Aggregate Implications of Corporate Taxation over the Business Cycle

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The Ohio State University

October 22, 2024

DKT Workshop

Outline

- Introduction
- Model
- Calibration
- Long-run effects of corporate tax deductions
- Short-run dynamics of corporate tax deduction
- Application: policy evaluation

What are the macro effects of corporate tax deductions?

Fact large deductions (86B), investment responses are large and heterogeneous

(The Joint Committee on Taxation (2017), Chodorow-Reich, Zidar and Zwick (2024b), Zwick and Mahon (2017), Ohrn (2018, 2019))

Model $\underbrace{\text{hetero. firms}}_{\text{size-dependent response}} + \underbrace{\text{financial frictions}}_{\text{limit investment loan}} + \underbrace{\text{corporate taxes}}_{\text{partial irreversibility}} + \underbrace{\text{investment deduction}}_{\text{winner/loser}}$

Calibrate match key moments in US economy and establishment-level investment data

Validation (i) $\underbrace{\text{investment rate distribution}}_{\text{Cooper and Haltiwanger (2006)}}$, (ii) $\underbrace{\text{heterogeneous investment response to policy}}_{\text{Zwick and Mahon (2017)}}$

Application equilibrium effects on investment deductions as counter-cyclical policies

- against different shocks (TFP v.s. credit); v.s. other stimulus policies (TCJA)

Preview of findings

Comparing two economy, with and without investment tax deductions,

- Investment deductions work with credit shocks but not TFP shocks
- Investment deductions reduce half life of agg. productivity by 25% (date 16 $\rightarrow$ 12)

Comparing policies that is implemented in 2017 Tax Cuts and Jobs Act,

- Targeted deduction policy boosts GDP by 1.6%, yet untargeted one boosts by 1.06%
- Current combination of both deductions lead to 20% drop in boosting GDP (Ohrn (2019))

Literature

Key mechanisms

Two inefficiencies: financial frictions and partial irreversibility created by tax wedges

- (S, s) decision rules induce large firms to invest higher than first-best level
- Financial frictions hinder capital accumulation of small firms by limit investment loan

Why targeted policy is better? Both policies alter the cost and benefit of investment:

Cost Targeted policy allow some firms to deduct more, resulting in lower relative prices

Untargeted policy induces large dividend payment as large firms also get subsidized

Benefit Targeting motivates self-selection $\Rightarrow$ alleviate misallocation for high productivity firms

Untargeted policy spread the tax incentives across firms $\Rightarrow$ effects are more diffused

Literature

- Large empirical literature on responsiveness of investment to tax credit
  - Public firm data: Goolsbee (1998), Cummins, Hassett and Hubbard (1996), House and Shapiro (2008), Lamont (1997); Firm/State-level data: Zwick and Mahon (2017), Ohrn (2018), Ohrn (2019)

  New - evaluates aggregate effects of both investment subsidy policies

- Representative firm model on the response of fiscal policies with simplistic tax structure
  - Hall and Jorgenson (1967), Summers, Bosworth, Tobin and White (1981), Fernández-Villaverde (2010), Occhino (2022), Occhino (2023), Chodorow-Reich, Smith, Zidar and Zwick (2024a)

  New - accounts for distributional effects and a realistic tax deduction structure

- Heterogeneous firm model on price elasticity of investment and policy transmission
  - Khan and Thomas (2013), House (2014), Koby and Wolf (2020), Winberry (2021)

  New - expands to fiscal policies and determines their aggregate effects

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Environment

Household: supplies labor, pays labor tax, lends risk-free loans, and owns the firms

Government: collect taxes to fund exogenous government spending

Firms: states $(k, b, \psi, \varepsilon)$

- DRS production; persistent idiosyncratic productivity ε; i.i.d. exit shock π_d
- capital k accumulation is hindered by financial frictions and tax wedges:
  1. collateral constraint $b' \leq \theta k'$
  2. both return and cost on investment are distorted by corporate taxation and deduction
  3. selling capital comes with capital gain $\Rightarrow$ similar to partial irreversibility on disinvestment

Taxable income and budget constraint

Firms' budget constraints

$$D = z\varepsilon F(k,n) - wn - b + qb' - (k' - (1-\delta)k) - \tau^c \mathcal{I}(k',k,\psi,\varepsilon)$$

Taxable income

$$\mathcal{I}(k',k,\psi,\varepsilon) = \max\left\{z\varepsilon f(k,n) - wn - \mathcal{J}(k',k)\omega(k' - (1-\delta)k) - \delta^\psi \psi, 0\right\}.$$

- $\mathcal{J}(k',k)\omega(k' - (1-\delta)k)$: (capital gain) deduction from current (dis)investment
- ψ: deductible stock; LoM: $\psi' = (1-\delta^\psi)\psi + (1-\mathcal{J}(k',k))\omega I$
  - $\delta^\psi \psi$: deduction from past investment
  - $\delta^\psi > \delta$: "accelerated" depreciation $\Rightarrow$ selling price $>$ adjusted basis (Hanlon, Maydew and Shevlin, 2008)

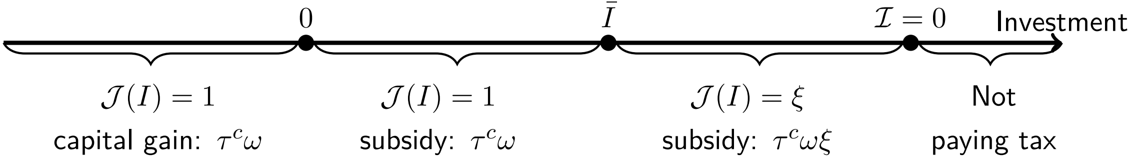
Discussion on taxable income

$$\mathcal{I}(k', k, \psi, \varepsilon) = \max\left\{ z\varepsilon f(k,n) - wn - \mathcal{J}(k', k)\omega(k' - (1-\delta)k) - \delta^{\psi}\psi, 0 \right\},$$

$\mathcal{J}(k', k)$: indicator function for government policy tools

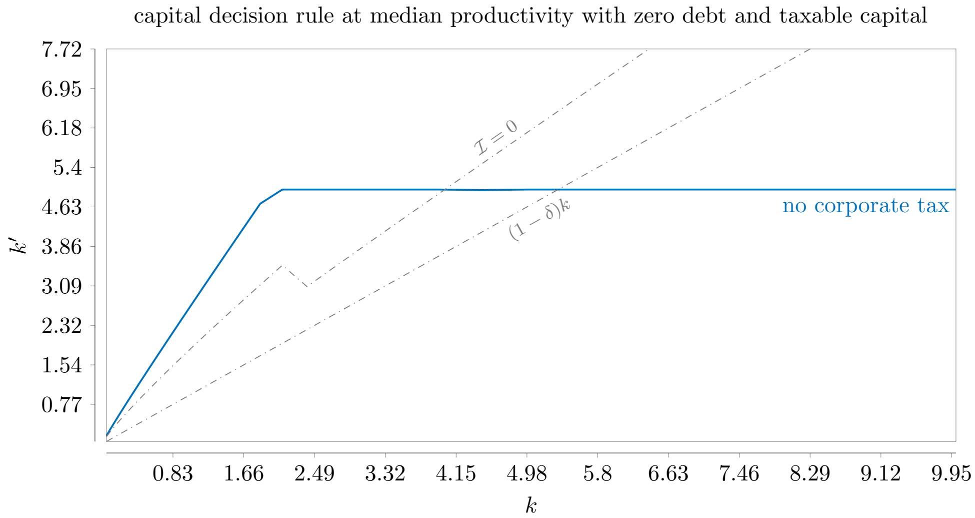
$$\mathcal{J}(k', k) = \begin{cases} 1 & \text{if } k' - (1-\delta)k \leq \bar{I} \\ \xi \in [0,1] & \text{if } k' - (1-\delta)k > \bar{I} \end{cases}$$

$\bar{I}$: Section 179 threshold (targeted policy); ξ: bonus depreciation rate (untargeted policy)



Distortion created by tax wedge

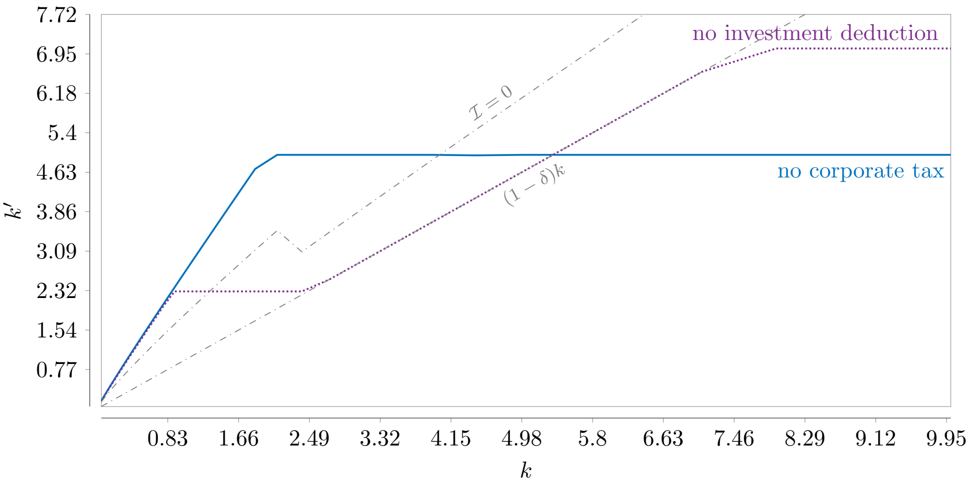
$$D = \quad (z\varepsilon F(k,n) - wn) - b + qb' - \quad - \quad I$$



Distortion created by tax wedge

$$D = (1-\tau^c)(z\varepsilon F(k,n) - wn) - b + qb' - \qquad I\mid_{I\geq 0} - (1-\tau^c\omega)I\mid_{I<0}$$

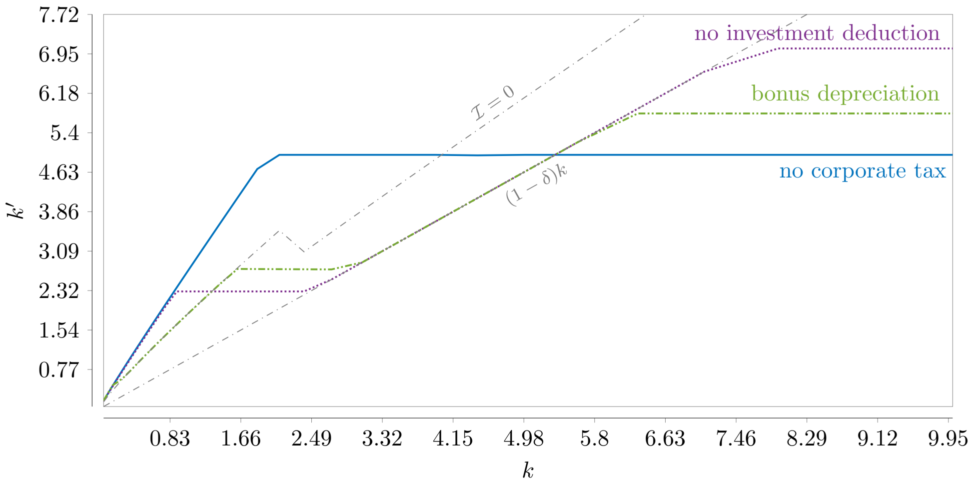
capital decision rule at median productivity with zero debt and taxable capital



Distortion created by tax wedge

$$D = (1-\tau^c)(z\varepsilon F(k,n) - wn) - b + qb' - (1-\tau^c \mathcal{J}(k',k)\omega) I \,|_{I\geq 0} - (1-\tau^c\omega) I \,|_{I<0} + \tau^c \delta^\psi \psi$$

capital decision rule at median productivity with zero debt and taxable capital



Distortion created by tax wedge

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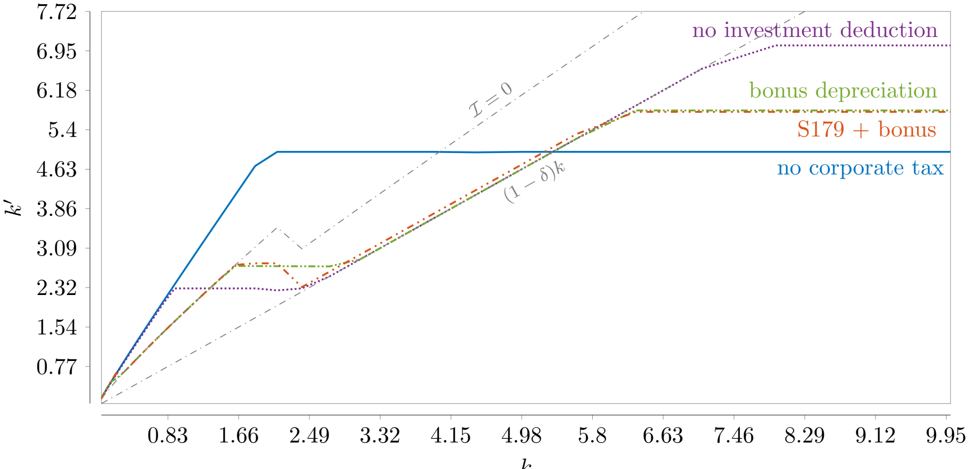
capital decision rule at median productivity with zero debt and taxable capital



Budget constraints and Discrete Choice

$$D = z\varepsilon F(k,n) - wn - b + qb' - (k' - (1-\delta)k) - \tau^c \mathcal{I}(k',k,\psi,\varepsilon)$$

$$= \underbrace{(1-\tau^c)}_{\text{taxed}}(z\varepsilon F(k,n) - wn) - b + qb' - \underbrace{(1-\tau^c \mathcal{J}(k',k)\omega)}_{\text{subsidized/capital gain tax}}(k' - (1-\delta)k) + \tau^c \delta^\psi \psi$$

$$v^0(k,b,\psi,\varepsilon;\mu) = \pi_d \max_n \left\{ z\varepsilon F(k,n) - wn - b + (1-\delta)k - \tau^c \mathcal{I}(0,k,\psi,\varepsilon) \right\} + (1-\pi_d) v(k,b,\psi,\varepsilon;\mu)$$

$$v(k,b,\psi,\varepsilon;\mu) = \max\left\{ v^H(k,b,\psi,\varepsilon;\mu), v^L(k,b,\psi,\varepsilon;\mu), v^N(k,b,\psi,\varepsilon;\mu) \right\}$$

For each option, firms maximize dividend and continuation value subject to (1) budget constraints, (2) collateral constraints, and (3) deductible stock LoM

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Calibrated Moments

Parameter	Target		Model
$\beta = 0.96$	real interest rate	$= 0.04$	0.04
$\alpha = 0.3$	private capital-output ratio	$= 2.3$	2.03
$\nu = 0.6$	labor share	$= 0.6$	0.6
$\tau^n = 0.25$	government spending-output ratio	$= 0.21$	0.201
$\delta = 0.069$	average investment-capital ratio	$= 0.069$	0.069
$\varphi = 2.05$	hours worked	$= 0.33$	0.33
$\theta = 0.54$	debt-to-assets ratio	$= 0.37$	0.371
$\theta_l = 0.3942$	decreases in debt	$= 0.26$	0.257
$\rho_\varepsilon = 0.6$	corr. in investment rate	$= 0.058$	0.050
$\sigma_\varepsilon = 0.1$	std. in investment rate	$= 0.337$	0.300
$\omega = 0.6$	lumpy investment $> 20\%$	$= 0.186$	0.185
$\xi = 0.5$	2015 bonus rate		
$\bar{I} = 0.092$	2015 threshold model counterpart Detail		

Baseline calibrated to US economy with 2015 policy level (ξ and $\bar{I}$)

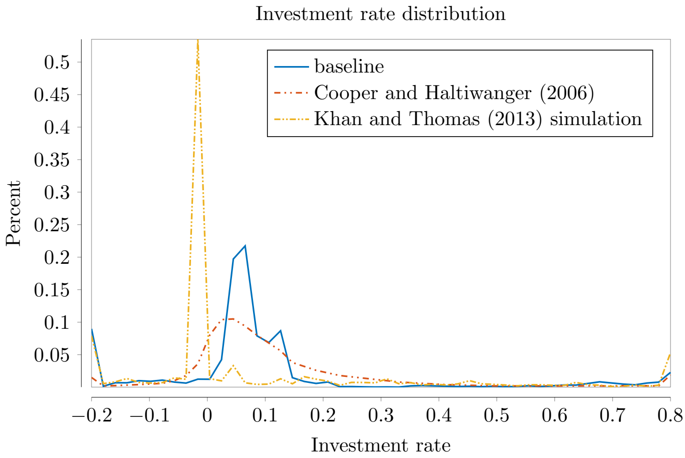
τ^n labor tax on HH, $\bar{G} =$ corporate tax $+\tau^n wn$

θ_l credit level in recessions

ε log normal AR(1)

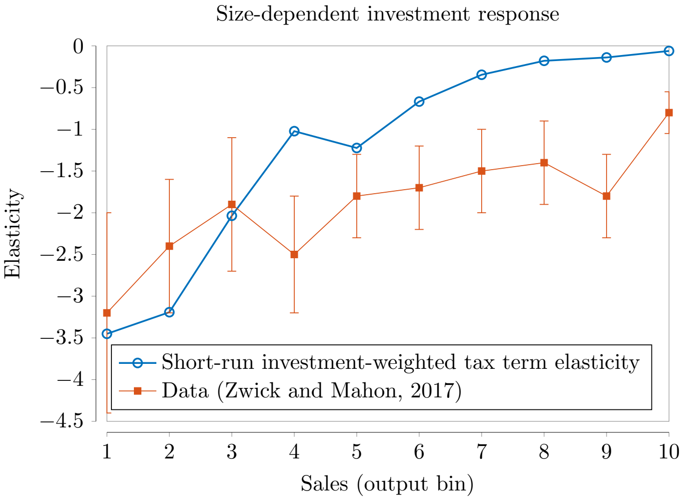
Functional Form | Exogenous parameters | investment rate distribution

Model validation: investment rate distribution for unconstrained firms



- Simulate $50,000$ unconstrained firms for 100 periods
- Take the last 17 periods and plot investment rate distribution
- Better match than standard partial irreversibility models (e.g. Khan and Thomas (2013))

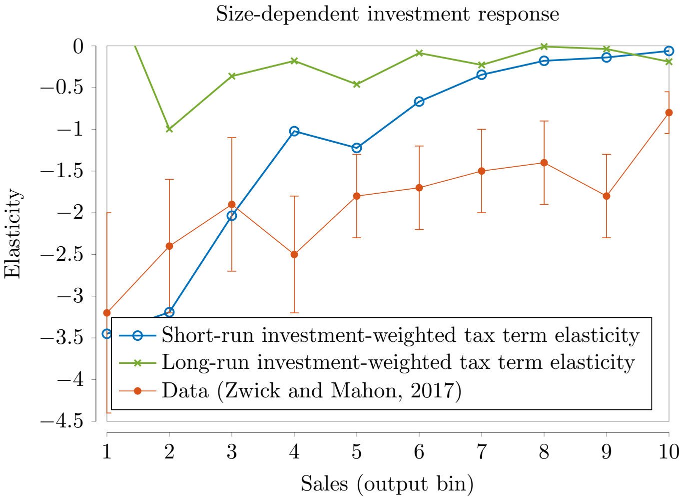
Model validation: heterogeneous investment response in the short-run



- Simulate $50,000$ firms for 100 periods
- Drop credit at date 79 and boost bonus rate at date 80
- aggregate tax term elasticity from date 79 to date 80: -1.23
- Zwick and Mahon (2017): -1.6

Response

Model prediction: not much heterogeneity in long-run investment response



- Include the GE effects
- aggregate elasticity: -0.17

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Aggregate outcomes as percentage deviation of baseline

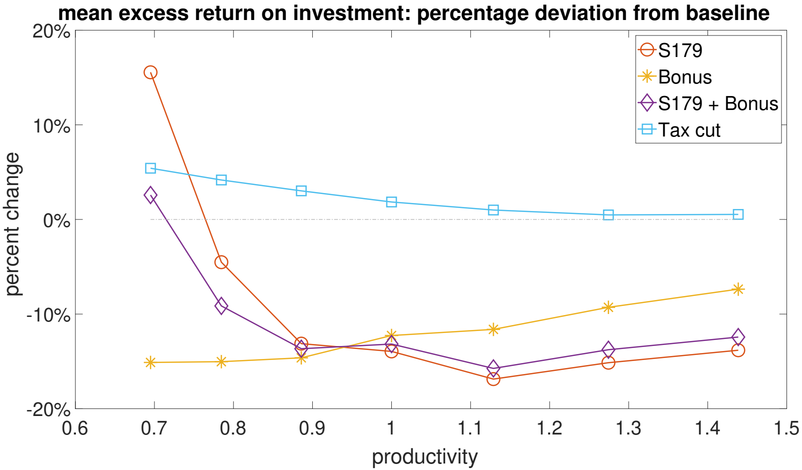
Variable	S179	Bonus	S179 + Bonus	Tax cut
Output	1.61%	1.06%	1.31%	0.64%
Consumption	1.55%	0.92%	1.27%	0.56%
Labor	0.06%	0.13%	0.04%	0.08%
Capital	4.22%	3.21%	3.39%	1.95%
Investment	4.22%	3.21%	3.39%	1.95%
Measured TFP	0.32%	0.03%	0.28%	0.01%
Dividend	2.08%	10.14%	2.99%	-2.09%

- Each policy costs 0.3% of baseline GDP and delivers the same government spending $\bar{G}$
- In S179 + Bonus, policy tools are 82% of the level in S179 and Bonus
- Untargeted nature of bonus induces dividend payment: recall $D \propto \mathcal{J}(k', k)$
  - unconstrained firms: user cost of capital drops, easier to achieve target capital

Distribution of Excess Return on Investment

	mean	mass at 0
baseline	1.24	20%
S179	1.08	31%
Bonus	1.09	26%

Expanding S179 reduces investment wedge for productive firms



efficiency	low excess return
S179	high ε firms: $(+)$
	low ε firms: $(-)$
Bonus	all firms $(+)$
	low ε firms: $(++)$

excess return

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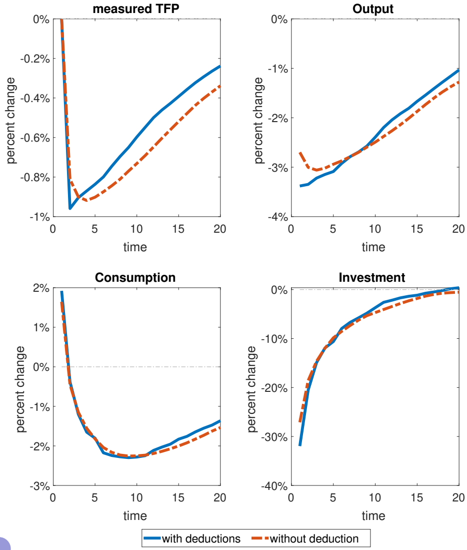
Corporate tax deductions leads to faster recoveries after credit shocks



Exercise Two economy, w/ and w/o deductions

Shock 27% initial drop in credit, $\rho = 0.909$ lead to 26% drop in debt

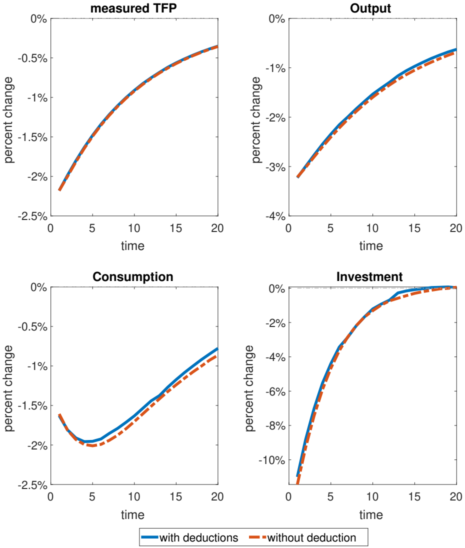
Control Hold $\{G\}_{t=0}^{T}$ fixed

Summary

	w/ deduct	w/o deduct
Half life: $\hat{z}$	12 period	16 period
Trough: $\hat{z}$	-0.95%	-0.91%
Half life: y	14 period	16 period
Trough: y	-3.38%	-3.05%

TFP

Almost no role of corporate taxation following a TFP shock



Back

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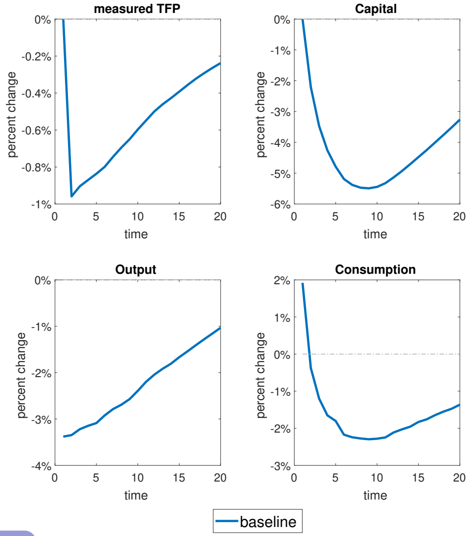
Comparison of temporary investment tax deductions under credit shocks



Shock 27% initial drop in credit, $\rho = 0.909$
lead to 26% drop in debt

Policy implement in date 4, unexpected by HH

S179 boost $\hat{z}$ by 0.05% at date 6

	Y	C	K
trough ↓	0.51%	0.28%	0.29%

Bonus boost $\hat{z}$ by 0.005% at date 6

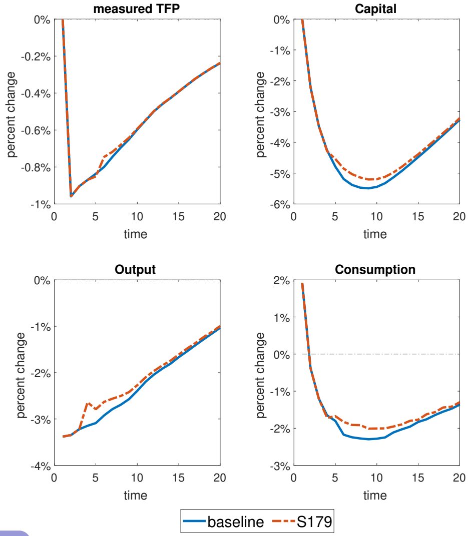
	Y	C	K
trough ↓	0.38%	0.14%	0.19%

S179 + Bonus boost $\hat{z}$ by 0.04% at date 6

	Y	C	K
trough ↓	0.35%	0.19%	0.25%

Detail

Comparison of temporary investment tax deductions under credit shocks



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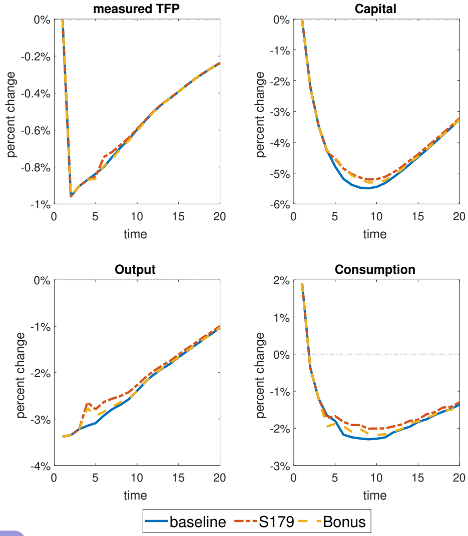

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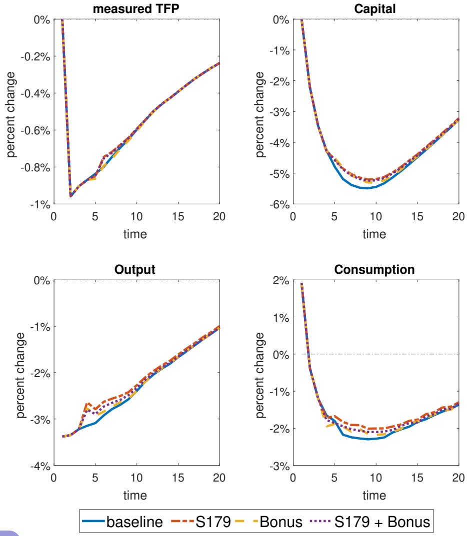

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Detail

Conclusions

- Equilibrium model of how investment tax credit and subsidy policies boost economy
- Use model to quantify the macroeconomics effects of both subsidy policies:
  - S179 boost GDP by motivating marginal firms to be unconstrained and alleviate misallocation
  - Bonus depreciation is 50% less effective than S179 as it motivates dividend payment
  - Cutting statutory tax rate is the least effective
- What's next:
  - Permanent change in policies
  - Policy effectiveness under aggregate uncertainty
  - Endogenizing financial frictions: does deduction policy reduce the incidence of firm default?

References I

Chodorow-Reich, Gabriel, Matthew Smith, Owen Zidar, and Eric Zwick (2024a) "Tax Policy and Investment in a Global Economy," *SSRN Electronic Journal*, 10.2139/ssrn.4746790.

Chodorow-Reich, Gabriel, Owen Zidar, and Eric Zwick (2024b) "Lessons from the Biggest Business Tax Cut in US History," *Journal of Economic Perspectives*, 38 (3), 61–88, 10.1257/jep.38.3.61.

Cooper, Russell W. and John C. Haltiwanger (2006) "On the Nature of Capital Adjustment Costs," *Review of Economic Studies*, 73 (3), 611–633, 10.1111/j.1467-937x.2006.00389.x.

Cummins, Jason G., Kevin A. Hassett, and R.Glenn Hubbard (1996) "Tax reforms and investment: A cross-country comparison," *Journal of Public Economics*, 62 (1), 237–273, https://doi.org/10.1016/0047-2727(96)01580-0, Proceedings of the Trans-Atlantic Public Economic Seminar on Market Failures and Public Policy.

Fernández-Villaverde, Jesús (2010) "Fiscal Policy in a Model With Financial Frictions," *American Economic Review*, 100 (2), 35–40, 10.1257/aer.100.2.35.

Goolsbee, A. (1998) "Investment Tax Incentives, Prices, and the Supply of Capital Goods," *The Quarterly Journal of Economics*, 113 (1), 121–148, 10.1162/003355398555540.

References II

Hall, Robert E. and Dale W. Jorgenson (1967) "Tax Policy and Investment Behavior," *The American Economic Review*, 57 (3), 391–414, `http://www.jstor.org/stable/1812110`.

Hanlon, Michelle, Edward L. Maydew, and Terry Shevlin (2008) "An unintended consequence of book-tax conformity: A loss of earnings informativeness," *Journal of Accounting and Economics*, 46 (2–3), 294–311, 10.1016/j.jacceco.2008.09.003.

House, Christopher L. (2014) "Fixed costs and long-lived investments," *Journal of Monetary Economics*, 68, 86–100, 10.1016/j.jmoneco.2014.07.011.

House, Christopher L and Matthew D Shapiro (2008) "Temporary Investment Tax Incentives: Theory with Evidence from Bonus Depreciation," *American Economic Review*, 98 (3), 737–768, 10.1257/aer.98.3.737.

Joint Committee on Taxation (2017) "Macroeconomic Analysis Of The Conference Agreement For H.R. 1, "The Tax Cuts And Jobs Act"."

Khan, Aubhik and Julia K. Thomas (2013) "Credit Shocks and Aggregate Fluctuations in an Economy with Production Heterogeneity," *Journal of Political Economy*, 121 (6), 1055–1107, 10.1086/674142.

References III

Koby, Yann and Christian Wolf (2020) "Aggregation in heterogeneous-firm models: Theory and measurement," *Working Paper*.

Lamont, Owen (1997) "Cash Flow and Investment: Evidence from Internal Capital Markets," *The Journal of Finance*, 52 (1), 83–109, 10.1111/j.1540-6261.1997.tb03809.x.

Occhino, Filippo (2022) "The macroeconomic effects of the tax cuts and jobs act," *Macroeconomic Dynamics*, 27 (6), 1495–1527, 10.1017/s1365100522000311.

——— (2023) "The macroeconomic effects of business tax cuts with debt financing and accelerated depreciation," *Economic Modelling*, 125, 106308, 10.1016/j.econmod.2023.106308.

Ohrn, Eric (2018) "The Effect of Corporate Taxation on Investment and Financial Policy: Evidence from the DPAD," *American Economic Journal: Economic Policy*, 10 (2), 272–301, 10.1257/pol.20150378.

——— (2019) "The effect of tax incentives on U.S. manufacturing: Evidence from state accelerated depreciation policies," *Journal of Public Economics*, 180, 104084, 10.1016/j.jpubeco.2019.104084.

References IV

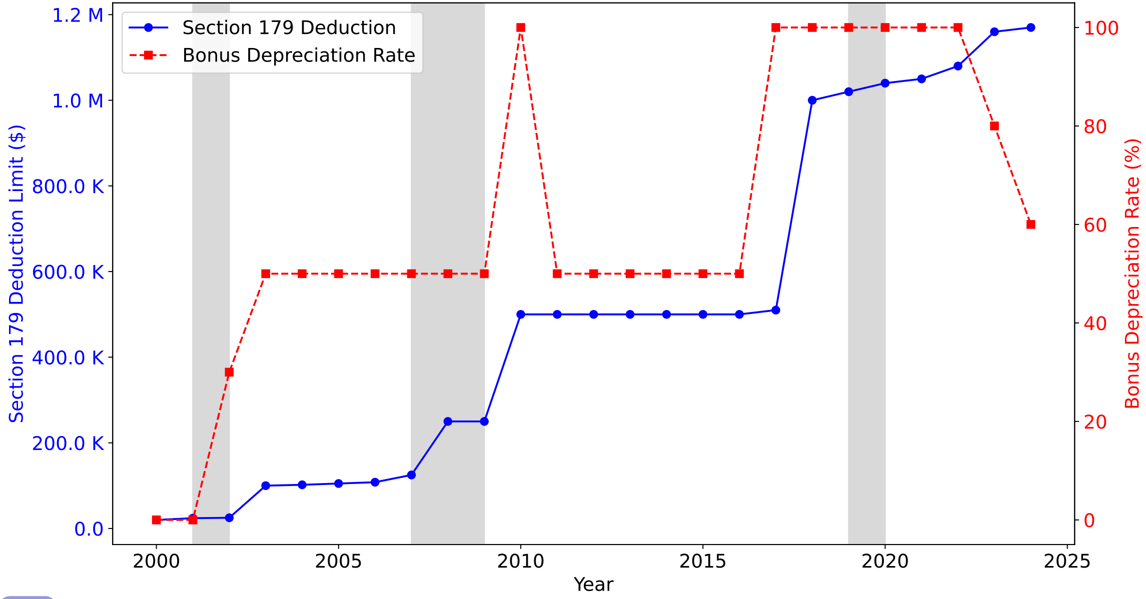
Summers, Lawrence H., Barry P. Bosworth, James Tobin, and Philip M. White (1981) "Taxation and Corporate Investment: A q-Theory Approach," *Brookings Papers on Economic Activity*, 1981 (1), 67, 10.2307/2534397.

Winberry, Thomas (2021) "Lumpy Investment, Business Cycles, and Stimulus Policy," *American Economic Review*, 111 (1), 364–396, 10.1257/aer.20161723.

Zwick, Eric and James Mahon (2017) "Tax Policy and Heterogeneous Investment Behavior," *American Economic Review*, 107 (1), 217–248, 10.1257/aer.20140855.

Outline

- Empirical Literatures
- Model Appendix


Section 179 Deduction
Bonus Depreciation Rate
Section 179 Deduction Limit ($)
1.2 M
1.0 M
800.0 K
600.0 K
400.0 K
200.0 K
0.0
Bonus Depreciation Rate (%)
100
80
60
40
20
0
2000
2005
2010
2015
2020
2025
Year

Corporate taxation in the US

- Two policies coexist: bonus depreciation (untargeted) and Section 179 (targeted)
- Consider a firm buying $\$1000$ of computer and interest rate is 4%:

Year	Cost $\times$ Depreciation %	Normal		50% Bonus	S179 eligible / 100% Bonus
0	$\$1000 \times 20.00\%$	$\$200$	$\xRightarrow[+800\times 0.5]{}$	$\$600$	$\$1000$
1	$\$1000 \times 32.00\%$	$\$320$		$\$160$	$\$0$
2	$\$1000 \times 19.20\%$	$\$192$		$\$96$	$\$0$
3	$\$1000 \times 11.52\%$	$\$115.2$	$\xRightarrow[\times 0.5]{}$	$\$57.5$	$\$0$
4	$\$1000 \times 11.52\%$	$\$115.2$		$\$57.5$	$\$0$
5	$\$1000 \times 5.76\%$	$\$57.6$		$\$29$	$\$0$
Total		$\$1000$		$\$1000$	$\$1000$
NPV		\$933		\$966	\$1000

Example: Modified Accelerated Cost Recovery System (MARCS)

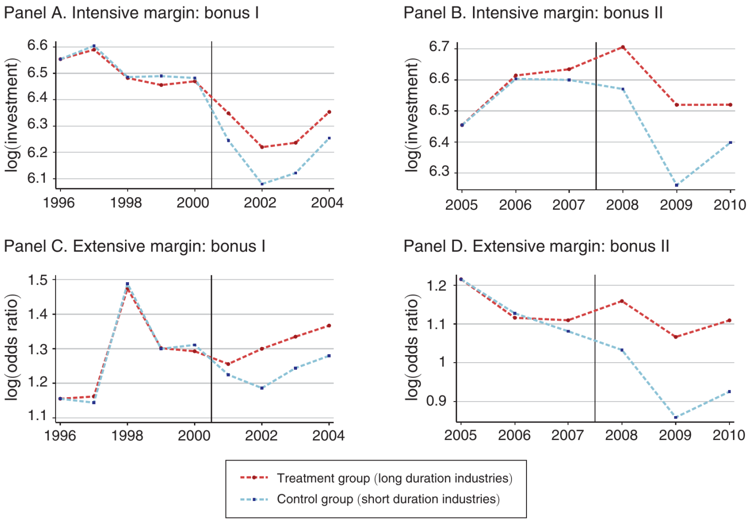
Shawn bought and placed in service a used pickup for $\$15,000$ on March 5,1998 . The pickup has a 5 year class life. His depreciation deduction for each year is computed in the following table.

Year	Cost × MACRS %	Depreciation
1998	$\$15,000 \times 20.00\%$	$\$3,000$
1999	$\$15,000 \times 32.00\%$	$\$4,800$
2000	$\$15,000 \times 19.20\%$	$\$2,880$
2001	$\$15,000 \times 11.52\%$	$\$2,880$
2002	$\$15,000 \times 11.52\%$	$\$2,880$
2003	$\$15,000 \times 5.76\%$	$\$864$
Total		$\$15,000$

MACRS Percentage Table

Year	3 Year	5 Year	7 Year
1	33.33%	20.00%	14.29%
2	44.45%	32.00%	24.49%
3	14.81%	19.20%	17.49%
4	7.41%	11.52%	12.49%
5		11.52%	8.93%
6		5.76%	8.92%
7			8.93%
8			4.46%

Long-duration industries respond more to bonus depreciation



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Conforming states enjoys 18% of investment boosts

Table: Investment Impacts of State Bonus and State 179

Dependent Var:	ln CapEx			
Specification	(1)	(2)	(3)	(4)
State Bonus	0.038		0.031	0.174^{**}
	(0.036)		(0.037)	(0.073)
State 179		0.013	0.012	0.020^{**}
		(0.009)	(0.009)	(0.009)
Bonus 179 Interaction				-0.047^{***}
				(0.016)
Year FE	✓	✓	✓	✓
State Controls, Time Trends	✓	✓	✓	✓
NAICS x Year FE	✓	✓	✓	✓
Adj. R-Square	0.286	0.286	0.286	0.286
State x NAICS Groups	883	883	883	883
Observations	11,987	11,987	11,987	11,987

Notes: Table 5 presents coefficient estimates of the impact of State 179 and State Bonus on Ln CapEx. All specifications include include year fixed effects, State $\times$ NAICS fixed effects, state linear time trends, NAICS $\times$ Year fixed effects, and a robust set if time-varying state level controls to capture the effect of changes in state politics, productivity, population, and finances. Standard errors are at the state level and are reported in parentheses. Statistical significance at the 1 percent level is denoted by $***$, 5 percent by $**$, and 10 percent by $*$.

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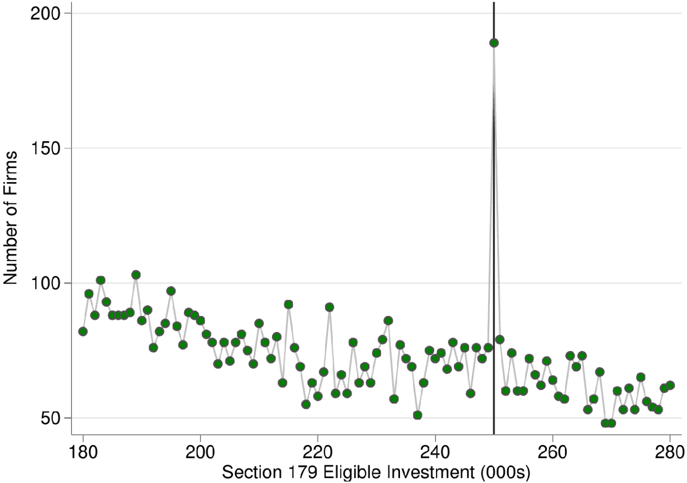
Firm distribution in 2008-2009

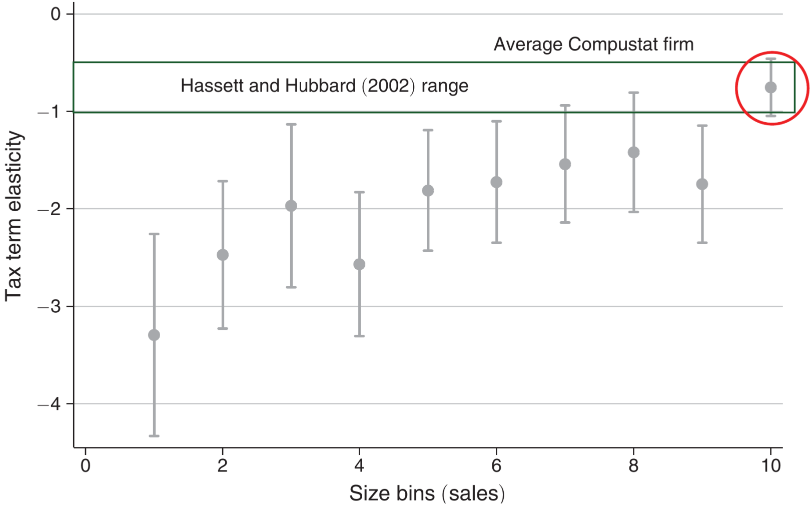


Heterogeneity in investment response

Table: Heterogeneity by Ex Ante Constraints

	Sales		Div payer?		Lagged cash	
	Small	Big	No	Yes	Low	High
$z_{N,t}$	6.29 (1.21)	3.22 (0.76)	5.98 (0.88)	3.67 (0.97)	7.21 (1.38)	2.76 (0.88)
Equality test	$p = 0.030$		$p = 0.079$		$p = 0.000$	
Observations	177,620	255,266	274,809	127,523	176,893	180,933
Clusters (firms)	29,618	29,637	39,195	12,543	45,824	48,936
R^2	0.44	0.76	0.69	0.80	0.81	0.76

Heterogeneous response to bonus depreciation



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How to determine $\bar{I}$

In 2015,

- Real investment: $\$2459.8$B (Table 3.7 BEA)
- Numbers of firms in US: $5,900,731$ (SUSB)
- Average investment: $\$416,853$
- Section 179 deduction: $\$500,000$
- Choose $\bar{I} = \frac{500{,}000}{416{,}853} \times$ aggregate investment ~ 0.092

Outline

- Empirical Literatures
- Model Appendix

Unconstrained firms' problem: positive taxable income

Let W function be the value function for unconstrained firms.

The start-of-period value before the realization of exit shock is

$$W^0(k,b,\psi,\varepsilon;\mu) = p(\mu)\pi_d \max_n \left\{ z\varepsilon F(k,n) - wn - b + (1-\delta)k - \tau^c \mathcal{I}(0,k,\psi) \right\} \\ + (1-\pi_d) W(k,b,\psi,\varepsilon;\mu)$$

Upon survival, unconstrained firms undertake binary choice,

$$W(k,b,\psi,\varepsilon;\mu) = \max \left\{ W^L(k,b,\psi,\varepsilon;\mu), W^H(k,b,\psi,\varepsilon;\mu), W^N(k,b,\psi,\varepsilon;\mu) \right\}.$$

Firm's current value: $W(k,b,\psi,\varepsilon;\mu) = W(k,0,\psi,\varepsilon;\mu) - pb$

Start-of-period value: $W^0(k,b,\psi,\varepsilon;\mu) = W^0(k,0,\psi,\varepsilon;\mu) - pb$.

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Unconstrained firms' problem (Cont.)

Given these transformation, firms' problem can be rewritten as

$$
\begin{aligned}
W^L(k,b,\psi,\varepsilon_i;\mu) &= p\left((1-\tau^c)(z\varepsilon f(k,n)-wn)-b+(1-\tau^c\omega)(1-\delta)k+\tau^c\delta^\psi\psi\right) \\
&\quad + \max_{k'\le(1-\delta)k+\bar{I}}\left\{-p(1-\tau^c\omega)k'+\beta\sum_{j=1}^{N_\varepsilon}\pi_{ij}^\varepsilon W^0(k',0,\psi',\varepsilon_j;\mu')\right\}, \\
W^H(k,b,\psi,\varepsilon_i;\mu) &= p\left((1-\tau^c)(z\varepsilon f(k,n)-wn)-b+(1-\tau^c\omega\xi)(1-\delta)k+\tau^c\delta^\psi\psi\right) \\
&\quad + \max_{k'\in((1-\delta)k+\bar{I},\bar{k})}\left\{-p(1-\tau^c\omega\xi)k'+\beta\sum_{j=1}^{N_\varepsilon}\pi_{ij}^\varepsilon W^0(k',0,\psi',\varepsilon_j;\mu')\right\}, \\
W^N(k,b,\psi,\varepsilon_i;\mu) &= p\left(z\varepsilon f(k,n)-wn-b+(1-\delta)k\right) \\
&\quad + \max_{k'\ge\bar{k}}\left\{-pk'+\beta\sum_{j=1}^{N_\varepsilon}\pi_{ij}^\varepsilon W^0(k',0,\psi',\varepsilon_j;\mu')\right\},
\end{aligned}
$$

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Unconstrained firms' problem when taxable income is nonpositive

The following question defines the lower bound for capital when the firms are having zero or negative taxable income:

$$W^N(k, b, \psi, \varepsilon_i; \mu) = p(y - wn - b + (1-\delta)k) + \max_{k'} \left\{ -pk' + \beta \sum_{j=1}^{N_\varepsilon} \pi_{ij}^{\varepsilon} W^0(k', 0, \psi', \varepsilon_j; \mu') \right\},$$

where

$$\psi' = (1-\delta^\psi)\psi + (1-\mathcal{J}(I))\omega I \qquad \text{if } (y - wn - \mathcal{J}(I)\omega I - \delta^\psi \psi) \geq 0$$

$$\psi' = \psi + \omega I - y + wn \qquad \text{if } (y - wn - \mathcal{J}(I)\omega I - \delta^\psi \psi) < 0$$

Minimum Saving Policy

The *minimum saving policy*, $B^w(k,\psi,\varepsilon)$, can be recursively calculated by the following two equations with both policy functions for labor, $N(k,\varepsilon)$, and capital, $K^w(k,\psi,\varepsilon)$,

$$
\begin{aligned}
B^w(k,\psi,\varepsilon) &= \min_{\varepsilon_j}\left(\tilde{B}(K^w(k,\psi,\varepsilon_i),\psi',\varepsilon_j)\right)\\
\tilde{B}(k,\psi,\varepsilon_i) &= \frac{1}{1-\tau^c\tau^b}\Big((1-\tau^c)\pi(k,\varepsilon_i)+\tau^c\delta^\psi\psi\\
&\qquad -(1-\tau^c\omega\mathcal{J}\left(K^w(k,\psi,\varepsilon_i)-(1-\delta)k\right))\left(K^w(k,\psi,\varepsilon_i)-(1-\delta)k\right)\\
&\qquad +q\min\left\{B^w(k,\psi,\varepsilon_i),\theta K^w(k,\psi,\varepsilon_i)\right\}\Big),
\end{aligned}
$$

I set interest deductability $\tau^b=0$ as minimum saving policy cannot converge with positive τ^b. As $\frac{1}{q}$ is the risk-free rate, firms are paying $\frac{q}{1-\tau^c\tau^b}>q$, implies the interest rate that firms are paying is less than risk-free rate.

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Constrained firms' problem

Constrained firms' bond decision is implied by binding collateral constraints, i.e., $B^c(k,b,\psi,\varepsilon) = \theta K^c(k,b,\psi,\varepsilon)$, and the capital decision $K^c(k,b,\psi,\varepsilon)$ has to be determined recursively.

$$J(k,b,\psi,\varepsilon;\mu) = \max\left\{J^H(k,b,\psi,\varepsilon;\mu), J^L(k,b,\psi,\varepsilon;\mu), J^N(k,b,\psi,\varepsilon;\mu)\right\},$$

and J^H, J_L and J_N are defined as

Constrained firms' problem: invest higher than threshold

$$J^H(k,b,\psi,\varepsilon;\mu) = \max_{k'\in\Omega_H(k,b,\psi,\varepsilon)} \beta \sum_{j=1}^{N_\varepsilon} \pi_{ij}^{\varepsilon} V^0(k', b_H^2(k'), \psi', \varepsilon_j; \mu'),$$

subject to

$$b_H(k') = -\frac{1}{q}\Big((1-\tau^c)\pi(k,\varepsilon) - b + \tau^c\delta^{\psi}\psi - (1-\tau^c\omega\xi)(k'-(1-\delta)k)\Big),$$

$$\psi' = (1-\delta^{\psi})\psi + (1-\xi)(k'-(1-\delta)k),$$

The choice sets for H-type firms' problem are defined by

$$\Omega_H(k,b,\psi,\varepsilon) = \left[\max\left\{(1-\delta)k+\bar{I}, \min\left\{\bar{k}_H(k,b,\psi,\varepsilon), \bar{k}\right\}\right\}, \min\left\{\bar{k}_H(k,b,\psi,\varepsilon), \bar{k}\right\}\right],$$

Maximum affordable capital: $\bar{k}_H = \frac{(1-\tau^c)\pi(k,\varepsilon)+\tau^c\delta^{\psi}\psi-b+(1-\tau^c\omega\xi)(1-\delta)k}{1-\tau^c\omega\xi-q\theta}$

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Constrained firms' problem: invest lower than threshold

$$J^L(k,b,\psi,\varepsilon;\mu) = \max_{k'\in\Omega_L(k,b,\psi,\varepsilon)} \beta \sum_{j=1}^{N_\varepsilon} \pi_{ij}^{\varepsilon} V^0(k', b_L^2(k'), \psi', \varepsilon_j; \mu'),$$

subject to

$$b_L(k') = \frac{1}{q}\Big(-(1-\tau^c)\pi(k,\varepsilon) + b - \tau^c\delta^{\psi}\psi + (1-\tau^c\omega)(k' - (1-\delta)k)\Big),$$

$$\psi' = (1-\delta^{\psi})\psi.$$

Choice set: $\Omega_L(k,b,\psi,\varepsilon) = \Big[0, \max\Big\{0, \min\Big\{(1-\delta)k + \bar{I}, \bar{k}_L(k,b,\psi,\varepsilon)\Big\}\Big\}\Big]$,

Maximum affordable capital: $\bar{k}_L = \frac{(1-\tau^c)\pi(k,\varepsilon)+\tau^c\delta^{\psi}\psi - b + (1-\tau^c\omega)(1-\delta)k}{1-\tau^c\omega - q\theta}$.

When taxable income is negative for constrained firms

$$J^N(k,b,\psi,\varepsilon;\mu) = \max_{k' \in \Omega^N(k,b)} \beta \sum_{j=1}^{N_\varepsilon} \pi_{ij}^{\varepsilon} V^0(k', b_N(k'), \psi', \varepsilon_j; \mu')$$

subject to

$$b_N(k') = -\frac{1}{q}\left(z\varepsilon f(k,n) - wn - b - (k' - (1-\delta)k)\right)$$

$$\psi' = (1-\delta^{\psi})\psi + (1-\xi)\omega(k' - (1-\delta)k)$$

$$\Omega^N(k,b,\varepsilon) = \left[\min\left\{\max\left\{\bar{k}, 0\right\}, \bar{k}_N(k,b,\varepsilon)\right\}, \bar{k}_N(k,b,\varepsilon)\right]$$

$$\bar{k}_N(k,b,\varepsilon) = \frac{z\varepsilon f(k,n) - wn - b + (1-\delta)k}{1-q\theta}$$

When taxable income is nonpositive

- In principle, IRS will not give tax subsidy if taxable income is negative.
- User cost of capital for firms with nonpositive taxable income is not affected by deduction.
- Solving for $\mathcal{I} \geq 0$ gives the upper threshold for capital decision that pays corporate tax:

$$k' \leq \bar{k} \equiv \min\left(\frac{z\varepsilon f(k,n) - wn - \delta^{\psi}\psi}{\xi\omega} + (1-\delta)k, \mathbf{K}_{max}\right),$$

Assume $F(k,n) = k^{\alpha}n^{\nu}$, I solve for $\bar{k} = (1-\delta)k + \bar{I}$ and get,

$$\tilde{k} \equiv \left(\frac{\delta^{\psi}\psi + \xi\omega\bar{I}}{A(w)z^{\frac{1}{1-\nu}}\varepsilon^{\frac{1}{1-\nu}}}\right)^{\frac{1-\nu}{\alpha}}$$

Firms that invest higher than threshold

$$v^H(k,b,\psi,\varepsilon_i;\mu) = \max_{D,k',b',n} D + \sum_{j=1}^{N_\varepsilon} \pi^\varepsilon_{ij} Q(\mu) v^0(k',b',\psi',\varepsilon_j;\mu'),$$

subject to

$$\begin{aligned} 0 \leq D &= (1-\tau^c)(z\varepsilon F(k,n) - wn) - b \\ &\quad + qb' - (1-\tau^c\xi\omega)(k' - (1-\delta)k) + \tau^c\delta^\psi\psi. && \text{(Dividend)} \\ k' &\in ((1-\delta)k + \bar{I}, \bar{k}) \text{ and } k > \tilde{k} && \text{(Choice Sets)} \\ b' &\leq \theta k' && \text{(Collateral)} \\ \psi' &= (1-\delta^\psi)\psi + (1-\xi)\omega(k' - (1-\delta)k) && \text{(deductible stock LoM)} \\ \mu' &= \Gamma(\mu) && \text{(Distribution LoM)} \end{aligned}$$

Firms that invest lower than threshold

$$v^L(k,b,\psi,\varepsilon_i;\mu) = \max_{D,k',b',n} D + \sum_{j=1}^{N_\varepsilon} \pi_{ij}^{\varepsilon} Q(\mu) v^0(k',b',\psi',\varepsilon_j;\mu'), \tag{1}$$

subject to

$$0 \leq D = (1-\tau^c)(z\varepsilon F(k,n) - wn) - b$$
$$+ qb' - (1-\tau^c\omega)(k' - (1-\delta)k) + \tau^c\delta^\psi\psi. \qquad \text{(Dividend)}$$
$$k' \leq (1-\delta)k + \bar{I} \text{ and } k > \hat{k} \qquad \text{(Choice Sets)}$$
$$b' \leq \theta k' \qquad \text{(Collateral)}$$
$$\psi' = (1-\delta^\psi)\psi \qquad \text{(Tax Benefit LoM)}$$
$$\mu' = \Gamma(\mu) \qquad \text{(Distribution LoM)}$$

Firms not paying corporate tax

$$v^N(k,b,\psi,\varepsilon_i;\mu) = \max_{D,k',b',n} D + \sum_{j=1}^{N_\varepsilon} \pi_{ij}^{\varepsilon} Q(\mu) v^0(k',b',\psi',\varepsilon_j;\mu'), \tag{2}$$

subject to

$$0 \leq D = z\varepsilon F(k,n) - wn - b + qb' - (k' - (1-\delta)k) \qquad \text{(Dividend)}$$

$$k' \geq \max(\bar{k}, 0) \qquad \text{(Choice Sets)}$$

$$b' \leq \theta k' \qquad \text{(Collateral)}$$

$$\psi' = (1-\delta^{\psi})\psi + (1 - \mathcal{J}(k',k))\omega(k' - (1-\delta)k) \qquad \text{(Tax Benefit LoM)}$$

$$\mu' = \Gamma(\mu) \qquad \text{(Distribution LoM)}$$

Household

In each period, representative households maximize their lifetime utility by choosing consumption, c, labor supply, n^h, future firm shareholding, λ', and future bond holding, a':

$$V^h(\lambda, a; \mu) = \max_{c, n^h, a', \lambda'} \left\{ u(c, 1 - n^h) + \beta V^h(\lambda', a'; \mu') \right\}$$

$$\text{s.t.} \quad c + q(\mu)a' + \int \rho_1(k', b', \psi', \varepsilon'; \mu)\lambda'(d[k' \times b' \times \psi' \times \varepsilon']) \leq (1 - \tau^n)w(\mu)n^h, \quad (3)$$

$$+ a + \int \rho_0(k, b, \psi, \varepsilon; \mu)\lambda(d[k \times b \times \psi \times \varepsilon]) + R - T$$

where $\rho_0(k, b, \psi, \varepsilon)$ is the dividend-inclusive price of the current share, $\rho_1(k', b', \psi', \varepsilon')$ is the ex-dividend price of the future share, τ^n is payroll tax, R is the steady state government lump-sum rebates to households, and T is lump-sum tax to fund policy changes.

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Equilibrium

$$
\begin{aligned}
\text{Market clear :} \quad & Y = C + \left[(1-\pi_d)\left(K' - (1-\delta)K\right) - \pi_d(1-\delta)K\right] + \pi_d k_0 + \bar{G} \\
\text{Output :} \quad & Y = \int z\varepsilon F(k, n(k,\varepsilon))d\mu \\
\text{Capital :} \quad & K = \int k d\mu \\
\text{Labor :} \quad & N^h = N, \text{ where } N = \int n(k,\varepsilon)d\mu \\
\text{Taxable capital :} \quad & \Psi = \int \psi(k,\psi,\varepsilon)d\mu \\
\text{Debt :} \quad & B = \int b d\mu \\
\text{Corp. revenue :} \quad & R = \tau^c\left(Y - w(\mu)N - \omega\mathcal{J}(I)(K' - (1-\delta)K) - \delta^\psi\Psi\right) \\
\text{Gov. Budget :} \quad & \bar{G} = \tau^n w N^h + R + T
\end{aligned}
$$

Household Optimality Conditions

- After-tax wage fully compensate MRS between leisure and consumption:

$$w(\mu) = \frac{1}{(1-\tau^n)} \frac{D_2 u(c, 1-n^h)}{D_1 u(c, 1-n^h)}$$

With $u(c, 1-n^h) = \log c + \varphi(1-n^h)$, implied Frisch elasticity is ∞,

$$w(\mu) = \frac{\varphi c}{(1-\tau^n)}$$

- As there's no agg. shock, SDF equals discounting factor equals to bond prices

$$Q(\mu) = \beta \frac{D_1 u(c, 1-n^h)}{D_1 u(c, 1-n^h)} = \beta = q$$

Frisch elasticity of labor supply

Let $u(c, L) = \log c + \varphi \log L$, the Lagrangian is

$$\max_L \log c + \varphi \log L + \lambda \left[w(1 - L) - c \right]$$

Thus

$$[L] : \frac{\varphi}{L} = \lambda w \Rightarrow L = \frac{\varphi}{\lambda w}, \frac{\partial L}{\partial w} = -\frac{\varphi}{\lambda w^2} = -\frac{L}{w}$$

and therefore

$$\eta^\lambda = \frac{\partial L}{\partial w} \frac{w}{L} = -1$$

Algorithm

I use Broyden's method to solve system of prices and policy tool equations.

For baseline model, I choose p and w to solve $p = \frac{1}{c}$ and $n^h = N$ to calibrate a fixed $\bar{G}$.

For all experiments, I choose p, w, and τ^n to solve $p = \frac{1}{c}$, $n^h = N$, and $\tau^n w n^h + R = \bar{G}$.

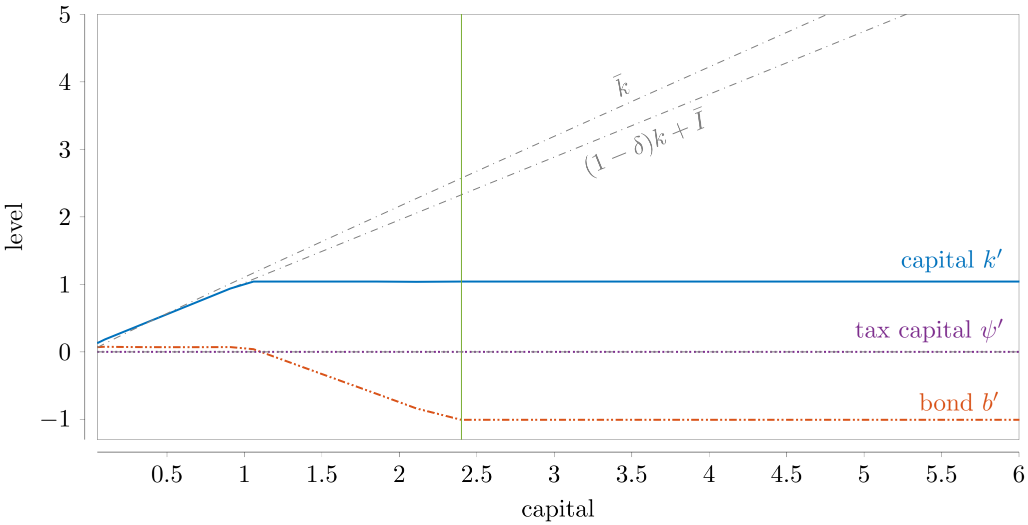
Exogenous Parameters

	Parameter	Value	Reason
Exogenous parameters			
fraction of entrants capital endowment	χ	0.1	10% of aggregate capital
exogenous exit rate	π_d	0.1	10% entry and exit
Corporate tax rate	τ^c	0.21	US Tax schedule after TCJA
Tax benefit depreciation rate	δ^ψ	0.138	$\delta^\psi = 2\delta$ (Double-declining balance)

Frequency and Functional Form

- Model frequency: annual
- Household utility function: $u(c, n^h) = \log c + \varphi(1 - n^h)$
- Production function: $F(k, n) = k^\alpha n^\nu$
- Initial capital for entrants: $k_0 = \chi \int k\tilde{\mu}(d[k \times b \times \psi \times \varepsilon])$
- Initial bond and taxable capital: $b_0 = 0$ and $\psi_0 = 0$
- Idiosyncratic productivity shock: $\log \varepsilon' = \rho_\varepsilon \log \varepsilon + \eta_\varepsilon'$, $\eta_\varepsilon \sim N(0, \sigma_\varepsilon^2)$
  - 7-state Markov chain discretized using Tauchen algorithm

Unproductive firm: similar to standard model ($\varepsilon = 0.7847$)



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Steady State Comparison

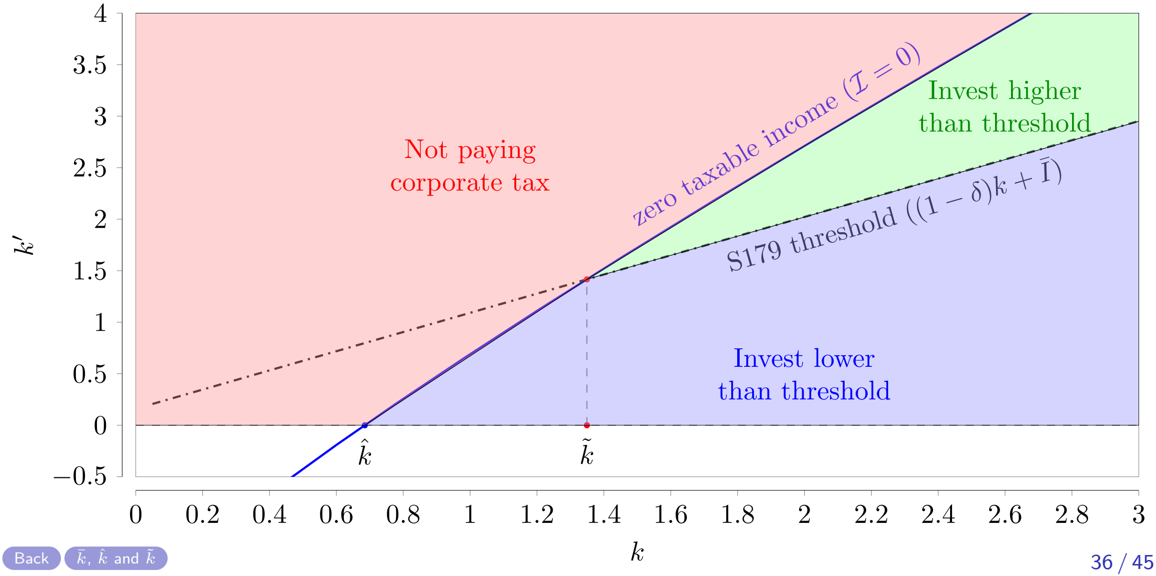
	Description	baseline	S179	bonus	both
$\tilde{T}/Y$	cost of policy / baseline output	-	0.30	0.31	0.42
Y	aggregate output	100 (0.54)	101.61	101.06	102.00
C	aggregate consumption	100 (0.36)	101.55	100.92	101.91
K	aggregate capital	100 (1.10)	104.22	103.21	105.30
I	aggregate investment	100 (0.08)	104.22	103.21	105.30
N	aggregate labor	100 (0.33)	100.06	100.13	100.09
$B > 0$	aggregate debt	100 (0.41)	106.35	113.01	112.48
R	corporate tax revenue	100 (0.03)	94.25	94.08	91.89
$\hat{z}$	measured TFP	100 (1.02)	100.32	100.02	100.38
$dY/\tilde{T}$		-	5.40	3.44	4.74
$dC/\tilde{T}$		-	3.42	1.98	2.98
$dI/\tilde{T}$		-	1.98	1.46	1.76

Notes: output, capital, debt, labor, consumption, government spending, measured TFP are expressed as fractions of baseline value.

Steady State Comparison (Cont.)

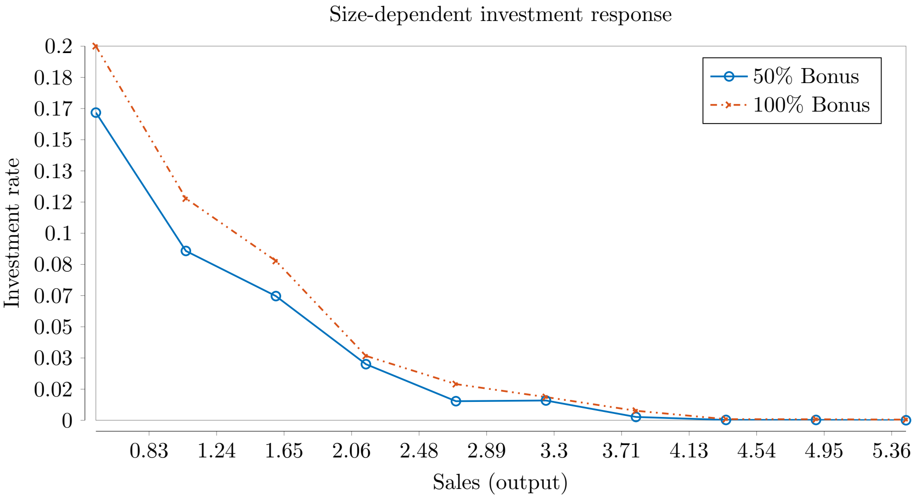
	Description	baseline	S179	bonus	both
Prices					
p	marginal utility of consumption	100 (2.80)	98.47	99.08	98.13
w	wage	100 (0.97)	101.55	100.92	101.91
Distribution					
μ_{unc}	unconstrained firm mass	0.080	0.093	0.099	0.129
μ_{con}	constrained firm mass	0.920	0.907	0.901	0.871
$\mu_{\text{unc}}K$	capital: unconstrained	100 (2.70)	94.31	99.78	92.51
$\mu_{\text{con}}K$	capital: constrained	100 (0.96)	104.36	100.39	100.03
$\mu_{\text{unc}}I$	investment: unconstrained	100 (0.01)	170.53	7.04	102.47
$\mu_{\text{con}}I$	investment: constrained	100 (0.18)	102.29	106.01	105.38
Financial Variables					
D	dividend	100 (0.03)	102.08	110.14	115.64
$\mu V(\cdot)$	average firm value	100 (3.41)	98.02	94.13	95.35
μc	user cost of capital	100 (0.14)	86.26	97.44	85.45
τ^*	effective corporate tax rate	100 (0.10)	92.43	94.08	91.68

Capital choice state space



Investment Response to raising bonus depreciation

Tax term: $\frac{1-\tau^c\omega\xi}{1-\tau^c}$; Elasticity: $\frac{\%\Delta\text{Investment at bin}}{\%\Delta\text{tax term}}$



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Private excess return on capital

N-type firms:

$$\beta \sum_{j=1}^{N_\varepsilon} \pi_{ij}^{\varepsilon} \left[\frac{\partial V^0(k', b', \psi', \varepsilon_j; \mu)}{\partial k'} + \frac{\partial V^0(k', b', \psi', \varepsilon_j; \mu)}{\partial \psi'} \frac{\partial \psi'}{\partial k'} \right] - 1$$

H-type firms:

$$\beta \sum_{j=1}^{N_\varepsilon} \pi_{ij}^{\varepsilon} \left[\frac{\partial V^0(k', b', \psi', \varepsilon_j; \mu)}{\partial k'} + \frac{\partial V^0(k', b', \psi', \varepsilon_j; \mu)}{\partial \psi'} \frac{\partial \psi'}{\partial k'} \right] - (1 - \tau^c \omega \xi)$$

L-type firms:

$$\beta \sum_{j=1}^{N_\varepsilon} \pi_{ij}^{\varepsilon} \left[\frac{\partial V^0(k', b', \psi', \varepsilon_j; \mu)}{\partial k'} + \frac{\partial V^0(k', b', \psi', \varepsilon_j; \mu)}{\partial \psi'} \frac{\partial \psi'}{\partial k'} \right] - (1 - \tau^c \omega)$$

Approximating the derivatives of the value functions

I use RHS and LHS secant to approximate the derivatives of the value functions.

Let $i_\varepsilon = 1, \ldots, N(\varepsilon)$, $i_b = 1, \ldots, N(b)$, $i_k = 1, \ldots, N(k)$ and $i_\psi = 1, \ldots, N(\psi)$.

RHS secant at $(k_{i_k}, b_{i_b}, \psi_{i_\psi}, \varepsilon_{i_\varepsilon})$, $i_k = 1, \ldots, N(k) - 1$ is

$$s_r(k_{i_k}, b_{i_b}, \psi_{i_\psi}, \varepsilon_{i_\varepsilon}) = \frac{V^0(k_{i_k+1}, b_{i_b}, \psi_{i_\psi}, \varepsilon_{i_\varepsilon}) - V^0(k_{i_k}, b_{i_b}, \psi_{i_\psi}, \varepsilon_{i_\varepsilon})}{k_{i_k+1} - k_{i_k}}$$

LHS secant at $(k_{i_k}, b_{i_b}, \psi_{i_\psi}, \varepsilon_{i_\varepsilon})$, $i_k = 2, \ldots, N(k)$ is

$$s_l(k_{i_k}, b_{i_b}, \psi_{i_\psi}, \varepsilon_{i_\varepsilon}) = \frac{V^0(k_{i_k}, b_{i_b}, \psi_{i_\psi}, \varepsilon_{i_\varepsilon}) - V^0(k_{i_k-1}, b_{i_b}, \psi_{i_\psi}, \varepsilon_{i_\varepsilon})}{k_{i_k} - k_{i_k-1}}$$

Approximating the derivatives of the value functions (Cont.)

When $i_k = 2, \ldots, N(k) - 1$,

$$D_k V^0(k_{i_k}, b_{i_b}, \psi_{i_\psi}, \varepsilon_{i_\varepsilon}) = 0.5 s_r(k_{i_k}, b_{i_b}, \psi_{i_\psi}, \varepsilon_{i_\varepsilon}) + 0.5 s_l(k_{i_k}, b_{i_b}, \psi_{i_\psi}, \varepsilon_{i_\varepsilon})$$

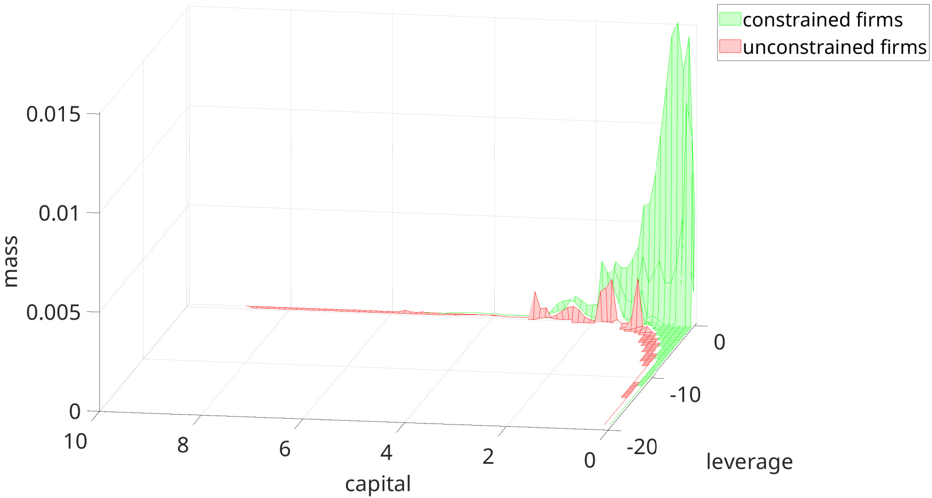
When $i_k = 1$,

$$D_k V^0(k_{i_k}, b_{i_b}, \psi_{i_\psi}, \varepsilon_{i_\varepsilon}) = s_r(k_{i_k}, b_{i_b}, \psi_{i_\psi}, \varepsilon_{i_\varepsilon})$$

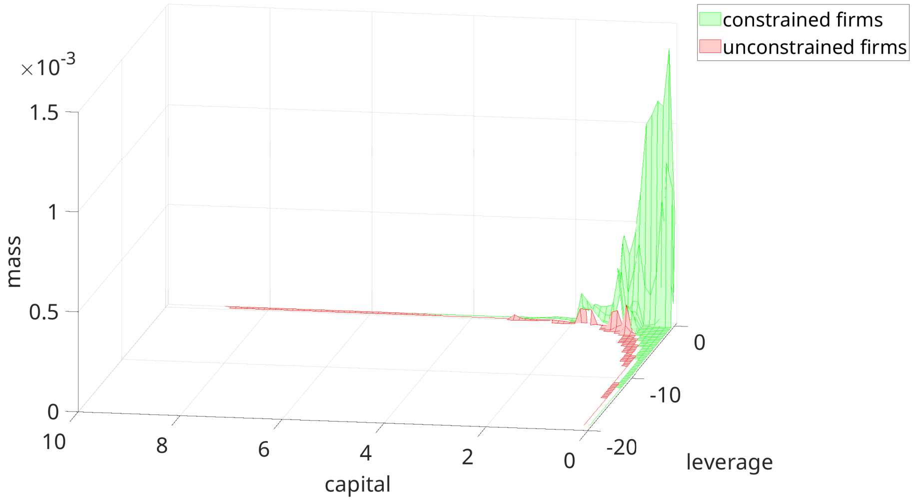
When $i_k = N(k)$,

$$D_k V^0(k_{i_k}, b_{i_b}, \psi_{i_\psi}, \varepsilon_{i_\varepsilon}) = s_l(k_{i_k}, b_{i_b}, \psi_{i_\psi}, \varepsilon_{i_\varepsilon})$$

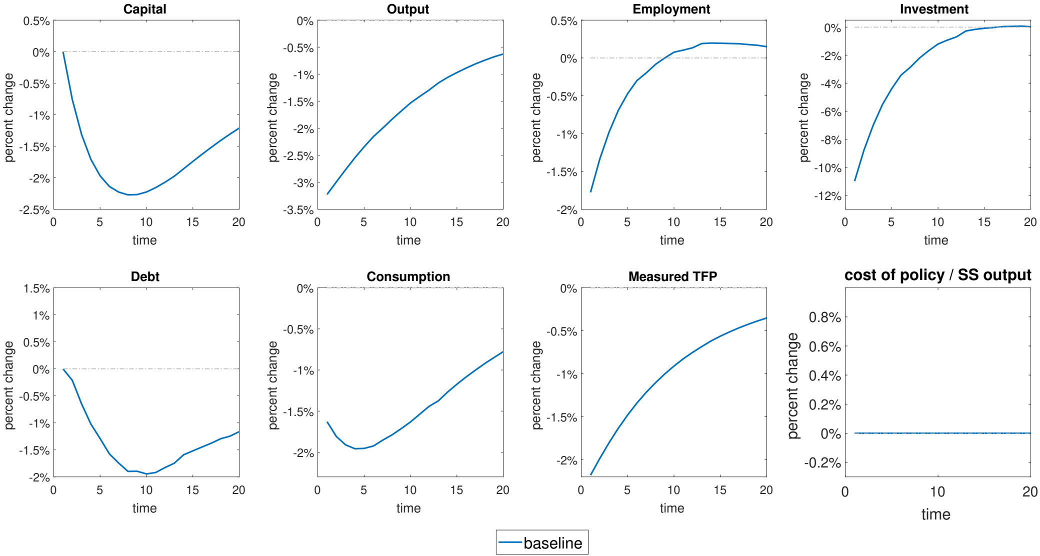
Distribution: median productivity



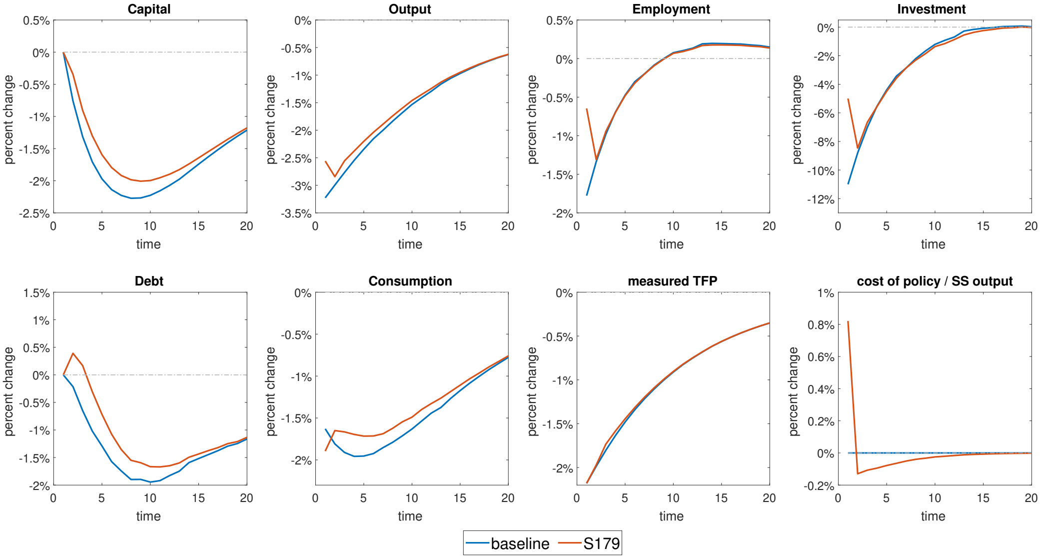
Distribution: minimum productivity



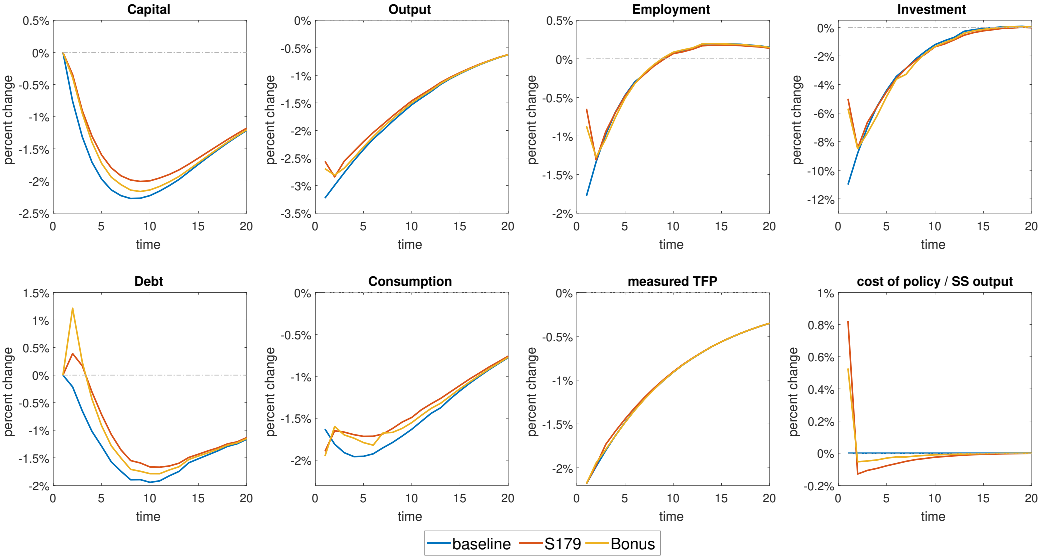
IRF: negative TFP shocks with scale 2.18% and persistence 0.909



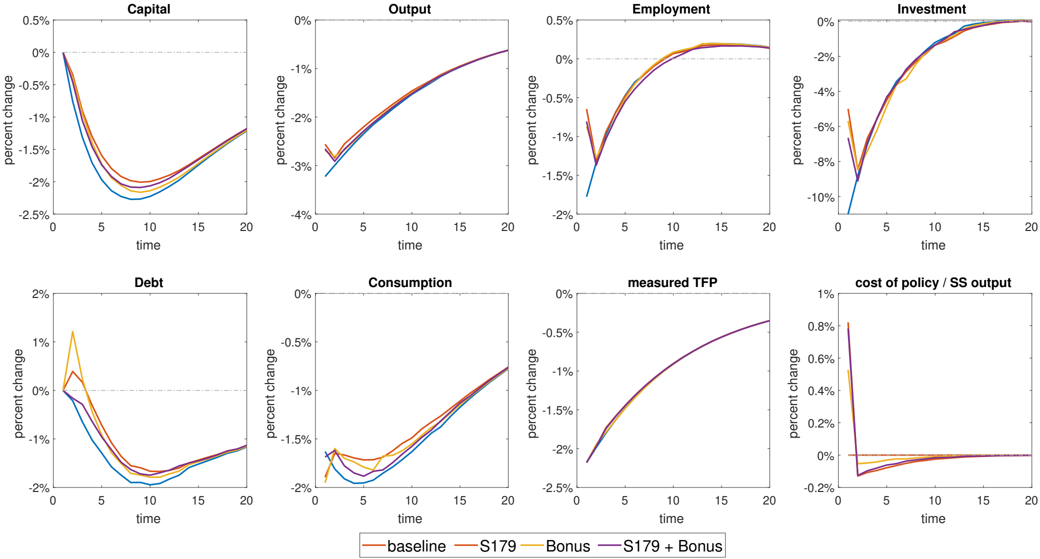
IRF: negative TFP shocks with scale 2.18% and persistence 0.909

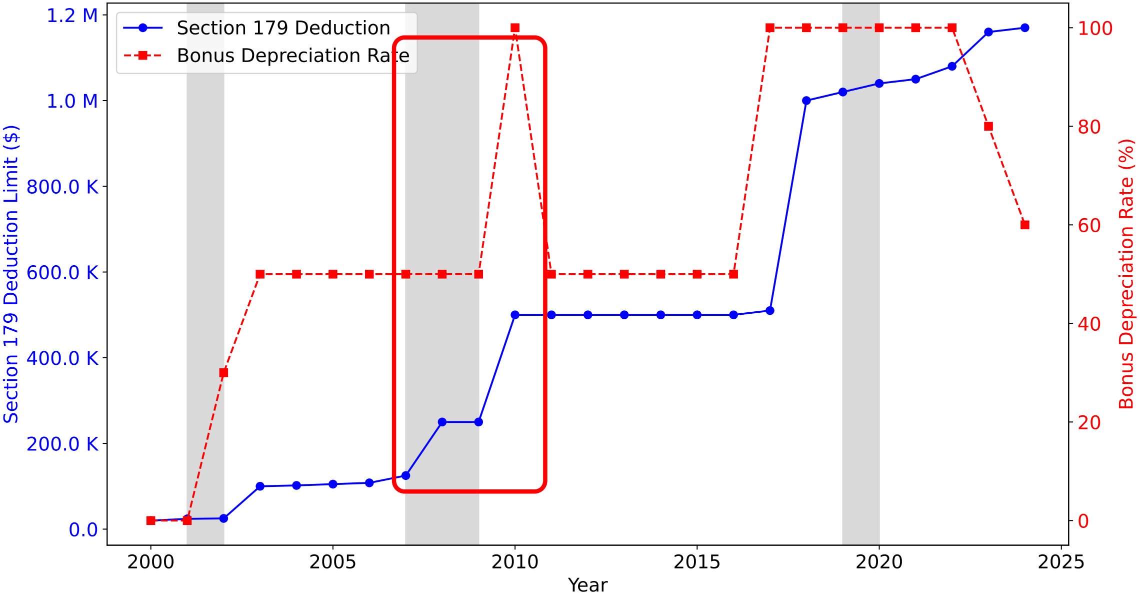


IRF: negative TFP shocks with scale 2.18% and persistence 0.909



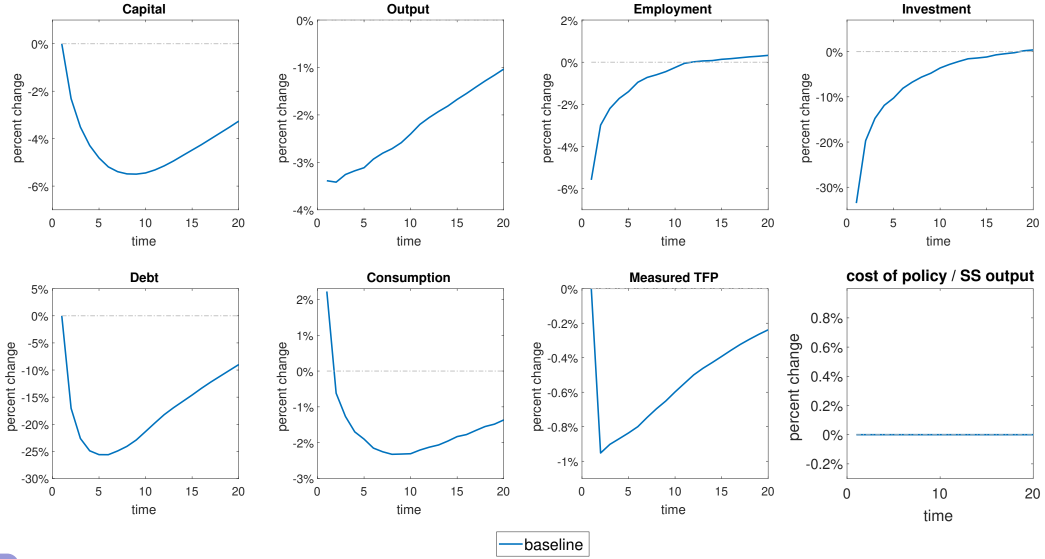
IRF: negative TFP shocks with scale 2.18% and persistence 0.909





Section 179 Deduction
Bonus Depreciation Rate
Section 179 Deduction Limit ($)
Bonus Depreciation Rate (%)
Year
0.0
200.0 K
400.0 K
600.0 K
800.0 K
1.0 M
1.2 M
0
20
40
60
80
100
2000
2005
2010
2015
2020
2025

IRF: negative credit shocks with scale 27% and persistence 0.909



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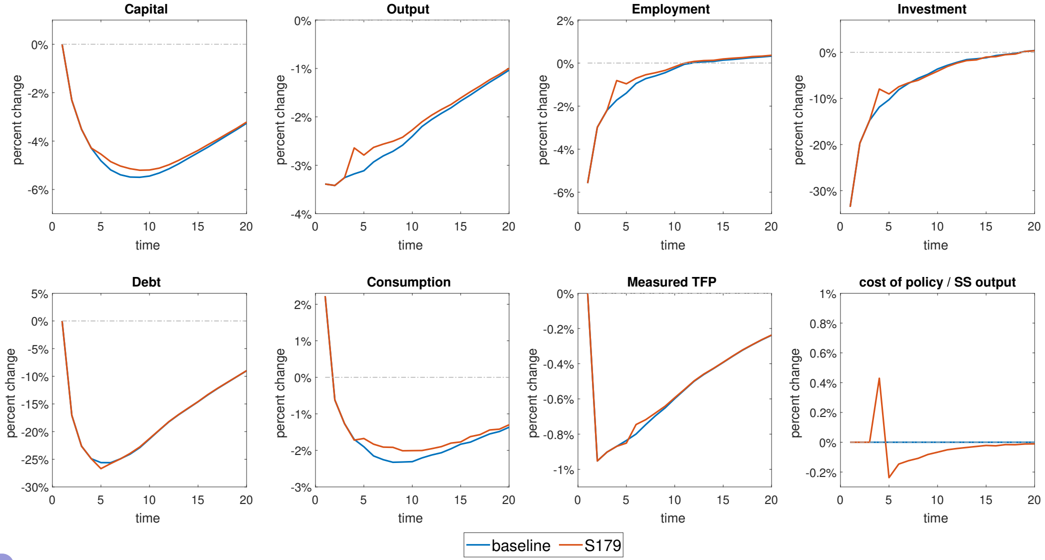
IRF: negative credit shocks with scale 27% and persistence 0.909



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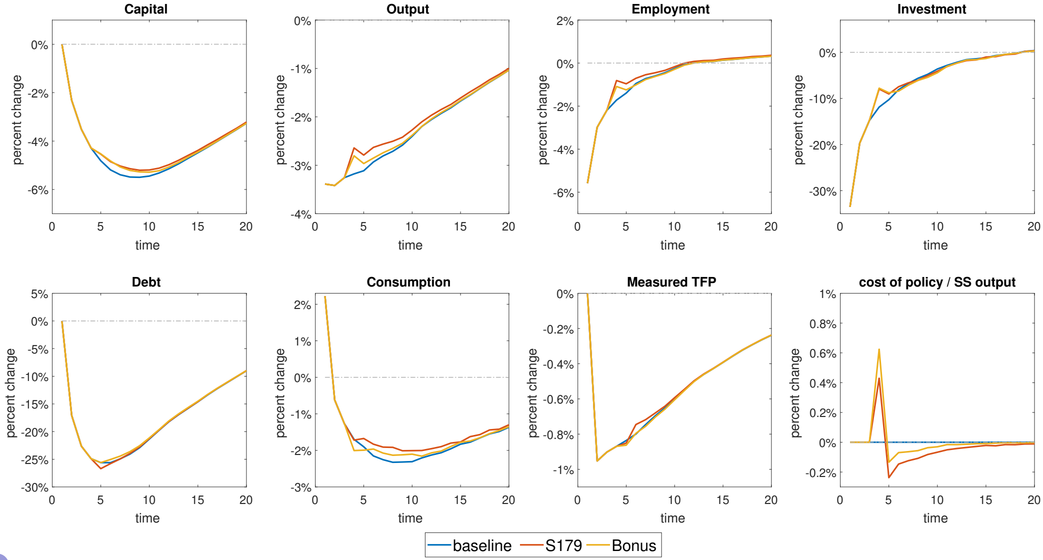
IRF: negative credit shocks with scale 27% and persistence 0.909



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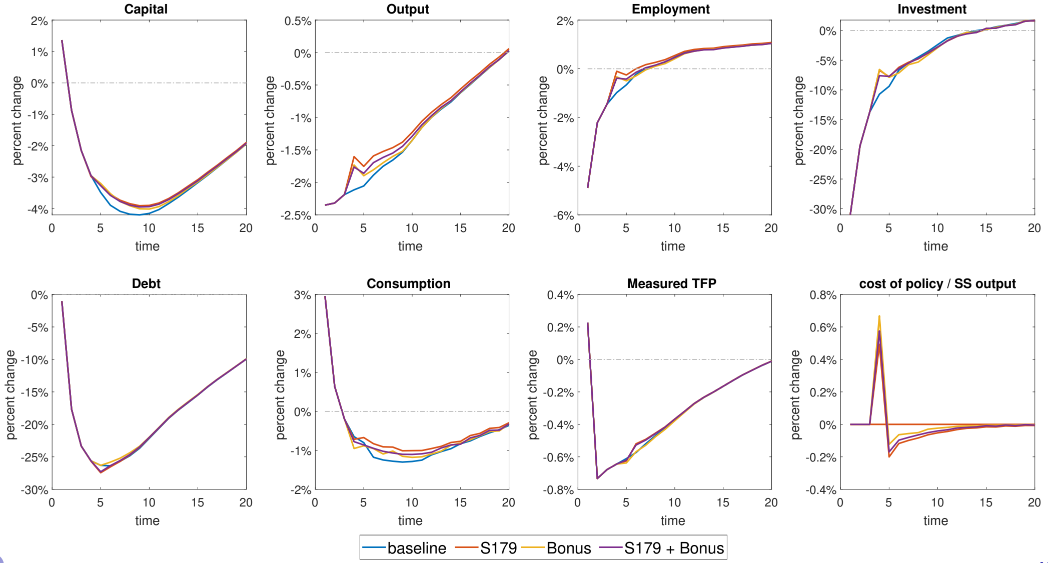
IRF: negative credit shocks with scale 27% and persistence 0.909



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