Unemployment and Long Run EPOP

Proposal for Spring 2025 NBER Macroeconomics Annual

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1 Summary

Employment to population ratios provide a concise measure of people's engagement with the labor market, capturing both the decision to participate and the successful search for a job. And while U.S. ratios have changed significantly over the last forty years overall and within specific populations, this occurred alongside a notable stability of within group rates of unemployment over the same period, placing restrictions on the role played by different structural factors in explaining these trends.

We propose a model of equilibrium employment to population ratios with random search by the unemployed and endogenous participation to understand the joint determinants of trend participation and unemployment. Individuals are heterogeneous along three key dimensions: their ability for market work, utility from non-market activities and bargaining power in setting wages. The theory clarifies the importance of endogenous unemployment and heterogeneity in ability, versus non-market utility, for the comparative statics of key forces on trend employment to population ratios. We then use the model to assess the contributions of several proposed explanations for trends in employment to population ratios of different demographic groups in the U.S. over the last four decades.

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2 U.S. Labor market trends, 1982 to 2023

Figure 1 displays the trends in the labor market status for prime aged women and men in the U.S. by level of educational attainment between 1982 and 2023. All labor market status, changes in status, and earnings data are drawn from the Current Population Survey (CPS) provided by the Bureau of Labor Statistics (BLS). The sample is individuals between the ages of 25 and 54 years old, and covers the period from January 1982 to December 2023[1]. We consider three broad education groups: individuals with (i) a high school degree or less; (ii) some college; and (iii) a bachelors or higher degree.[2]

Panels (a) to (c) of Figure 1 plot the employment to population ratios for prime age women and men by level of educational attainment. The rise in women's engagement with the formal labor market from the late 1970s to the mid-1990s is clearly evident within each level of educational attainment. Overall, women's employment to population ratio rose from about 55 percent in the early 1980s to slightly above 70 percent in the early 2000s, while men's employment to population ratios declined somewhat throughout the period considered. The overall gender gap in employment to population ratios declined from about 30 percentage points in the early 1980s to about 15 percentage points over this period. However, the narrowing of the gap has slowed significantly since the 2000's. Women's employment to population ratio stayed relatively constant over the past 20 years while men's ratio continued on its downward trajectory to about 89 percent in 2023. These trends are common across education groups.

Changes and gaps in the employment to population ratio can be decomposed into changes and gaps in labor force participation rate and unemployment rates. Panels (d) through (i) of Figure 1 show that the trend and gaps employment to population ratios are accounted for by movements in labor force participation rates: unemployment rates by gender, even within education group, are remarkably similar and stable over the medium to long run horizons.

The stability of the unemployment rate could provide constraints on the role play by different flow rates across labor market status in explaining the longer run trends in employment to population ratios. Figures 2 and 7 display these flow rate across gender and level of education. In Figure 2, flow rates out of employment and into unemployment show no long run trends both across gender and level of education, though they do decline with the level of education. Moreover, within levels of education, the rates are similar for men and women, with a somewhat higher rate for men with a high school education or less until the 2010s.

Flow rates from employment into non-participation (Figure 3), however, are higher for women. The gap is largest in the early 1980s and narrows until the mid- to late 1990s, after

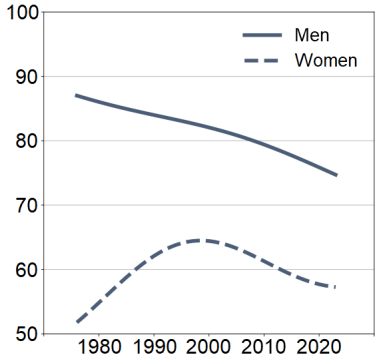
[1] 1982 is the first year where we have data on wages.

[2] We find adjusting for the changing age distribution within each sex/education group over time within has negligible effects within the prime age population.

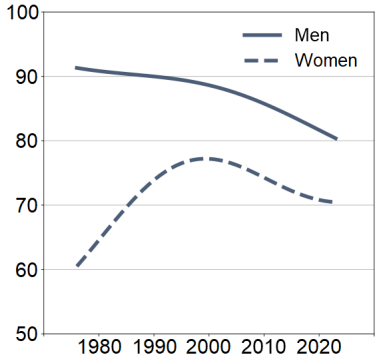
Figure 1: **Prime age employment to population ratios, labor force participation rates and unemployment rates by gender and level of education attainment, U.S. 1982 - 2023**

Employment to population ratios:

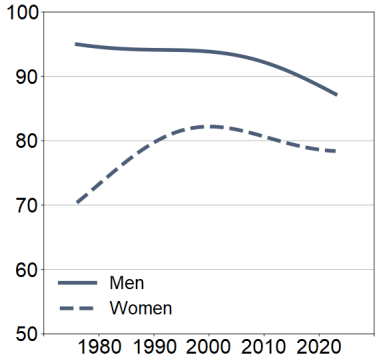
(a) high school or less



(b) some college

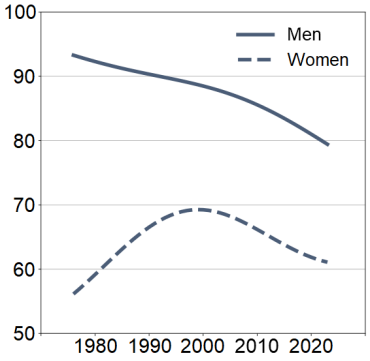


(c) bachelor's degree or more

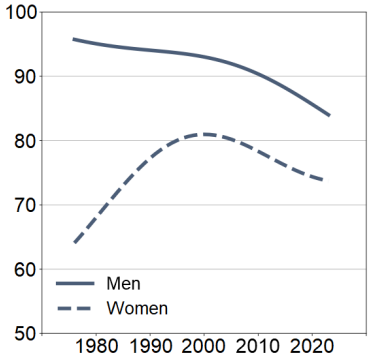


Labor force participation rates:

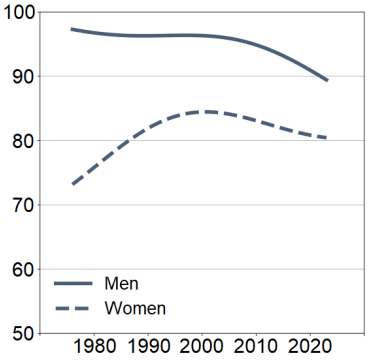
(d) high school or less



(e) some college

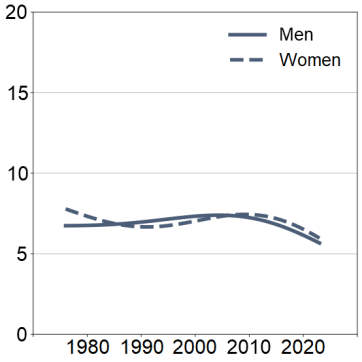


(f) bachelor's degree or more

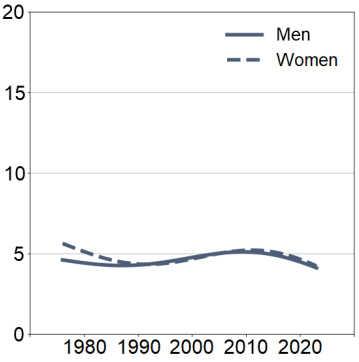


Unemployment rates:

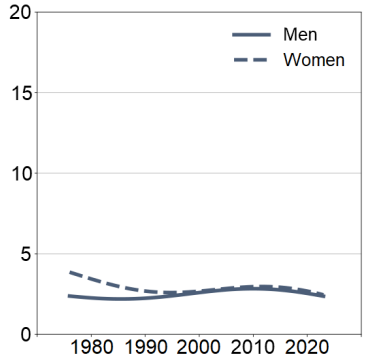
(g) high school or less



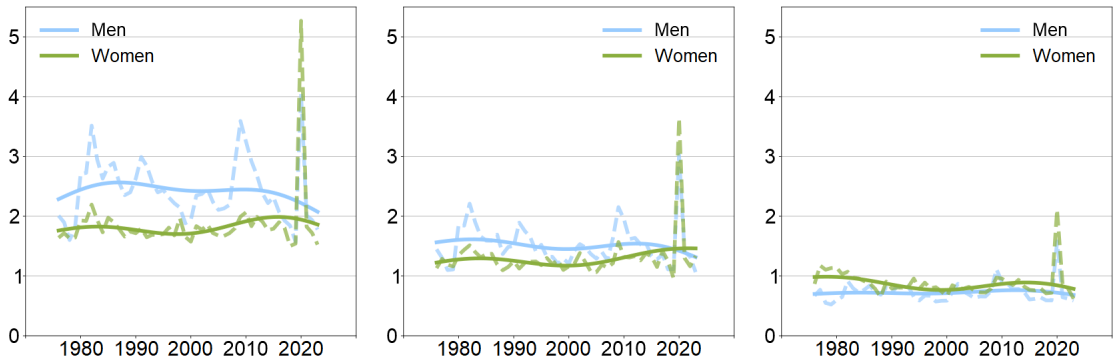
(h) some college



(i) bachelor's degree or more



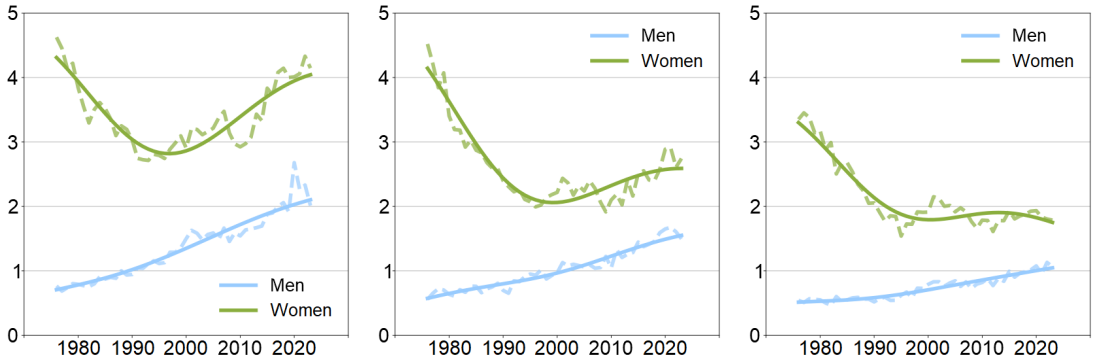
Source: Calculations based on the CPS from the BLS, individuals aged 25 to 54 years old. The solid lines are trends extracted using a band-pass filter. See data appendix for details.



(a) high school or less (b) some college (c) bachelor's degree or more

Figure 2: **EU flow rate (EU/E) trends U.S. 1976 - 2020**

Notes: This is calculated as the EU flow (backward-looking) divided by the previous period's employment level.



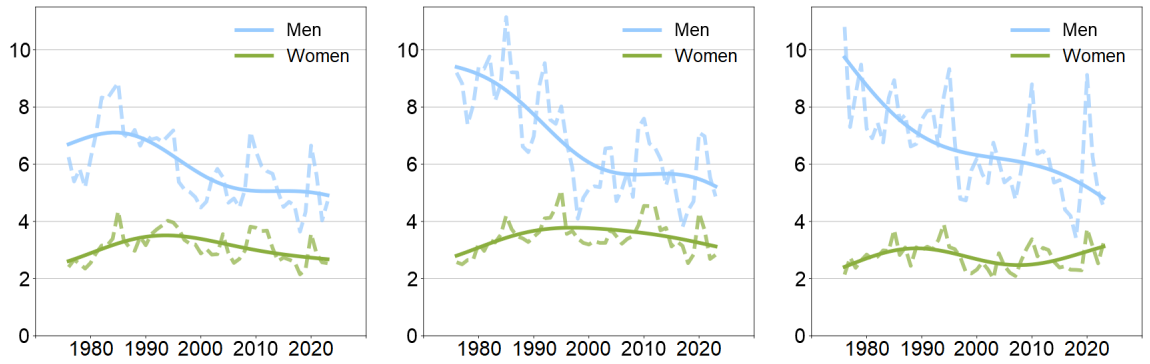
(a) high school or less (b) some college (c) bachelor's degree or more

Figure 3: **EN flow rate (EN/E) trends U.S. 1976 - 2020**

Notes: This is calculated as the EN flow (backward-looking) divided by the previous period's employment level.

which men and women are on parallel upward trends in employment to non-participation transition rates. One exception that may be related to a narrowing of the employment to population gap can be seen for women with a college education, whose employment to non-participation flow rate decline until the mid-1990s and then remained stable.

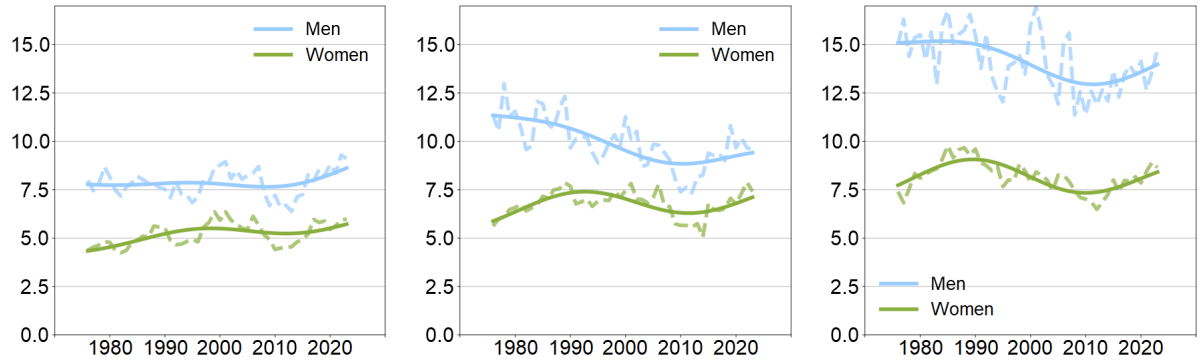
Flow rates from non-participation into either unemployment or employment are higher for men across all levels of education (Figure 4). The rate of non-participation to unemployment transitions for women has been stable over the decades and across levels of education, while that of men has been on a downward trend throughout the period. Flow rate into employment, in contrast, have been stable for both men and women (Figure 5)



(a) high school or less (b) some college (c) bachelor's degree or more

Figure 4: **NU flow rate (NU/N) trends U.S. 1976 - 2020**

Notes: This is calculated as the NU flow (backward-looking) divided by the previous period's level of persons not in the labor force.



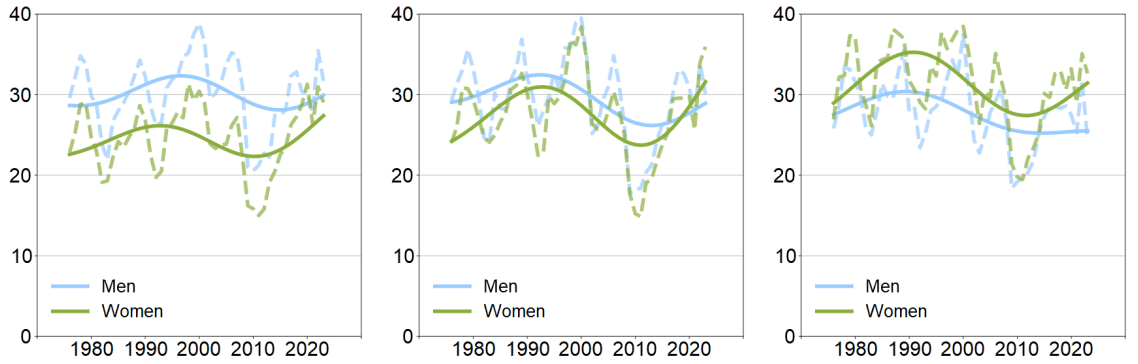
(a) high school or less (b) some college (c) bachelor's degree or more

Figure 5: **NE flow rate (NE/N) trends U.S. 1976 - 2020**

Notes: This is calculated as the NE flow (backward-looking) divided by the previous period's level of persons not in the labor force.

Lastly, Figures 6 and 7 show the flows out of unemployment. In the case of rates of transition into employment, the overall picture is one of little change in the trend rates across level of education, of similar rates across levels of education, and of little to no gaps between men and women. Rates of transition in non-participation from unemployment present a reverse image of the trends in flow rates from non-participation to unemployment: the rates have been constant for women and rising for men throughout the period and across levels of education.

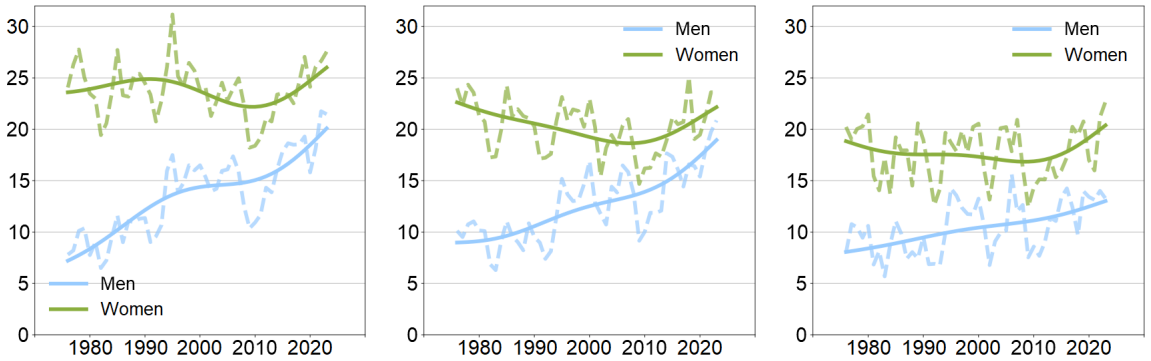
Earnings by gender and education have also changed significantly over the time period considered. Panels (a) to (c) of Figure 8 report real average hourly earnings for women and



(a) high school or less (b) some college (c) bachelor's degree or more

Figure 6: **UE flow rate (UE/U) trends U.S. 1976 - 2020**

Notes: This is calculated as the UE flow (backward-looking) divided by the previous period's unemployment level.



(a) high school or less (b) some college (c) bachelor's degree or more

Figure 7: **UN flow rate (UN/U) trends U.S. 1976 - 2020**

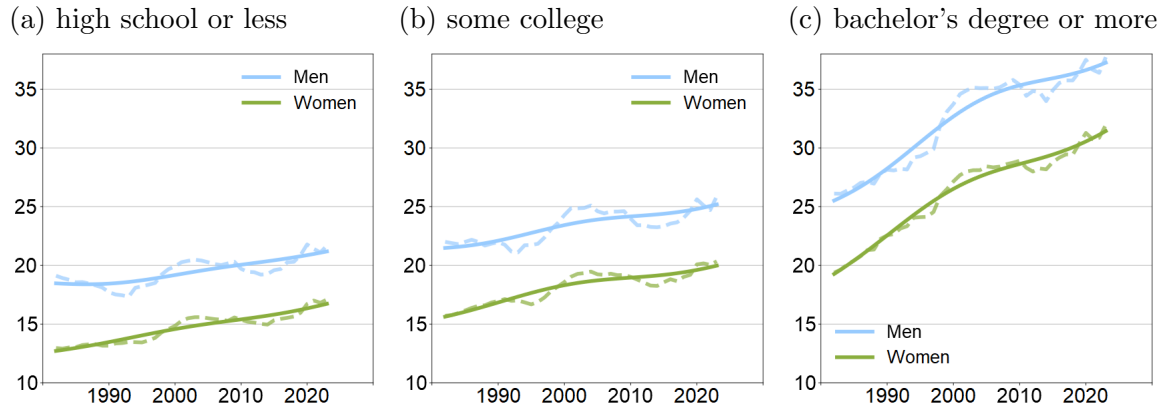
Notes: This is calculated as the UN flow (backward-looking) divided by the previous period's unemployment level.

men by level of education. Comparing across education groups, the college wage premium increased over time for both men and women. Comparing between genders within each education group, they show that real average hourly earnings have risen at a greater pace for women.

Indeed, the gender earnings gaps narrowed over time, particularly in the first half of the time sample, although they remain elevated even after controlling for sorting by gender across occupations and the relative prevalence of full time employment. Figure 9 shows the wage gap between men and women narrowing even after adjusting for gender differences in occupation and full-time status within education groups. Men's wage relative to women

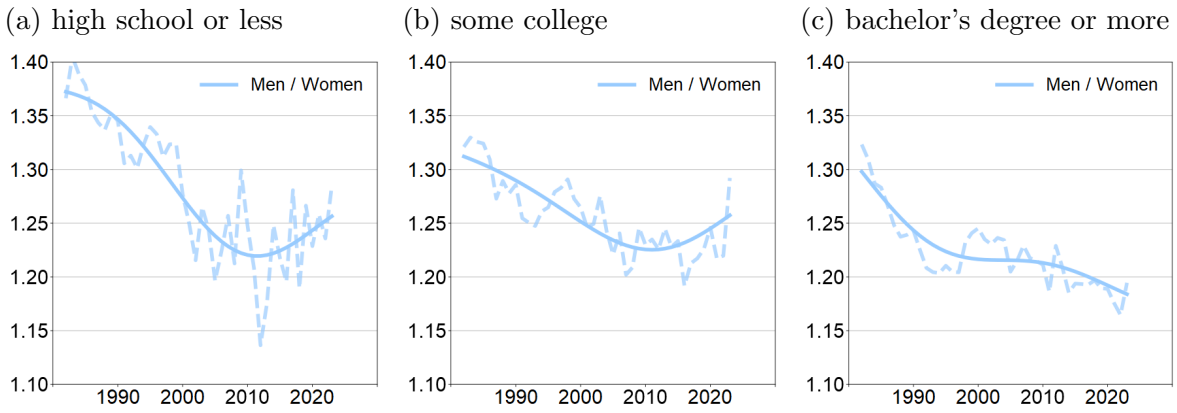
shrank from about 1.4 to 1.25 for high school or less and about 1.3 to 1.2 for some college and college educated workers. Interestingly, the wage gap between college educated women and men has continued to decline during the last two decades, whereas is has somewhat increased within other education groups.

Figure 8: **Prime age real average hourly earnings by gender and level of education attainment, U.S. 1982 - 2023**



Source: Calculations based on the CPS from the BLS, individuals aged 25 to 54 years old. The solid lines are trends extracted using a band-pass filter. See data appendix for details.

Figure 9: **Adjusted average hourly earnings gender ratios by level of education attainment, U.S. 1982 - 2023**



Calculations based on the CPS from the BLS, individuals aged 25 to 54 years old. The solid lines are trends extracted using a band-pass filter. Ratios adjusted for gender differences in occupational and full-time employment status.

3 Description of the model

We build a model of equilibrium employment to population ratios with endogenous unemployment and labor market participation decisions in order to shed light on the forces shaping the endogenous supply and demand for labor that underlie trends in employment to population ratios and earnings gaps. It allows for multiple types of workers, themselves heterogeneous in their ability for market work and value to non-market activities.

Allowing for endogenous unemployment matters for two significant reasons. First, the impact of changes in key structural parameters on employment to population ratios differ whether or not agents face an endogenous expected duration of unemployment spells. Second, the joint empirical behavior of trends in labor force participation and unemployment rates places restrictions on the role played by different structural factors affecting employment to population ratios.

Compared to prior work, our introduction of heterogeneity in ability for market work introduces a distinction between the marginal worker a firm is willing to hire and the marginal worker willing to enter the labor market. This distinction is not brought about by a heterogeneity in the value of non-market work as both firms and workers incur costs to forming a match that do not depend on the worker's ability. In the case of firms, there exists a minimal level of ability such that they are willing to hire the job applicant rather than return to the labor market to search for another potential match (hereafter a "hiring" threshold). This threshold is such that marginal revenue generated by a hire covers the fixed cost of production and the wage payment. In the case of workers, there exists a minimal level of ability at which the value to entering the labor market in order to find an acceptable job offer exceeds the value of remaining out of the labor force (hereafter a "worker entry" threshold). This threshold depends on the likelihood of finding a job, or the expected duration of unemployment spells, and the value of market employment, which depends largely on earnings on the job, compared to the value of non-participation.

In equilibrium, participation in the labor market is determined by the greater of these two cut-offs, the firm's hiring threshold or the worker's entry threshold. Only individuals with ability above the greater of these two thresholds are willing to participate in the labor market: they must the able to generate an offer from a firm, and the offer must be good enough to warrant entering the labor market. That is, this "participation cut-off" ability may be determined by either the worker's entry or the firm's hiring threshold, each with distinct implications for the effects of structural forces on employment to population ratios. As an example, declining worker's bargaining power has an ambiguous effect on employment to population ratios when participation and unemployment are endogenous. A fall in worker's bargaining power always lowers the unemployment rate but the effect on partici-

pation depends on whether the worker's entry cut-off or the firm's hiring cut-off determines participation. A decline in labor's market power directly increases the marginal profit to hiring labor, lowering the rate of unemployment. When the firm's hiring threshold determines participation the result is an unambiguous increase in participation as firms are willing to hiring workers of lower ability. Overall the employment to population ratio increases. However, if the individual's entry threshold determines participation, the direct effect of a change in bargaining power would tend to lower participation as worker's receive a smaller share of the surplus to accepting any job, while the indirect effect of a greater job finding rate goes in the opposite direction.

Rising non-market utility, in contrast, has no effect on unemployment and participation, and hence employment to population ratios, when the firm's hiring decisions determine the equilibrium labor force participation rate. If the worker's entry decision determines participation, a rise in non-market utility has an ambiguous effect on employment to population ratios: it reduces both the labor force participation and unemployment rates. By increasing the value of non-participation it leads to a higher ability of the marginal entrant, thereby increasing conditional mean ability in the pool of unemployed and the expected profit to hiring a worker. The indirect effect of rising non-market utility on participation, through an increased market tightness and job finding rate, dampens but does not dominate the direct effect, preserving the decline labor force participation.

3.1 Details of the model

Time is continuous and discounted at rate $r > 0$. We consider a deterministic steady state and omit time subscripts. Agents, individuals and firms, are risk neutral and infinitely lived.

The economy consists of $i = 1, 2, \ldots, I$ groups of individuals each with educational attainment level $s = 1, 2, \ldots, S$ and population shares $\phi^p_{i,s}$. Individuals either participate in the labor market, as employed $E_{i,s}$ or unemployed workers $U_{i,s}$, or remain out of the labor force as non-participants $N_{i,s}$. Each individual is endowed with an ability for market work a that is permanent and distributed in the population according to distribution $G(a)$ on an unbounded support, which we assume does not depend on s or i. While all individual draw from the same ability distribution for market work $G(a)$, the marginal product of market work varies by the level of education $a \times h_s$, where $h_s > 0$ is a fixed parameter. Individuals enjoy a level of utility $b_{i,s}$ when not participating in the labor market, which includes the returns to leisure, and utility $z_{i,s} < b_{i,s}$ when unemployed and searching for a job. The difference in utility flow $b_{i,s} - z_{i,s}$ when unemployed may capture the cost of searching for a job, but also the interruption of certain indivisible non-market activities such as caring for children. Each individual draws a new value of $b_{i,s} > z_{i,s}$ from distribution $H_{i,s}(b)$ at Poisson

rate $\lambda_{i,s} > 0$. Individuals receiving a new $b_{i,s}$ while employed can choose to stay on the job or quit and move to unemployment or non-participation. Individuals who are unemployed or out of the labor force can choose between unemployment and non-participation when they receive a new draw.

We denote the labor force of a group by $LF_{i,s} = U_{i,s}+E_{i,s}$, and aggregate employed, unemployed and labor force as $E = \sum_{i\times s} E_{i,s}$, $U = \sum_{i\times s} U_{i,s}$, and $LF = \sum_{i\times s} LF_{i,s}$, respectively. By normalizing total population to one, E and LF are also the aggregate employment to population ratio and labor force participation rate. The rate of unemployment of a group is denoted by $u_{i,s} \equiv U_{i,s}/LF_{i,s}$, the labor force participation rate of a group by $lf_{i,s} \equiv LF_{i,s}/\phi^p_{i,s}$, and employment to population ratio $epop_{i,s} = E_{i,s}/\phi^p_{i,s}$. Denoting the labor force share of a group by $\phi^{lf}_{i,s} \equiv LF_{i,s}/LF$, the aggregate unemployment rate is the labor force share weighted average of group unemployment rates:

$$u = \sum_{i\times s} \phi^{lf}_{i,s}\, u_{i,s} \tag{1}$$

The aggregate participation rate is the population share weighted average of group participation rates:

$$LF = \sum_{i\times s} \phi^{p}_{i,s}\, lf_{i,s} \tag{2}$$

Similarly, the aggregate employment to population ratio is equal to the population share weighted average of group employment to population ratios $epop_{i,s} = lf_{i,s}\,(1-u_{i,s})$:

$$epop = \sum_{i\times s} \phi^{p}_{i,s}\, lf_{i,s}\,(1-u_{i,s}) \tag{3}$$

For simplicity we assume the labor market is segmented by level of education s and matching between firms and workers within a labor market is random. In each market s, unemployed individuals randomly meet vacant positions at a rate governed by the matching function $M_s(U_s, V_s)$, where $U_s = \sum_i U_{i,s}$ is the number of unemployed and V_s is the number of vacancies. The function $M_s(U_s, V_s)$ is assumed to have constant returns to scale and elasticity with respect to the unemployed $\eta_s \in (0,1)$. Denote $\theta_s \equiv V_s/U_s$ the ratio of vacancies to the unemployed. Then the probability an unemployed individual meets a vacant position in a unit of time is equal to $f_s(\theta_s) \equiv M_s(U_s,V_s)/U_s = M_s(1,\theta_s)$ and the probability for a given vacant position of meeting an unemployed worker is given by $q_s(\theta_s) \equiv M_s(U_s,V_s)/V_s = M_s(\theta_s^{-1},1) = f_s(\theta_s)/\theta_s$. The job finding rate increases with θ_s with constant elasticity $(1-\nu_s)$ while $q_s(\theta_s)$ declines with θ_s with elasticity $-\nu_s$. As such, θ_s is the tightness of the labor market from the perspective of the firm. Finally, we allow for heterogeneity in an exogenous

separation out of employment with a match destruction rate $\delta_{i,s}$.

The value functions of non-participation, unemployment, and employment for an individual in group i with ability a and education s are given, respectively, by:

$$rW^n_{i,s}(a,b) = b_{i,s} + \lambda_{i,s}\left(\mathbb{E}_{H_{i,s}}[\max(W^u_{i,s}(a,b'),W^n_{i,s}(a,b'))] - W^n_{i,s}(a,b)\right) \quad (4)$$

$$\begin{aligned} rW^u_{i,s}(a,b) &= z_{i,s} + o^f_{i,s}(a) f_s \max(W^e_{i,s}(a,b) - W^u_{i,s}(a,b), 0) \\ &\quad + \lambda_{i,s}(\mathbb{E}_{H_{i,s}}[\max(W^u_{i,s}(a,b'),W^n_{i,s}(a,b'))] - W^u_{i,s}(a,b)) \end{aligned} \quad (5)$$

$$\begin{aligned} rW^e_{i,s}(a,b) &= w_{i,s}(a) + \delta_{i,s}(\max\left(W^u_{i,s}(a,b),W^n_{i,s}(a,b)\right) - W^e_{i,s}(a,b)) \\ &\quad + \lambda_{i,s}(\mathbb{E}_{H_{i,s}}[\max(W^e_{i,s}(a,b'),W^n_{i,s}(a,b'))] - W^e_{i,s}(a,b)) \end{aligned} \quad (6)$$

where $\mathbb{E}_{H_{i,s}}$ denotes the expected value taken with respect to the distribution of non-mark utility $H_{i,s}(b)$, $w_{i,s}(a)$ is a wage that may depend on individual type and education level but assumed to not depend on the value of non-market utility b, and $o^f_{i,s}(a)$ an indicator function equal to 1 when the individual's ability a is sufficient to generate a job offer upon meeting an employer.

The unemployed meet a vacant position at rate f_s and, if the firm offer indicator function $o^f_{i,s}(a) = 1$, the person may accept or reject the offer. Once employed at a wage $w_{i,s}(a)$ in (6) a job match can terminate at an exogenous rate $\delta_{i,s}$ upon which the individual can choose to return to unemployment or exit the labor force.

Individuals draw a new value of non-participation at rate $\lambda_{i,s}$ independently of labor market status. Non-participants decide whether or not to enter the labor market and search for a job, while the unemployed decided whether to continue their search or exit the labor market. Both decisions involve comparing the expected payoff to unemployment $W^u_{i,s}(a,b)$ in (5) to the value of non-participation $W^n_{i,s}(a,b)$ described in (4). Employed individuals decide between the payoff to remaining employed $W^e_{i,s}(a,b)$ described in (6) and or quitting to non-participation.

Vacant positions incur a flow cost $\gamma_s > 0$ and firms randomly meet a job seeker of ability a from within the pool of unemployed at rate q_s. Firms cannot directly target type and idiosyncratic ability with a job opening. Hence the probability of meeting an individual of ability a and type i is given by $\phi^u_{i,s} \times dF^U_{i,s}(a)$, where $\phi^u_{i,s} \equiv U_{i,s}/U_s$ is the share of type i in the pool of unemployed with education s and $F^U_{i,s}(a)$ is the distribution of ability within the unemployed individuals in group i,s. Ability and type are perfectly observable after a meeting. Firms must then choose between making an offer of employment, with value to the firm $J^e_{i,s}(a)$, or maintaining the position vacant with value J^v_s.[3] Once formed, the match produces $a \times h_s$ units of output but incurs a per period fixed cost to producing, k_s, that

[3]In equilibrium only workers who would accept a job offer remain in the pool of unemployed, thus we omit an indicator of job acceptance by the worker in the firm's value function.

is independent of the worker's ability or type i but may depend on the worker's level of education.[4] We assume that wages $w_{i,s}(a)$ and output net of labor costs $ah_s - w_{i,s}(a)$ are both strictly increasing in a.[5]

To summarize, the values to a firm in market s of a vacant position and a position filled by an individual of type i and ability a, are given by:

$$rJ_s^v = -\gamma_s + q_s(\theta_s)\sum_i \phi_{i,s}^u \left(\int \max\left(J_{i,s}^e(a) - J_s^v, 0\right)\ dF_{i,s}^U(a) \right) \tag{7}$$

$$rJ_{i,s}^e(a) = a \times h_s - w_{i,s}(a) - k_s + (\delta_{i,s} + \lambda_{i,s}^{en}(a))(J_s^v - J_{i,s}^e(a)) \tag{8}$$

where $\lambda_{i,s}^{en}(a)$ is the probability of a worker of ability a quitting after drawing a new value of non-market utility b. This probability, which we define later, does not depend on the worker's current level of non-market utility as new draws are independent of the current level of utility. Finally, the firm's value function for a filled position only depend on a worker's ability as output, wages and separation rates only depend on the worker's ability. We assume there is free entry of firms in each labor market s such that the equilibrium value of a vacant position $J_s^v = 0$.

We will introduce a few notations to help us define worker transition rates across labor market status. First, recall that $o_{i,s}^f(a)$ is the indicator function that summarizes firm's decision to offer a position to a worker of ability a upon meeting the worker. Similarly, we define an indicator function $o_{i,s}^{nu}(a,b)$ that takes on value 1 for workers who prefers unemployment over non-participation ($W_{i,s}^u(a,b) \geq W_{i,s}^n(a,b)$) and indicator function $o_{i,s}^q(a,b)$ that takes on value 1 if the worker prefers non-participation over employment ($W_{i,s}^n(a,b) \geq W_{i,s}^e(a,b)$), that is, the worker would quit their job if employed at the time of a new draw of non-market utility.

At the steady state equilibrium, we require the distributions of abilities and non-market utility value among each group i,s to be constant. Let $P_{i,s}^x(a,b)$, where $x = N, U, E$, denote the steady state joint distribution of a,b within a pool of individuals from group i,s of labor market status x. We denote $F_{i,s}^x(a)$ the marginal distribution of ability for the corresponding $P_{i,s}^x(a,b)$.

With these notations in hand, we can write the conditional probability an individual

[4] An example of k_s are overhead costs such as intangible capital inputs and managerial compensation. An increase in k_s can be interpreted as an increase in the cost share of these inputs as documented by Koh, Santaeulàlia-Llopis and Zheng (2020) and Bivens and Mishel (2013).

[5] This holds under reasonable assumptions on wage setting, such as bilateral Nash wage bargaining.

flowing from status x to status x' after receiving a new non-market utility draw b' as

$$\begin{aligned}
\lambda_{i,s}^{en}(a) &= \lambda_{i,s}\ \mathbb{E}_{H_{i,s}}[o^q(a,b')] && (9)\\
\lambda_{i,s}^{un}(a) &= \lambda_{i,s}\ \mathbb{E}_{H_{i,s}}[1-o^{nu}(a,b')] && (10)\\
\lambda_{i,s}^{nu}(a) &= \lambda_{i,s}\ \mathbb{E}_{H_{i,s}}[o^{nu}(a,b')]. && (11)
\end{aligned}$$

where $\lambda_{i,s}^{en}(a)$ is the conditional probability of going from employment to non-participation, $\lambda_{i,s}^{un}(a)$ of going from unemployment to non-participation, and $\lambda_{i,s}^{nu}(a)$ of going from non-participation to unemployment.

Similarly, the probability of an employed individual with ability a and non-market utility value b switching from employment to either non-participation or unemployment following an exogenous match destruction shock is given by, respectively,

$$\begin{aligned}
\delta_{i,s}^{en}(a,b) &= \delta_{i,s}\ (1-o^{nu}(a,b)) && (12)\\
\delta_{i,s}^{eu}(a,b) &= \delta_{i,s}\ o^{nu}(a,b) && (13)
\end{aligned}$$

The transition rate across labor market status x to x' is then given by taking expected values of the above conditional probabilities with respect to the distribution of ability and non-market utility level among the pool of individuals with status x. That is, we have the following flow rates:

$$\begin{aligned}
U \to E: \quad & UE_{i,s}/U_{i,s} = && f_s\\
U \to N: \quad & UN_{i,s}/U_{i,s} = && \lambda_{i,s}^{un} \equiv \mathbb{E}_{F_{i,s}^{U}(a)}[\lambda_{i,s}^{un}(a)]\\
N \to U: \quad & NU_{i,s}/N_{i,s} = && \lambda_{i,s}^{nu} \equiv \mathbb{E}_{F_{i,s}^{N}(a)}[\lambda_{i,s}^{nu}(a)]\\
E \to U: \quad & EU_{i,s}/E_{i,s} = && \delta_{i,s}^{eu} \equiv \mathbb{E}_{P_{i,s}^{E}(a,b)}[\delta_{i,s}^{eu}(a,b)]\\
E \to N: \quad & EN_{i,s}/E_{i,s} = && \delta_{i,s}^{en} + \lambda_{i,s}^{en} \equiv \mathbb{E}_{P_{i,s}^{E}(a,b)}[\delta_{i,s}^{en}(a,b)] + \mathbb{E}_{F_{i,s}^{E}(a)}[\lambda_{i,s}^{en}(a)]
\end{aligned}$$

Flows in and out of a labor market status are balanced in a steady state such that $E_{i,s}$, $U_{i,s}$ and $N_{i,s}$ are constant:

$$\begin{aligned}
f_s U_{i,s} &= (\delta_{i,s}^{eu} + \delta_{i,s}^{en} + \lambda_{i,s}^{en}) E_{i,s} && (14)\\
\lambda_{i,s}^{nu} N_{i,s} + \delta_{i,s}^{eu} E_{i,s} &= (f_s + \lambda_{i,s}^{un}) U_{i,s} && (15)\\
\lambda_{i,s}^{un} U_{i,s} + (\lambda_{i,s}^{en} + \delta_{i,s}^{en}) E_{i,s} &= \lambda_{i,s}^{nu} N_{i,s} && (16)
\end{aligned}$$

The first condition corresponds to flows in and out of employment. The second corresponds to flows in and out of unemployment, and the third to flows in and out of non-participation. Note that two of these conditions imply the third.

To summarize, the steady state equilibrium consists of firm and individual decisions $o^f_{i,s}(a)$, $o^{nu}_{i,s}(a,b)$ and $o^q_{i,s}(a,b)$, market tightness θ_s, stocks $E_{i,s}$, $N_{i,s}$, and $U_{i,s}$, flow rates f_s, $\delta^{eu}_{i,s}$, $\delta^{en}_{i,s}$, $\lambda^{en}_{i,s}$, $\lambda^{un}_{i,s}$ and $\lambda^{nu}_{i,s}$, joint distributions $P^E_{i,s}(a,b)$, $P^U_{i,s}(a,b)$ and $P^N_{i,s}(a,b)$ and marginal distribution $F^E_{i,s}(a)$, $F^U_{i,s}(a,b)$ and $F^N_{i,s}(a)$ such that

1. $o^f_{i,s}(a)$, $o^{nu}_{i,s}(a,b)$ and $o^q_{i,s}(a,b)$ solve the firms' and individuals' decision problems
2. f_s and q_s relate to market tightness θ_s through the matching function
3. θ_s satisfies a job creation condition from free entry $J^v_s = 0$
4. the stocks rate satisfy (14) and (15) given individual and firm decisions, equilibrium flow rates, and $E_{i,s} + N_{i,s} + U_{i,s} = \phi^p_{i,s}$
5. the distributions $P^E_{i,s}(a,b)$, $P^U_{i,s}(a,b)$ and $P^N_{i,s}(a,b)$ are consistent with individual's decisions and are constant
6. $F^E_{i,s}(a)$, $F^U_{i,s}(a,b)$ and $F^N_{i,s}(a)$ are the marginal distributions of ability from $P^E_{i,s}(a,b)$, $P^U_{i,s}(a,b)$ and $P^N_{i,s}(a,b)$

4 Relation to the literature

A large stream of research applies accounting methodologies, such as shift-share and stock-and-flow analysis, to attribute the changes in participation and unemployment rates to particular aspects of the labor force on the one hand, and to distinguish between trend and cyclical movements on the other.[6] This literature highlights the importance of the changing demographic characteristics of the population, including educational attainment, in accounting for these trends.[7] Moreover, this research generally concludes that the aging of the population plays a large role in the decline in the overall employment to population ratio and participation rate and, as a result, we focus our empirical analysis on prime age workers.[8]

[6] Except for a few papers, such as Autor, Dorn and Hanson (2013), Barnichon and Mesters (2018), Hobijn and Şahin (2021) and Cajner, Coglianese and Montes (2021) much of the literature reviewed below tends to study participation and unemployment rates separately. This paper provides a general equilibrium framework that highlights the tight link between the two trends.

[7] See, among others, Shimer (1998), Daly, Jackson and Valletta (2007), Aaronson, Hu, Seifoddini and Sullivan (2014) and Montes (2018), Barnichon and Mesters (2018) and Hornstein and Kudlyak (2019). A related set of work estimating the rate of unemployment consistent with the absence of inflationary pressures also document a trend decline in this rate of unemployment (see Crump, Eusepi, Giannoni and Sahin, 2019).

[8] In addition, labor market flows accounting exercises suggest that a declining share of marginally attached non-participants contributes, in an accounting sense, to a large share of both the decline in participation and unemployment rates (Barnichon and Figura, 2016). Elsby, Hobijn, Karahan, Kosar and Sahin (2019) decompose the trend decline in male and female participation into labor force entry and exit components. Coglianese (2018) finds an increase in individuals who temporarily leave the labor force accounts for 20–40% of the decline in prime-age male participation.

Research into the underlying causes of declining rates of participation in the labor market, for the overall population and prime age workforce in particular, tends to focus on the trend in a single outcome individually (see surveys such as Krause and Sawhill, 2017 or Council of Economic Advisers, 2014). Moreover, research often focuses on either a labor demand or a labor supply explanation in isolation. Structural factors affecting labor supply include, among others, rising returns to leisure relative to that accessible when participating in the labor market, and reforms to welfare and transfer programs (see Aguiar, Bils, Charles and Hurst, 2021, Rachel (2022), Barnichon and Figura, 2016, and Autor and Duggan, 2003).[9] Work emphasizing structural factors reducing the demand for labor focuses rising fixed production costs, labor substituting technical change, skill biased technical change, and increased exposure to trade and globalization (Autor, Dorn and Hanson, 2013, Dix-Carneiro, Pessoa, Reyes-Heroles and Traiberman, 2023, Autor and Salomons, 2018, Acemoglu and Restrepo, 2020, Autor, Katz and Kearney, 2006, Autor, 2019, Cortes, Jaimovich and Siu, 2017). Finally, an extensive literature starting with Katz, Krueger, Burtless and Dickens (1999) has documented a decline in labor's market power, which would have opposing effects on the supply (negative) and demand (positive) for labor. This has been attributed to the decline in unions (Schanbel, 2013), the rise of large employers (Azar, Marinescu and Steinbaum, 2022, Benmelech, Bergman and Kim, 2022), and the increasing use of contracts that limit workers' bargaining power such as non-compete clauses and binding arbitration (Krueger and Posner, 2018, Starr et al., 2021). More recent work documents gender differences in wage bargaining with implications for gender differences in compensation over the life-cycle (Cortés, Pan, Pilossoph and Zafar, 2021). We provide a framework for evaluating these different hypothesis and use the stability of the unemployment rate to discipline the contribution of different driving forces.

Classic theories of participation in equilibrium assume individuals are heterogeneous in non-market utility instead of ability or returns to market work in order to derive a margin of participation in the labor market (McKenna, 1987, Pissarides, 2000, ch. 7). In our paper individuals are instead heterogeneous in market ability as well and non-market utility. The distinction matters in that the structural changes we consider change the composition of ability within the labor force, which can undo the result that the labor force participation rate is positively correlated with the tightness of labor market (measured as the v-u ratio). It also results in the presence of individuals who would like a job but do not search, the marginally attached, as in Garibaldi and Wasmer (2005) but for different reasons as individuals in their model are homogenous in market productivity. Building on this earlier work a growing research effort into modeling the observed flows across labor market state include Pries and

[9] In addition, Krueger (2017), Case and Deaton (2015) consider the role of increasing health problems and morbidity, while Holzer, Offner and Sorensen (2005) examines increased incarceration rates.

Rogerson (2009), Krusell, Mukoyama and Şahin (2010), Krusell, Mukoyama, Rogerson and Şahin (2011). The main analysis in our paper are the trends in the stocks rather than the flows in the labor market, though changes in flow rate help discipline the model parameters.

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