

Personal Income Taxation and Entrepreneurship

– role of productivity learning

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Motivation

Passthrough business owners in US are subject to progressive personal income taxes

Question: How does personal income tax progressivity affect the choice to become an entrepreneur? — e.g., current U.S. progressive tax v.s. flat tax

- **static environment:** expected return v.s. insurance through redistribution
- **life cycle:** progressive tax favors the **young** (high uncertainty + low asset)
 - lower tax burden and higher insurance value

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This paper: macro & policy implications of **life cycle** & **entrep. productivity learning**

- **conventional wisdom:** flat tax favors high productivity entrepreneurs + redistribution and GE effects lead to welfare gains
- **our paper:** entrepreneurs have uncertainty about innate productivity + learning takes time \implies flat tax that discourages entry of young further decreases entrepreneurship at older ages + worse occupational allocation efficiency

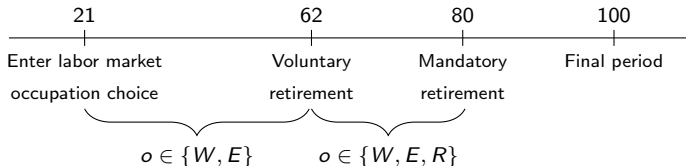
What We Do

- **Data:** infer entrepreneurial learning process with **micro subjective belief data** on expectation formation of business performances
 - **size & dynamics** of uncertainty
- **Model:** GE **life cycle** with heterogeneous agents choosing to
 - work for someone else or
 - run own private business and
 - gradually **learn** about innate productivity s.t. **ex-post transitory shocks**
 - **accumulate wealth** & produce s.t. **financial friction**
- **Policy:** benchmark progressive tax system v.s. counterfactual flat tax reform
 - aggregate & distributional effects across age and entre. productivity types
 - compare with a case of **perfect information**, where agents perfectly know innate type since period 0 thus do not need to learn

Framework

Model: Overview

- Time is discrete, age $j \in \{21, \dots, 100\}$, stochastic mortality shocks



Determinants of **occupational choice over the life cycle**:

- Entrepreneurial productivity learning** in a Bayesian fashion
 - enter economy with innate productivity, which is unobserved to agents
 - gradually learn innate productivity **only** by actively working as entrep.
 - occ. choice made at the **end** of each period (before shocks realize)
- Asset accumulation & bequests & **incomplete markets**
- Permanent non-pecuniary utilities of being an entrepreneur
- Progressive** personal income tax on wage/business incomes a la HSV

States & Flow Utility

- **Individual states** $\mathbf{x}_j = (x_e, a_j, \epsilon_{w,j}, \chi_w, \tilde{\mu}_{e,j}, \tilde{\nu}_{e,j}, \epsilon_{e,j})$
 - x_e : (permanent) love of business characteristic
 - a : assets
 - ϵ_w : wage income shock for worker
 - χ_w : permanent types as worker
 - $\tilde{\mu}_e$: belief about innate entrep. productivity, mean
 - $\tilde{\nu}_e$: belief about innate entrep. productivity, std. dev.
 - ϵ_e : entrep. productivity realization shock (signal)
- **Flow utility**

$$u(c, l; x_e) = \frac{(c^\gamma l^{1-\gamma})^{1-\nu}}{1-\nu}, \quad \gamma \in (0, 1), \nu > 0$$

$$l = 1 - h \mathbb{1}_{\{o=W\}} - \phi_e(x_e) \mathbb{1}_{\{o=E\}}$$

- c : consumption
- l : leisure affected by occupational choice & hours (h)

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Entrepreneurial Productivity: Information Structure

- Uncertainty about **innate productivity**:

prior to entering the labor market (model period 0)

- agents draw innate entrep. productivity from $\mu \sim N(\mu_e, \nu_e^2)$
- agents belief about their innate productivity follows $N(\mu_e, \nu_e^2)$

- **Learning about innate productivity** in following periods:

agents observe a productivity shock (signal) ϵ_e

- only in periods actively working as entrepreneurs
- $\epsilon_e = \text{true type } (\mu) + \text{transitory shock}$
- transitory shock $\overset{i.i.d.}{\sim} \mathcal{N}(0, \sigma_e^2)$
- ϵ_e is also the productivity shock for production

Entrepreneurial Productivity: Learning Process

- The n -th observed realized entrep. prod. shock (signal): $\epsilon_{e,n}$
 - n : number of periods being an entrepreneur
- Let the posterior belief after observing n th signals be $\mathcal{N}(\tilde{\mu}_{e,n}, \tilde{\nu}_{e,n}^2)$
- Recursive Bayesian updating formula:

$$\tilde{\nu}_{e,n}^2 = \frac{\nu_e^2 \sigma_e^2}{n\nu_e^2 + \sigma_e^2} = \frac{1}{n/\sigma_e^2 + 1/\nu_e^2}$$
$$\tilde{\mu}_{e,n} = \tilde{\nu}_{e,n}^2 \left(\frac{\tilde{\mu}_{e,n-1}}{\tilde{\nu}_{e,n-1}^2} + \frac{\epsilon_{e,n}}{\sigma_e^2} \right)$$

- ν_e^2 and σ_e^2 together determines forecast precision
- ν_e^2 relative to σ_e^2 determines learning speed
 - \implies identification: size of uncertainty & learning speed to identify ν_e^2 and σ_e^2 jointly

Identifying Learning Parameters from Data

Data from **Panel Studies of Entrepreneurial Dynamics** Wave1 (PSED 1998–2004)

- Sample of **nascent entrepreneurs (NE)** in U.S., 4 waves
- Survey questions: NE's expectations regarding the future of the new firm
 - Wave 1 (**before becoming an entrepreneur**) ask (1) expected sales in the first full year of operation and (2) in the fifth full year of operation
 - Wave 2-4 (**currently operating as an entrepreneur**) ask (1) realized sales in current year and (2) predicted sales in the fifth full year of operation

Identifying Learning Parameters from Data

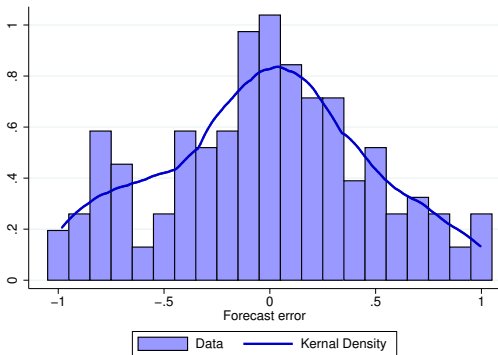
With raw data variables:

- `ESale`: forecasts on sales in a future year
- `RSale`: realized sales in current year

we further define:

- **Forecast errors**: deviation of `RSale` from `ESale`
- **Forecast revisions**: updates in `ESale` (on same objective)

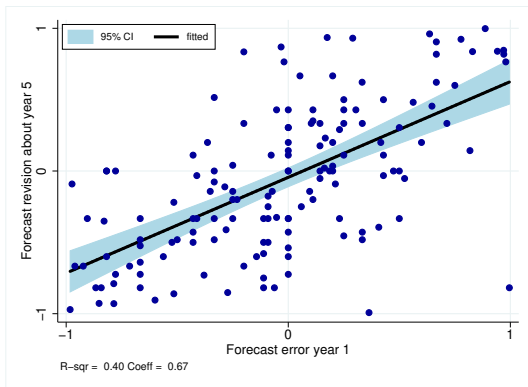
Fact 1: Forecast Errors are Dispersed



Forecasting error : forecast in year 0, reveal in year $s = 1$

$$\text{FError}_0^s = \frac{\text{RSale}_s - \text{ESale}_0^s}{\text{RSale}_s + \text{ESale}_0^s}$$

Fact 2: Forecast Errors Predict Future Forecast Revisions



Year-1 forecast revision on year-5 sales
$$FRev_1^5 = \frac{ESale_1^5 - ESale_0^5}{RSale_1 + ESale_0^5}$$

→ Entrepreneurs update their expectation on their business performances using new observed info

Recursive Problem: Working Periods

- **Normal working ages:** $1 \leq j < J^V$, for $o \in \{W, E\}$

$$V_j^o(x_e, a, \epsilon_w, \chi_w, \tilde{\mu}_e, \tilde{\nu}_e, \epsilon_e) = \max_{l, a', o'} \{u(c, l; x_e) + \beta \mathbb{E} V_{j+1}^{o'}(a', \epsilon'_w, \chi_w, \tilde{\mu}'_e, \tilde{\nu}'_e, \epsilon'_e)\}$$

$$s.t. \quad a' + c(1 + \tau_c) = a(1 + r) + (1 - \tau_{ss})y_{o,j} - T_o(y_{o,j})$$

$$\tilde{\mu}'_e, \tilde{\nu}'_e = \begin{cases} \Pi(\tilde{\mu}'_e, \tilde{\nu}'_e | \tilde{\mu}_e, \tilde{\nu}_e, \epsilon_e) & \text{for } o = E \\ \tilde{\mu}_e, \tilde{\nu}_e & \text{otherwise} \end{cases}$$

$$a' \geq \underline{a}$$

Note: occupational choice is predetermined from previous period

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\Rightarrow income tax imposed on total pre-tax personal income $y_{o,j}(a, \epsilon_w, \epsilon_e)$

- **wage incomes** for workers: GE wage + age profile + perm. prod. + shocks

$$\log y_{w,j} = \log \omega + \log \theta_j + \log \chi_w + \log \epsilon_{w,j}$$

- **business incomes** for entrepreneurs

$$y_b = \pi(a, \epsilon_e) = \max_{k, n_b} \{\epsilon_e f(k, n_b) - \omega n_b - (r + \delta)k\}$$

$$s.t. \quad 0 \leq k \leq \lambda a, \quad n_b \geq 0$$

Recursive Problem: Working Periods

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$a' \geq \underline{a}$ liquidity constraint binding for low realization/productivity entre.

Note: occupational choice is predetermined from previous period

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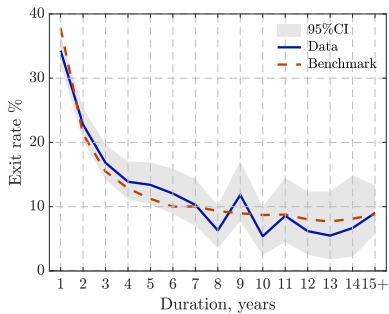
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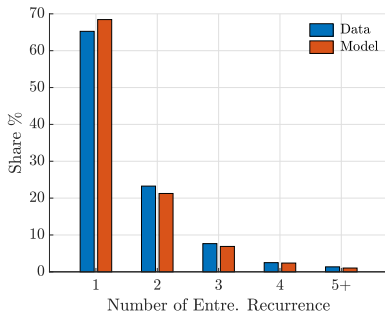
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collateral constraint binding for high productivity entre.

Model Fit: Exit and Recurrent Entre. Activities

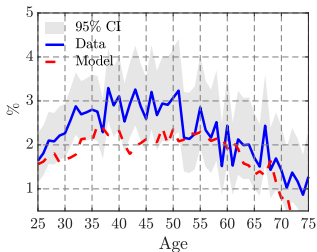


(a) Exit Rate by Entre. Duration

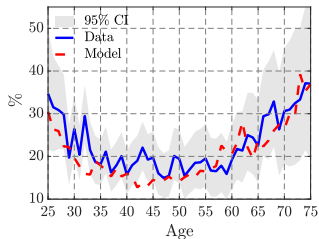


(b) Recurrent Entre. Activities

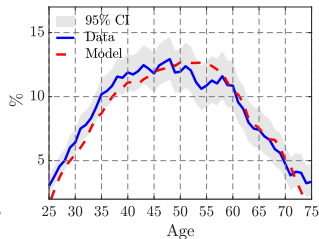
Model Fit: Entrepreneurship over the Life Cycle



(a) Entry rate



(b) Exit rate



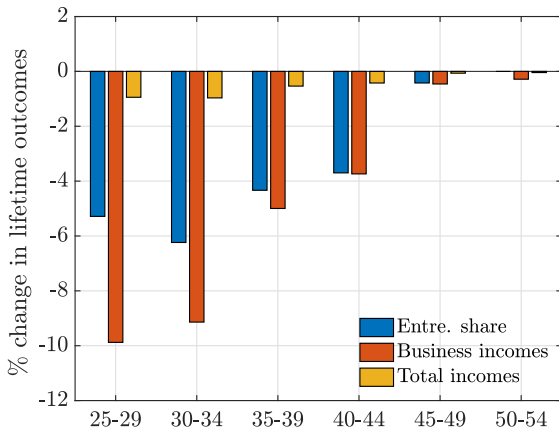
(c) Entre. share

Model implications on:

value of learning and the cost of uncertainty

Q1: How Does Value of Learning Vary by Age

- **Counterfactual:** what if agents do not update belief at specific age?
- **Lifetime outcomes:** (1) entre. share (2) discounted business inc. (3) discounted total inc.



- Value of learning is **monotonically decreasing** in age

Q2: Who Bears Larger Costs of Uncertainty by Innate Entrepreneur Types

Innate ability types	-3 sd	-2 sd	-1 sd	0 sd	+1 sd	+2 sd	+3 sd
Benchmark with Info. friction and learning							
Lifetime entrepreneur share	0.01	0.01	0.02	0.04	0.14	0.34	0.39
Lifetime y^b in total y	0.00	0.00	0.01	0.02	0.12	0.40	0.61
Lifetime incomes (normalized)	1.00	1.00	1.00	1.00	1.06	1.35	1.87

- Entrepreneur share & business income/total income increase by type
 - but ... still plenty of time working as workers even for the high types

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- Entrepreneur share & business income/total income increase by type
 - but ... still plenty of time working as workers even for the high types
- What if agents have **perfect information** about innate ability?
 - since period 0, individuals know their innate entre. ability
 - no need to learn
 - only transitory shocks when working as entrepreneurs

Lifetime Outcomes by Innate Entrepreneur Types

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Perfect information (PI)							
Lifetime entrepreneur share	0.00	0.00	0.00	0.00	0.12	0.71	0.94
Lifetime y^b in total y	0.00	0.00	0.00	0.00	0.09	0.64	0.99
Lifetime incomes(normalized)	1.00	1.00	1.00	1.00	1.04	1.48	2.56

- In PI case: only high type choose to be entrepreneurs

Lifetime Outcomes by Innate Entrepreneur Types

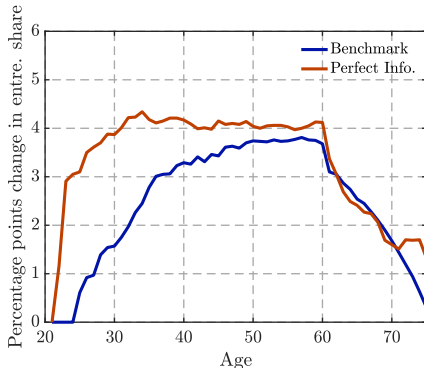
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- Switching to PI makes high types gain more (relative to middle/low types)
→ value of learning higher for high types

Q3: How Important is Asset Accumulation Channel?

- Impact on entre share by age when

increase collateral param. λ from 1.5 to 2.0, i.e. borrowing up to 50% (100%) of own's assets



Relaxing collateral constraint

- PI: high types to enter immediately – collateral constraint binding for high types
- benchmark: much slower increase – liquidity constraint is still potentially binding with uncertainty

Tax Policy

Tax Experiments Overview

- Revenue-neutral flat business income tax reform
 - stationary equilibrium comparisons
 - fix wage income tax schedule as in the benchmark
 - apply flat tax rate to business income
 - compare with the case of perfect information
- aggregate & distributional outcomes

Impact under Revenue Neutral Reform

Revenue neutral flat rate = 20%

- close to the peak of revenue Laffer curve

Overall impacts

- entre. share 9.0% \rightarrow 6.0%
- AMTR 26.0% \rightarrow 24.1%
- wage rate -1.1% , GDP -1.6% , CEV -2.0%

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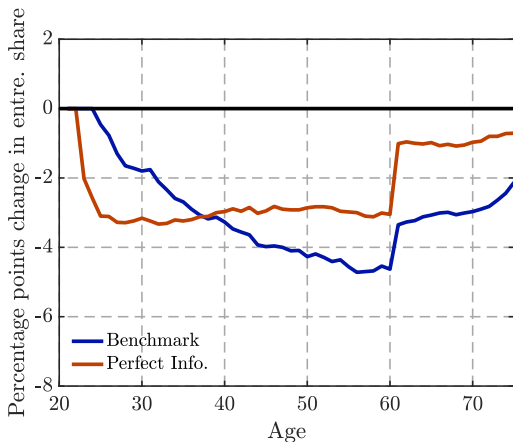
Age	Entre. Share	ATR	Assets	Output
25-34	-33.6	29.4	5.0	4.7
35-44	-35.7	-1.7	14.2	10.4
45-54	-35.0	-9.0	17.9	11.3
55-64	-38.0	-16.0	26.0	16.4
65-74	-43.0	-20.0	36.9	22.6

Table: Percentage change relative to benchmark, %

Compare with Perfect Info.: Change in Entre. Share by Age

Impact of flat tax reform on entrepreneur share over the life cycle

— deviation relative to economy under progressive income tax



- Much less persistent dynamic effect in the case of PI [▶ PE](#)

Comparing with Perfect Info.: Lifetime Outcomes by Innate Type

Flat tax reform relative to benchmark

Innate ability types	-3 sd	-2 sd	-1 sd	0 sd	+1 sd	+2 sd	+3 sd
Benchmark with learning, GE							
Lifetime entre share, p.p.	-0.52	-0.72	-1.18	-2.59	-4.44	-7.15	-7.76
Lifetime incomes, %	-1.15	-1.15	-1.30	-2.11	-3.82	-6.93	-8.00

⇒ losses monotonically increasing in types

Comparing with Perfect Info.: Lifetime Outcomes by Innate Type

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⇒ losses monotonically increasing in types

Perfect information, GE

Lifetime entre share, p.p.	0	0	0	-0.91	-4.35	-9.12	-4.30
Lifetime incomes, %	0.01	0.03	0.02	-0.42	-1.55	-2.60	2.60

⇒ redistribution effect leads to gains for highest type

Calibration

Data Sources

PSID: life cycle

- Entrepreneur entry/exit
- Moments on assets, earnings, and bequests [▶ Prob. of Receiving Bequest](#)

PSID Wave 1 (1998-2004): NE (entrants)

- Love of business (LoB) characteristic:
 - use Principal Component Analysis (PCA) to convert 25 survey questions into 6 personality traits:
love of business + 'Big 5' (OCEAN) [▶ PCA Details](#)
 - stable over life, no gender difference [▶ Details](#)
 - only LoB is found to affect the entrepreneur choice [▶ Regression](#)
- Entrepreneurial productivity learning [▶ Graphics](#)

Functional Specifications

- **Utility cost of being an entrepreneur:**

$$\phi_e(x_e) = \phi_{e,0} + \phi_{e,1}x_e$$

- **Production functions:**

$$f(k, n_b) = (k^\alpha n_b^{1-\alpha})^\eta, \quad \eta < 1$$

$$F_C(K_C, N_C) = A_C K_C^\mu N_C^{1-\mu}$$

- **Personal income tax:** same for W, E

$$T(y) = y - (1 - \kappa_0)y^{(1-\kappa_1)}$$

- **Bequest:** following De Nardi (2004) and Lockwood (2018)

$$\mathcal{V}(b) = \left(\frac{\phi_b}{1-\phi_b}\right)^{\tilde{\nu}} \frac{\left(\frac{\phi_b}{1-\phi_b}c_b + b\right)^{1-\tilde{\nu}}}{1-\nu}$$

► Properties of $\mathcal{V}(b)$

Calibration

- Benchmark steady state: matching moments of year 1996

Key parameters of entrepreneurs

Parameter	Description	Value	Target
Non-pecuniary utility			
$(\beta_{e,1}, \beta_{e,2})$	Beta distribution: LoB state x_e	(3.2, 2.8)	PSED-LoB score ▶ Detail
$\phi_{e,0}$	Fixed util. cost of entrep.: intercept	0.60	Share of entrepreneur = 9.0%
$\phi_{e,1}$	Fixed util. cost of entrep.: slope	-0.09	Diff. in mean LoB score: entrep. & worker= 0.20
Bayesian learning of entrep. productivity			
μ_e	Mean: dist. of innate entrep. prod.	1.25	Median business to wage income = 1.3
ν_e	Std: dist. of innate entrep. prod.	0.37	Std. dev. of forecasting error = 0.40
σ_e	Std: i.i.d.shocks	0.50	Slope of forecast revision = 0.66
Financial friction & bequest function			
λ	Collateral parameter	1.50	Median wealth entrep. to worker = 6.0
c_b	Threshold consump. level	0.30	17000 USD (2010\$)
ϕ_b	Marginal propensity to bequeath	0.95	Bequest as a share of total wealth = 0.60

Calibration: other parameters

Parameter	Description	Value	Source/Target
Preferences			
ζ	Risk aversion	4	IES = 0.5
γ	Intensity of consumption	0.38	2,000 annual hours for workers
β	Discount factor	0.96	K/Y= 2.7
ϕ_ω	Fixed cost of working	0.25	Employment rate
Wage income			
$\{\theta_j\}_{j=1,\dots,60}$	Age-dependent labor productivity	► Figure	Hansen (1993)
ρ_w	Wage income shock: persistence	0.98	Consea, Kitao, Krueger (2009)
σ_w	Wage income shock: std. dev	0.17	Consea, Kitao, Krueger (2009)
σ_χ	Permanent types dist.: std. dev	0.37	Consea, Kitao, Krueger (2009) ► Detail
Technology			
ξ	Capital share: corporate	0.36	Corporate labor share
α	Capital share: entrepreneurs	0.36	-
η	Scale parameters: entrepreneurs	0.79	Buera, Kaboski, Shin (2011)
δ	Capital depreciation rate	0.06	BEA fixed asset tables
Government policy			
τ_c	Consumption tax rate	0.065	Bhandari and McGrattan (2020)
τ_{ss}	Payroll tax rate	0.124	Consea, Kitao, Krueger (2009)
κ_0	Personal income tax: level shifter	0.09	Estimated by PSID
κ_1	Personal income tax: progressivity	0.15	Estimated by PSID

Model Fit: Income & Wealth Distribution

	Benchmark	Data
Gini coefficient		
Income - all	0.54	0.55
Income - worker	0.29	0.38
Income - entre	0.59	0.66
Wealth - all	0.64	0.85
Income/wealth ratios: entrepreneur to worker		
Income median	1.60	1.30
Income mean	2.60	2.50
Wealth median	5.90	6.00
Fraction of entrepreneurs in wealth percentiles		
Top 1%	0.56	0.54
Top 5%	0.48	0.39
Top 10%	0.31	0.32
Top 20%	0.22	0.22

More model fit results:

► Entrepreneurial Earnings

► Aggregate Moments

► First Time Entry