The Aggregate Implications of Labor Supply Near Retirement*

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Abstract

This paper examines the policy implications from changing the mechanism driving the decrease in labor supply late in life. The predictions of two life cycle models of labor supply are compared over a wide set of policy experiments to answer this question. The first model makes the standard assumption that the declining age-specific component of labor productivity drives labor supply as people age. Alternatively, the second model assumes productivity is flat later in life and instead age dependent preferences for work are responsible for labor supply changes with age. Both models are calibrated such that aggregate labor supply decisions are the same and have similar aggregate implications for policy changes. While both models have the same driving process for fluctuations in individual labor productivity, they have different predictions for the amount and source of wage volatility late in life, which is relevant for social policies designed to provide redistribution.


Keywords: Labor Supply, Endogenous Retirement.

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1 Introduction

Life cycle models have become the workhorse for answering quantitative questions regarding programs such as Social Security, Medicare, and private pensions. Critical for the policy predictions of these models are their assumptions on labor supply near retirement. In order to replicate the observed fall in earnings and labor supply later in life, standard models typically assume that the age-specific productivity falls and as a consequence individuals optimally choose to reduce hours as they approach retirement.\(^1\) To the extent that wages reflect productivity, human capital theory reconciles the assumed wage profile as early in life investment increases the stock of skills while later in life the stock of skills falls since investment optimally falls below depreciation.

However, a number of empirical studies suggest that average wages do not decline by much later in life and individual wage declines may not reflect exogenous productivity changes. Work as early as Mincer (1974) found no visible decline of weekly earnings at later ages, while Murphy and Welch (1992) found no or very little hourly wage declines for full time men. More recently, Rupert and Zanella (2012b) confirm these assertions with panel data spanning a worker’s entire career. Additionally, work by Casanova (2012) argues that the decline in average wages found in cross-sectional analyses is not the result of declining productivity but rather an increasing fraction of individuals optimally choosing part time work which incurs a productivity penalty.\(^2\) Hence, wages and hours are determined simultaneously.

Thus, to reconcile these observations the literature has relied on changes in preferences for work as people age along with endogenously determined wages and hours.\(^3\)

\(^1\)Indeed, Weiss (1986) argued that the observations a life cycle model should explain are: hump shaped profiles of wages, earnings, and hours with hours peaking earlier than the latter profiles.

\(^2\)See also, Aaronson and French (2004) for evidence on the part time productivity penalty.

\(^3\)Rupert and Zanella (2012b) find that a standard life cycle model requires an disutility increasing of labor to generate a decline in hours when wages are flat. Similarly, Casanova (2012) uses changes in preferences for work and a part time productivity penalty to match flat individual wage profiles and average wages that fall with age. Lastly, French and Jones (2011) use a similar modeling approach in explaining the effect of health insurance on retirement behavior.
Changes in preferences may capture, for example, deteriorating health, relative increases in the value of leisure as individuals age, or social norms that make retirement more acceptable for older individuals. As the answers to many of the previously examined policy questions hinge on decisions late in life, an important question is to determine the policy implications of modeling labor supply through declining productivity versus changes in preferences.

This paper addresses this issue by formulating two Aiyagari-Bewley-Huggett overlapping generations models. Both models feature discrete labor supply choices between full and part time work, along with endogenous retirement and a realistic social security program. However, the two models differ in the mechanism generating movements in labor supply near retirement. The first model, referred to as the productivity model, makes the standard assumption of exogenously declining labor productivity with age. The second model, referred to as the preferences model, assumes productivity is flat later in life and instead age dependent preferences for work lead individuals to reduce their labor supply. Importantly, the second model incorporates a productivity penalty when choosing part time work, which makes hours and wages endogenous.

While the models are calibrated to match the same profiles of average wages, hours, and retirement choices, the preferences model has micro level predictions more consistent with actual data. Importantly, it generates are larger fraction of individuals working part time prior to retirement. Because part time work involves a productivity penalty, the cross-sectional variance of wages by age is higher, relative to the productivity model, and persists as individuals flow from part time (and full time) into retirement. Thus, to the extent that both models should match the same variance profile of observed wages, the procedure used to calibrated the productivity processes is incorrect, a point that we emphasize below.

Next, policy experiments are conducted to gauge the importance of the alternative

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4See for example, Rupert and Zanella (2012a) who argue that grandparenting may explain a portion of the decline in market hours worked as individuals approach retirement.
labor supply mechanisms. First, social security is eliminated in both models. This is a natural starting point given the focus on labor supply near retirement. The standard result is obtained as in both models the welfare benefits of insuring against shocks exceed the costs associated with the crowding out of private investment.\textsuperscript{5}

Welfare gains are nearly identical across models. Measured in consumption equivalent variation, welfare increases by roughly 10 percent.

A more careful analysis of this result highlights the importance of social security for insuring against exogenous wage variation. As mentioned above, the observed variance of wages for older individuals is higher in the preferences model even though both models are fed the same stochastic productivity process. The difference arises from the prevalence of part time work in the preferences model, which induces an endogenous increase in wage volatility. This feature does not exist in the productivity model. To assess the implications of this difference in the variance of observed wages the variance of observed wages in the productivity model is raised to match the preferences model. This leads to a smaller welfare gain from eliminating social security in the productivity model (8.7 percent in consumption equivalent variation terms) as the benefits of social security are now larger in the presence of additional exogenous wage risk.

Thus, the results from the social security experiment call for caution when conducting policy analysis with productivity processes that are estimated outside the model in question as is done here. Importantly, this last point suggests the government’s motive for insuring wage volatility critically depends on whether the source of variation is exogenous (i.e. risk) versus endogenous. Such an accounting, however, suggests structural estimation of the model including the exogenous components of productivity, a venue that will be pursued.

The remaining experiments pertain to taxes. In the spirit of Rogerson and Wallenius (2009), the Laffer curves of each economy are calculated. The results of this

\textsuperscript{5}See for example, Krueger and Kubler (2006) or Hong and Rios-Rull (2007).
experiment suggest a similar tax rate sensitivity across models. Notably, across both models the ability of the government to raise revenue from older individuals is muted relative to prime aged workers, who have much less elastic labor supply. Lastly, optimal taxes on capital and labor are calculated and are found to be roughly similar across models.

This paper is related to several recent papers in the life cycle and retirement literature. It is closely related to the work of Rogerson and Wallenius (2009) who show that for a class of life cycle models with homogenous agents and no discounting changes in productivity or preferences have similar implications for the aggregate effects of changing taxes. In their model, productivity or preferences serve the same role of breaking the indeterminacy of the timing of labor supply. This paper extends their analysis to models, albeit sacrificing analytical tractability. This paper is also related to the work of Rogerson and Wallenius (2013) who emphasize the importance of nonconvexities for generating retirement. Both of these studies allow for wages to depend on hours worked.

The observation that wages do not decline late in life draws from the work of Rupert and Zanella (2012b) and Casanova (2012). Using data on the same workers from the Panel Survey of Income Dynamics (PSID), Rupert and Zanella (2012b) find that the wage profile does not decline with age while the earnings profile does decline. The discrepancy is explained by a drop in hours worked after age 50. Meanwhile, Casanova (2012) uses data from the Health and Retirement Study (HRS) to show that conditional on working full time wages of older workers are flat or slightly increasing with age. She argues that wages only decrease when individuals choose to work part time, and thus, the corresponding wage drop is endogenously determined. Additionally, this paper is related to the work of Cahill et al. (2005) and Gustman and Steinmeier (1985) who view retirement as a gradual rather than abrupt process.

The structure of the paper is as follows. The next section provides some empirical facts motivating the modeling choices. Section 3 presents the models, while
section 4 presents their calibrations. Section 5 discusses the steady states and policy experiments. The sixth section concludes.

2 Data

This section presents a few motivating facts highlighting the importance of part time work near retirement. Data from the Merged Outgoing Rotation Groups of the Current Population Survey (MORG-CPS) is used to measure individuals’ employment status and hours worked. Importantly, the MORG-CPS is a large representative sample of the US population and provides information on labor supply in a given week rather than over the course of a year. This last feature is important for the analysis as evidence from Rosen (1976) and Aaronson and French (2004) suggests that many individuals working fewer than 1,750 hours per year (a typical cut-off for full time work at an annual frequency) are not part time workers but rather full time workers who are only working part of the year. Presumably, this labor market dynamic is more prevalent with age and important to account for when measuring transitions from full to part time or retirement. Additionally, using data for a given week avoids combining wage and hour observations that encompass two ages (i.e. annual wages and hours reported when an individual is currently 62 may reflect wages earned and hours worked at ages 62 and 61). A draw back of using the CPS is that it does not have detailed information on older individuals like surveys such as the Health and Retirement Survey (HRS).

The sample is restricted males ages 20-70 interviewed in 2001-2007. The year restrictions are imposed to avoid the Great Recession and changes in social security policy in 2000, both which are events beyond the scope of the current paper. Meanwhile, restricting the analysis to men is standard in the literature. Individuals must not be in the armed forces or be attending school full-time. No restrictions are placed on self-employment as this margin may be increasingly important with age. Hours
worked are defined by an individual’s actual hours worked in the week prior to the survey week. Consistent with BLS definitions, individuals are full time employed if working at least 35 hours. An individual is considered part time if their hours are less than 35 but more than 5. Lastly, an individual is considered to work zero hours if their reported hours are less than 5 or their recorded labor market status is not employed. To record transitions between labor market states individuals interviewed during the fourth month in sample are matched with their records a year later during the eighth month in sample.

Figure 1 suggests that part time employment is quantitatively important as individuals approach retirement. This figure displays average weekly hours worked by males in the constructed sample. As can be seen from the solid black line, average weekly hours worked for all males decline after age 55. Importantly, one of the main sources of adjustment is movement into zero hours (e.g. retirement). However, even when removing workers contributing zero hours (blue), average hours still decline with age. Conditional on working full time (red) or part time (purple) hours worked tend to be stable over the life cycle. Hence, the decline in hours worked by those working (blue) is mostly attributable to individuals switching employment status’ from full to part time. Indeed, holding fixed the fraction of individuals working full and part time to the levels observed at age 55, and allowing average hours to vary by status, leads to a prediction of average hours for those working at age 70 of 42 hours. To further emphasize the last point, figure 2 displays how the incidence of full and part time conditional on working changes over the life cycle. As can be seen from this figure, part time work becomes increasingly more common relative to full time work starting at age 55.

Rather than focusing on stocks, table 1 displays the annual transition rates between full time, part time, and zero time by age groups. Prime age refers to individuals ages 25-54; pre-retirement refers to individuals ages 55-60; early retirement refers to

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6 This empirical regularity has also been highlighted by Hurd (1996) and Rogerson and Wallenius (2013).
Figure 1: Average weekly hours worked by age for males in CPS 2001-2007.

individuals at least 61 but younger than full retirement age; while full retirement age refers to individuals at full retirement age through age 70. These definitions are chosen to account for the change in full retirement age for individuals born after 1937. For each matrix, a row represents the annual transition probabilities to the different labor market states conditional on the individual’s current labor market state. For example, the top left cell in the first matrix implies that a prime aged male who is working full time this year has an 86.9 percent chance of being employed full time in the following year. The numbers highlighted in red show how the probability of becoming part time employed, conditional on being full time employed, rises substantially with age. Judging by the second rows of each matrix, part time employment becomes more persistent with age, while transitions back to full time are less common with age. Concert with retirement behavior, working zero hours becomes an absorbing state as individuals age. These observations confirm what previous authors have
Figure 2: Percent of employed population working full versus part time by age for males in CPS 2001-2007.

called partial retirement or bridge employment: individuals transiting from full to part time employment before finally reaching full retirement.\textsuperscript{7}

3 Models

This section outlines the characteristics of the productivity and preferences models highlighting their similarities and differences. Both models consist of three sectors: individuals who work, consume and save; a representative firm operating a constant returns to scale technology; and a government sector that taxes income to finance social security. Time is assumed to be discrete and markets are incomplete in both models. As previously mentioned the crucial differences across models lie in structure

\textsuperscript{7}See for example, Ruhm (1990) of Casanova (2012).
Table 1: Annual employment status transition probabilities for males in CPS 2001-2007.

<table>
<thead>
<tr>
<th>Prime age</th>
<th>Pre-retirement age</th>
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<tbody>
<tr>
<td></td>
<td>FT'</td>
</tr>
<tr>
<td>FT</td>
<td>86.9</td>
</tr>
<tr>
<td>PT</td>
<td>58.3</td>
</tr>
<tr>
<td>ZT</td>
<td>30.2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Early retirement age</th>
<th>Full retirement age</th>
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</thead>
<tbody>
<tr>
<td>FT'</td>
<td>PT'</td>
</tr>
<tr>
<td>FT</td>
<td>72.8</td>
</tr>
<tr>
<td>PT</td>
<td>25.8</td>
</tr>
<tr>
<td>ZT</td>
<td>4.8</td>
</tr>
</tbody>
</table>

Note: prime age are individuals 25-54; pre-retirement are individuals ages 55-60; early retirement are individuals ages 61 up to normal retirement age; full retirement are individuals at full retirement age through age 70.

of labor productivity, preferences for labor, and the relationship between hours and wages. In the productivity model, the age-specific component of labor productivity falls later in life and wages do not depend on hours worked. In the preferences model, the age-specific component of labor productivity is flat with age, preferences for work change with age, and wages depend on hours worked.

3.1 Demographics

There are J overlapping generations. The probability of an agent living to age $j + 1$ conditional on being alive at age $j$ is represented by $\Psi_j$. All agents who live to an age of $J$ die the next period. If an agent dies with assets, the assets are confiscated by the government and distributed equally to all the living agents as transfers ($Tr$).

In each period a continuum of new agents is born. The population of new agents born each period grows at rate $n$. Given the population growth rate and conditional survival probabilities, the time invariant cohort shares, $\{\mu_j\}_{j=1}^J$, are given by

$$\mu_j = \frac{\Psi_{j-1}}{1 + n} \mu_{j-1}, \text{ for } i = 2, \ldots, J$$  \hspace{1cm} (1)
where $\mu_1$ is normalized such that

$$\sum_{j=1}^{J} \mu_j = 1 \quad (2)$$

### 3.2 Individuals

An agent is endowed with zero assets at birth. They are also endowed with one unit of time in each period which they split between labor and leisure. Individuals can only choose between working full, part, or zero time, or $h_j \in \{h_{FT}, h_{PT}, 0\}$. As is commonly assumed, in the productivity model, hourly wages are independent of hours worked. Meanwhile, the preferences model allows for hours to influence hourly wages. Following Aaronson and French (2004) among others, if individuals choose to work part time their hourly wage rate is scaled down by $\phi < 1$.

In both models, retirement, $j_r$, is an endogenous choice and is irreversible. Agents who choose to retire prior to full retirement age (e.g. early retirement) must also start claiming social security benefits. Upon reaching full retirement age, non-retired individuals can begin receiving benefits and still work. This latter assumption is made for computational simplicity at the expense of modeling reality. Claiming benefits is assumed to be an irreversible decision. Lastly, social security benefits depend on an agents’ lifetime average annual earnings $s$.

Individual labor earnings are given by $y_{ij} = w \varpi_{ij} h_{ij}$, where $w$ represents the wage rate per efficiency unit of labor and $h_{ij}$ is the fraction of the time endowment spent on labor market activities. Idiosyncratic labor productivity, $\varpi_{ij}$ follows:

$$\ln \varpi_{ij} = \theta_j + \zeta_i + z_{ij} + \epsilon_{ij} \quad (3)$$

In this specification, $\theta_j$ is an age specific component governing the deterministic component of productivity; $\zeta_i \sim N(0, \sigma^2_\zeta)$ is an individual-specific fixed effect observed at birth; $\epsilon_{ij} \sim N(0, \sigma^2_\epsilon)$ is a transitory idiosyncratic component; and $z_{ij}$ is a persistent
idiosyncratic component following a first-order autoregressive process:

\[ z_{ij} = \rho z_{ij-1} + \nu_{ij} \quad \nu_{ij} \sim N(0, \sigma_\nu^2), \quad z_{i0} = 0. \]  

(4)

The innovations \( \epsilon_{ij} \) and \( \nu_{ij} \) are uncorrelated across individuals and over time. Across models, the distributions (processes) of \( \zeta_i \), \( z_{ij} \), and \( \epsilon_{ij} \) are the same. However, the shape of \( \theta_j \) varies across models. Reflecting standard assumptions, in the productivity model \( \theta_j \) is allowed to decline later in life, while in the preferences model it remains flat.

An agent of age \( j \) chooses labor, leisure, and consumption in order to maximize expected lifetime utility:

\[ \left\{ \sum_{j=1}^{J} \beta^j \prod_{q=1}^{j-1} \Psi_{q-1} u(c_j, h_j) \right\}, \]  

(5)

where \( c_j \) is the consumption of an agent at age \( j \) and \( h_j \) is the percent of the time endowment that is spent providing labor services. Preferences over consumption and labor are given by:

\[ \frac{c^{1-\sigma}}{1 - \sigma} \leq B \frac{h^{1+1/\gamma}}{1 + 1/\gamma} \leq D(j, h) \cdot \left( 1 - I_{j \geq \tilde{h}} \right) \]  

(6)

The first two terms in the utility function are standard and their functional forms do not vary across models. The third term varies across models and reflects fixed costs associated with working. Importantly, in the productivity model fixed costs are assumed to be constant across ages and hours, so \( D(j, h) = D \).

Meanwhile, in the preferences model fixed costs are allowed to vary with age and hours worked.\(^8\) Allowing \( D \) to rise with age may capture the desire to spend more leisure time on activities such as grandparenting (e.g. Rupert and Zanella (2012a)), or the lowering of the social stigma attached to not working when older. Allowing \( D \) to

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\(^8\)This assumption follows for example, Rupert and Zanella (2012b), Casanova (2012), and French and Jones (2011). Rogerson and Wallenius (2009) also consider age dependent preferences as a driver of labor supply decisions.
vary with hours may capture the fact that part time work entails shorter commuting distances or other benefits that a shorter work week entails. Allowing $D$ to vary with hourly employment status and age captures succinctly the notion that Medicare eligibility breaks the dependence of health insurance on full time work, which may be an important motive for choosing part time work when older (e.g. French and Jones (2011)).

The term involving the indicator variable $I_{j \geq j_r}$ is needed to distinguish permanent retirement from temporarily working zero hours. This captures fixed costs with being attached to the labor force, such as maintaining employment contacts or clothes.\footnote{Alternatively, this cost can be interpreted as a labor force re-entry cost as in French and Jones (2011).}

Lastly, individuals can hold quantities of a single risk-free security $a$ that pays interest at rate $r$. Holdings cannot be negative, so $a \geq 0$.

With these primitives the constraints a working age individual faces are:

$$c + a' = (1 + r)a + y(1 - \tau_{ss}) - T(ra + y)$$  \hfill (7)

$$y = w \varpi_{ij}(z) h$$  \hfill (8)

$$a' \geq 0$$  \hfill (9)

$$s' = g_j(s, y)$$  \hfill (10)

where $r$ is the pre-tax net return to capital, $\tau_{ss}$ is a flat social security tax, $T(y + r)$ are the taxes paid on capital and labor income, and $g_j(\cdot)$ governs the evolution of individual average lifetime earnings. As alluded to above, the only constraint that changes across models is (8), where the term $\phi$ must be incorporated when an individual chooses part time employment.
The constraints faced by a retired individual who is claiming benefits are:

\[ c + a' = (1 + r)a + b_{ss}(s) - T(ra) \] (11)

\[ a' \geq 0 \] (12)

\[ s' = s \] (13)

where \( b_{ss}(\cdot) \) is the function that determines social security benefits received and will be discussed in the next section. The constraints faced by a full retirement age individual who is choosing between working, working and claiming, retiring, retiring and claiming follow immediately and are omitted for sake of brevity.

3.3 Firms

Firms are perfectly competitive with constant returns to scale production technology. Aggregate technology is represented by a Cobb-Douglas production function of the form \( Y = F(K, L) = K^\alpha L^{1-\alpha} \), where \( K \) and \( L \) are aggregate capital and labor (measured in efficiency units) and \( \alpha \) is the capital share of output. Capital depreciates at a constant rate \( \delta \in (0, 1) \). Firms rent capital and hire labor from households in competitive markets at factor prices \( r \) and \( w \), respectively, which are determined competitively.

3.4 Government Policy

The government consumes resources in an unproductive sector, \( G \). The government taxes total individual income from labor and capital to finance its consumption. Taxes are set according to the schedule \( T(y_k + y_l) \) where \( y_k \) total capital income and \( y_l \) is total labor income. Part of the pre-tax labor income is accounted for by the employer’s contributions to social security, which is not taxable under current U.S. tax law.
3.5 Social security program

In addition to consuming in an unproductive sector, the government runs a pay-as-you-go social security system. The agent chooses when to start receiving social security benefits. As such, the system of social security payments, $b_s(s(\cdot))$, is modeled to mimic the U.S. system in several key respects. In the U.S., social security benefits are based on each worker’s average level of earnings, $s$, calculated over the highest 35 years of earnings.\footnote{These earnings are expressed as workers’ average indexed monthly earnings (AIME), indexed to present by wage growth. We abstract from wage indexation in the model and, for computational simplicity, base the social security payment $b_{ss}$ on the average life cycle earnings with some adjustments described later in this section in Equation 16.} A baseline benefit formula is then applied to each worker’s average level of labor earnings to calculate the pre-adjustment social security benefit.\footnote{The monthly social security benefit is called primary insurance amount (PIA). Once annualized, the PIA corresponds to the model baseline retirement benefit $b_{base}$. In general, the PIA is the benefit a person would receive if she elects to begin receiving retirement benefits at her normal retirement age (NRA).} The benefit formula is designed to ensure that the Social Security system is progressive, with the replacement rate being inversely related to past earnings. The baseline benefit calculation is governed by two cut-off points (also known as “bend points”) which jointly determine the degree of progressivity of the social security system. The third, implicit bend point is the cutoff on social security benefits and contributions. The cutoff limits the annual amount of earnings subject to taxation for a given year by determining $\bar{y}_t$, but also applies when those earnings are used in a benefit computation. Finally, the social security system makes various adjustments to the baseline benefit amount, such as permanent percentage reductions for early benefit claiming and permanent percentage credits for claiming after the normal retirement age (NRA).\footnote{Under the current law, the age at which a worker becomes eligible for full Social Security retirement benefits – the NRA – depends on the worker’s year of birth. For people born before 1938, the NRA is 65. For slightly younger workers, it increases by two months per birth year, reaching 66 for people born in 1943. The NRA remains at 66 for workers born between 1944 and 1954 and then begins to increase in two-month increments again, reaching 67 for workers born in 1960 or later.}

The social security system is modeled in three steps. First, following Huggett
and Parra (2010) and Kitao (2012), the model analog of each worker’s average level of labor earnings over the working life cycle is calculated. At every age, the total accumulated earnings follow the law of motion:

\[
s' = \begin{cases} 
\frac{\min\{y, \bar{y}\} + (j-1)s_j}{j} & \text{if } j \leq 35, \\
\max\{s, \frac{\min\{y, \bar{y}\} + (t-j)s_j}{j}\} & \text{if } 35 < j < R, \\
s & \text{if } j \geq R,
\end{cases}
\]

where \(s\) is the accounting variable capturing the equally-weighted average of earnings before the retirement age \(R\); and \(\bar{y}\) is the maximum allowable level of labor earnings subject to the social security tax that corresponds to the benefit-contribution cap. Moreover, to infuse an additional degree of realism while maintaining the model’s tractability, the specification in Huggett and Parra (2010) is extended by introducing a rule to ensure that the total accumulated labor earnings, \(s\), accrued over the working life cycle and used in the benefit calculation cannot fall below their previously realized level, \(s_{-1}\), after 35 working periods.\(^{13}\) Finally, \(s\) becomes constant at \(j_{ss}\) once agents start receiving benefits.

Second, the pre-adjustment social security benefit, \(b_{base}^{ss}\), for each recipient is calculated using a convex, piecewise-linear function of average past earnings observed at retirement age, \(j_{ssR}\), so that the marginal benefit rate varies over three levels of taxable income:

\[
\tau_{r1} \quad \text{for } 0 \leq j_{ssR} < b_1 \\
\tau_{r2} \quad \text{for } b_1 \leq j_{ssR} < b_2 \\
\tau_{r3} \quad \text{for } b_2 \leq j_{ssR} < b_3,
\]

where \(\{b_1, b_2, b_3 = \bar{y}\}\) are the two bend points plus the benefit-contribution cut-off point, and where \(\tau_{r1}, \tau_{r2}, \tau_{r3}\) represent the marginal replacement rates in the progressive social security payment schedule associated with the respective bend points.

\(^{13}\)Computing the social security benefit over the highest 35 years of earnings would render the model intractable, as it would require tracking each period’s earnings as part of the model’s state space.
Finally, adjustments for early and late benefit claiming are calculated. In the U.S., workers can begin receiving permanently reduced monthly benefits after reaching the early retirement age, \( R \). \(^{14}\) The size of the reduction varies with the months out of labor force between the time at which the worker starts claiming benefits and her \( NRA \). \(^{15}\) Conversely, when an individual starts claiming benefits after reaching the \( NRA \), the social security benefit payments are increased by a fixed permanent proportion for every year spent working between the \( NRA \) and the maximum age cap \( R \) for which the credit is available. \(^{16}\) As a result, the total social security benefit \( ss \) is defined as:

\[
ss = \begin{cases} 
(1 - n\kappa_1(n))ss_{base} & \text{if } R \leq R < NRA \\
(1 - n\kappa_2(n))ss_{base} & \text{if } NRA \leq R < R, 
\end{cases}
\]

where \( n = (NRA - R) \) represents the years of early (delayed) retirement over which the penalty (credit) is accrued; and where \( \kappa_1(n) \) and \( \kappa_2(n) \) represent functions of yearly rates for early (delayed) retirement penalty (credit), respectively. Finally, \( \tau_{ss} \), is a flat tax on labor income used to fund the social security program.

### 3.6 Definition of Stationary Competitive Equilibrium

This section defines the competitive equilibria for applicable to both models. Given a social security replacement rate \( b_{ss} \), government expenditures \( G \), and a sequence of population shares \( \{\mu_j\}_{j=1}^J \), a stationary competitive equilibrium is a sequence of individual policy functions, \( \{c_j, a_{j+1}, h_j, j_r\} \), a production plan for the firm \( (N, K) \),

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\(^{14}\)In the U.S., the minimum retirement age at which social security benefits become available is set at 62. In the data, more than two-thirds of the workers began receiving Social Security retirement benefits before their normal retirement age. The majority of those early recipients began collecting benefits at age 62. Source: Social Security Administration, Annual Statistical Supplement, 2000, p. 240.

\(^{15}\)A benefit is reduced 5/9 of one percent for each month before normal retirement age, up to 36 months. If the number of months exceeds 36, then the benefit is further reduced 5/12 of one percent per month.

\(^{16}\)The delayed benefit retirement varies with year of birth, but reaches 2/3 of 1 percent of the benefit for every month delayed (or 8 percent annualized) for individuals born in 1943 or later. Source: Jonathan F. Pingle, Social Security’s Delayed Retirement Credit and the Labor Supply of Older Men, 2006. No credit is given after age 69.
a government labor tax function $T^l : \mathbb{R}_+ \rightarrow \mathbb{R}_+$, a government capital tax function 
$T^k : \mathbb{R}_+ \rightarrow \mathbb{R}_+$, a social security tax rate $\tau_{ss}$, a utility function $U : \mathbb{R}_+ \times \mathbb{R}_+ \rightarrow \mathbb{R}_+$, 
social security benefits formula $B_{ss} : \mathbb{R}_+ \times \mathbb{R}_+ \rightarrow \mathbb{R}_+$, a formula to calculate the 
lifetime average annual earnings $G : \mathbb{R}_+ \times \mathbb{R}_+ \times \mathbb{R}_+ \rightarrow \mathbb{R}_+$, prices $(w, r)$, and transfers 
$Tr$ such that:

1. Given prices, transfers, and benefits the individual policy functions solve the
   Bellman equations.

2. Prices $w$ and $r$ satisfy:
   $$r - \delta = \alpha \left( \frac{L}{K} \right)^{1-\alpha} \text{ and } w = (1 - \alpha) \left( \frac{K}{L} \right)^{\alpha}$$

3. The social security policies satisfy:
   $$\sum_{j=1}^{J-1} y_j \tau_{ss} \mu_j = \sum_{j=j_r}^{J} b_{ss}(\cdot) \mu_j.$$

4. Transfers are given by:
   $$Tr = \sum_{j=1}^{J} (1 - \Psi_j) a_{j+1} \mu_j.$$

5. Government budget balance:
   $$G = \sum_{j=1}^{J} T[r a_j + Tr + y_j (1 - 0.5 \tau_{ss})] \mu_j.$$

6. Market clearing:
   $$K = \sum_{j=1}^{J} a_j \mu_j, \quad L = \sum_{j=1}^{J} \omega_j h_j \mu_j \quad \text{and}$$
   $$\sum_{j=1}^{J} c_j \mu_j + \sum_{j=1}^{J} a_{j+1} \mu_j + G = K^\alpha L^{1-\alpha} + (1 - \delta)K.$$

Note that in the preferences model effective labor when working part time is scaled 
down by $\phi$. Meanwhile, the productivity model has no such adjustment.
4 Calibrations

This section describes the procedure used to calibrate both models. Broadly speaking, both models are calibrated to match the same profiles of average wages and hours, and to match the same fraction of individuals retired at age 66. More specifically, the crucial differences across models are in the choices for the age-dependent component of productivity, $\theta_j$, and the disutility or fixed costs of working $D(j, h)$. In the productivity model, $\theta_j$ is set to match recent estimates of the profile of unconditional average wages by age. Additionally, $D$ is fixed and set to match the fraction of individuals retired at age 66. Meanwhile, in the preferences model, $\theta_j$ follows the same set of estimates on average wages during the early portion of the life cycle, but is assumed to be flat in the latter part of the life cycle. Thus, $D(j, h)$ is calibrated such that the preferences model matches the wage, hours, and retirement profiles that the productivity model generates late in life.

4.1 Demographics, endowments and preferences

There are 80 overlapping generations of individuals of ages $j = 20, ..., 100$. Following Conesa et al. (2009) and Kitao (2012) the population growth rate, $n$, is set to 1.1 percent, to match the growth rate in the U.S. economy. The conditional survival probabilities $\{\Psi_j\}_{j=20}^{100}$ are derived from the U.S. life tables (Bell and Miller (2002)).

Following Aaronson and French (2004) the productivity penalty of part time work is calibrated to 30 percent of full time wages, so $\phi = 0.7$. Following Huggett and Parra (2010), the parameter values for the labor income process specified in Section 3.2 are set equal to the values estimated by Kaplan (2012).

The deterministic labor profile, $\theta_j$, is taken from Kaplan (2012) and is shown in Figure 3. The profile is smoothed by fitting a quadratic function in age, normalized such that the value of an agent entering the economy is one, and extended to cover ages 20 through 69 which is defined as the last period in which households are assumed...
to participate in the labor activities ($\bar{R}$). This figure also includes the calibrated profile of $\theta_j$ in the preferences model. By assumption, it flattens late in life.

The remaining productivity parameters are also set in accordance with the estimates in Kaplan (2012): $\rho = 0.958$, $\sigma^2_\zeta = 0.065$, $\sigma^2_\zeta = 0.081$ and $\sigma^2_\nu = 0.017$. All three of the shocks are discretized in order to solve the model. Two states are used to represent the transitory and permanent shock and five states for the persistent shock. For expositional convenience the two permanent shocks are referred to as the high and low ability types.

![Figure 3: Profiles of age-specific productivity across models.](image)

Recalling, the discussion in section 3.2, preferences are modeled as:

$$c^{1-\sigma} - B j^{1+1/\gamma} h \frac{1+1/\gamma}{1 - \sigma} - D(j, h) \cdot (1 - I_{j \geq j^*})$$

---

$^{17}$The estimates in Kaplan (2012) are available for ages 25-65.
with $\sigma > 0$, $\gamma > 0$, and $B > 0$. Existing estimates of $\gamma$ typically ranging between 1 and 3; this paper sets $\gamma = 2$. The parameter $\sigma$ represents the Frisch labor supply elasticity on the intensive margin. Past microeconometric studies estimate the Frisch elasticity to be between 0 and 0.5. As such, $\sigma$ is calibrated at $\frac{1}{2}$ – the upper range of the available estimates.\(^{20}\)

The scaling constant $B$ is calibrated such that on average agents in each model work one third of their endowment prior to the normal retirement age. The value of $D$ in the productivity model is calibrated such that seventy percent of individuals retire by the normal retirement age which matches the data.\(^{21}\) Alternatively, the functional form of $D(j, h)$ in the preferences model is calibrated so that this model can generate similar profiles for hours, wages, and retirement. Figure 4 displays the relationship between the calibrated values of $D$ in each model. Note, that the calibration of $D$ in the preferences model implies that the part time employment becomes more attractive relative to full time work as individuals age. However, individuals eventually retire since retirement involves no disutility costs. Lastly, the discount factor $\beta$ is calibrated to 0.996 such that the capital-to-output ratio matches U.S. data of 2.7.

4.2 Government

Government spending in the unproductive sector is set to 17 percent of GDP in the steady state, so that $G/Y = 0.17$. A host of literature is followed in using the three

\(^{18}\)This utility function that is additively separable in labor and consumption is used since Peterman (2013) and Conesa et al. (2009) demonstrate that when leisure, instead of labor, enters the utility function that the Frisch labor supply elasticity on the intensive margin is not constant over the lifetime and can affect the economy.

\(^{19}\)See for example, Kaplan (2012), Altonji (1986), MaCurdy (1981), Domeij and Floden (2006) or Browning et al. (1999). However, more recent research shows that these estimates may be biased downward (see Imai and Keane (2004), Domeij and Floden (2006), Pistaferri (2003), Chetty (2009), and Contreras and Sinclair (2008))

\(^{20}\)We note that estimates of the Frisch elasticity from simulated data in this model would be larger than 0.5 due to changes in the wages affecting an individuals P.I.A. However, Peterman (2012) demonstrates that the increase in elasticity from endogenously determined social security benefits is small.

Table 2: Calibration Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Demographics:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal Retirement Age: $j_{exog}$</td>
<td>66</td>
<td>By Assumption</td>
</tr>
<tr>
<td>Max Age: $J$</td>
<td>100</td>
<td>By Assumption</td>
</tr>
<tr>
<td>Surv. Prob: $\Psi_j$</td>
<td></td>
<td>Bell and Miller (2002)</td>
</tr>
<tr>
<td>Pop. Growth: $n$</td>
<td>1.1%</td>
<td>Conesa et al. (2009)</td>
</tr>
<tr>
<td><strong>Firm Parameters:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\alpha$</td>
<td>.36</td>
<td>Data</td>
</tr>
<tr>
<td>$\delta$</td>
<td>8.33%</td>
<td>$\frac{I}{Y} = 25.5%$</td>
</tr>
<tr>
<td>$A$</td>
<td>1</td>
<td>Normalization</td>
</tr>
<tr>
<td><strong>Preference Parameters:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conditional Discount: $\beta$</td>
<td>0.996</td>
<td>$\frac{K}{Y} = 2.7$</td>
</tr>
<tr>
<td>Risk aversion: $\gamma$</td>
<td>2</td>
<td>Conesa et al. (2009)</td>
</tr>
<tr>
<td>Frisch Elasticity: $\sigma$</td>
<td>0.5</td>
<td>Intensive Frisch= $\frac{1}{2}$</td>
</tr>
<tr>
<td><strong>Productivity Parameters:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Permanent Shock: $\sigma^2_z$</td>
<td>0.065</td>
<td>Kaplan (2012)</td>
</tr>
<tr>
<td>Transitory Shock: $\sigma^2_t$</td>
<td>0.081</td>
<td>Kaplan (2012)</td>
</tr>
<tr>
<td>Persistence: $\rho$</td>
<td>0.958</td>
<td>Kaplan (2012)</td>
</tr>
<tr>
<td>Persistence Shock: $\sigma^2_{\nu}$</td>
<td>0.017</td>
<td>Kaplan (2012)</td>
</tr>
<tr>
<td><strong>Government Parameters:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Upsilon_0$</td>
<td>.258</td>
<td>Gouveia and Strauss (1994)</td>
</tr>
<tr>
<td>$\Upsilon_1$</td>
<td>.768</td>
<td>Gouveia and Strauss (1994)</td>
</tr>
<tr>
<td>$G/Y$</td>
<td>17%</td>
<td>Conesa et al. (2009)</td>
</tr>
<tr>
<td><strong>Social Security:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\kappa_{1a}$</td>
<td>6.7%</td>
<td>U.S. SS Program</td>
</tr>
<tr>
<td>$\kappa_{1b}$</td>
<td>5%</td>
<td>U.S. SS Program</td>
</tr>
<tr>
<td>$\kappa_2$</td>
<td>8%</td>
<td>U.S. SS Program</td>
</tr>
<tr>
<td>$\tau_{r1}$</td>
<td>90%</td>
<td>U.S. SS Program</td>
</tr>
<tr>
<td>$\tau_{r2}$</td>
<td>32%</td>
<td>U.S. SS Program</td>
</tr>
<tr>
<td>$\tau_{r3}$</td>
<td>15%</td>
<td>U.S. SS Program</td>
</tr>
<tr>
<td>$b_1$</td>
<td>.21 x Avg Earnings</td>
<td>Huggett and Parra (2010)</td>
</tr>
<tr>
<td>$b_2$</td>
<td>1.29 x Avg Earnings</td>
<td>Huggett and Parra (2010)</td>
</tr>
<tr>
<td>$b_3$</td>
<td>2.42 x Avg Earnings</td>
<td>Huggett and Parra (2010)</td>
</tr>
<tr>
<td>$\tau_{ss}$</td>
<td>10.0%</td>
<td>Mrkt Clearing</td>
</tr>
</tbody>
</table>
Figure 4: Disutility costs of working in productivity and preference models.

parameter tax function from Gouveia and Strauss (1994) to calculate the income taxes over the taxable income for each individual.

\[ T(\tilde{y}_t; \gamma_0, \gamma_1, \gamma_2) = \gamma_0(\tilde{y}_t - (\tilde{y}_t^{-\gamma_1} + \gamma_2)^{-\frac{1}{\gamma_1}}), \] (17)

These parameters are set to the estimates in Gouveia and Strauss (1994). Similar to Conesa et al. (2009), the scaling factor \( \gamma_2 \) is solved for such that in steady state income taxes equal government spending.

### 4.3 Social Security

The NRA is set at 66 to match the normal retirement age for current individuals considering retirement. Following the current U.S. social security system, the early
retirement age $R$ is set at 62 while the maximum age over which delay retirement credits can be accrued is set at 69. As discussed above, it is assumed that by age 70 all agents in the economy begin collecting benefits. The early benefit claiming percentage penalty, $\kappa_1$ is based on the actual value in the U.S. Social Security system and is set at 6.7 percent ($\kappa_{1a}$) for the first three years of early recipiency and is set at 5 percent ($\kappa_{1b}$) for prior years. The delayed claiming credit, $\kappa_2$ is set at 8 percent per annum. The marginal replacement rates in the progressive social security payment schedule ($\tau_{r1}$, $\tau_{r2}$, $\tau_{r3}$) are also set at their actual respective values of 0.9, 0.32 and 0.15. Finally, Huggett and Parra (2010) are followed in setting the bend points and the maximum earnings $y_{max}$ equal to the actual multiples of mean earnings used in the U.S. social security system so that the bend points $b_1$ and $b_2$ occur at 0.21 and 1.29 times average earnings in the economy. The third implicit bend point $b_3$ and the maximum taxable earnings by social security, $y_{max}$ are equal to 2.42 times average earnings in the economy. In equilibrium, $\tau_{ss} = 10\%$ is calibrated to balance the government’s budget.

5 Results

5.1 Comparison of steady states

As mentioned in the previous section the models are calibrated to replicate similar profiles of hours, wages, and retirement. Figure 5 displays how the models resemble each other along these dimensions and how they match the data. Notably, both models have nearly identical predictions for the profile of retirement, while average observed wages and hours worked (including zero hours worked) line up quite well. Table 3 confirms that any minor differences in these average profiles have no aggregate consequences as output, capital, and effective labor are virtually identical across the two economies.
Figure 5: Profiles of hours, wages, and retirement across models and data.

Table 3: Comparison of steady state aggregates across models.

<table>
<thead>
<tr>
<th></th>
<th>Y</th>
<th>K</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Productivity Model</td>
<td>1.19</td>
<td>3.20</td>
<td>0.68</td>
</tr>
<tr>
<td>Preference Model</td>
<td>1.19</td>
<td>3.19</td>
<td>0.68</td>
</tr>
</tbody>
</table>

However, beneath these similarities in averages and aggregates lie micro level differences. Figure 6 shows the fraction of employed individuals working full and part time across models and in the data. These figures show that the rise in part time work with age is more pronounced in the preferences model. Importantly, this is in spite of
the fact that both models were calibrated to match the same moments, none of which directly pertained to part time work. Looking at the profile of part time employment in the data suggests the preferences model may be a more accurate description of reality as this model mimics the rise and persistence of part time employment later in life.

An important consequence of this difference is that the preferences model displays a higher variance of observed wages, as seen in figure 7. The intuition connecting the variance profiles with the profiles of part time work is straightforward. Across models the exogenous sources of wage variation, by age, are the same. Namely, the variance of transitory and persistent shocks are the same across models. However, the preferences model has an additional source of wage variation, which is the productivity penalty for part time work \( \phi \). This source of variation is amplified as more individuals become

![Figure 6: Percent of employed population working full versus part time across models and data.](image)
part time employed while others remain full time employed, which is what figure 6 depicts. Thus, these figures not only reveal that the amount of wage variation across models differs, but so does it source. Importantly, the additional observed variation in the preferences model stems from the endogenous decision of working part time at a lower wage rate. These results also highlight that to the extent that both models should match the same profile of observed wage variation, the procedure used to calibrated the productivity processes is incorrect for at least two reasons. First, the selection of who chooses to work at a given wage may vary across models. Second, the preferences model has an additional source of wage variation that is endogenous, which is the productivity penalty when individuals choose part time work.

Figure 7: Variance of observed wages across models
5.2 Policy experiments

5.2.1 Eliminating social security

This section discusses the implications of eliminating social security across models. This experiment is a natural starting point given the focus on labor supply near retirement and is akin to the experiments in French (2005). The results suggest that eliminating social security in either model has similar aggregate and welfare consequences. However, as shown below, some of this similarity reflects how the labor productivity processes were calibrated.

Table 4 displays how output, capital, and effective labor change in both models once social security is eliminated. The table shows that across models aggregate labor supply increases by roughly 4 percent as individuals work more given the loss of wealth. A consequence of this is that the capital stock increases since the crowding out of private investment, which social security induces, is eliminated. Both of these effects lead to an increase of output of roughly 19 percent across models.

Table 4: Comparison of aggregates across models when social security is eliminated.

<table>
<thead>
<tr>
<th></th>
<th>Y</th>
<th>K</th>
<th>N</th>
<th>(\tau_{ss})</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Productivity Model</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Benchmark</td>
<td>1.19</td>
<td>3.20</td>
<td>0.68</td>
<td>0.1</td>
</tr>
<tr>
<td>No Social Security</td>
<td>1.42</td>
<td>4.85</td>
<td>0.71</td>
<td>0</td>
</tr>
<tr>
<td><strong>Preferences Model</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Benchmark</td>
<td>1.19</td>
<td>3.19</td>
<td>0.68</td>
<td>0.1</td>
</tr>
<tr>
<td>No Social Security</td>
<td>1.43</td>
<td>4.95</td>
<td>0.71</td>
<td>0</td>
</tr>
</tbody>
</table>

Figure 8 displays how the labor supply and retirement profiles change in the two models given the elimination of social security. Importantly, average hours increase by slightly more in the productivity model while retirement decisions are further delayed in the preferences model. The reason why average hours are higher in the

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22Increasing the normal retirement age by one year was also considered and revealed similar responses across models.
productivity model is shown in figure 9. This figure displays the fraction of the population who is employed full or part time. The fractions do not add up 1 as the remained of the population is retired. As can be seen from the left panel of this figure, full time employment is always higher in the productivity model and this difference is amplified when social security is eliminated. Conversely, part time employment is always higher in the preferences model and difference is also amplified when social security is eliminated. Notably in the preferences model, between the ages of 60 to 69 the fraction of the population who is part time employed remains roughly constant at 40 percent.

![Graph](image)

Figure 8: Labor supply and retirement responses when social security is eliminated.

In terms of welfare, both models also reveal similar gains from eliminating social security. In consumption equivalent variation terms, eliminating social security in either model increases welfare by roughly 10 percent. In other words, an individual must be given a 10 percent increase in consumption per period to be indifferent between living in a model with or without social security.

It is important to note that the similarity of welfare gains across models is sensitive to how the productivity processes were calibrated. Recall that all exogenous wage

---

23This harkens the results of İmrohoroğlu, İmrohoroğlu and Joines (1994).
Figure 9: Fraction of population working full or part time when social security is eliminated.

variation (namely, the persistent and transitory shocks) were calibrated identically in both models. However, the preferences model has an additional source of wage variation that is endogenous, which is the productivity penalty when individuals choose part time work.

To gauge the sensitivity of the welfare results to the differences in wage risk a simple recalibration is performed. In the productivity model the variance of the permanent component of productivity is raised such that the variance of observed wages in both models matches. Doing this reveals smaller welfare gains (8.7 percent in consumption equivalent variation) from eliminating social security in the productivity model. Thus, these results emphasize two points. First, the government’s motive for insuring against wage risk depends on the source of this risk (i.e. endogenous versus exogenous reasons). Second, and related to the first, care must be taken when conducting policy experiments using models with labor productivity processes that were estimated independently from the model in question.
5.2.2 Laffer curve

This section constructs the Laffer curves of each economy. Akin to Rogerson and Wallenius (2009), the results of this section suggest that changes in labor supply late in life stemming from declining productivity or changes in preferences have similar tax implications. Figure 10 displays the government revenue raised when the progressive tax policy is scaled. As can be seen from the figure there is no discernible difference in the curves of each model.

Figure 11 decomposes the previous figure by considering the Laffer curves by age and permanent productivity (ability) type. Focusing on the left panel, the figure reveals that the ability of the government to raise revenue across age groups is virtually identical across models. In both models, the ability to raise revenue from old individuals (i.e. those who have reached full retirement age) is low compared to young individuals. This immediately follows from the availability of taxable labor income from young individuals.

Lastly, the right panel shows that Laffer curves by ability type are also similar across models. As higher ability types have higher earnings and wealth, relative to lower ability types, the government can raise more revenue from them. Meanwhile, because the precautionary savings motive is higher for low ability types they are less responsive to tax changes. Hence, the Laffer curve of low ability types is flatter, relative to high ability types. Taken as a whole, these two panels depict similar tax responsiveness across models.

5.2.3 Optimal taxes

To be added.

\footnote{The x-axis in these figures represents the top marginal tax rate in the economy.}
Figure 10: Laffer curves across models

Figure 11: Laffer curves by age and permanent type across models
6 Conclusion

This paper examines the policy repercussions of changing the mechanism driving the decrease in labor supply late in life. To this end, two life cycle models of labor supply are calibrated and their predictions over a wide set of policy experiments are compared. The first model (productivity model) makes the standard assumption that the declining age-specific component of labor productivity drives labor supply as people age. Meanwhile, the second model (preferences model) assumes that productivity is flat later in life and instead age dependent preferences for work are responsible for labor supply changes with age.

While the models are calibrated to match the same profiles of average wages, hours, and retirement choices, the preferences model has micro level predictions more consistent with actual data. Namely, it generates are larger fraction of individuals working part time prior to retirement. Additionally, because part time work involves a productivity penalty in this model, the cross-sectional variance of wages by age is higher, relative to the productivity model, and persists as individuals flow from part time (and full time) into retirement. This is in spite of the fact that both models are fed the same exogenous process for productivity. Hence, the additional observed wage volatility in the preferences model arises from endogenous choices.

Policy experiments are conducted to gauge the importance of the alternative labor supply mechanisms and the results emphasize the importance of differentiating between endogenous versus exogenous productivity shocks. Specifically, when eliminating social security, welfare improves by roughly the same amount in both models, as the crowding out of private investment is eliminated. A more careful analysis of this result, however, highlights the importance of social security for insuring against exogenous wage variation. Raising the variance of observed wages in the productivity model, by increasing the variance of exogenous shocks, leads to a smaller welfare gain from eliminating social security. Hence, whether wage volatility stems from exogenous reasons (as in the productivity model) versus endogenous reasons (as in the
preferences model) matters for welfare. Thus, the results from the social security experiment call for caution when conducting policy analysis with productivity processes that are estimated outside the model in question.

References


İmrohoroglu et al.


