Wage Risk and the Skill Premium

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The skill premium has increased significantly in the United States in the last five decades. During the same period, individual wage risk has also increased. This paper proposes a mechanism through which a rise in wage risk increases the skill premium. Intuitively, a rise in uninsured wage risk increases precautionary savings, thereby boosting capital accumulation, which increases the skill premium due to capital-skill complementarity. Using a quantitative macroeconomic model, we find that the rise in wage risk observed between 1967 and 2010 increases the skill premium significantly. This finding is robust across a variety of model specifications.

JEL classification: E25, J31.
Keywords: Skill premium, wage risk, capital-skill complementarity, precautionary savings.

Appendix - For Online Publication

A Stationary Recursive Competitive Equilibrium

In order to define a stationary equilibrium, government policies (expenditure, debt and taxes) are assumed not to change over time.

Define the vector of idiosyncratic productivity components by $\mathbf{z_i} = (\theta_i, \varepsilon_i) \in \mathcal{Z}_i$ and let $\mathcal{A} = [0, \infty)$ denote the set of possible asset levels that agents can hold. Let $\mathcal{B}_{\mathcal{A}}$ and $\mathcal{B}_{\mathcal{Z}_i}$ denote Borel $\sigma-$algebras of the sets $\mathcal{A}$ and $\mathcal{Z}_i$ for $i = \{s, u\}$. The state space for type i is defined as $s_i = (\mathbf{z_i}, a) \in \mathcal{S}_i = \mathcal{Z}_i \times \mathcal{A}$. Let $\mathcal{B}_{\mathcal{S}_i} = \mathcal{B}_{\mathcal{Z}_i} \times \mathcal{B}_{\mathcal{A}}$ be the Borel $\sigma-$algebra of the set $\mathcal{S}_i$.

Definition. Stationary Recursive Competitive Equilibrium is value functions, V_u, V_s, policy functions, $c_u, c_s, l_u, l_s, a'_u, a'_s$, the firm's decision rules, K_s, K_e, L_s, L_u, net exports, NX, distributions over productivity-asset types, λ_u, λ_s, and prices, w_u, w_s, r_s, r_e, R, such that, given government policies, $\tau_s, \tau_e, T(\cdot), D, G$, and net-foreign asset position, $NFAP$:

1. The value functions and the policy functions solve the consumer problem given prices and government policies, i.e., for all $i \in \{u, s\}$:

$$
\begin{aligned}
V_i(\mathbf{z_i}, a_i) = \max_{\{c_i, l_i, a_i'\}} \quad & u(c_i, l_i) + \beta\delta E_i[V_i(\mathbf{z_i'}, a_i')] \qquad \text{s.t.} \\
c_i + \delta a_i' \quad & \leq \quad w_i z_i l_i - T(w_i z_i l_i) + R a_i, \\
c_i \geq 0, \quad l_i \quad & \in \quad [0, 1], \quad a_i' \in \mathcal{A},
\end{aligned}
$$

where $R = 1 + (r_s - \delta_s)(1 - \tau_s) = \frac{q + (r_e - q\delta_e)(1-\tau_e)}{q}$ is the after-tax asset return.

2. The firm solves:

$$
\max_{K_s, K_e, L_s, L_u} \qquad F(K_s, K_e, L_s, L_u) - r_s K_s - r_e K_e - w_s L_s - w_u L_u.
$$

3. The distribution λ_i is stationary for each type, i.e. $\forall i = \{s, u\}, \forall s_i \in \mathcal{S}_i, \forall S_i = Z_i \times A \in \mathcal{B}_{\mathcal{S}_i}$, λ_i satisfies

$$
\lambda_i(S_i) \quad = \quad \int_{\mathcal{S}_i} Q(s_i, S_i) d\lambda_i(s_i),
$$

where $Q(s_i, S_i) = \delta I_{\{a_i'(s_i) \in A\}} Pr\{\mathbf{z_i'} \in Z_i | \mathbf{z_i}\} + (1 - \delta) I_{\{0 \in A\}} Pr_0\{\mathbf{z_i'} \in Z_i\}$ and $Pr_0(\cdot)$ is computed according to the initial unconditional distribution of entrants over the persistent component θ_i.

4. Markets clear:

$$
\begin{aligned}
\sum_{i=u,s} \pi_i \int_{\mathcal{S}_i} a_i'(s_i) d\lambda_i(s_i) \quad &= \quad K_s + K_e + D + NFAP, \\
\pi_i \int_{\mathcal{S}_i} z_i l_i(s_i) d\lambda_i(s_i) \quad &= \quad L_i, \quad \forall i \in \{s, u\}, \\
C + G + K_s + K_e + NX \quad &= \quad F(K_s, K_e, L_s, L_u) + (1 - \delta_s) K_s + (1 - \delta_e) K_e,
\end{aligned}
$$

where $C = \sum_{i=u,s} \pi_i \int_{\mathcal{S}_i} c_i(s_i) d\lambda_i(s_i)$ denotes aggregate consumption.

5. The government budget constraint is satisfied:

$$
RD + G = D + \tau_e(r_e - \delta_e) K_e + \tau_s(r_s - \delta_s) K_s + T_{agg},
$$

where $T_{agg} = \sum_{i=u,s} \pi_i \int_{\mathcal{S}_i} T(w_i z_i l_i(s_i)) d\lambda_i(s_i)$ denotes aggregate labor tax revenue.

B Data Construction

Skill Premium. Heathcote, Perri, and Violante (2010) use the Current Population Survey (CPS) administered by the U.S. Census Bureau and the U.S. Bureau of Labor Statistics data to compute the skill premium for 1967-2005, with subsequent work extending the series to 2016. They focus on the population of working age males aged 25-60 with at least 260 working hours per year. They drop individuals giving inconsistent answers to questions about labor income and hours worked (i.e. those who claim they received labor income, but who did not work or vice versa) and individuals whose hourly wage rate is less than half of the federal minimum wage.

Skill Biased Technical Change. We use the declining price of equipment as a measure of skill biased technical change. The price of equipment is calculated using the series PERIC (Relative Price of Equipment, Index 2009=1, Annual, Seasonally Adjusted) in the Federal Reserve Economic Data (FRED) database as reported by the Federal Reserve Bank of St. Louis (2021), which is an update of the time series constructed in DiCecio (2009). We normalize the price of equipment to 1 for the decade 1967-1976 and recover the corresponding value for 2001-2010. These values are used for the two steady states representing 1967 and 2010.

Fraction of Skilled Agents. The fraction of skilled agents is calculated using Current Population Survey (CPS) of the U.S. Census Bureau (2021). There was a change in terms of how CPS reports educational attainment in 1992. We follow Krusell, Ohanian, Ríos-Rull, and Violante (2000) and define the fraction of skilled agents as follows. For 1967, it is the ratio of males aged 25 and older with earnings and 4 years or more of college divided by the total number of males aged 25 and older with earnings in Table P-17. For 2010, it is the ratio of males aged 25 and older with earnings and a bachelor's degree or more divided by the total number of males aged 25 and older with earnings in Table P-16.

Government Consumption-to-GDP ratio. The government consumption-to-output ratio is recovered from the National Income and Product Accounts (NIPA) database of the U.S. Bureau of Economic Analysis (2021). It is defined as the ratio of nominal government consumption expenditure (line 16 in NIPA Table 3.1) to nominal GDP (line 1 in NIPA Table 1.1.5).

Government-debt-to-GDP ratio. The government-debt-to-GDP ratio for the 1967 and 2010 U.S. economy for the open economy exercise is taken directly from FRED. We use their time series called FYGFGDQ188S (Federal Debt Held by the Public as Percent of Gross Domestic Product, Percent of GDP, Quarterly, Seasonally Adjusted). This time series includes U.S. debt held by foreign and international investors. This time series is quarterly. We construct the annual statistics by averaging over the particular year. The earliest data is available for 1970, so we use 1970 government-debt-to-GDP ratio in place of the 1967 value. This value is approximately 26%. The value for 2010 is approximately 60%.

Labor share. The labor share is computed from NIPA using the methodology described in Ríos-Rull and Santaeulàlia-Llopis (2010) and for details, we refer the reader to that paper. It offers several alternative ways of calculating the labor share. We use the following: we first calculate what Ríos-Rull and Santaeulàlia-Llopis (2010) call "unambiguously capital income" and "unambiguously labor income." Income which cannot be unambiguously classified as labor or capital income is then divided between capital and labor using the ratio between capital and labor income in unambiguously assigned income. To get the labor share, labor income is then divided by GNP.

Capital-to-output ratio. Housing is excluded from both output and capital when calculating the capital-to-output ratio. For this calculation, output is defined using Table 1.5.5 in NIPA as GDP (line 1) net of Housing and utilities (line 16) and Residential investment (line 41). Capital stock is calculated using the Fixed Asset Tables (FAT), Table 1.1 as the sum of the stocks of private and government structure and equipment capital (line 5 + line 6 + line 11 + line 12).

Net Foreign Asset Position as a Fraction of National Wealth. The net foreign asset position of the United States as a fraction of U.S. National Wealth is constructed using quarterly data from the Flow of Funds tables as reported by the FRED Database. Specifically, the Net Foreign Asset Position in a quarter equals the difference between Rest of the World Total Liabilities and Equity (which stands for foreign assets held by Americans) reported by series ROWTLEQ027S minus Rest of the World Total Financial Assets (which stands for American assets held by foreigners) reported by series ROWTASQ027S. The U.S. national wealth equals U.S. wealth (series BOGZ1FL892090005Q) minus U.S. government capital (series BOGZ1LM212010095Q for state and local governments plus series BOGZ1LM315015005Q for federal government). We subtract government capital as the government does not own any capital stock in our model. Calculating the net foreign asset position over national wealth this way gives 1.8% for 1967 and -5.4% for 2010. For both years, annual values are calculated by averaging over four quarterly values.

Gross National Saving Rate. The gross national saving rate is taken from the FRED database. The specific time series is called W206RC1Q156SBEA.

C 1980 Steady State

This Appendix explains the parameters that are used in the computation of the 1980 steady state. The only parameters whose values change relative to 1967 steady state are those regarding the five factors that are important for the determination of the skill premium. The values of these parameters are changed from their 1967 values to 1980 values. Table 11 reports the parameter values for technology, relative supply of skilled workers, wage risk parameters, and government policy parameters that we feed in to compute the 1980 steady state. The column entitled 1967 reports the values of these parameters in 1967 for comparison purposes. The data sources for these parameters are the same as in the baseline calibration. Similar to the 1967 benchmark, the price of equipments, the wage shock parameters, and tax rates on equipment and structures are the averages over a ten-year period (1980-1989), and the labor tax progressivity parameter as well as the fraction of skilled workers are the values in 1980. The labor tax parameter χ is set so that the government budget clears. The interest rate is 3.78% to guarantee that the U.S. NFAP-to-national wealth ratio equals 2.3% in 1980 as in data. The rest of the parameters of the model, which are kept the same as in the 1967 steady state, are not reported here and can be found in Table 1.

D Insurance

One way economists measure insurance is by computing the degree of pass-through from earnings to consumption. Formally, the pass-through coefficient from earnings to consumption is defined as the regression coefficient b of the following panel regression:

$$\Delta c_{j,t} = b\Delta y_{j,t} + \epsilon_{j,t},$$

where $\Delta c_{j,t}$ denotes change in individual j's log consumption between $t-1$ and t and $\Delta y_{j,t}$ denotes the same individual's change in log earnings. The estimated coefficient b is expected to take values between 0 and 1. A pass-through coefficient of 0 would mean perfect insurance, whereas that of 1 would imply no insurance.

Computing the pass-through coefficient using model generated data, we find it to be 0.18 in the 1967 steady state. This value is close to the pass-through coefficients implied by Blundell, Pistaferri, and Preston (2008), BPP henceforth, who use the Panel Study of

Table 11: Benchmark Parameters for the 1980 Steady State

Parameter	Symbol	1967	1980	Source
Technology				
Price of equipment capital	q	1	0.5795	D, FRED
Demography				
Fraction of skilled workers	π_s	0.1356	0.2127	CPS
Residual wage risk				
Skilled agents				
Variance of the transitory shock	$\sigma^2_{s,\varepsilon}$	0.0201	0.0412	HSY
Variance of the persistent shock	$\sigma^2_{s,\kappa}$	0.0089	0.0141	HSY
Unskilled agents				
Variance of the transitory shock	$\sigma^2_{u,\varepsilon}$	0.0259	0.0594	HSY
Variance of the persistent shock	$\sigma^2_{u,\kappa}$	0.0073	0.0112	HSY
Government polices				
Labor tax progressivity	τ_l	0.124	0.160	FN
Overall structure capital tax	τ_s	0.567	0.584	A
Overall equipment capital tax	τ_e	0.499	0.337	A
Government debt	D/Y	0.26	0.24	FRED

This table reports the benchmark parameters taken directly from the literature or the data. The column entitled '1967' and '2010' report the values of these parameters for the 1967 and 2010 steady states, respectively. The acronyms A, D, FN, and HSY stand for Auerbach (1983), DiCecio (2009), Ferrière and Navarro (2018), and Hong, Seok, and You (2019), respectively. CPS and FRED stand for the Current Population Survey of the U.S. Census Bureau (2021), and the Federal Reserve Economic Data database of the Federal Reserve Bank of St. Louis (2021), respectively.

Income Dynamics and Consumer Expenditure Survey data to analyze the evolution of the extent of partial insurance in the United States in the 1980s and early 1990s. Replicating the simple regression above gives an average value of around 0.2 for the pass-through from consumption to earnings in the 1980s in their work. We also calculate the pass-through coefficient in the 2010 steady state and find it to be 0.17. This decline in pass-through is also in line with BPP, who find that the consumption pass-through of earnings declined in the 1990s.

BPP also compute the pass-through separately for transitory and permanent income shocks. For comparison, we compute the pass-through of the transitory and persistent wage shocks individually by estimating the following regression equation on model generated data:[1]

$$\Delta c_{j,t} = b^{trans} \Delta w_{j,t}^{trans} + b^{pers} \Delta w_{j,t}^{pers} + \epsilon_{j,t},$$

$\Delta w_{j,t}^{trans}$ denotes the log change in the transitory wage component and $\Delta w_{j,t}^{pers}$ the log change in the persistent wage component. We find that b^{trans} equals 0.20 in both the 1967 and 2010 steady states and b^{pers} equals 0.67 in 1967 and 0.65 in 2010. Indeed, these results indicate that individuals are better insured against transitory shocks and are also quantitatively in line with BPP, who report a pass-through of 0.64 for permanent income shocks and 0.05 for transitory income shocks.

The fact that pass-through is slightly larger for transitory *wage* shocks in our model than for transitory *income* shocks in BPP also makes sense, since a positive wage shock induces people to take advantage of the (temporarily) higher wages and increase their labor supply, meaning that the same consumption change is associated with a larger change in income than in wages.

Overall we conclude that the fact that our model generates reasonable pass-through values suggests that through endogenous labor supply, progressive taxation and self-insurance the model provides a realistic degree of insurance opportunities.

E Sensitivity Analysis

E.1 Sensitivity to Risk Aversion

The link between the wage risk and the skill premium works through precautionary savings in the proposed mechanism. It is then natural to expect that the strength of this mechanism may depend on the degree of risk aversion. The aim of this section is to measure how

[1] BPP estimate the impact of *income* shocks, while we directly estimate the impact of *wage* shocks. Another difference is that the wage shocks in our model are *persistent* rather than *permanent*.

Table 12: Risk Aversion

σ	1967	2010	Only Risk	All But Risk
1	1.500	1.876	1.540	1.853
2	1.500	1.905	1.600	1.845
3	1.500	1.948	1.684	1.835

The second row of this table reports the skill premia in the model for the benchmark analysis with $\sigma = 2$. The first two columns report the skill premium in the 1967 and the 2010 steady states. The column 'Only Risk' reports the skill premium in the counterfactual exercise in which wage risk parameters are set to their 2010 values but all other factors remain at their 1967 values. The column 'All but Risk' reports the skill premium in the exercise in which wage risk parameters are set to their 1967 values, while the parameters that control all other factors are at their 2010 values. The first and third rows report the same set of values for $\sigma = 1$ and $\sigma = 3$ cases.

sensitive our results are to the degree of risk aversion. To this end, this section repeats the main quantitative exercises for relative risk aversion coefficients of $\sigma = 1$ and $\sigma = 3$, in addition to the benchmark value of $\sigma = 2$. We recalibrate the internally calibrated parameters for each σ exercise. The results of the quantitative exercises are presented in Table 12.

Each row in Table 12 reports our findings for a different level of σ. The column entitled 2010 reports the model's prediction of the skill premium when all factors change to their 2010 levels. This column reveals that while the $\sigma = 1$ case falls somewhat short of explaining the overall rise of the skill premium, the $\sigma = 3$ model overshoots this rise. The last two columns show that the effect of the rise in wage risk on the skill premium increases as the risk aversion parameter increases.

E.2 Sensitivity to Elasticity of Labor Supply

This section analyzes the robustness of our results with respect to the elasticity of labor supply. Given our preference choice, the elasticity of labor supply in the model is given by $1/\gamma$. In the benchmark exercise, we use $\gamma = 2$, which implies a labor supply elasticity of 0.5 and is reported in the middle row of Table 13. The last row of the table reports our findings for a higher labor supply elasticity of 0.75 as suggested by Chetty, Guren, Manoli, and Weber (2011) while the first row reports them for a lower elasticity level. We find that our results are robust to a wide range of labor supply elasticity values.

F Endogenous Skill Supply

In the baseline environment, the fraction of skilled and unskilled agents are assumed to be fixed since the main focus of this paper is the relative prices of labor given the observed

Table 13: Elasticity of Labor Supply

$1/\gamma$	1967	2010	Only Risk	All But Risk
0.25	1.500	1.901	1.597	1.843
0.5	1.500	1.905	1.600	1.845
0.75	1.500	1.907	1.602	1.846

The second row of the table reports the skill premia in the model for the benchmark analysis with $\gamma = 2$. The first two columns report the skill premium in the 1967 and the 2010 steady states. The column 'Only Risk' reports the skill premium in the counterfactual exercise in which wage risk parameters are set to their 2010 values but all other factors remain at their 1967 values. The column 'All but Risk' reports the skill premium in the exercise in which wage risk parameters are set to their 1967 values, while the parameters that control all other factors are at their 2010 values. The first and third rows report the same set of values for $\gamma = 4$ and $\sigma = 4/3$ cases.

relative supply of skilled agents. In particular, in the counterfactual exercise in which only risk changes, we do not allow for skill supplies to change. This section provides an alternative measure of how much the rise in wage risk affects the skill premium, which takes into account the effect of the rise in risk on people's education decisions. We find that the effect of the rise in wage risk on the skill premium remains significant when the education decision is endogenous.

F.1 Model with Endogenous Skill Supply

In this version of the model, agents make education decisions at the beginning of their lives, just before they enter the labor market and before they draw the first wage shocks. They can choose to pursue a college degree, in which case they become skilled agents or a lower level of education, in which case they become unskilled agents. As before, skilled agents can only work in the skilled labor sector, and unskilled agents only in the unskilled labor sector. As in Heathcote, Storesletten, and Violante (2010), there is a utility cost of attaining a college degree, ψ, which is idiosyncratic and drawn from a distribution $H(\psi)$. This distribution is a reduced form way of capturing the cross-sectional variation in the psychological and pecuniary costs of acquiring a college degree such as variation in scholastic talent, tuition fees, parental resources, access to credit, and government aid programs.

Upon drawing the cost of education, ψ, the agent compares this cost to the benefit of attaining a college degree, which is simply the net present utility gain of receiving the skilled wage rather than the unskilled wage in each date and state after entering the labor market. Let $E_{i,0}[V_i(z_i, 0)]$ be the beginning of the lifetime expected utility of an agent who chooses education level i, where the expectation is taken over the set of possible productivity realizations at age 0. The benefit of acquiring a college degree is given by $E_{s,0}[V_s(z_s, 0)] -$

Table 14: Endogenous Skill Supply

			Exogenous		Endogenous	
	1967	2010	Only Risk	All but Risk	Only Risk	All but Risk
Skill premium	1.500	1.905	1.600	1.845	1.582	1.848
Fraction skilled	13.56%	31.69%	13.56%	31.69%	13.72%	31.62%

This table reports the skill premium along with the fraction of skilled agents in the model economy. The first and second columns report these variables for the 1967 and the 2010 steady states. The first column of the panel 'Exogeneous' reports these variables for the counterfactual exercise in which only wage risk changes in the benchmark exogenous skill supply economy ('Only Risk'). The second column of that panel reports them for the counterfactual exercise in which all factors are set to their 2010 values but wage risk parameters are at their 1967 values ('All but Risk'). The panel 'Endogeneous' report the values of the same set of variables for the endogenous skill supply economy. Numbers may not add up due to rounding.

$E_{u,0}[V_u(z_u,0)]$. Therefore, an individual attends college if and only if

$$E_{s,0}[V_s(z_s,0)] - E_{u,0}[V_u(z_u,0)] \geq \psi.$$

Since people choose whether to become skilled or not, the fraction of skilled people in the economy, π_s, which was a parameter in the baseline model, becomes an endogeneous variable in this section. The rest of the economic environment is identical to the one developed in Section 2 of the paper and will not be described here.

To conduct quantitative work, the cost distribution for attending college needs to be specified. We assume that the utility cost of attending college is distributed according to an exponential distribution with parameter m, a pdf, $h(\psi) = me^{-m\psi}$, and a cdf, $H(\psi) = 1-e^{m\psi}$. For the marginal agent who chooses to go to college, the cost of attending college exactly equals the benefit of doing so, $\bar{\psi} := E_{s,0}[V_s(z_s,0)] - E_{u,0}[V_u(z_u,0)]$. The total measure of agents who face an education cost that is at most $\bar{\psi}$ is equal to 0.1356 in 1967. Thus, we calibrate m by setting $H(\bar{\psi}) = 0.1356$.[2]

F.2 Results

The result of the "Only Risk" counterfactual exercise under endogenous skill supply is reported in the penultimate column of Table 14. For comparison purposes, the table also reports the same exercise for the benchmark case with exogenous skill supplies in the third column of Table 14. The effect of the rise in wage risk on the skill premium is smaller in the endogenous skill supply exercise (8 vs. 10 percentage points). This happens because when

[2]The quantitative results are almost identical if, instead of being exponential, the utility cost distribution H is assumed to be uniform $U[0,m]$ and one calibrates m to the same target, i.e. so that $H(\bar{\psi}) = 0.1356$.

the skill premium increases in response to rise in wage risk, a higher fraction of the population attends college (13.72% vs. 13.56%), which then dampens the rise of the skill premium. We obtain a similar result when we consider the “All but Risk” counterfactual exercise. With endogenous skill supply, the effect of wage risk on the skill premium is slightly smaller than its effect in the case of exogenous skill supply. They both round up to 6 percentage points.

G Role of Wealth Inequality

This section lays out the details of the calibration of the model with heterogeneity in discount factors and a positive borrowing limit. The benchmark parameters reported in Table 1 are kept the same as in the baseline model. Table 15 reports the internally calibrated for the 1967 steady state. Within each skill type, people can have one of two discount factors. The population share of the two discount factors within each skill type is 0.5. In total, there are 4 discount-factor groups and their discount factors are set to match 4 targets. Loosely speaking, the average size of the discount factors controls the capital-to-output ratio, the difference between discount factors across groups controls the average wealth of the skilled relative to the unskilled, and the heterogeneity of the discount factors within each skill type controls the within group wealth heterogeneity. The borrowing limit $\bar{a}$ is set so that approximately 15% of people hold negative wealth. The parameters in the panel called *Common parameters* are present in the both the baseline model and the heterogenous discount factor model, and we recalibrate them to match the same targets. As in the baseline, the equilibrium interest rate clears the asset market with a U.S. NFAP-to-wealth ratio being equal to 1.8%.

For the 2010 model, we first set all exogenous parameters to their 2010 values, as summarized in Table 1. We then set the NFAP-to-wealth ratio to its 2010 value, -5.4%, and solve for the equilibrium interest rate. We also set the labor tax function parameter so that the government budget clears in the 2010 steady state. Unlike in the baseline analysis, we recalibrate the four discount factors to match the 2010 values of the relevant targets to ensure that the model not only matches the levels of wealth inequality moments but also their changes. The 2010 calibration is summarized in Table 16.

Table 15: Internally Calibrated Parameters for Heterogenous Discount Factor Model 1967

Parameter	Symbol	Value	Target	Data & SRCE	Source
Discount factors					
Discount factor	$\beta_{s,h}$	0.9778	Capital-to-output ratio	1.87	NIPA, FAT
Discount factor	$\beta_{s,l}$	0.9530	Wealth Gini skilled	0.75	K
Discount factor	$\beta_{u,h}$	0.9673	Wealth Gini unskilled	0.79	K
Discount factor	$\beta_{u,l}$	0.9427	Skilled-unskilled wealth	3.35	K
Borrowing constraints					
Borrowing limit	$\bar{a}$	0.0124	Agents with negative wealth	15%	HSV
Common parameters					
Production parameter	ω	0.7904	Labor share	0.67	NIPA
Production parameter	ν	0.4540	Skill premium	1.5	HPV
Disutility of labor	ϕ	12.3524	Labor supply	1/3	
Tax function parameter	χ	0.8808	Gvt. budget balance		

This table reports the calibration procedure of the heterogeneous-discount-factor model for 1967. FAT and NIPA stand Fixed Asset Tables, and National Income and Product Accounts of the U.S. Bureau of Economic Analysis (2021), respectively. HSV stands for Heathcote, Storesletten, and Violante (2010), HPV for Heathcote, Perri, and Violante (2010), and K for Kuhn and Rios-Rull (2016).

Table 16: Internally Calibrated Parameters for Heterogenous Discount Factor Model 2010

Parameter	Symbol	Value	Target	Data & SRCE	Source
Discount factor	$\beta_{s,h}$	0.9767	Capital-to-output ratio	2.10	NIPA, FAT
Discount factor	$\beta_{s,l}$	0.9014	Wealth Gini Skilled	0.79	K
Discount factor	$\beta_{u,h}$	0.9611	Wealth Gini Unskilled	0.81	K
Discount factor	$\beta_{u,l}$	0.8150	Skilled-unskilled wealth	5.10	K
Tax function parameter	χ	0.8288	Gvt. budget balance		

This table reports the calibration procedure of the heterogeneous-discount-factor model for 1967. FAT and NIPA stand Fixed Asset Tables, and National Income and Product Accounts of the U.S. Bureau of Economic Analysis (2021), respectively, and K for Kuhn and Rios-Rull (2016).

References

Auerbach, A. J. (1983): "Corporate Taxation in the United States," *Brookings Papers on Economic Activity*, 14(2), 451–514.

Blundell, R., L. Pistaferri, and I. Preston (2008): "Consumption Inequality and Partial Insurance," *American Economic Review*, 98(5), 1887–1921.

Chetty, R., A. Guren, D. Manoli, and A. Weber (2011): "Are Micro and Macro Labor Supply Elasticities Consistent? A Review of Evidence on the Intensive and Extensive Margins," *American Economic Review*, 101(3), 471–75.

DiCecio, R. (2009): "Sticky wages and sectoral labor comovement," *Journal of Economic Dynamics and Control*, 33(3), 538–553.

Federal Reserve Bank of St. Louis (2021): "Federal Reserve Economic Data," https://fred.stlouisfed.org/. Last accessed: 2021-12-21. For details, see the readme.pdf file in the replication package.

Ferrière, A., and G. Navarro (2018): "The Heterogeneous Effects of Government Spending: It's All About Taxes," International Finance Discussion Papers 1237, Board of Governors of the Federal Reserve System (U.S.).

Heathcote, J., F. Perri, and G. L. Violante (2010): "Unequal We Stand: An Empirical Analysis of Economic Inequality in the United States: 1967–2006," *Review of Economic Dynamics*, 13(1), 15–51.

Heathcote, J., K. Storesletten, and G. L. Violante (2010): "The Macroeconomic Implications of Rising Wage Inequality in the United States," *Journal of Political Economy*, 118(4), 681–722.

Hong, J. H., B. H. Seok, and H. M. You (2019): "Wage Volatility and Changing Patterns of Labor Supply," *International Economic Review*, 60(2), 595–630.

Krusell, P., L. E. Ohanian, J.-V. Ríos-Rull, and G. L. Violante (2000): "Capital-Skill Complementarity and Inequality: A Macroeconomic Analysis," *Econometrica*, 68(5), 1029–1054.

Kuhn, M., and J.-V. Rios-Rull (2016): "2013 Update on the U.S. Earnings, Income, and Wealth Distributional Facts: A View from Macroeconomics," *Quarterly Review*, (April), 1–75.

Ríos-Rull, J.-V., and R. Santaeulàlia-Llopis (2010): "Redistributive shocks and productivity shocks," *Journal of Monetary Economics*, 57(8), 931–948.

U.S. Bureau of Economic Analysis (2021): "National Income Accounts," https://apps.bea.gov/iTable/. Last accessed: 2021-12-21. For details, see the readme.pdf file in the replication package.

U.S. Census Bureau (2021): "Current Population Survey," https://www.census.gov/data/tables/time-series/demo/income-poverty/historical-income-people.html. Last accessed: 2021-12-21. For details, see the readme.pdf file in the replication package.