

An Entrepreneurship Fiscal Multiplier

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Heterogeneity and Macro Policy

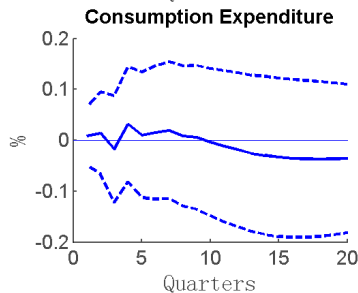
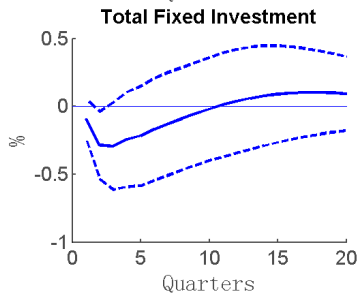
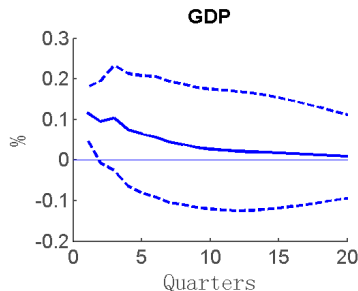
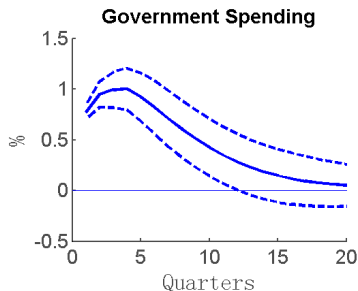
Facts – Mechanism – Policy Implications

Heterogeneity and Macro Policy

Facts: **Entrepreneurs** respond differently to **Government Spending** compared to other households and firms.

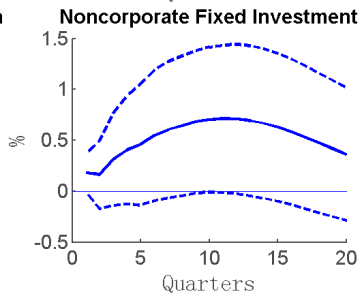
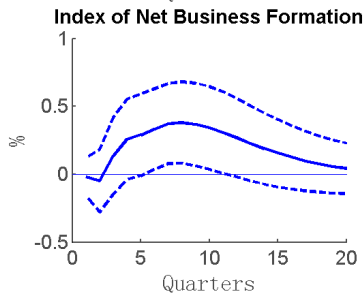
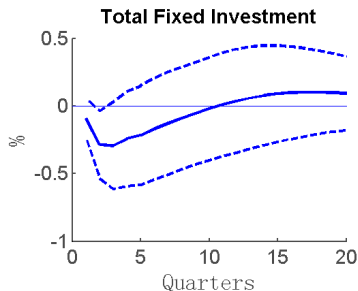
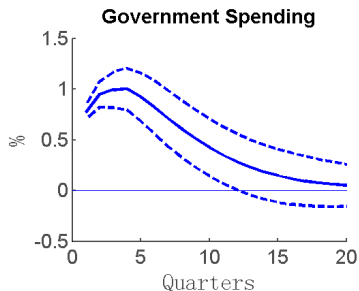
Fiscal multiplier: identified through recursive ordering

$(\log(G), \log(Y), MTR, TB3), 1947I-2008IV$



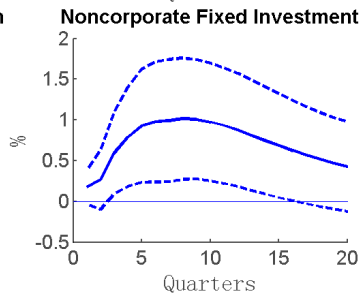
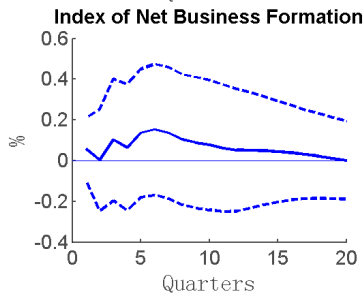
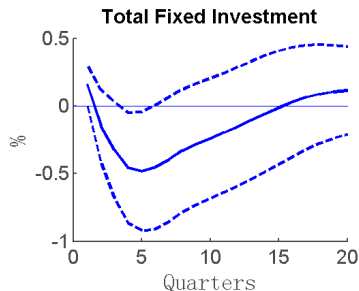
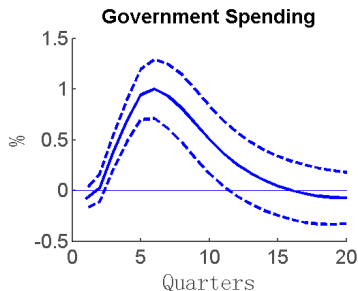
Entrepreneur fiscal multiplier

$(\log(G), \log(Y), MTR, TB3), 1947I-2008IV$



Entrepreneur fiscal multiplier: Ramey's pdvmlly shock

$(\log(G), \log(Y), MTR, TB3), 1947I-2008IV$

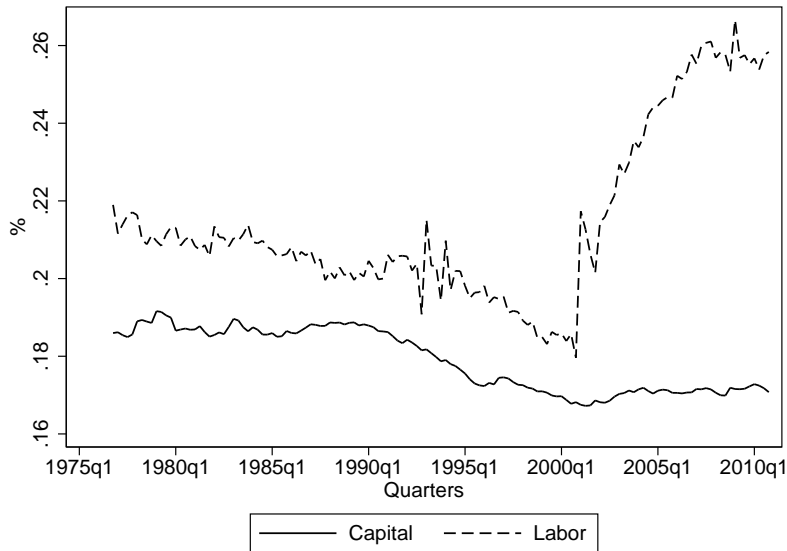


Mechanism

- ▶ Government spending is to be financed by tax.
- ▶ ... Tax generates negative income effects, increases labor supply, and decreases saving.
- ▶ ... Wage falls and interest rates rise.
- ▶ ... Entrepreneur sector is more “labor-intensive”. Profits increase which encourages entry.

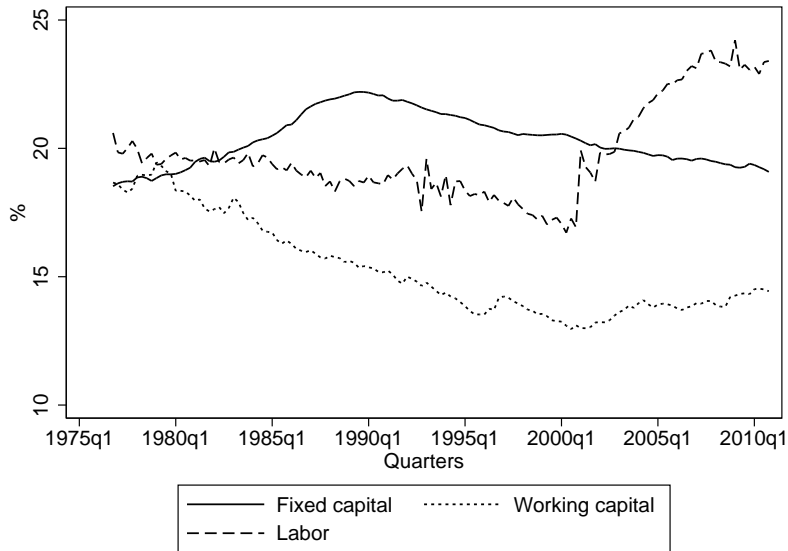
Mechanism: entrepreneurs use more labor than capital

Fractions of factors used in non-corporate sector



Mechanism

Why does entrepreneur sector use more labor than capital?



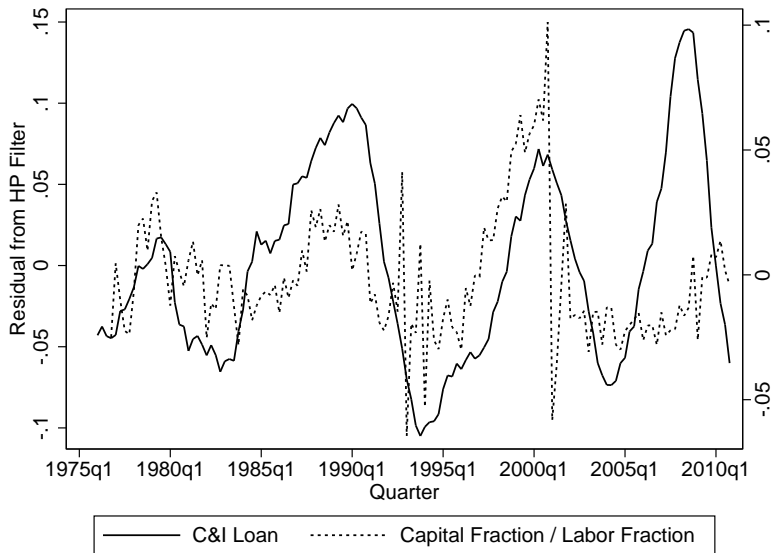
Mechanism

Why does entrepreneur sector use more labor than capital?

- ▶ It's not (I'm not assuming) different technology...
- ▶ Working capital financing is hampered by financial friction...
- ▶ If this is the case, entrepreneur sector should appear even more “labor-intensive” when credit condition is worse...
- ▶ What's in the data?

Mechanism: financial frictions vs labor-intensity

Why does entrepreneur sector use more labor than capital?



Mechanism

- ▶ Government spending is to be financed by tax.
- ▶ ... Tax generates negative income effects, increases labor supply, and decreases saving.
- ▶ ... Wage falls and interest rates rise.
- ▶ ... Entrepreneur sector is more “labor-intensive” due to financial frictions.
- ▶ ... Profits increase which encourages entry.
- ▶ ... Anticipating profits increase \Rightarrow Marginal productivity of capital increases \Rightarrow Entrepreneurs increase saving (investment) countering the consumption smoothing incentive from negative income effects.

Quantitative questions

Questions:

- ▶ Does this mechanism generate qualitative/quantitative results consistent with data?
- ▶ What are the implications for aggregate response? Does it imply interactions between fiscal policy and other economic conditions?

Strategy:

- ▶ A model featuring entrepreneur entry/saving decision which are affected by financial frictions.
- ▶ Calibrated to match (1) fraction of factor use; (2) entrepreneur size distribution; (3) wealth distribution.
- ▶ Feed in government spending shock and inspect the response.
- ▶ Feed in fluctuations of credit conditions and inspect the interactions.

Quantitative questions

Questions:

- ▶ Does this mechanism generate qualitative/quantitative results consistent with data?
- ▶ What are the implications for aggregate response? Does it imply interactions between fiscal policy and other economic conditions?

Answers:

- ▶ Model generates responses of entrepreneur entry and investment consistent with data.
- ▶ Generates a sizable output fiscal multiplier close to data, without any Keynesian features.
- ▶ Both entrepreneur and output multipliers are greater when credit is tighter.

Related literature

- ▶ **Mechanism of fiscal multiplier.** Hall (2009), Dyrda and Ríos-Rull (2012), Woodford (2010), Uhlig (2010).
- ▶ **Distributional effects of fiscal policy.** Heathcote (2005), Bachmann et al. (2013).
- ▶ **State-dependent effects of government spending.** Auerbach and Gorodnichenko (2012), Owyang et al. (2013), Fazzari et al. (2015)
- ▶ **Entrepreneur entry and saving.** Decker et al. (2014), Quadrini (2000), Cagetti and De Nardi (2006), Buera and Shin (2013).
- ▶ **Heterogeneous agent model with aggregate fluctuations.** Krusell and Smith (1997), Reiter (2009), Winberry (2014).

Model

Mechanisms and corresponding model elements

- ▶ Time is discrete. Continuum of Infinitely-lived households with constant measure, a corporate firm, and a government. Single consumption good. Single asset.
- ▶ Households receive shocks on labor productivity and entrepreneur productivity; **choose** to be entrepreneurs and workers; program **consumption/saving**, **labor/leisure**; face tight borrowing constraints across periods.
- ▶ As a worker, household works and receives wages.
- ▶ As an entrepreneur, household does not work; employs capital and labor to produce at market prices.
- ▶ Entrepreneur can finance additional capital within period **up to** a fraction of his own wealth due to financial frictions.
- ▶ A government specifying policies for **bond and tax**.
- ▶ Exogenous government spending shocks, financial shocks, and TFP shocks.

Model

Households' problems: as an entrepreneur

$$V^E(\varepsilon, \zeta, a; \Omega) = \max_{k_D, n_D, c, a'} u(c, l) + \beta EV(\varepsilon', \zeta', a'; \Omega')$$

s.t.

$$c + a' \leq \pi + a - Tax(\Omega)$$

$$\pi = z\zeta(k_D^\gamma n_D^{1-\gamma})^\theta - r(\Omega)(k_D - a) - \delta k_D - w(\Omega)n_D$$

$$k_D \leq \lambda a$$

$$a' \geq 0$$

$$l = 1$$

Model

Households' problems: as a worker

$$V^W(\varepsilon, \zeta, a; \Omega) = \max_{c, l, a'} u(c, l) + \beta EV(\varepsilon', \zeta', a'; \Omega')$$

s.t.

$$c + a' \leq w(\Omega)\varepsilon(1 - l) + a(1 + r(\Omega)) - Tax(\Omega)$$

$$a' \geq 0$$

$$0 \leq l \leq 1$$

Model

Households' problems: entrepreneur or worker?

$$V(\varepsilon, \zeta, a; \Omega) = E_{\tilde{u}_E, \tilde{u}_W} \max\{V^E(\varepsilon, \zeta, a; \Omega) + \tilde{u}_E, V^W(\varepsilon, \zeta, a; \Omega) + \tilde{u}_W\}$$

u_E, u_W i.i.d. Gumbel distribution.

$$V(\varepsilon, \zeta, a; \Omega) = \log(\exp(V^E(\varepsilon, \zeta, a; \Omega)) + \exp(V^W(\varepsilon, \zeta, a; \Omega)))$$

$$Pr^E(\varepsilon, \zeta, a; \Omega) = \frac{\exp(V^E(\varepsilon, \zeta, a; \Omega))}{\exp(V^E(\varepsilon, \zeta, a; \Omega)) + \exp(V^W(\varepsilon, \zeta, a; \Omega))}$$

Model

Closure

- ▶ Corporate firm:

$$r = z\gamma\left(\frac{K}{N}\right)^{\gamma-1}, z(1-\gamma)\left(\frac{K}{N}\right)^{\gamma}$$

- ▶ Government:

- ▶ Promise to pay interest rates of bond equal to interest rate of capital, state by state, following Heathcote (2005) and Bachmann et al. (2013).

- ▶ Tax rule:

$$Tax = \rho_0 + \rho_1 B + \rho_2 G$$

- ▶ Budget:

$$B' = B(1+r) + G - Tax$$

- ▶ Exogenous process: $\log(z') = \rho_z \log(z) + \varepsilon^z$,
 $G' = \rho_G G + (1 - \rho_G) \bar{G} + \varepsilon^G$, $\lambda' = \rho_\lambda \lambda + (1 - \rho_\lambda) \bar{\lambda} + \varepsilon^\lambda$

Model

Definition of equilibrium

Individual state $x = (\varepsilon, \zeta, a)$. Aggregate state $\Omega = (z, G, \lambda; B, \Phi)$. A recursive equilibrium is

1. Policy and value functions as functions of (x, Ω) :
 $V(x, \Omega), V^E, V^W, Pr^E, a'^E, a'^W, n, n^D, k^D$
2. Aggregates as functions of Ω : $K(\Omega), N, w, r, Tax$
3. Transition for $B, J : \Omega \rightarrow B'$. Transition for $\Phi, H : \Omega \rightarrow \Phi'$.

Model

Definition of equilibrium

1. Policy and value functions solve agent's problem.

$$V^{W,E}(x, \Omega) = \max \dots + \beta EV(\varepsilon', \zeta', a'; z', G', \lambda'; J(\Omega), H(\Omega))$$

2. Market clear.

$$\text{Labor} : \int n \cdot (1 - Pr^E) d\Phi = \int n^D \cdot Pr^E d\Phi + N$$

$$\text{Asset} : \int a d\Phi = \int k^D \cdot Pr^E d\Phi + K + B$$

$$\text{Interest rate} : r = z\gamma\left(\frac{K}{N}\right)^{\gamma-1}$$

$$\text{Wage} : w = z(1 - \gamma)\left(\frac{K}{N}\right)^{\gamma}$$

3. Government policy.

$$\text{Tax} : Tax = \rho_0 + \rho_1 B + \rho_2 G$$

$$\text{Bond} : B' = J(B) = B(1 + r) + G - Tax$$

4. Transition of Φ is consistent.

Model solutions

Challenges:

- ▶ Multiple aggregate shocks and continuous aggregate states. Higher moments matter. De Nardi et al. (2015), Bachmann et al. (2013).
- ▶ Pure projection + perturbation (as Reiter (2009)) can't address state-dependent effects.

Solutions:

- ▶ Discretize value functions and distributions. Solve non-stochastic steady state.
- ▶ Solve dynamics by linear perturbation around non-stochastic steady state. State variables include the discretized distributions over individual states. Jump variables include the discretized value functions over individual states.
- ▶ Only use linear perturbation as **forecasting rules of future value functions**. In simulations, solve decision problems and market clear conditions exactly, and update future states exactly.

Linear forecasting is very accurate

Forecasting error (%):

Vars	1-step	100-step	1000-step
r	0.4261		
w	0.1626		
Ea	0.0249		
Ea^2	0.0181		
Ea^3	0.0276		
Ea^4	0.0382		

Calibration

Parameters fixed exogenously

$$u = \frac{(c^\chi l^{1-\chi})^{1-\sigma}}{1-\sigma}, \sigma = 2$$

$$F(K, L) = zK^\gamma L^{1-\gamma}, \gamma = 0.36$$

$$\varepsilon, \varepsilon' = \rho_\varepsilon \varepsilon + e', \rho_\varepsilon = 0.94, \sigma_\varepsilon^2 = 0.01$$

$$z, \rho_z = 0.75, \sigma_z = 0.012, \text{ US Data}$$

$$G, \rho_G = 0.8909, \sigma_G = 0.0145 \bar{G}, \text{ US Data}$$

$\lambda, \rho_\lambda = 0.9170, \sigma_\lambda = 0.049$, matching anecdotal evidence (Khan and Thomas (2013)):

...debts falling more than 26% as a financial crisis...

...13 crises in the last 200 years (800 quarters)...

...Average duration is 2 years...

Calibration

Parameters calibrated to match moments

Parameters	Value	Target	Data	Model
δ	0.021	r	0.0125	0.0125
β	0.980	K/Y	10.6	10.85
χ	0.31	\bar{n}_w	0.33	0.33
p_1	0.0039	% Entrepreneurs	0.0755	0.072
p_2	0.97	Gini	0.81	0.76
μ_ζ	0.76	% Size 1-5	0.7510	0.7768
σ_ζ	0.23	% Size 6-10	0.1460	0.1124
θ	0.76	Capital fraction	0.1780	0.1854
λ	1.32	Labor fraction	0.2180	0.2086
$\bar{T}ax$	1.68	G/Y	0.2086	0.2086
\bar{B}	0.3597	B/Y	1.2	1.2

Model performance

Size and wealth distribution

Size of entrepreneur firms measured by employment level, KFS

	1-4	5-9	10-19	20-99	100+
Data	75.1	14.6	6.6	3.5	0.3
Model	77.7	12.4	5.0	4.9	0.0

Wealth distribution, SCF, Díaz-Giménez et al. (2011)

	Top 1%	Top 5%	Top 10%	Top 20%	Gini
Data	30	51	64	79	0.79
Model	23.8	57.6	82.5	91.2	0.76

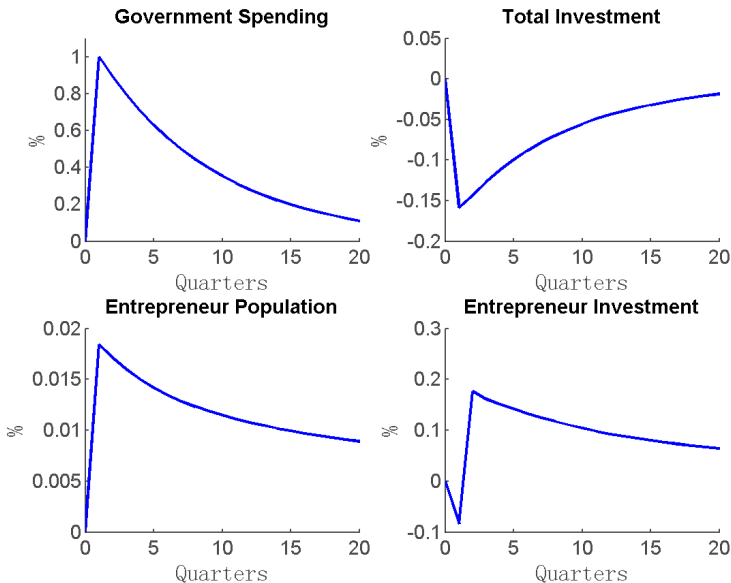
TODO(wenlan): business cycle property

Roadmap for results

- ▶ Entrepreneur fiscal multiplier.
- ▶ Implied for output.
- ▶ State-dependent effects.

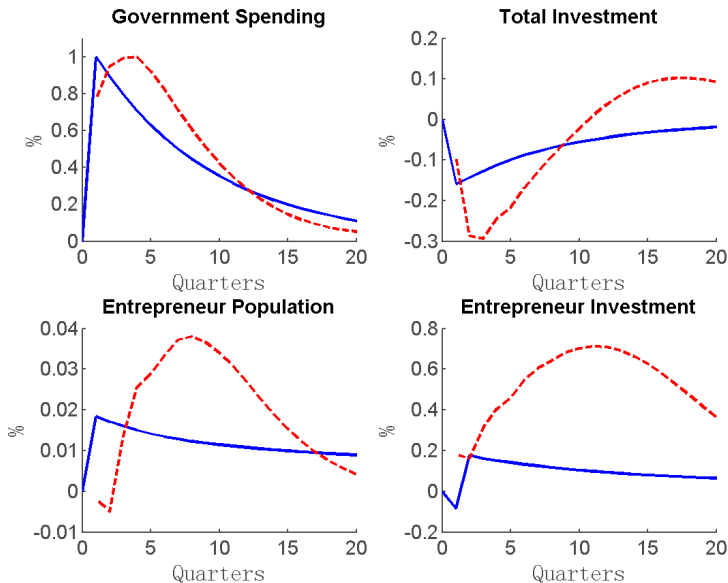
Entrepreneur fiscal multiplier

Response to +G shock at period 1



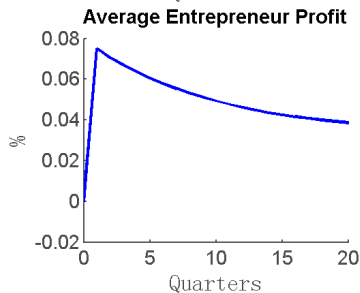
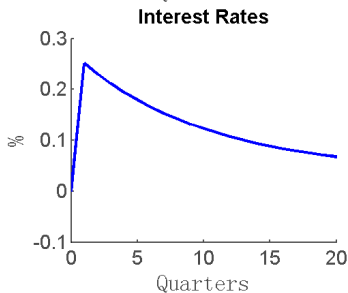
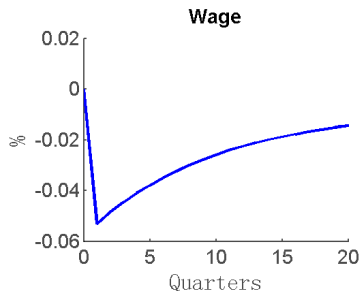
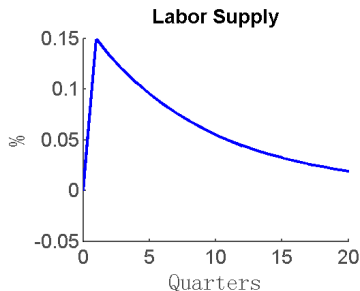
Entrepreneur fiscal multiplier

Response to +G shock at period 1



Entrepreneur fiscal multiplier: Mechanism

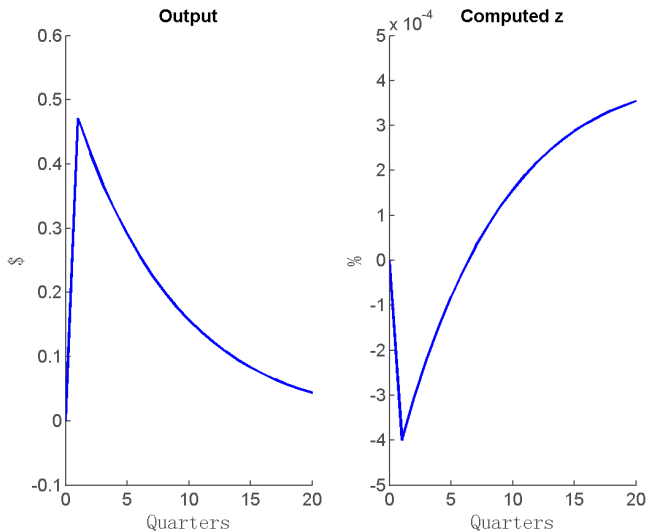
Response to +G shock at period 1



Mechanism: Wealth distribution and occupation choice

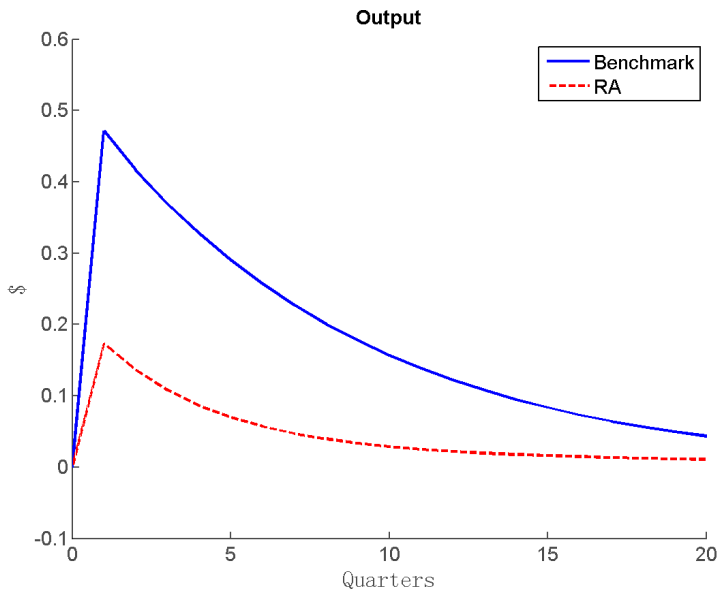
Output multiplier

Response to +G shock at period 1



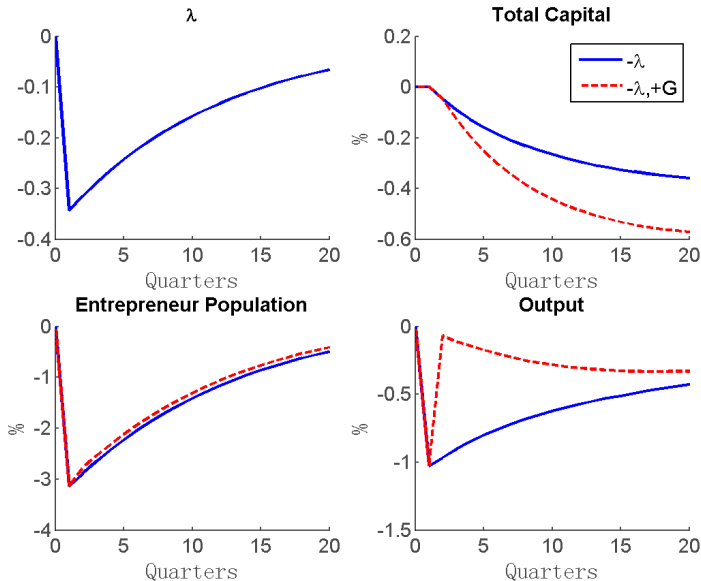
Output multiplier: heterogeneity matters

Response to +G shock at period 1



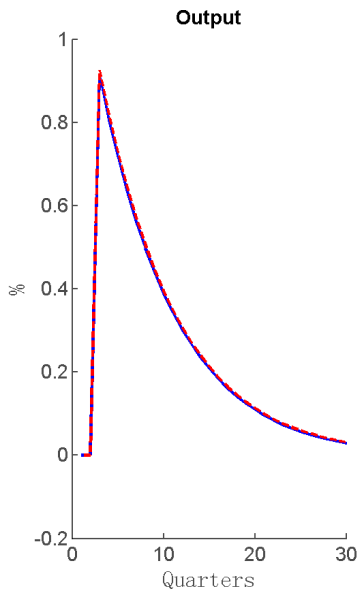
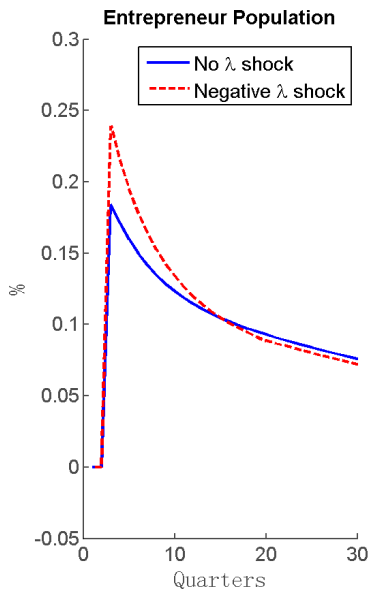
State-dependent multiplier

Response to $-\lambda$ shock at period 1, $+G$ shock at period 2



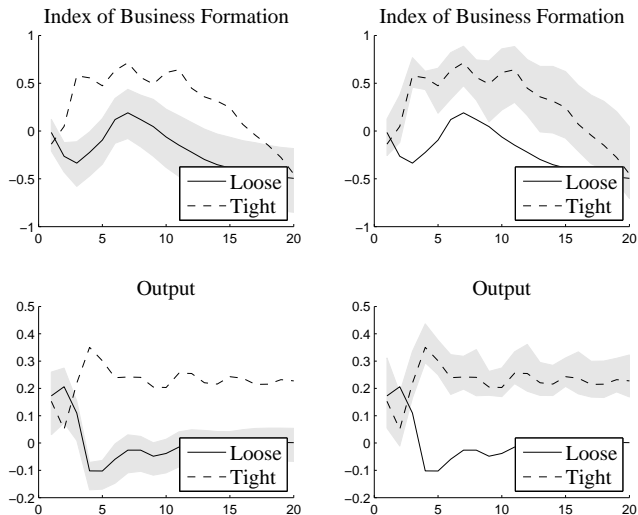
State-dependent multiplier

Response to +G shock, no λ shock V.S. $-\lambda$ shock



STVAR and state-dependent response

Following Auerbach and Gorodnichenko (2012):



Conclusions

Facts:

- ▶ Government spending crowds out overall investment but crowds in entrepreneur activity of both entry and investment.
- ▶ The effect is larger when credit condition is worse.

Mechanism:

- ▶ Entrepreneur sector uses more labor than capital due to financial frictions.
- ▶ Change in factor prices caused by G shock increases profits of entrepreneur activity, encourages entry and investment.

Implications:

- ▶ An output multiplier close to data.
- ▶ State dependence consistent with data.

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