The importance of countercyclical income risk for the welfare costs of business cycles

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December 3, 2024

Income Risk & Business Cycles

Motivation: 3 business cycle facts, in recessions:

i. Log earnings changes are more negatively skewed (Gueven, Ozkan & Song (2014))

ii. Earnings losses after displacement are larger (Davis & von Wachter (2012))

iii. Inflows into unemployment (UE rate) increases

Question: What are the welfare consequences of business cycles when recessions are consistent w/ these 3 business cycle facts?

Income Risk & Business Cycles

Quantitative contribution: Bewley model + directed search in labor market w/

a. human capital losses in unemployment
b. counter-cyclical employment risk
c. aggregate productivity shocks

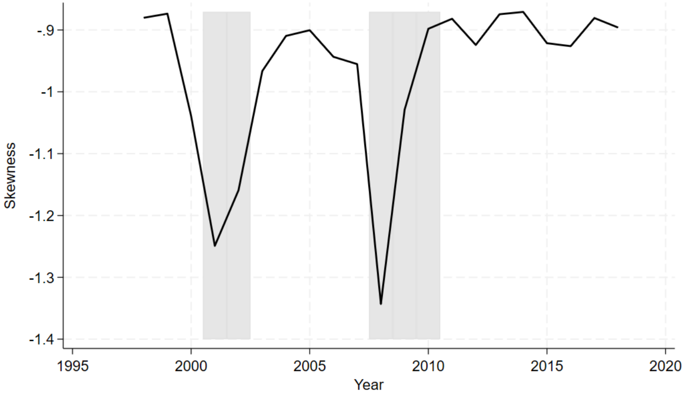
Findings:

i. Model ingredients (a.) & (b.) generate empirically relevant amount of excess negative skewness in recessions
ii. Welfare gain from eliminating business cycles is large in baseline model, 2.7% of lifetime consumption
iii. Welfare gain from eliminating business cycles in model w/o (a.) & (b.) is small, 0.03% of lifetime consumption

Empirical Motivation

Empirical Fact 1: Log earnings changes income are more negatively skewed in recessions (Guvenen, Ozkan & Song, 2014)

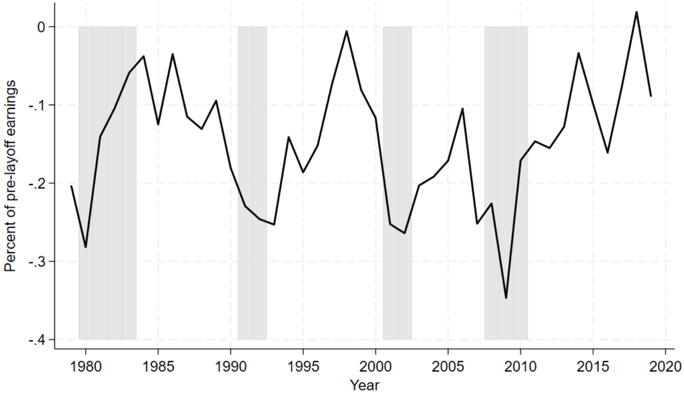
- GRID database: Skewness in expansions: -0.915; recessions: -1.135



Empirical Motivation

Empirical Fact 2: Earnings losses after displace are larger negatively skewed in recessions (Davis & von Wachter, 2012)

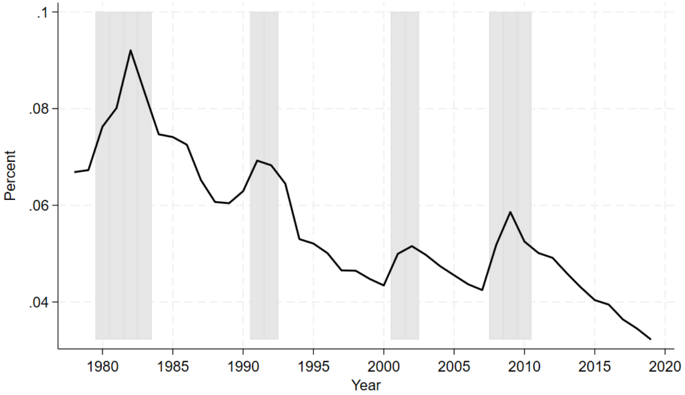
- CPS DWS: Avg. earnings decline in expansions: -12.0%; recessions: -16.7%



Empirical Motivation

Empirical Fact 3: Inflows into unemployment increase in recessions (Davis & von Wachter, 2012)

- CPS: Quarterly EU rate in expansions: -5.2%; recessions: 6.7%



Model Environment

Overview

- Directed search
- Discrete time
- Finite horizon: agents live for T periods
- Aggregate labor productivity shocks, y

Model Environment: Agents

Workers

- Either unemployed or employed
- Age t
- Heterogeneous in human capital level, h
- Direct search over piece rates, ω
- Self insure through saving and borrowing, a, at price Q
    - $a \geq \underline{a}$
- Unemployed workers receive unemployment benefit, b, and home production, g
- Employed workers search on the job with probability λ_e
- Employed workers exogenously separate from firm with probability δ

Firms

- Post wage contracts

Model Environment: Human Capital Evolution

Unemployed Workers - Two Sources of Human Capital Risk

1. Gradual skill decline - human capital declines by Δ_h w/ probability p_h
2. Obsolescence - draw h_{obs} from lower human capital distribution w/ probability $\psi(y)$

$$h' = \begin{cases} h & (1 - p_{h,u})(1 - \psi(y)) \\ h - \Delta_h & p_{h,u}(1 - \psi(y)) \\ h_{obs} & (1 - p_{h,u})\psi(y) \\ h_{obs} - \Delta_h & p_{h,u}\psi(y) \end{cases}$$

Employed workers

- Gain Δ_h amount of skills with probability $p_{h,e}$

$$h' = \begin{cases} h + \Delta_h & p_{h,w} \\ h & (1 - p_{h,w}) \end{cases}$$

Model Environment: Aggregate Productivity and Separation Shock

Aggregate Productivity

$$y' = \rho_y \cdot y + \epsilon_y, \quad \epsilon_y \sim N(0, \sigma_Y)$$

Separation Shock

- Workers separate in unemployment with probability $\delta(y)$

$$\delta(y) = \delta \exp(\eta_y^\delta (y - \bar{y}))$$

Model Timing

i. Aggregate state, y, and human capital, h is realized

ii. Firms post vacancies according to free entry: $\kappa \geq q(\theta(\cdot))J(\cdot)$

iii. Exogenous separation shock $\delta(y)$ is realized by employed workers

iv. Employed workers search on-the-job if draw λ_e

v. Agents enter labor market

vi. Search and match occurs

vii. Production, consumption and savings occurs

Unemployed Bellman

Today: Age t and make savings/consumption decisions, a'

$$U_t(a,h,y) = \max_{a' \geq \underline{a}} u(c) + \beta \mathbb{E}_{y'|y,h'|h}\left[\hat{U}_{t+1}(a',h',y')\right]$$

$$s.t. \quad c + Qa' \leq a + b + g$$

Tomorrow: Search in labor market over wage piece rates ω'

$$\begin{aligned}\hat{U}_{t+1}(a',h',y') = \max_{\omega' \in [0,1]} & \, p(\theta_{t+1}(a',h',\omega',y'))W_{t+1}(a',h',\omega',y') \\ & + (1 - p(\theta_{t+1}(a',h',\omega',y')))U_{t+1}(a',h',y')\end{aligned}$$

Employed Bellman

Today: Receive earnings $\omega f(y,h)$, make savings/consumption decisions a'

$$W_t(a,h,\omega,y) = \max_{a' \geq \underline{a'}} u(c) + \beta \mathbb{E}_{y'|y,h'|h}\Big[\delta(y')\hat{U}_{t+1}(a',h',y') + (1-\delta(y'))\hat{W}_{t+1}(a',h',\omega,y')\Big]$$

$$s.t. \quad c + Qa' \leq a + \omega f(y,h)$$

Tomorrow: Separate with probability $\delta(y')$. If avoid separation, search w/ prob. λ_e

$$\begin{aligned}\hat{W}_{t+1}(a',h',\omega,y') = \max_{\omega' \in [0,1]} & \lambda_e p(\theta_{t+1}(a',h',\omega',y')(W_{t+1}(a',h',\omega',y') \\ & + (1-\lambda_e p(\theta_{t+1}(a',h',\omega',y'))W_{t+1}(a',h',\omega,y')\end{aligned}$$

Firm Bellman

Matched Firms:

$$J_t(a,h,\omega,y) = (1-\omega)f(y,h) + \beta \mathbb{E}_{y'|y,h'|h}\Big[(1-\lambda_e p(\theta_{t+1}(a',h',\omega',y'))(1-\delta(y'))J_{t+1}(a',h',\omega,y')\Big]$$

- Today: Produce $f(y,h)$ w/ worker, keep $(1-\omega)$ of output
- Tomorrow: Continue match if avoid exogenous separation $\delta(y')$ or OJS $(1-\lambda_e p(\cdot))$

New Firms: Pay κ to post new vacancies:

$$\kappa \geq q(\theta_t(a,h,\omega,y))J_t(a,h,\omega,y)$$

Equilibrium

Recursive Competitive Equilibrium

i. Individual decision rules are optimal

ii. Firms satisfy free entry into each submarket

iii. The aggregate distribution of agents across states is consistent with optimal decision rules

Block Recursive

- As in Menzio and Shi (2011), individual optimal decision rules are independent of aggregate distribution of agents across states

Calibration

Externally Calibrated Parameters

- Model calibrated at quarterly frequency
- Aggregate productivity process (ρ_y & σ_y) from Herkenhoff (2019)

Parameter	Value	Description
σ	2	Risk Aversion
r	0.985%	(Quarterly) Risk free rate
δ	5%	Average job destruction rate
ρ_y	0.8961	Auto Correlation of Labor Productivity
σ_y	0.0055	Standard Deviation of Labor Productivity
γ	1.6	Labor Matching Elasticity
T	120	Lifespan in quarters

Calibration

Exogenous separation probability: $\delta(y) = \delta \exp(\eta_y^\delta (y - \bar{y}))$

Obsolescence shock: $\psi(y) = \psi$ if $y < \bar{y}$

Parameter	Target	Model	Data	Source
β	Fraction of agents borrowing	34.9%	30.5%	SCF, 1999-2013
b	Replacement rate of unemployment benefit	41.1%	41.2%	PSID
κ	Unemployment Rate in Expansions	5.7%	5.5%	BLS
λ_e	E-E Transition Rate	6.7%	7.3%	Fujita et al (2021)
$p_{h,e}$	Elasticity of earnings gain with age	1.4	0.95	LEHD-TU
$p_{h,u}$	Earnings loss 4Q after job loss (expansions)	-11.8%	-12%	DWS
ψ	Earnings loss from job loss (recessions)	-15.2%	-16.7%	DWS
λ_H	Dispersion of initial earnings among young	0.63	0.66	LEHD-TU
η_y^δ	Unemployment rate in recessions	7.4%	7.6%	BLS

Model Validation: Non-targeted moments

Higher order moments of log earnings changes

- Difference between recession and expansions

Moment	Model	Data	Source
Difference in Variance	0.020	0.024	GRID - LEHD 1998 - 2018
Difference in Skewness	-0.23	-0.22	GRID - LEHD 1998 - 2018

EU transition rate over business cycle

Moment	Model	Data	Source
Expansions	4.6%	5.2%	CPS 1978-2019
Recessions	6.4%	6.7%	CPS 1978-2019

Generating Negatively Skewed Income Risk Across the Business Cycle

Two Sources

1. Increase in unemployment during recessions
   - $\delta(y)$ decreasing in y

2. Size of earnings losses larger during recessions
   - Obsolescence shock $\psi(y)$ decreasing in y

Moment	Data	Baseline Model	No $\psi(y)$, $\delta(y)$
Difference in Variance	0.024	0.020	0.002
Difference in Skewness	-0.22	-0.23	-0.03

Welfare Experiment

Eliminate business cycles ($y_t = 1 \; \forall t$) in:

i. Baseline Model

ii. Model without $\psi(y)$, $\delta(y)$

Measure welfare cost of business cycles using lifetime consumption equivalents

	Baseline Model	No $\psi(y)$, $\delta(y)$
Welfare Change Removing Business Cycle	2.71%	0.03%
Difference in Variance	0.020	0.002
Difference in Skewness	-0.23	-0.03

Conclusion

- Use a quantitative model of the labor to understand sources of negatively skewed income risk
- Find negatively skewed income risk amplifies larger welfare losses from business cycle

Future Work

- Decompose the welfare losses from negatively skewed income shocks
- Match the time series of earnings across the business cycle to data

Model Environment: Firms

- Produce $f(y, h)$ when matched with worker
- Post piece rate contracts, ω
- Exogenously separate from worker with probability δ
- Submarket indexed by (t, ω, a, y, h)
- Pay κ to enter competitively into each submarket

Free entry condition

$$\kappa \geq q(\theta_t(\omega, a, y, h))J_t(\omega, a, y, h)$$