Quantifying the Macroeconomic Impact of Credit Expansions

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Motivation

- Motivating questions:
  - How do shocks to bank credit supply affect real economy?
  - Through what channels do these effects occur?
    - Literature has variously emphasized effects on demand, investment, misallocation.

- What we do:
  - Estimate effects of a specific expansionary credit shock.
    - US banking deregulation in 1980s.
  - Estimate a theoretical model to understand mechanisms.

This paper

- Empirical analysis
  - Quasi-natural experiment of US bank branching deregulation.
  - Expansionary effects on e.g. employment, GDP.
  - Consistent with empirical literature.
  - Not sufficient to infer which mechanisms are important.
    - E.g. are supply or demand side effects more important?
- Build and estimate a quantitative model
  - Heterogeneous households and firms.
  - Model replicates the empirical responses quite well.
  - Use model to evaluate different channels of shock effects.
- Main finding: lion's share of effect is via firm side:
  - Cheaper credit increases investment and entry.
  - Household demand channel less important.

Literature Review

- **Effects of US Banking Deregulation:**

  Jayaratne and Strahan (1996); Kroszner and Strahan (2014); Mian, Sufi, Verner (2020).

- **Macroeconomic Effects of Financial Shocks:**

  Buera and Moll (2012); Buera and Nicolini (2020); Khan and Thomas (2013); Guerrieri and Lorenzoni (2017).

- **Our contribution:**
  - Estimating impulse responses of bank deregulation.
  - Estimating a quantitative model to evaluate mechanisms.

Data sources

Compile state-level panels for:

- Bank related variables: history
  - Deregulation dates: Jayaratne and Strahan (1996), Morgan, Rime and Strahan (2004), Park (2011)
  - Federal Deposit Insurance Corporation (FDIC) - Call Reports: interest rates on loans, loan quantities
- Real variables:
  - Bureau of Economic Analysis (BEA): GDP, employment, wages
  - Business Dynamics Statistics (BDS): firm entry and exit

Estimation method

Local Projection Method - Jorda (2005), Teulings and Zubanov (2014)

- In a nutshell:

$$g_{i,t+k} = \gamma_k D_{i,t} + \epsilon_{i,t+k}, \quad k \geq 0 \tag{1}$$

  - $g_{i,t+k}$: growth rate of variable of interest, in state i at $t+k$
  - $D_{i,t}$: 1 if intrastate branch deregulation in state i at time t
  - γ_k: impulse response at $t+k$

Estimation method

Local Projection Method - Jorda (2005), Teulings and Zubanov (2014)

- Actual specification:

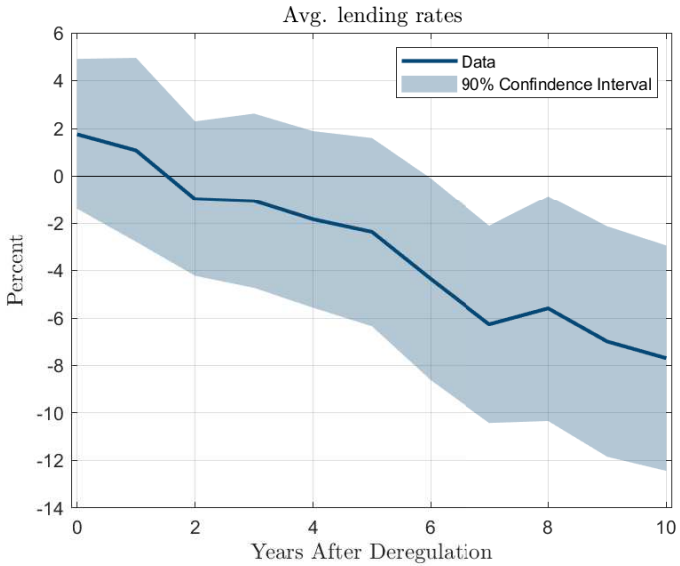
$$g_{i,t+k} = \alpha_i^k + \bar{\alpha}_t^k + \sum_{j=1}^{J} \beta_j^k g_{i,t-j} + \sum_{j=0}^{J} \gamma_j^k D_{i,t-j} + \sum_{j=0}^{k-1} \delta_j^k D_{i,t+k-j} + \Gamma \mathbf{X_{i,t}} + \varepsilon_{i,t+k}$$

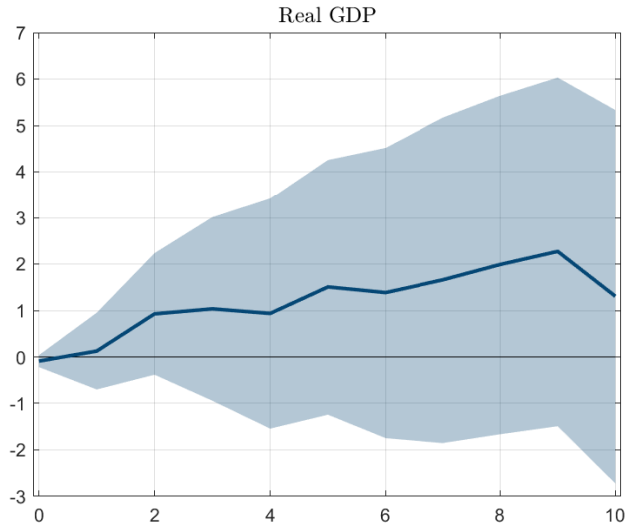
$$IRF_g(k) = \gamma_0^k,\ k \geq 0$$

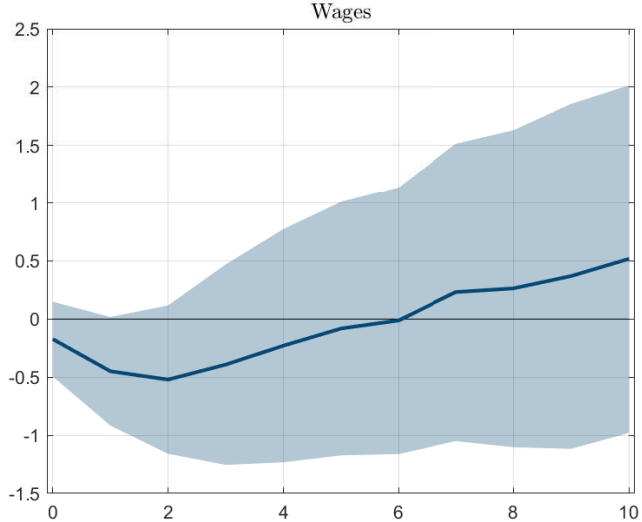
- Exploit variation across states in the timing of deregulation
  - *Identifying assumption*: timing not affected by the outcome variables we consider, conditional on controls (political related, banking industry related, and local business cycles, ...)

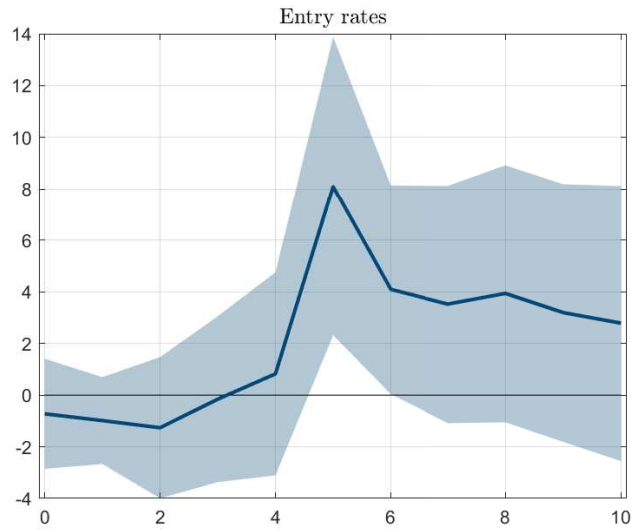
Deregulation Details

Expansionary effects of bank deregulations





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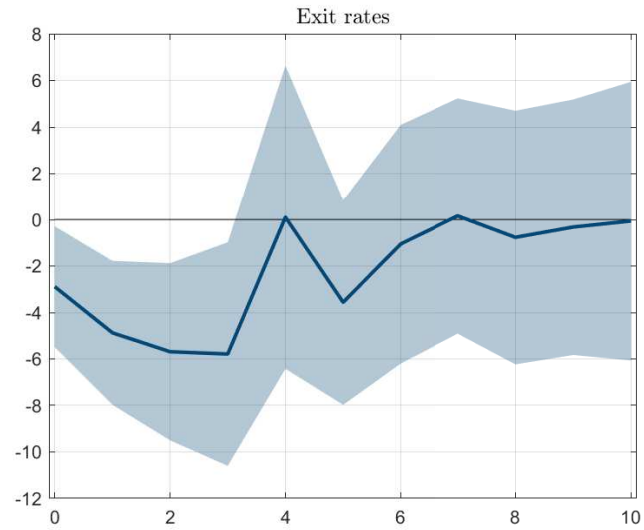
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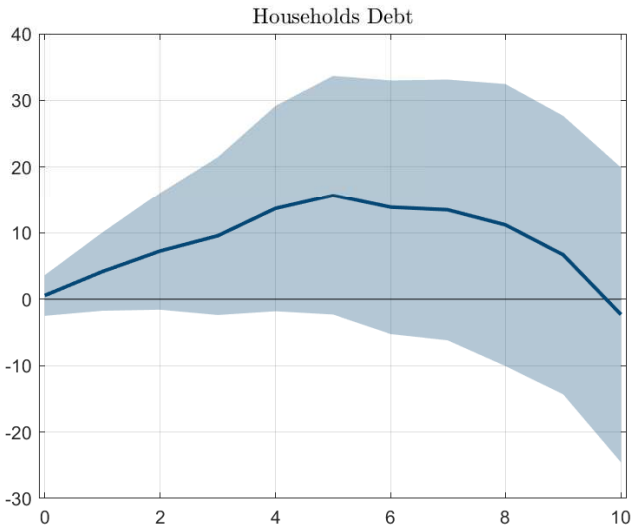
Households Debt
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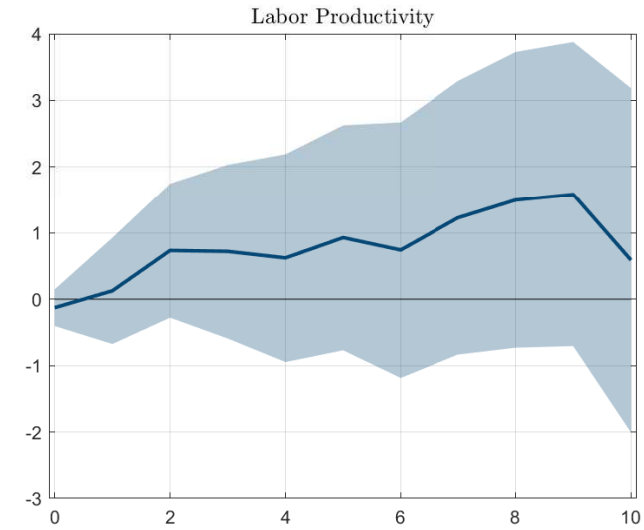
Labor Productivity
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Model

- Small open economy model of a US state.
- To replicate the empirical responses
- To investigate channels and distinguish demand vs. supply effects

Households

- Two types of households:
  - Constrained (measure χ) & unconstrained $(1-\chi)$.

- All are identical, except that

  constrained cannot participate in asset markets (i.e. hand-to-mouth).

- No idiosyncratic risk.

  $\Rightarrow$ a representative household of each type.

- Households choose non-tradable and tradable goods, $C_{T,t}, C_{N,t}$, labor supply N_t and next-period financial assets B_t (only the unconstrained) to maximize

$$E_0 \sum_{t \geq 0} \beta^t U(C_{T,t}, C_{N,t}, N_t)$$

Households

- Budget constraints:
  - Constrained:
$$C_{T,t}^{\text{Con.}} + P_{N,t} C_{N,t}^{\text{Con.}} = w_t N_t^{\text{Con.}}$$
  - Unconstrained:
$$B_t^{\text{Un.}} + C_{T,t}^{\text{Un.}} + P_{N,t} C_{N,t}^{\text{Un.}} = \Pi_t^{\text{Un.}} + w_t N_t^{\text{Un.}} + B_{t-1}^{\text{Un.}} \left(1 + r_{t-1}^H\right)$$

- The interest rate faced by the household
$$r_t^H = r + \psi_0 \left(e^{\frac{\overline{B} - B_t}{|\overline{B}|}} - 1 \right) + \psi_t^H \tag{1}$$
  - r: common interest rates across different states
  - $\psi_0 > 0$: interest rates increasing in level of debt
  - ψ_t^H: underlying shocks, changed when deregulation

Production

- Intermediate goods and final goods producers
- Intermediate goods producers
  - Monopolistically competitive
  - Each produces a separate variety i, sold at price p_i
  - Rent capital and hire labor

Final goods producers

- Choose input of intermediate goods q_i, and output of each final good, to maximize profits

$$y_T + P_N y_N - \int_0^1 p_i q_i di$$

subject to production constraint:

$$(y_T^{\mu} + y_N^{\mu})^{\frac{1}{\mu}} \leq \left[\int_0^1 (q_i)^{\frac{\eta-1}{\eta}} \, di \right]^{\frac{\eta}{\eta-1}}$$

Intermediate goods producers: Setup

- New firms pay entry cost before entering
- After entry, draw productivity z from distribution G_z.
  - $G_z \sim$ Pareto.
  - i.i.d. across firms
- Each period:
  - z stays the same with prob. ρ_z.
  - Draws new z' from G_z with prob. $1 - \rho_z$.
  - Pays fixed cost c^F to stay in business, or exits.
  - Rents capital & labor.
- Intermediate goods firms production function

$$y = z^{\left(\frac{1}{\eta-1}\right)} k^{1-\alpha} n^{\alpha}$$

- Endogenous exit $\rightarrow$ endogenous firm dynamics and distrib.

Intermediate goods producers: Entry

- Entry cost is paid in units of tradeable goods
- Firm's entry cost is increasing and convex in aggregate measure of entrants: $\nu \left(M_t^e\right)^{\Theta}$ (e.g., Gutierrez, Jones, Philippon, 2019)
- Entry cost = expected discounted profits for entrants.

Capital goods producer

- Perfectly competitive, owns capital stock and leases it to intermediate goods producers at rate $r_t^K + \delta_K$
- Produces capital K_t according to

$$K_{t+1} = (1 - \delta_K)K_t + I_t - \kappa \left(\frac{K_{t+1}}{K_t} - 1 \right)^2 (K_t)$$

- Assume households own capital goods producers

Equilibrium

- Households and firms optimize
- Total profits (net of entry costs) are given by

$$\Pi_t = \int_i \pi_{i,t}^F di + \Pi_t^K - \nu \left(M_t^e\right)^{1+\Theta}$$

- Markets clear
  - Labor market (labor not moving across states)

$$M_t^F \int I_{\{z \geq z^\star(\mathbf{x}_t)\}} n^\star(z) \mu_t(z) dz = N_t$$

  - Capital goods market

$$\int I_{\{z \geq z^\star(\mathbf{x}_t)\}} k^\star(z) \mu_t(z) dz = K_t.$$

  - Non-tradable goods market

$$C_{N,t} \quad = \quad Y_{N,t}$$

Calibration

Table: Parameters set exogenously

Parameter	Description	Value
β	Discount factor	0.96
σ	Risk aversion	2.0
γ	Preference over Tradable goods	0.7
δ_K	Capital depreciation	0.1
α	Labor share for intermediate goods firms	0.64
η	Demand elas. for intermediate goods	10
ς	elas. of substitution between tradable and local goods	-2
υ_L	Labor supply elasticity	2.0
ξ	Productivity Pareto dist.: scale para.	1.3

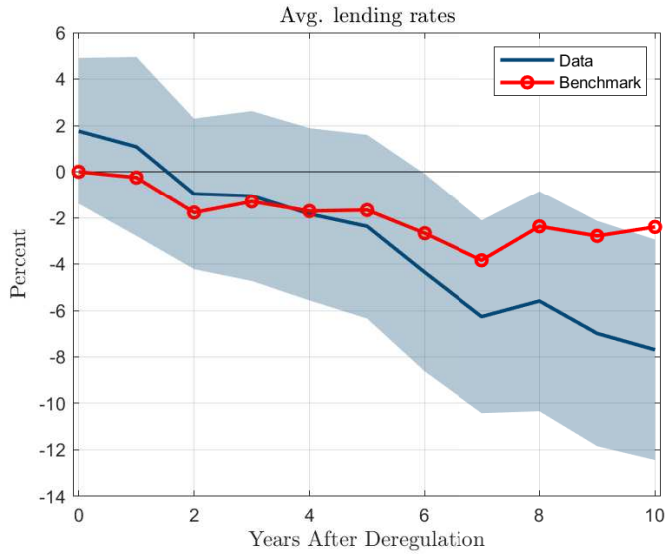
Estimation

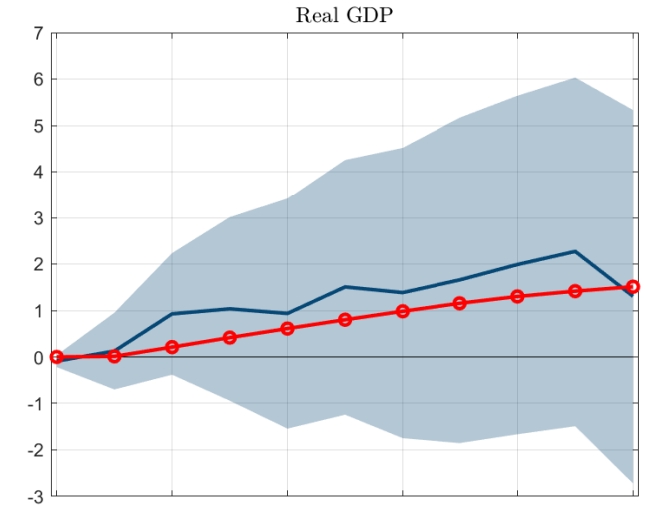
Table: Endogenously estimated parameters

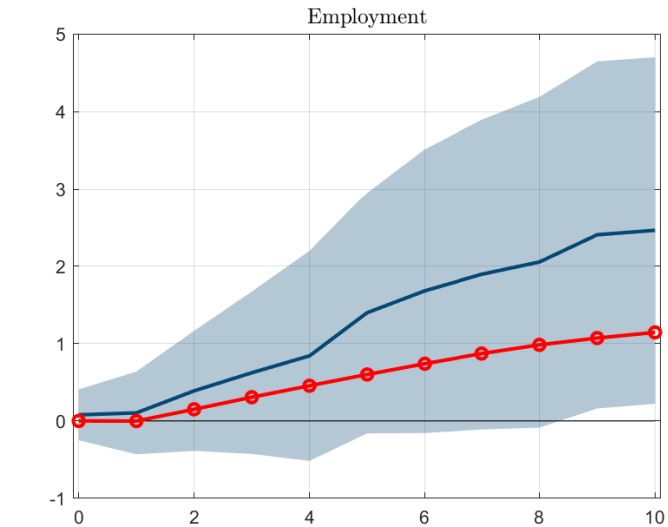
Parameter	Description	Value	Relevant Moments
$\{\psi_t^H\}t = 0^\infty$	Sequence of credit shocks	...	Lending rate responses
$\bar{B}$	HH steady state debt level	-0.4542	s.s. Debt/GDP
ν	Entry cost: linear coefficient	2.4274	s.s. Entry and exit rates
c^F	Flow operation costs	0.1031	s.s. Entry and exit rates
κ	Capital adj. costs	1.2002	Employment and GDP responses
Θ	Elasticity of entry costs w.r.t. to mass of new firms	0.5192	Entry and exit responses
ρ_z	Persistence for firm-level productivity	0.8813	Entry and exit responses
ψ_0	Elasticity of HH interest rate to debt	0.0096	HH Debt responses

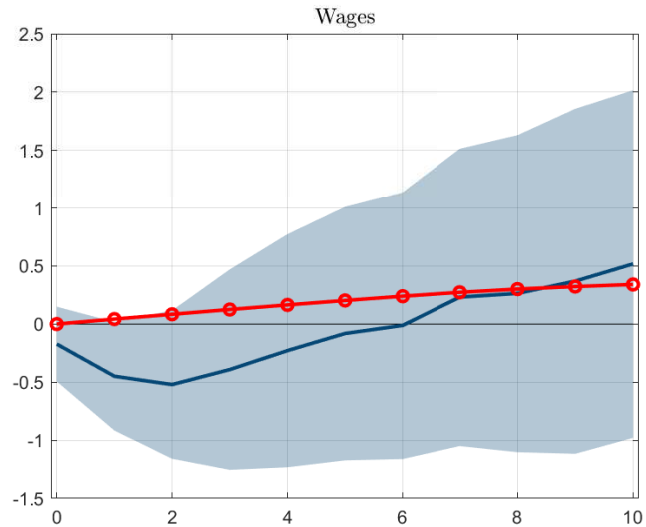
Results

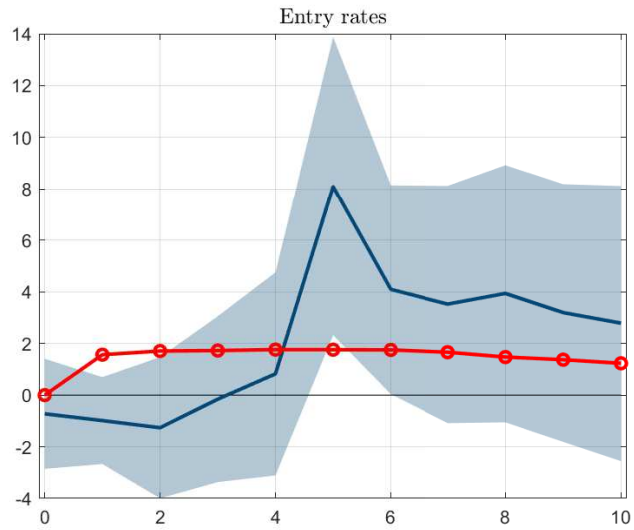
Model can replicate the empirical responses quite well










Entry rates
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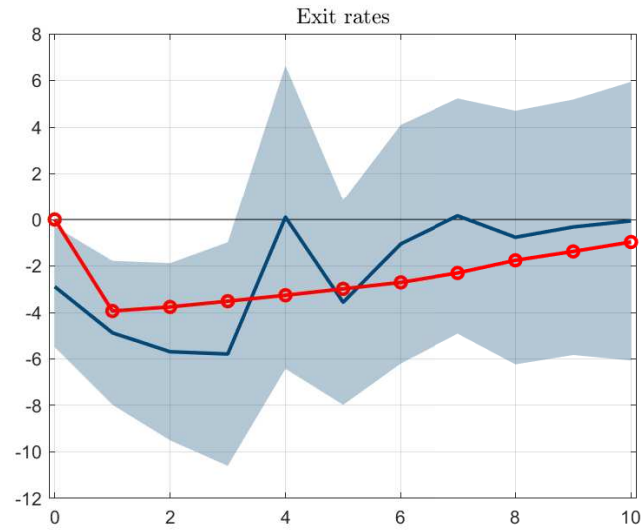
Exit rates
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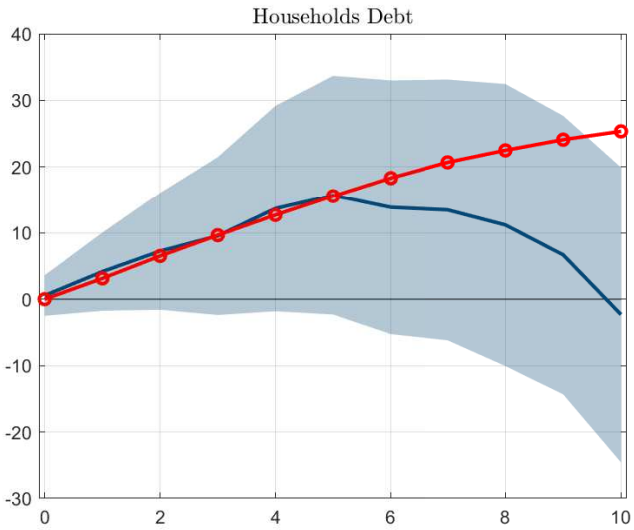
Households Debt
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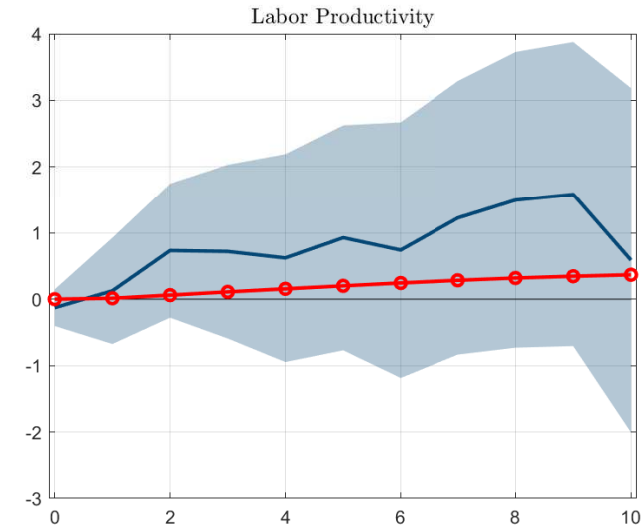
Labor Productivity
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Inspecting the mechanism

- Gauge the relative importance of demand vs. supply side
  - Lower borrowing rates for either households (demand) or firms (supply)

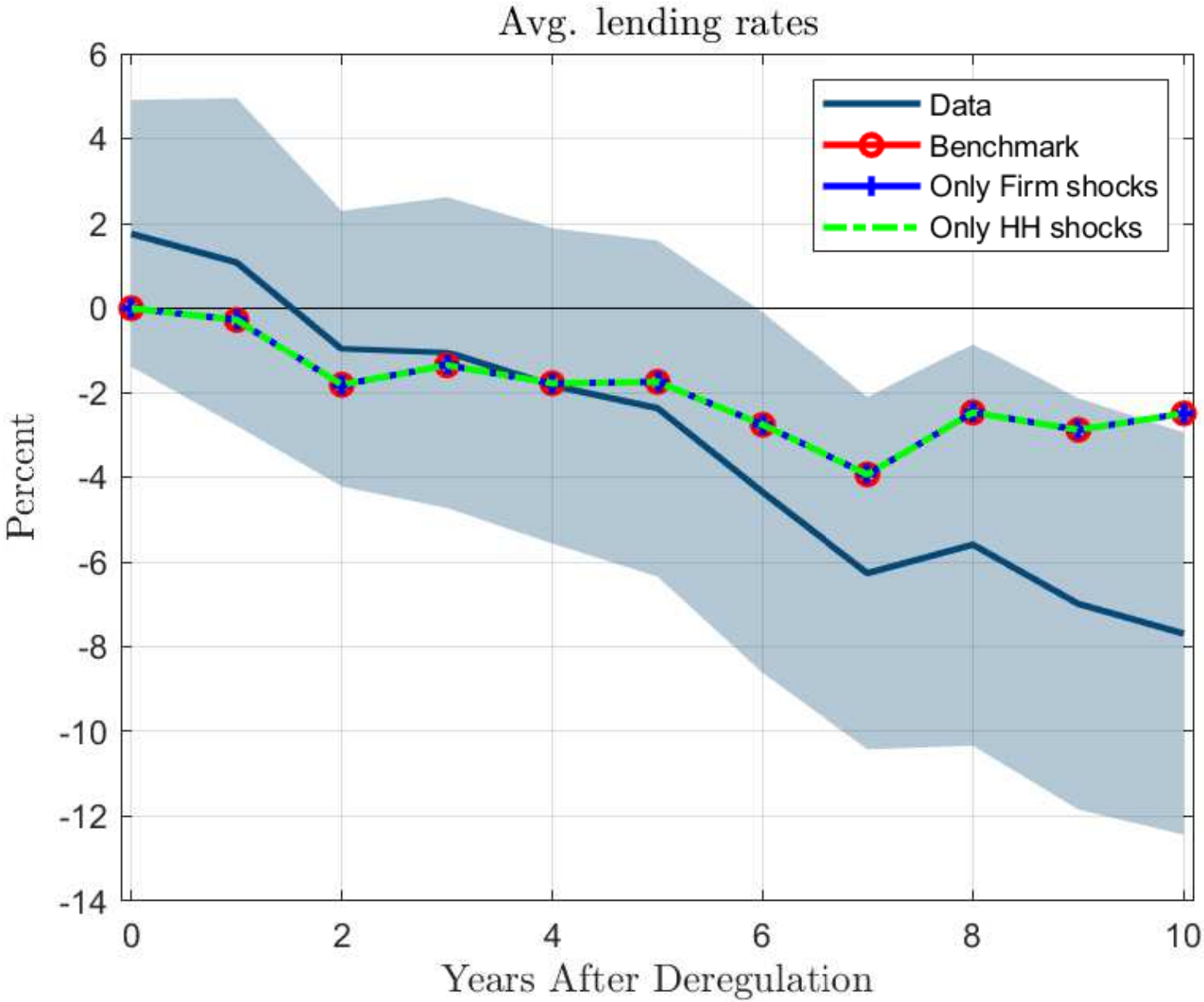
- (1) Suppose only shocks to firms
  - Firms face same interest rates path as in benchmark

$$\widetilde{r}_t^{\text{Firms}} = r_t^{\text{Benchmark Model}}$$

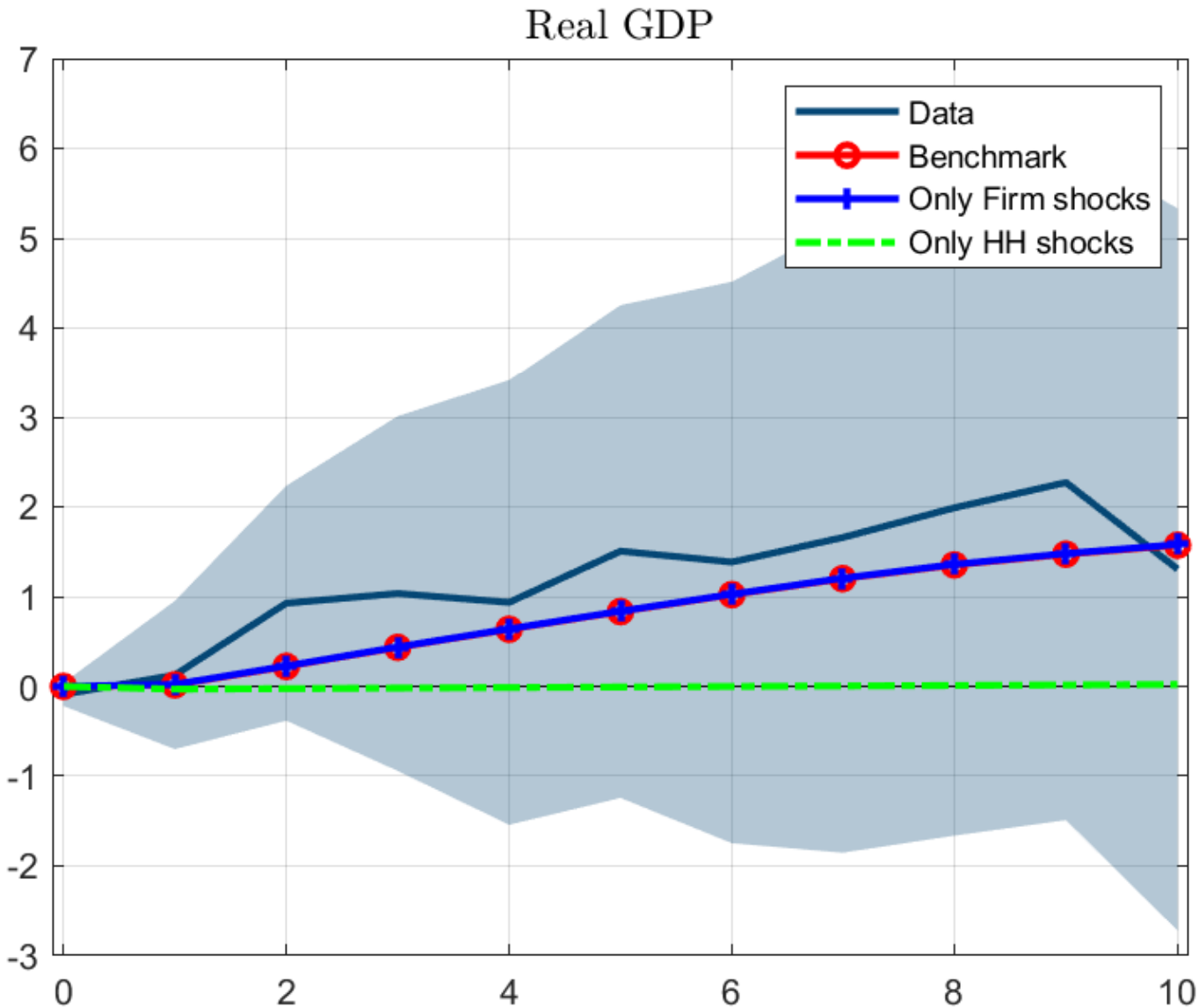
  - Households face constant interest rate: $\widetilde{r}_t^{\text{HH}} = r + 0 + 0$

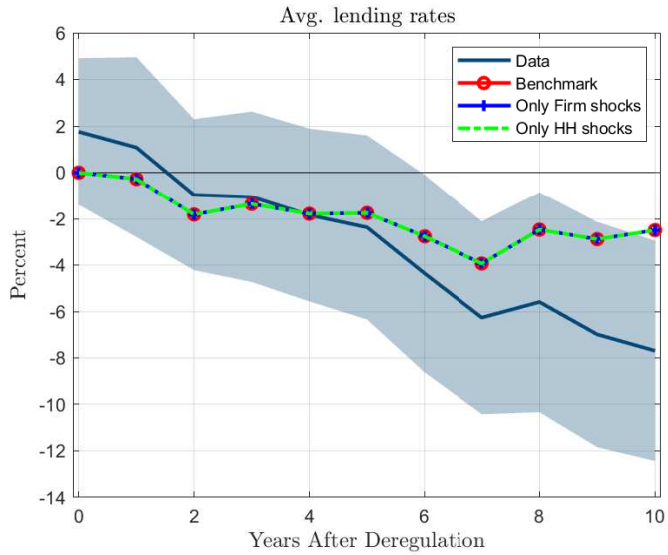
- (2) Suppose only shocks to households
  - $\widetilde{r}_t^{\text{HH}} = r_t^{\text{Benchmark Model}}$ and $\widetilde{r}_t^{\text{Firms}} = r + 0 + 0$

Interest rates path



Almost all effect comes from firms




Avg. lending rates
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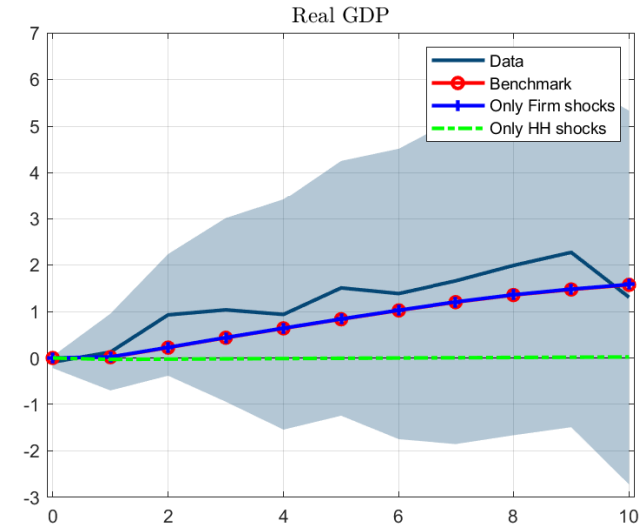
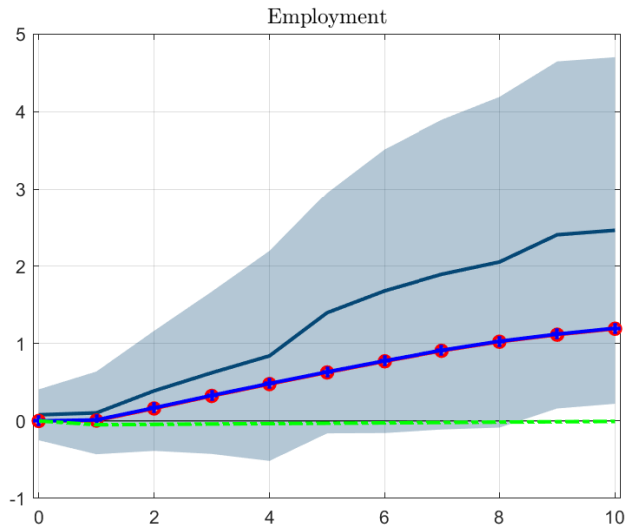
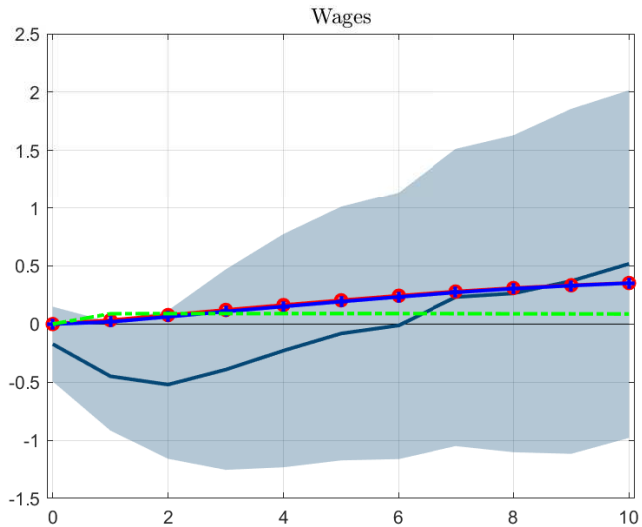
Benchmark
Only Firm shocks
Only HH shocks
Percent
Years After Deregulation


Real GDP
Data
Benchmark
Only Firm shocks
Only HH shocks


Employment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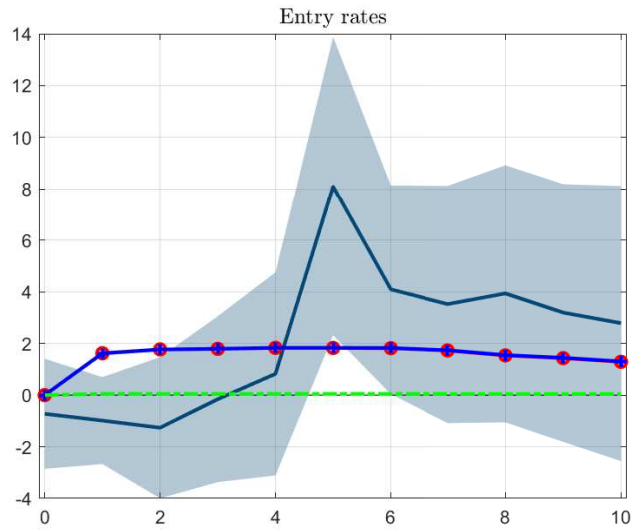
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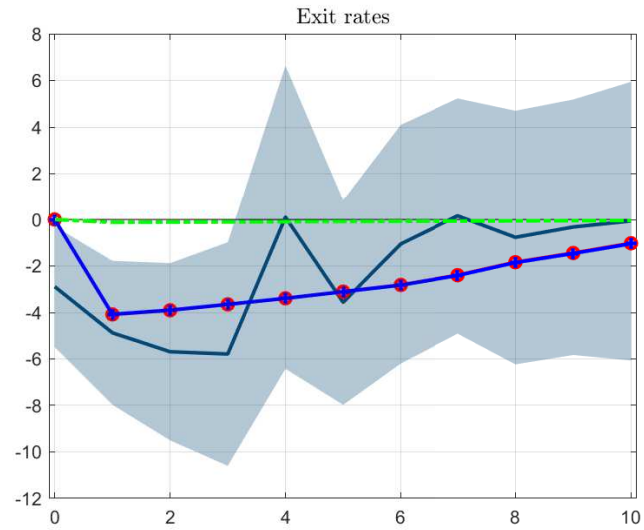
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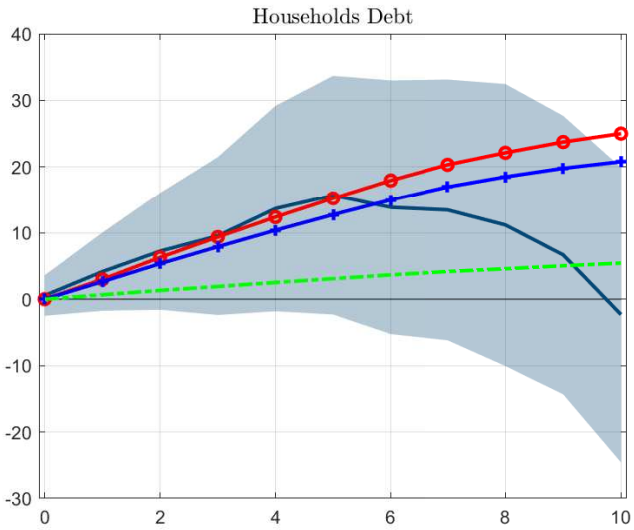
Households Debt
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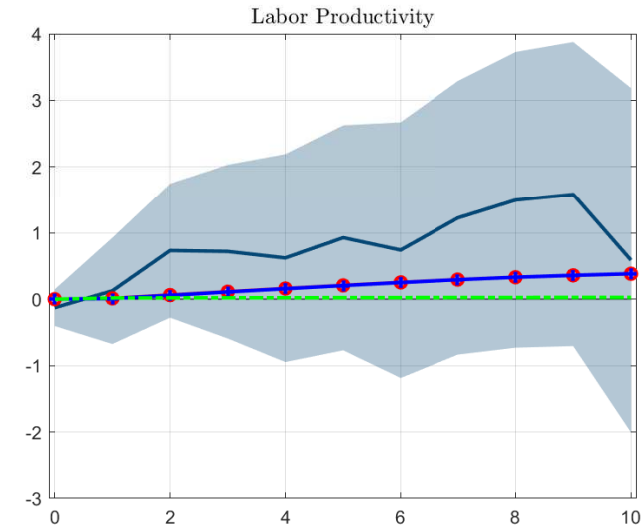
Labor Productivity
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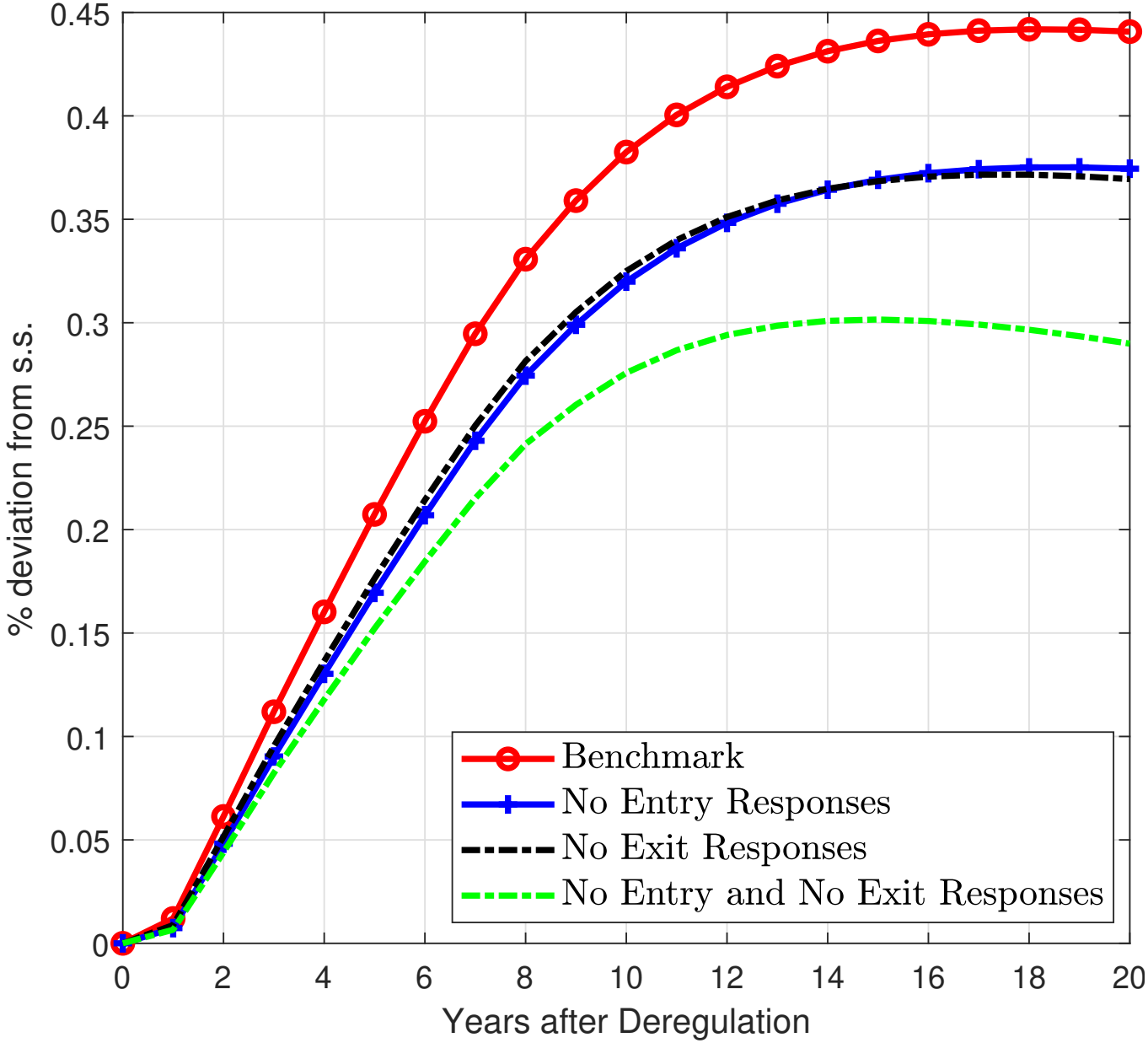
Demand vs. Supply side

- When firms face lower interest rate (supply shock)
  - Lower costs to supply capital goods
  - $\Rightarrow$ More capital goods supplied to intermediate goods firms and thus more production
  - $\Rightarrow$ Higher profits, more entry and less exit
- When households face lower interest rate (demand shock)
  - Households move consumption upfront
  - Very little and very transitory: $P_{N,t} \uparrow$, $C_{N,t} \uparrow$; also increases in nominal wages; relatively big increases in household debt
  - Very little change in production and employment overall (details)
- Overall, after deregulation, firms' responses account for almost all changes

Further analysis of the supply side

- Compare the magnitude of different channels
- (1) Suppose no endogenous responses in entry
  - Keep the mass of new entrants as in the initial steady state
  - Households/firms still optimize; all local markets clear
- (2) Suppose no endogenous responses in exit
- (3) Suppose no endogenous responses in entry and exit
- Focus on labor productivity

Figure: Labor productivity and counterfactuals



Further analysis of the supply side: findings

- Aggregate labor productivity increases
  - Without endogenous entry and exit, magnitude is 30% less
  - Entry vs. exit, are roughly equally important
  - Intensive margin: using more capital accounts for 70% of the effect
- Confirm this pattern by also looking at Solow Residual (controlling for the contribution of Capital) (details)
- Also robust with different model parameters (details)

Conclusions

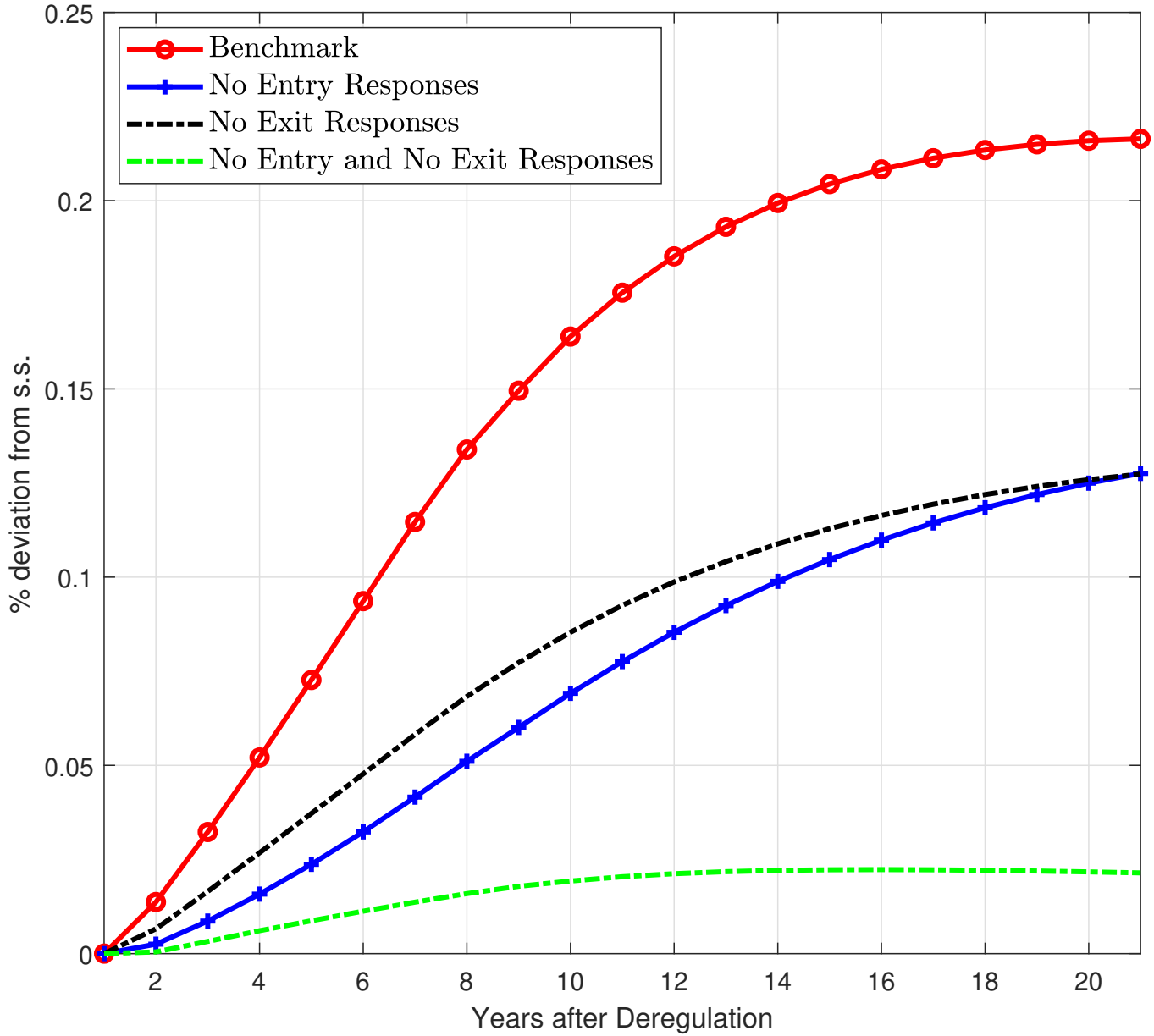
- How does increase in bank credit stimulate the economy?
- Empirical and quantitative analysis: most of the effects are through firms
- Going forward, allow for additional features
  1. Introduce nominal rigidities for prices/wages ("best shot" for demand side)
  2. Entry and exit for intermediate goods firms within each sector (so that the EoS between tradables and non-tradables is time-varying)

Further analysis of the supply side: Solow residual;

(Go back)

- Calculate Solow residual, controlling the contribution from Capital
  - Using standard growth accounting
  - Assume Cobb-Douglas production with capital share of 1/3
- Results: Solow residual increases following financial liberalization
  - Entry and exit are roughly equally important in accounting for the rise in the Solow residual
  - Without endogenous responses in entry and exit, almost no change in Solow residual

Figure: Solow residuals and counterfactuals



Labor productivity and decompositions: robustness;

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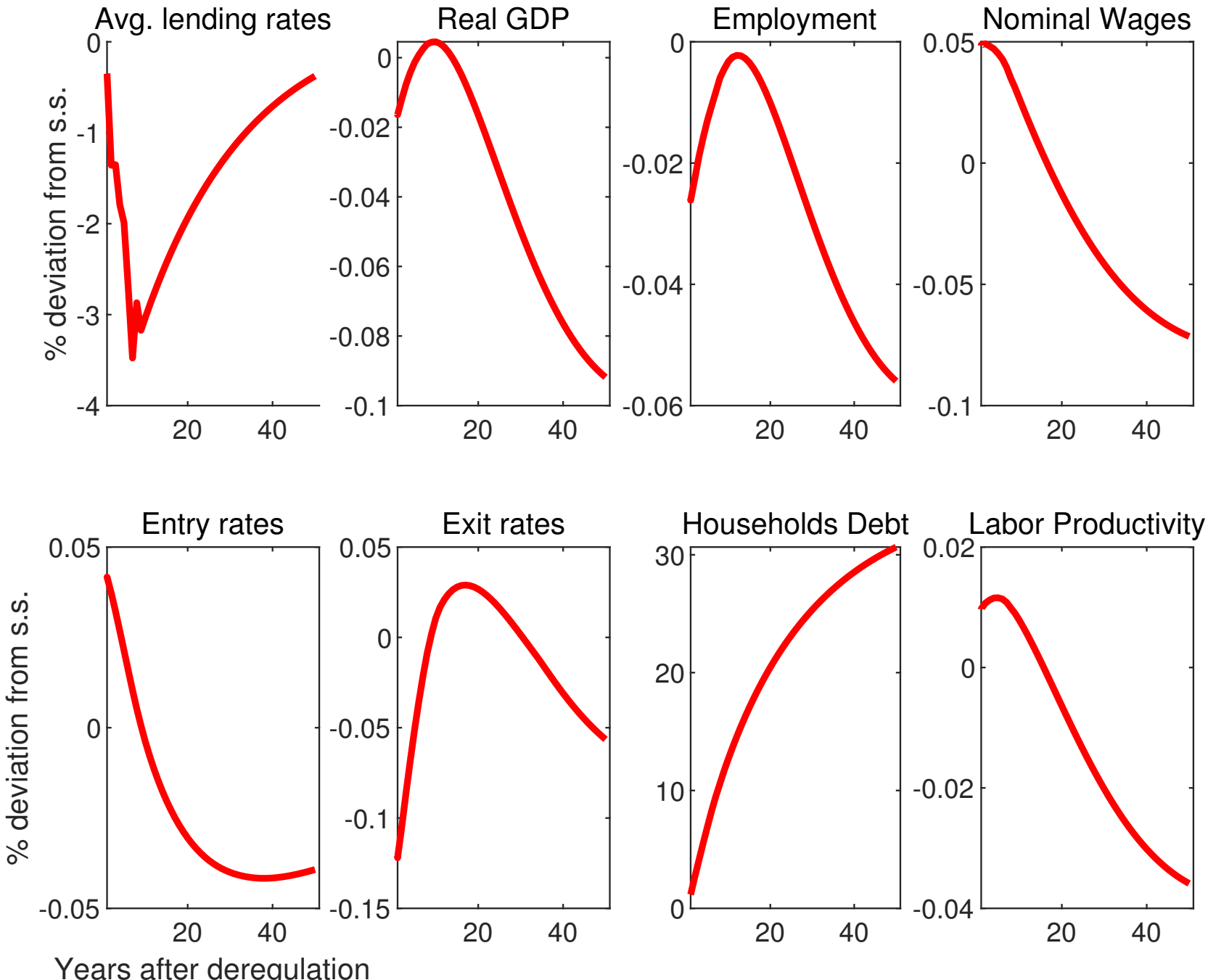
	Total increases (%)	Relative to Total changes		
		No entry	No exit	No entry and exit
Benchmark	0.40	84%	85%	71%
Risk aversion				
$\sigma = 3.0$	0.41	84%	85%	72%
$\sigma = 1.2$	0.38	83%	84%	69%
Labor supply Elasticity				
$\upsilon_L = 2.0$	0.44	85%	86%	73%
$\upsilon_L = 6.0$	0.30	80%	81%	65%
Elasticity of entry costs				
$\Theta = 0.78$	0.40	85%	82%	72%
$\Theta = 0.31$	0.41	83%	88%	70%
Capital adj. costs				
$\kappa = 1.80$	0.37	83%	85%	71%
$\kappa = 0.72$	0.43	85%	85%	72%
Interest rate Elasticity				
$\psi_0 = 9.5 \times 10^{-4}$	0.75	72%	75%	56%
$\psi_0 = 6.2 \times 10^{-2}$	0.14	92%	91%	81%

Shocks to hhs only;

Go back



History of bank deregulation

Intrastate Branching

- 1927 McFadden Act gave states the authority over branching activities within their borders
- Most states restricted branch expansion into the 1970s
- *Intrastate deregulation*: between 1970 and 1999 other states lifted restrictions on branching in cohorts
  - Allowed acquisition of existing banks and creation of new branches

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Determinants of bank deregulation

1. *Private interest factors*: larger share of small banks delays deregulation

2. *Economic environment*: larger share of small bank-dependent firms speeds deregulation

3. *Partisan structure*: larger share of Democrats delays deregulation

4. Timing: 3 innovations in the 1970s $\downarrow$ the value of local monopolies
   - invention of the ATM
   - banking by mail and telephone of mutual funds products
   - reduction of transportation and communication costs

back