These interpolations preserve transition mass.

Given a parameter vector $\boldsymbol{\vartheta}$, survival probabilities $\{s_a\}$, age weights $\{\mu_a\}$, and candidate tightness θ, the fixed-tightness model is solved as follows:

1. Compute the capital-effective-labor ratio k^*, the marginal product of effective labor p, and the contact rates

$$\phi(\theta) = A\theta^{1-\alpha}, \qquad q(\theta) = A\theta^{-\alpha}.$$

   Compute the rent-portability factor $m_a = \exp(-\kappa_m \tau_a)$ at every age.

2. Set the terminal arrays to zero:

$$U_T(h_j) = 0, \qquad S_T(h_j, \varepsilon_k) = 0.$$

   Retirement and death therefore have zero continuation value. Because the life-cycle problem is finite, the fixed-θ calculation does not require an inner value-function fixed point.

3. For $a = T-1, T-2, \ldots, 0$, solve the worker problem by backward induction:

   (a) For each h_j, interpolate U_{a+1} and S_{a+1} at $H^U(h_j)$. Integrate positive new-match surplus over the productivity distribution, solve the unemployed-search condition (29), compute $\lambda_a^u(h_j)$, and update $U_a(h_j)$ from (28).

   (b) For each (h_j, ε_k), interpolate continuation values at $H^E(h_j)$ and $H^U(h_j)$. For every outside draw $\varepsilon_{k'}$, apply the three auction branches in (26). These calculations deliver the expected gain from employed search and the expected continuation surplus. Solve the floor-contract employed-search condition (32), insert the resulting policy into (57), and store

   $$S_a(h_j, \varepsilon_k) = \max\{S_a^{\text{raw}}(h_j, \varepsilon_k), 0\}.$$

   (c) For each $(h_j, \varepsilon_k, \eta_\ell)$, construct the effective bargaining share $\eta_a^e(\eta_\ell)$ and the corresponding auction threshold. Apply the contract-independent search policy $\zeta_a^e(h_j, \varepsilon_k)$, integrate the worker's continuation surplus over outside draws, and compute the wage from (33).

4. For $a = 0, 1, \ldots, T-2$, construct the next-age conditional distributions:

   (a) Unemployed workers carry $H^U(h)$ into the next age. With probability $\lambda_a^u(h)$, they accept draws for which next-period match surplus is positive and enter employment at η_0. Workers with no contact or an unacceptable draw remain unemployed.

   (b) Employed workers who separate exogenously enter unemployment at $H^U(h)$. Conditional on no separation, they carry $H^E(h)$ into the next age; workers with no contact retain (ε, η). After a contact, a weak offer leaves the state unchanged, an intermediate offer generates an incumbent counteroffer and updates η, and a higher-surplus offer generates an EE move and updates both ε and η. Equations (46) and (48) determine the next recorded bargaining share before interpolation onto the η grid.

   (c) Accumulate unemployment-to-employment flows, EE flows, and wage changes for movers and nonmovers. These flow counters enter the calibration moments and validation profiles directly.

5. Aggregate the conditional distributions and policies using the age weights μ_a. The same pass computes the wage bill, unemployment, the job-finding rate, EE transitions, age-specific

wages and flows, log-wage dispersion, and transition-weighted wage changes. The EE wage-premium slope is the inverse-variance-weighted slope across the 20s, 30s, 40s, and 50s age bins.

6. Compute effective search N^s from (14) and the contact value $\Omega(\theta)$ from (61). Store the implied vacancy flow cost

$$c^{\text{imp}}(\theta) = \beta q(\theta)\Omega(\theta).$$

This completes one evaluation of the model at fixed tightness.

General equilibrium is computed by an outer bisection. In the 1995 calibration, tightness is fixed at its data target $\theta_{1995} = 0.5$. After a candidate parameter vector has been evaluated at this tightness, vacancy flow cost is set to

$$c = c^{\text{imp}}(\theta_{1995}).$$

Holding c fixed, a counterfactual equilibrium solves

$$F(\theta; \boldsymbol{\vartheta}, \{s_a, \mu_a\}) = \beta A \theta^{-\alpha} \Omega(\theta; \boldsymbol{\vartheta}, \{s_a, \mu_a\}) - c = 0. \tag{78}$$

For every trial value of θ, we repeat the complete backward and forward calculations before evaluating F. It expands the initial bracket when necessary and then applies bisection. The fixed-θ demographic counterfactual skips this root search and evaluates the new age distribution at θ_{1995}.

Let d_j denote a data target, $M_j(\boldsymbol{\vartheta})$ its model counterpart, and ω_j its objective weight. The 13 residual moments are the replacement ratio; the age-20 wage; the age-30, age-40, and age-50 wage ratios relative to age 20; the average EE wage gain; log-wage dispersion; unemployment; the labor share; the job-finding rate; the EE rate; the age-40-to-age-20 EE-rate ratio; and the slope of the EE wage-growth premium from ages 20 through 59. Baseline tightness identifies c through free entry and is not an additional residual moment. We map parameters from finite bounds to an unconstrained vector using a logit transformation. A standard nonlinear least-squares routine updates that vector, and each objective evaluation solves the fixed-tightness model.

The annual demographic exercise uses the same equilibrium algorithm. For each year from 1995 through 2015, we read that year's mortality rates and cohort sizes, reconstruct $\{s_{a,t}, \mu_{a,t}\}$, and hold all structural parameters and the vacancy flow cost fixed. It solves (78) for the general-equilibrium series and separately evaluates the same demographic distribution at θ_{1995} for the fixed-tightness composition series.

E Additional Quantitative Results

E.1 Policy: Old-age search subsidy

The old-age search subsidy lowers the private employed-search cost scale for workers aged 50 and older to $\sigma_e^{50+}(s) = (1-s)\sigma_e$ and finances the difference with the progressive tax. Its direct effect is the intended one: older workers search more, and the aggregate EE rate rises. Yet the increase is small—from 0.02750 at zero subsidy to 0.02769 at a 90 percent subsidy— and the remaining equilibrium responses have the opposite sign. At the 90 percent grid point, tightness falls to 0.469, unemployment rises to 0.0516, GDP falls by 0.29 percent, and the labor share falls to 0.6152. Worker welfare falls by approximately 5.0 percent, including the tax needed to finance the 0.0345 subsidy bill.

The result illustrates why a microeconomic search intervention need not raise aggregate mobility or bargaining power enough to restore labor's share. More subsidized search expands effective search supply and shifts a larger fraction of vacancy contacts toward older workers, whose remaining horizons are shorter and whose surplus composition differs. Although lower rent portability raises a poaching firm's residual holding match surpluses fixed, the duration and endogenous composition effects dominate in the calibrated equilibrium and lower the distribution-weighted contact value Ω. Firms respond through free entry by posting fewer vacancies. The resulting decline in labor-market tightness weakens job finding, outside-offer competition, and wage rents for the whole market, offsetting the targeted workers' increase in search effort.

No positive point on the subsidy grid moves the labor share toward the 1995 target, so the restoration choice is $s = 0$. The policy's failure is not that older workers are unresponsive to lower search costs; it is that the policy expands effective search supply without correcting the low value of contacts that caused vacancy creation to fall in the first place.

E.2 Policy: Tax-financed bargaining-power improvement

The tax-financed portability experiment gives the preceding bargaining-power support program an explicit fiscal cost. It uses the same improvement $m_a^I = m_a + r(1 - m_a)$ for workers aged 50 and older, assigns a resource cost equal to the portability improvement times human-capital marginal product, and finances the bill with the progressive income tax. This comparison holds the technological effect on m_a fixed and changes only whether the resources needed to produce that effect are priced.

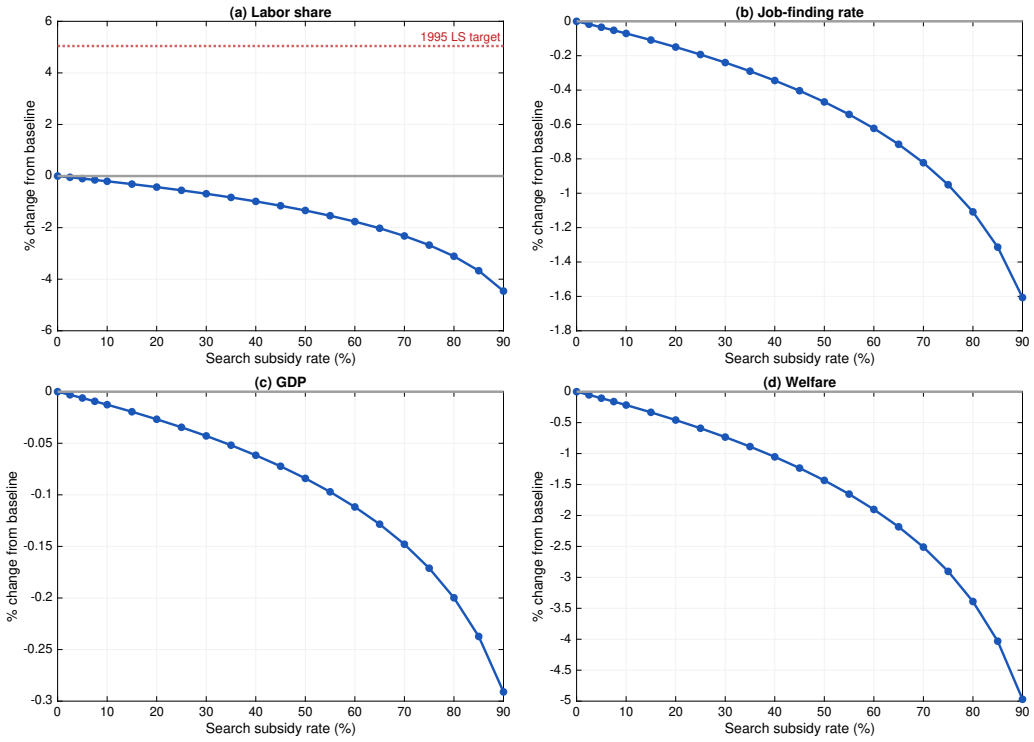


Figure E.1: Old-age search subsidy

The restoration intensity remains $r = 0.95$. The before-tax allocation is the same as in the mechanism experiment: labor share is 0.6778, tightness is 0.4908, and GDP is 3.83 percent below the 2015 baseline. The fiscal incidence is very different. The investment bill and tax revenue are both 0.5328, budget balance requires $\kappa_\tau = 1.114$, and the after-tax labor share is only 0.6516.

Worker welfare falls by 2.78 percent rather than rising by 1.39 percent. The comparison isolates the reason: once the portability improvement absorbs resources and must be financed, its wage-rent benefit is not large enough to cover its cost. The result also shows why the labor-share target alone is an incomplete policy criterion. An intervention can restore the before-tax wage bill while reducing output and disposable worker value. Since the cost schedule is a transparent model normalization rather than an estimated training production function, the quantitative welfare result is best viewed as a break-even warning and a motivation for empirical evidence on the cost and effectiveness of actual bargaining-power support programs.

E.3 Policy: Improving matching efficiency for older workers

Here we consider a matching-efficiency policy that multiplies the effective search units of workers aged 50 and older by $1 + g$. We apply the same efficiency weights to workers' contact rates,

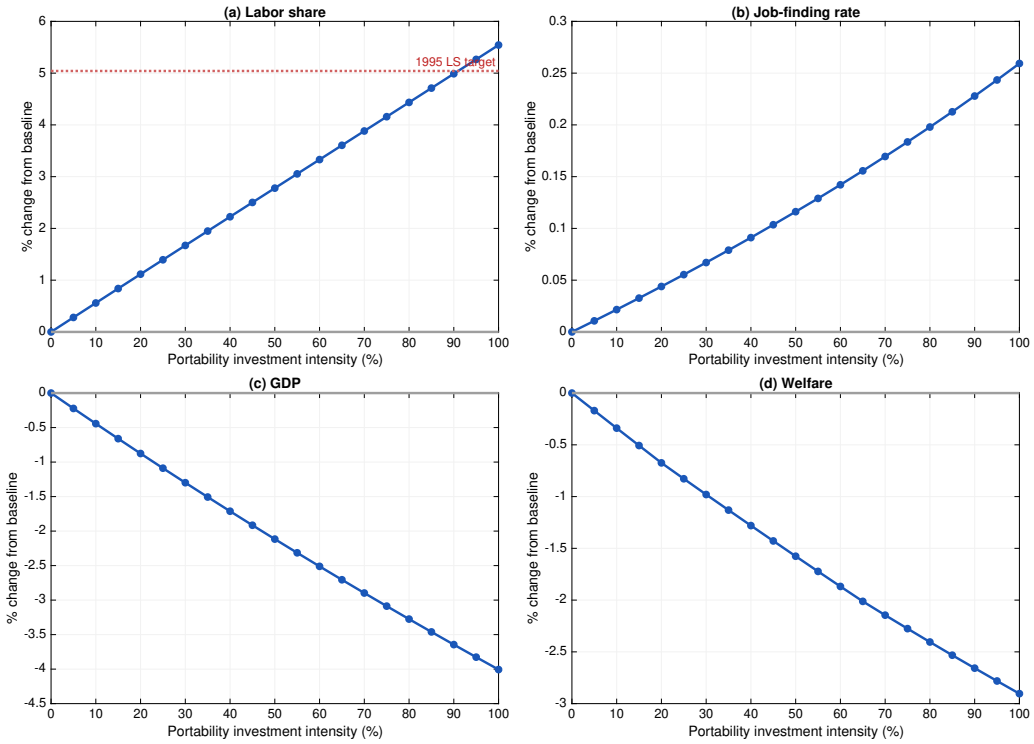


Figure E.2: Tax-financed portability investment

the effective-searcher measure, and firms' contact values. Thus the experiment is not a partial-equilibrium increase in an older worker's offer rate: vacancies and labor-market tightness adjust to the change in the matching technology.

A 10 percent efficiency increase raises the aggregate job-finding rate from 0.3491 to 0.3527 and the EE rate from 0.02750 to 0.02760. Nevertheless, tightness falls sharply from 0.4879 to 0.4719, and the labor share falls to 0.6204. The direct matching gain slightly raises GDP, but worker welfare falls because declines in vacancy abundance, outside-offer competition, and wage rents affect the entire workforce.

The equilibrium logic parallels the search-subsidy experiment. For a given vacancy stock, more efficiency units expand effective search supply and lower vacancies per effective searcher. They also shift a greater share of contacts toward older workers. Although lower rent portability raises the poaching firm's residual conditional on fixed match surpluses, the shorter horizon and endogenous contact-composition effects dominate in the calibrated equilibrium. Free entry therefore reduces vacancy creation, so the improvement in conditional matching efficiency is accompanied by a deterioration in the market-wide outside-offer environment. The latter dominates for labor's share. No positive value of g restores the 1995 level, and the restoration choice is there-

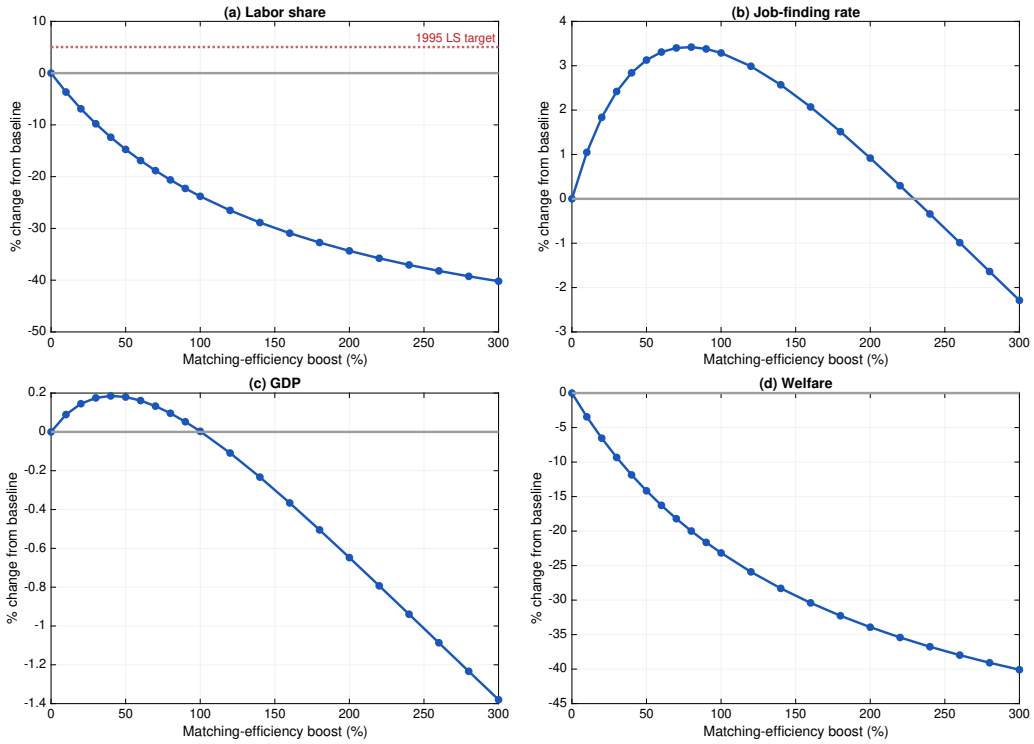


Figure E.3: Old-age matching efficiency

fore zero.

E.4 Policy: Old-age earnings supplement

Would providing an earnings supplement to older workers raise measured labor compensation and the labor share? Here the old-age earnings supplement pays a fraction of the pre-policy wage to workers aged 50 and older and finances the payment with the progressive income tax. Unlike the preceding policies, it need not change mobility or vacancy creation to increase measured labor compensation. Figure E.4 shows that a 15 percent supplement is sufficient to raise the before-tax labor share to the 1995 level.

The pre-tax allocation is unchanged. Tightness, unemployment, the EE rate, and GDP are virtually unchanged. The government pays 0.7740 in supplements and raises the same amount in taxes, with $\kappa_\tau = 1.099$.

Worker welfare rises by 1.39 percent because the age-targeted supplement and progressive financing redistribute disposable income across workers. The result is therefore primarily distributional.

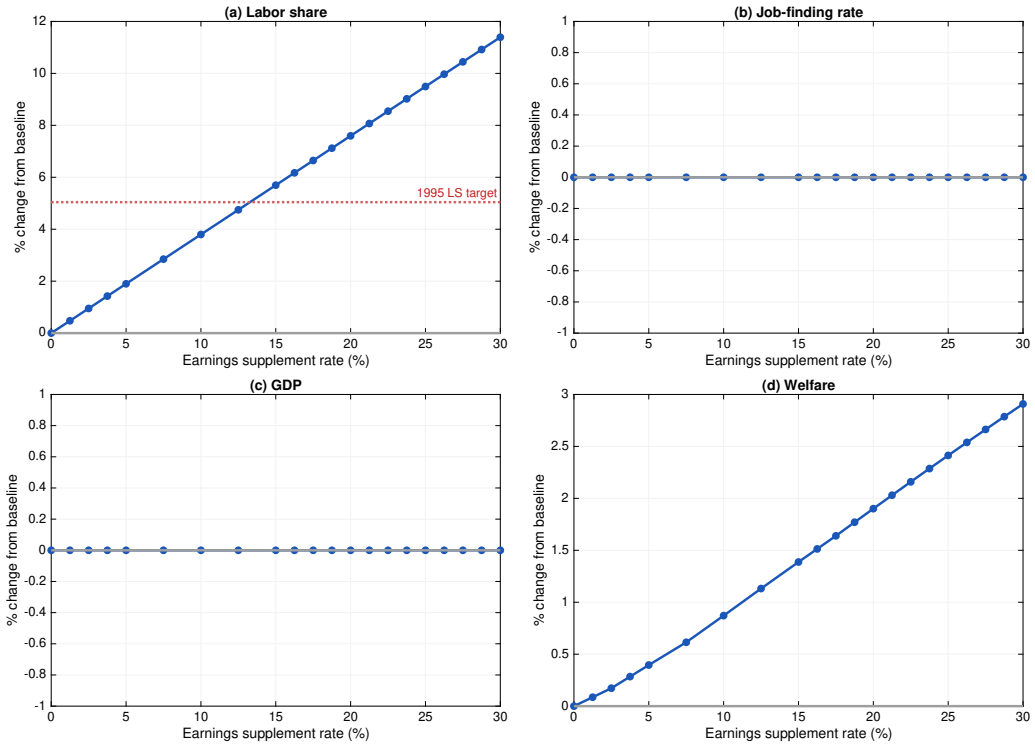


Figure E.4: Old-age earnings supplement

E.5 Vacancy composition under age-targeted policies

From the above results, one could mistakenly infer that the decline in market tightness in the general equilibrium under age-targeted policies is mainly due to older employed workers being unattractive poaching targets relative to other employed workers. This is not accurate. In fact, evaluated at the calibrated allocation, the poaching value of an employed worker is similar across ages.

The relevant comparison for aggregate vacancy incentives is instead between meeting employed and unemployed job searchers. A contact with an unemployed worker produces firm surplus whenever the new match has positive surplus. A contact with an employed worker produces value only if the prospective match dominates the incumbent match, after which the poacher receives the residual net of the worker's portable incumbent rent. With an employed worker, the outside draw must first dominate the incumbent match, after which the poacher receives only the residual.

The age-targeted policies create a dynamic job-ladder effect: better incumbent matches make superior offers less likely and reduce their surplus increments. Under the 90 percent search sub-

sidy, the probability that an outside draw dominates the incumbent match falls from 9.52 to 8.74 percent, the mean surplus improvement conditional on a move falls from 0.974 to 0.891, and the older employed poaching value falls by 8.66 percent.

To isolate the contact-composition channel, write the expected value of a vacancy contact as

$$\Omega = s_U V_U + (1 - s_U) V_E,$$

where s_U is the unemployed share of effective search and V_U and V_E are the conditional values of contacts with unemployed and employed searchers, respectively. The old-age search subsidy directly expands search by employed workers aged 50 and older, while the matching-efficiency policy raises older workers' effective contact opportunities. In both experiments, the expansion in effective search is concentrated among employed workers, shifting vacancy contacts away from unemployed searchers. Under the 90 percent search subsidy, for example, s_U falls from 6.72 to 6.41 percent, contributing to the decline in Ω.

This shift matters because a contact with an employed worker is less valuable on average than a contact with an unemployed worker. A prospective match with an employed worker must first dominate the incumbent match, after which the poaching firm receives only the residual surplus net of the worker's portable incumbent rent. This does not imply that older employed workers are intrinsically poor poaching targets: their calibrated poaching values are broadly similar to those of other employed workers. Rather, the policies increase older workers' effective contact opportunities while shifting vacancy contacts toward workers whose incumbent matches must be beaten. In the search-subsidy experiment, additional mobility also moves older workers further up the job ladder, making subsequent poaches less likely and less valuable. Together with the shorter duration of matches formed later in the career, these changes reduce the expected contact value and, through free entry, equilibrium labor-market tightness. Unlike baseline workforce aging, the adverse policy response therefore does not arise from a further reduction in older workers' search, but from changes in the composition and conditional value of vacancy contacts.