# Discount Rates, Labor Market Dynamics and Income Risk

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# Motivation

#### What we know:

- Recessions have persistent effects on worker earnings:
  - Earnings growth becomes more left-skewed, job loss important.
  - ► Increase in inequality at the bottom.
  - ► Sensitivity is U-shaped as function of income.
- Unemployment fluctuations only weakly uncorrelated with measured productivity.
- Time-varying discount rates can generate significant fluctuations in unemployment.

### Question:

• How do discount rates impact worker earnings?

1. New Facts: Worker earnings respond differently to aggregate shocks:

- Earnings of top workers more sensitive to TFP shocks
- Earnings of bottom workers more sensitive to DR shocks

#### 2. New Model:

- Quantitatively accounts for these facts.
- Links discount rates to worker earnings risk and inequality.
- ► Key ingredients:
  - · directed labor search
  - wage smoothing
  - limited commitment.

### Empirics: Exposure of Workers to Aggregate Fluctuations

Model

Model Implications

Calibration and Fit

Mechanisms

Additional (Non-Targeted) Predictions

# Sensitivity of Worker Earnings to the Business Cycle



Source: Guvenen, Schulhofer-Wohl, Song, and Yogo, 2017

# **Discount Rate and Cashflow Shocks**

Campbell-Shiller decompose stock market returns into discount rate and cashflow news

$$\underbrace{r_t - \mathbb{E}_{t-1} r_t}_{\equiv N_{MKT,t}} = \underbrace{\Delta \mathbb{E}_t \sum_{s=0}^{\infty} \rho^s \Delta d_{t+s}}_{\equiv N_{CF,t}} - \underbrace{\Delta \mathbb{E}_t \sum_{s=1}^{\infty} \rho^s r_{t+s}}_{\equiv N_{DR,t}}.$$

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Identify discount rate news through local projections of future market returns

on a set of traded factors

$$\sum_{s=1}^{S} \rho^{s} r_{t+s}^{mkt} = a \Omega_{t-1} + \underbrace{\sum_{k=1}^{N} w_{k} f_{k,t}}_{\equiv N_{DR,t}} + \eta_{t}.$$

•  $\Omega_{t-1}$  includes: short rate, term spread, past return, smoothed P/E ratio

Estimated discount rate shocks strongly predict future stock returns across different horizons / assets DR shocks and future returns OR shocks and future returns of high-vs low-beta firms

Administrative Data: 5% random sample of all workers from the LEHD matched to Compustat firms, 1990 - 2020

Main outcome variable: growth in cumulative age-adjusted W2 earnings:

 $g_{i,t:t+h} \equiv w_{i,t+1,t+h} - w_{i,t-2,t},$ 

where

$$w_{i,\tau_1,\tau_2} \equiv \log\left(\frac{\sum_{\tau=\tau_1}^{\tau_2} \text{W-2 earnings}_{i,\tau}}{\sum_{\tau=\tau_1}^{\tau_2} D(\text{age}_{i,\tau})}\right).$$

Heterogeneity: Examine workers separately as a function of their prior income level (rank relative to other workers in same firm)

### Income Exposures to Aggregate Cashflow News



### Income Exposures to Aggregate Discount Rate News



### Income Exposures to Firm TFP shocks

• Alternative cashflow measure: firm-level TFP shocks



## Income Exposures to Maturing Debt in 2008-09 Crisis

• Alternative discount rate measure: firms with maturing debt in 2008-09



• **Coming soon**: Common component (PC1) of measures of 'risk appetite' used in the macro literature. Comparison

Using different sources of variation:

- Labor earnings of highly-paid workers are more sensitive to cashflow/productivity news relative to their lower-paid peers.
- Lower-paid workers are more exposed to discount rate (financial) shocks than higher-paid workers at horizons longer than 1 year

Mechanism? Examine intensive/extensive margin next.

### Stayers vs Movers: Aggregate Cashflow News



Estimates are similar for stayers vs movers

### Stayers vs Movers: Aggregate Discount Rate News



points to important role of extensive margin

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- 4. Wage Smoothing
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### 5. Limited Commitment

- Firms & workers can threaten to (inefficiently) terminate matches at a cost.
- Effect on wages not allocations.

# Worker Productivity

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• z: transitory worker productivity

$$\log z_{i,t+1} = \Psi_z \log z_{i,t} + (1 - \Psi_z) \log \overline{z} + \sigma_z \cdot \varepsilon_{z,i,t+1}$$

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• A: aggregate productivity

$$\Delta \log A_{t+1} = \mu_A + \sigma_A \cdot \varepsilon_{A,t+1},$$

Model SDF exogenously following Lettau and Wachter (2007)

$$\Lambda_{t+1} = \exp\left\{-r_f - \frac{1}{2}x_t^2 - x_t \varepsilon_{A,t+1}\right\},\,$$

where  $r_f$  is the constant real risk-free rate.

Market price of risk is driven by a single state variable

$$x_{t+1} = \Psi_x x_t + (1 - \Psi_x) \overline{x} + \sigma_x \varepsilon_{x,t+1},$$

Interpretation of discount rate shocks:

- Time varying risk (or risk aversion)
- Shocks to financial sector (intermediaries)

#### Firms.

- Post vacancies directed at worker of type (h, z) with cost  $\kappa_t(h, z) = \overline{\kappa} A_t h z$
- Matching between vacancies and workers:  $m(u,v) \equiv uv(u^{\alpha}+v^{\alpha})^{-\frac{1}{\alpha}}$

# Firms and Labor Markets

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Workers. Workers in the model can be

- Employed:
  - ► Receive wage flow
  - Endogenous and exogenous separations
- Unemployed
  - Initiating search incurs fixed cost  $c_t(h) = \bar{c}A_th$
  - Search ends randomly with prob.  $\lambda$
- Nonparticipant

• Non-employment has flow payoff  $b_t(h) = \bar{b}A_th$ 

#### Worker value of new match determined by labor market conditions:

$$W_t(h,z) = \underbrace{J_t^S(h,z)}_{\text{Value of unemployment}} + \underbrace{\eta(\theta_t(h,z))}_{\text{elasticity of vacancy filling rate}} \underbrace{\left(J_t^{MC}(h,z) - J_t^S(h,z)\right)}_{\text{Match surplus}}$$

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Assumptions:

- Free entry of firms
- Firms compete by posting wages (in NPV terms)

Result is that competitive equilibrium is efficient.

# Worker Wage Dynamics for Continuing Matches

- Wage NPV pinned down at time of hiring
- Path of wages indeterminate absent additional assumptions
  - ► Firm could pay a constant wage, or a wage proportional to productivity, or a lump sum payment when the match is created, or...

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#### Our assumptions:

- 1. Preference for smooth wages
- 2. Subject to limited commitment constraints
  - ► Workers prefer staying employed to (inefficiently) separating at a cost.
  - Firms prefer to keep worker to (inefficiently) ending match at a cost.
  - In equilibrium, termination is always efficient, but these constraints impose bounds on path of worker wages.
  - Simplified version of optimal risk-sharing (Thomas and Worrall, 1988).

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## Targeted Moments: Worker Transition Rates

Employment  $\rightarrow$  Unemployment rate, by income bin:



 $\mathsf{Employment} \to \mathsf{Non}\text{-}\mathsf{participation}$  rate, by income bin:



Unemployment  $\rightarrow$  Employment rate, by income bin:



# Model Can Reproduce Exposures by Income

Coefficient of Income Growth on Discount Rate News (Targeted)



Coefficient of Income Growth on Cash Flow News (Targeted)



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# Impulse Responses to DR Shocks



### Model: Wage Earnings Exposure to DR Shocks Across Horizons



- Transitory DR shocks have permanent impact on worker earnings
- Differences larger in the medium run than on impact

## Impulse Responses to DR Shocks: Stayers vs Switchers



- Main discount rate effects come from extensive margin
- Intuition: payoffs in employment more back-loaded than non-employment Duration of payoffs

# Impulse Responses to CF Shocks: Stayers vs Switchers



Heterogeneous pass-through of CF shocks along intensive margin

- Bounds increase following a positive CF shock Details
- Wage sensitivity to CF shocks high for workers near wage bounds Details
- High income (high-z) workers cluster at bounds Details

# Asymmetric Response of Earnings to Worker Productivity



- Negative productivity shocks have larger pass through, especially for low income workers due to
  - ▶ increased separation probability
  - higher likelihood of binding firm IC constraint
- · Pass through coefficients increase when discount rates are elevated

# Asymmetric passthrough and labor income risk



Asymmetric passthrough  $\Rightarrow$  distribution of earnings changes is highly leptokurtotic and negatively skewed ...

• ... even as underlying shocks are normally distributed

#### 1. A decline in TFP (A)

 Increases firms' incentives to lower wages of highly-paid employees as worker productivity has fallen.

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  - Increases firms' incentives to lower wages of highly-paid employees as worker productivity has fallen.
- 2. An increase in discount rates (x)
  - Destroys low-surplus, low-productivity matches.
  - Reduces incentive for firms to search  $\rightarrow$  increases unemployment.
  - Reduces incentive for workers to search  $\rightarrow$  increases non-participation.
  - Reduces NPV of firm firing costs  $\rightarrow$  downward pressure on wages.

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# Model vs Data: Stayer versus Mover Responses to DR News

Coefficient on DR news-Stayers

Coefficient on DR news-Movers



- Model reproduces fact that DR shocks concentrated among switchers
- Relative to data, model places slightly more emphasis on probability of switching than losses conditional on switching
- In model and data, probability of zero earnings year increases w/ DR shocks, especially for low income workers Details

- Model generates reasonable fluctuations in aggregate unemployment rate, pro-cyclical job finding rates and counter-cyclical job destruction rates
- Model replicates U-shape exposure of wages to aggregate GDP by prior income (Guvenen, Schulhofer-Wohl, Song, and Yogo, 2017)
- Model implies that average wage can fall much less than average individual wage in recessions, due to composition effects

Feed realized monthly series of CF shocks and DR shocks into model

Examine model's ability to predict realized path of

- 1. Employment
- 2. Income risk
- 3. Income inequality

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Recall:

- 1. We are feeding stock returns into the model, correlation with output is essentially zero (Stock and Watson, 2003)
- 2. Productivity (A) shocks affect output directly, DR (x) shocks affect output on extensive margin (employment)

### Model vs Data: Employment

Unemployment Rate



## Model vs Data: Labor Income Risk

Left tail (P50-P10)



### Model vs Data: Income Inequality

Inequality at the Bottom (log P50/P20)



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- Time-variation in discount rates helpful in understanding the fluctuations in employment and worker earnings.
- Labor search model with assumptions on wage contracts:
  - ▶ replicates heterogeneity in CF and DR exposures for worker earnings
  - generates asymmetric and state-dependent passthrough of worker productivity shocks to earnings

- Portfolio choice: less incentive for low-wage workers to participate in stock markets due to background risk from exposure to discount rates.
- HANK: Add households and hand-to-mouth workers: discount rate shocks disproportionately affect low-wage (and high MPC) workers, impact on aggregate demand.
- Composition effects and average wage dynamics: low-wage workers more likely to be fired when discount rates rise (and output falls), likely implying counter-cyclical average wages and labor productivity.
- Scarring effects and misallocation: adding job ladders, misallocation of workers to jobs rises with discount rates.

# APPENDIX SLIDES

# Discount Rate News Predicts Market Returns at Different Horizons



### Validation: DR Shock Predicts Returns by Market Beta

	Market Beta Portfolio					
	(1)	(2)	(3)	(4)	(5)	(5)-(1)
Cashflow News	-0.839	0.835	-0.172	0.902	0.017	0.856
	(1.147)	(1.292)	(1.112)	(1.569)	(2.243)	(2.171)
Discount Rate News	$2.378^{***}$	$2.342^{***}$	$3.758^{***}$	$4.834^{***}$	$7.478^{***}$	$5.100^{***}$
	(0.649)	(0.873)	(0.676)	(0.707)	(0.647)	(0.711)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	550	550	550	550	550	550
R2	0.820	0.603	0.657	0.546	0.468	0.195

Table reports slope coefficients of predictive regressions of returns of beta-sorted portfolios:

$$\sum_{s=1}^{S} \rho^{s} r_{t+s}^{i} = b_1 N_{CF,t} + b_2 N_{DR,t} + a \Omega_{t-1} + \eta_t$$

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# DR vs Financial Shocks



#### Value-Weighted Shares of Individual Strips in Total NPV, Evaluated at



 $x = \overline{x}$  and Separation Threshold  $z^*(\overline{x})$ 

- Blue solid line: weighted average of PV of cash flows appearing at each horizon in value of match  $J_t^{MC}(h, z * (\bar{x}))$  for  $x_t = \bar{x}$
- Red dashed line: weighted average of PV of cash flows appearing at each horizon in outside option  $J_t^O(h, z * (x))$  for  $x_t = \overline{x}$  (Back)

### Wage Sensitivity to DR Shocks, Distance From Bounds



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# Wage Bounds and CF/DR shocks



For workers at the bounds

- A positive TFP shock increases wages
- A positive DR shock depresses wages

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Wage sensitivity to CF news given distance to upper/lower bound

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### Distribution of Matches Within Contract Bounds



#### CDF of distance to upper/lower bound given prior income

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# Non-Employment Response to DR/CF News



Coefficient of Zero Earnings Indicator on Cashflow News

Coefficient of Zero Earnings Indicator on Discount Rate News

