Make America Great:
Long-Run Impacts of Short-Run Public Investment

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The Wharton School

May 9, 2018

Donald J. Trump
@realDonaldTrump

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The roads and sidewalks, airports and bridges, are perfect in Dubai. Everything looks clean & strong. In U.S., everything is falling apart!

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7:33 AM - 19 May 2014

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Hillary Clinton
@HillaryClinton

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Investing in our infrastructure is about more than creating good jobs: it's about maintaining our status as the world's economic superpower.

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184 598 1.3K

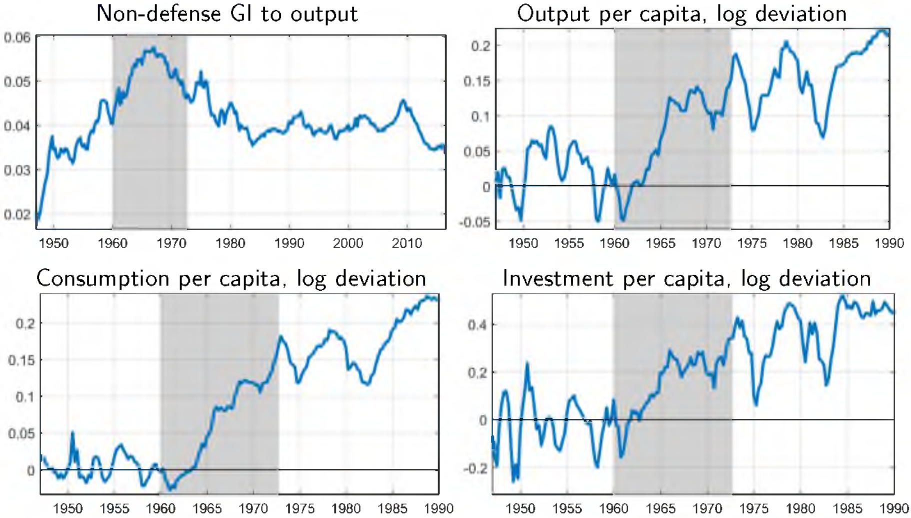
- Larry Summers: "The issue now is not whether the US should invest [in infrastructure] more but what the policy framework should be."
- Ben Bernanke: "I would think ... that infrastructure spending that improves our roads, our bridges, our schools, and ... would probably be the highest-return fiscal actions in terms of getting higher growth."
- Paul Krugman: "Infrastructure please."
- Joseph Stiglitz: "Infrastructure alone could absorb trillions of dollars in investment, not only true in the developing world, but also in the US, which has underinvested in its core infrastructure for decades."

Motivation

- One of the few consensuses: A large-scale short-run government investment (GI) program
- Crucial to understand economic consequences produced by a large transitory GI shock
- Current macro frameworks: Consider small GI shocks in (almost) linear RBC models (Baxter and King, 1993; Leeper et al., 2010)
- Is there non-linearity?

Motivation

Facts: Interstate Highway Construction around 1960s



Full sample   Gross series

Overview

- We construct a RBC model with two stable steady states (s.s.)
  - Multiplicity arises because public capital complements private choice
  - Small shocks have temporary outcomes, while large ones can lead to steady state transitions
  - Rare switches across steady states can generate medium term cycles as in the data
- Apply our model to two case studies:
  - Can the large GI in the 1960s explain S-shaped dynamics of the US economy?
  - Can a large GI expansion trigger a recovery from the Great Recession?

Literature Review

- RBC models with transitory shock to GI
  - Baxter and King (1993), Leeper, Walker and Yang (2010)
- Endogenous growth models with permanent change in GI
  - Barro (1990), Futagami, Morita and Shibata (1993), Eicher and Turnovsky (2000)
- Empirical analysis of GI
  - Public capital elasticity: Aschauer (1989), Bom and Ligthart (2013)
  - Nonlinear impact of GI: Fernald (1999), Candelon, Colletaz and Hurlin (2013)
  - Multiplier papers: Perotti (2004), Auerbach and Gorodnichenko (2012), Ilzetzki, Mendoza and Vegh (2013)
- RBC models with multiple steady states
  - Schaal and Taschereau-Dumouchel (2015), Cai (2016)
- Medium term fluctuations
  - Comin and Gertler (2006), Anzoategui, Comin, Gertler, Martinez (2017)

I. Model

Households

- Household with GHH preference subject to distortionary income tax and lump sum tax (transfers):

$$\max \mathbb{E} \sum_t \beta^t \frac{\left(C_t - \frac{L_t^{1+\nu}}{1+\nu}\right)^{1-\gamma}}{1-\gamma}$$

s.t.

$$C_t = (1-\tau)(W_t L_t + R_t K_t + \Pi_t) - I_t - T_t$$

$$K_{t+1} = (1-\delta_k)K_t + I_t$$

Firms

- A continuum of short-lived firms produce under C-D technology subject to non-convex technology choice $u \in \{H, L\}$:

$$\pi = \max\{\pi_H, \pi_L\}$$

where

$$\pi_H = \max_{k,l} \underbrace{Al^{\theta_l} k^{\theta_k} (K^G)^{\alpha} \omega - Wl - Rk - f}_{\text{high (H) utilization}}$$

$$\pi_L = \max_{k,l} \underbrace{Al^{\theta_l} k^{\theta_k} (K^G)^{\alpha} - Wl - Rk}_{\text{low (L) utilization}}$$

- A is aggregate shock: $\log A_{t+1} = \rho_A \log A_t + \sigma_A \epsilon^A_{t+1}, \ \epsilon^A \sim N(0,1)$
- Define $\Delta\pi = \pi_H - \pi_L$. Firm chooses H when $\Delta\pi \geq 0$

Fiscal Rule

- Law of motion of public capital:

$$K_{t+1}^G = (1-\delta_g)K_t^G + G_t^I$$

where GI/output ratio $g_t^I \equiv G_t^I / Y_t$ follows AR(1):

$$g_{t+1}^I = (1-\rho_g)\bar{g}^I + \rho_g g_t^I + \sigma_g \epsilon_{t+1}^g, \ \epsilon^g \sim N(0,1)$$

- Gov consumes a given fraction of output:

$$\frac{G_t^C}{Y_t} = \bar{g}^C$$

- Financing:

$$G_t^I + G_t^C = \tau Y_t + T_t$$

Mechanisms

- From public capital to private capital $K^G \uparrow \Rightarrow K, L, Y \uparrow \Rightarrow K^G \uparrow$
  - (1) Complementarity between private factors, (K, L), and public capital, K^G, in Cobb-Douglas production function
  - (2) GI proportional to output
- From capital accumulation $K, K^G \uparrow$ to technology adoption
  - (3) A non-convex adoption cost

Characterization

Multiple Steady States

- Denote fraction of H firms as $m \in [0, 1]$
- Define $\Delta\Pi(m^{ss})$ as $\Delta\pi(m^{ss})$ evaluated at steady state with $m = m^{ss}$

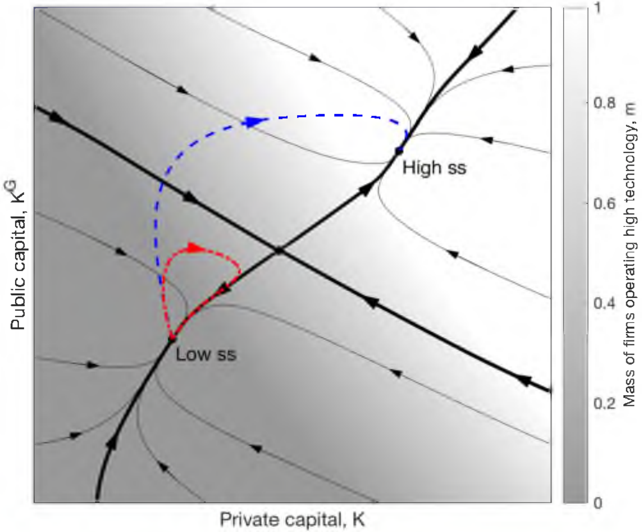
Proposition

The model has two stable deterministic steady states $m^{ss} \in \{0, 1\}$ if i) $\Delta\Pi(m^{ss})$ is increasing in m^{ss} and ii) $\Delta\Pi(1) > 0 > \Delta\Pi(0)$.

- i) requires moderate social IRS: $1 - \theta_k - \frac{\theta_l}{1+\nu} > \alpha > \frac{\nu}{1+\nu}\theta_l$
- ii) non-convex cost creates no deviation incentive and supports two stable steady states

Characterization

Multiple Steady States



II. Calibration and Assessments

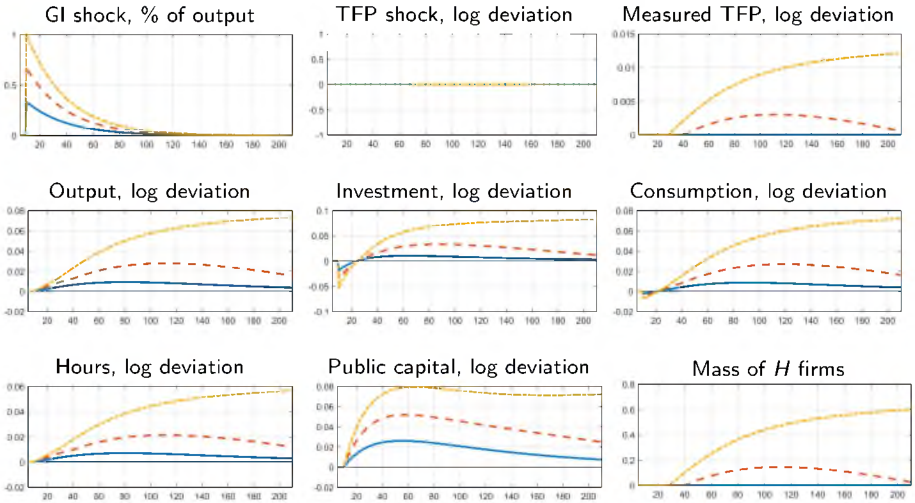
Parametrization I

Parameter	Value	Source
Preferences		
Risk aversion	$\gamma = 1.0$	Log utility
Labor elasticity	$1/\nu = 3.33$	Higher end of macro estimates
Time discounting	$\beta = 0.95^{1/4}$	0.95 annually
Production function		
Labor share	$\theta_l = 0.56$	Basu and Fernald (1997)
Capital share	$\theta_k = 0.24$	Basu and Fernald (1997)
Public capital elasticity	$\alpha = 0.15$	Bom and Ligthart (2013)
Depreciation rates		
Private capital	$\delta_k = 1 - 0.9^{1/4}$	10% annually
Public capital	$\delta_g = 1 - 0.92^{1/4}$	8% annually, Leeper et al (2010)
Fiscal Spending Rule		
Government consumption	$\bar{g}^C = 0.235$	Postwar US data
Transfers	$\bar{z} = 0.060$	Postwar US data
Government investment	$\bar{g}^I = 0.041$	Postwar US data

Parameterization II

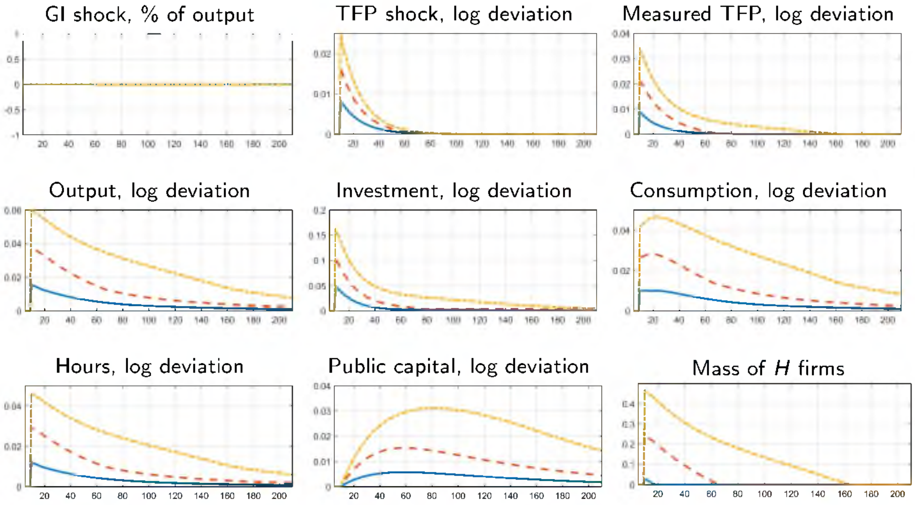
Parameter	Value	Source
GI shock		
Persistence	$\rho_g = 0.967$	Postwar US data
Standard deviation of shocks	$\sigma_g = 0.0011$	Postwar US data
TFP		
Persistence	$\rho_A = 0.94$	Output persistence
Standard deviation of shocks	$\sigma_A = 0.008$	Output volatility
Technology adoption		
Fixed cost	$f = 0.0051$	Frequency of transitions
Scaling up parameter	$\omega = 1.02$	Distance between steady states

IRFs: GI Shocks at s.s. L



financing

IRFs: TFP Shocks at s.s. L



Medium-Term Cycles

	Medium-term cycle, 0-200 qtr		High frequency component, 0-32 qtr		Medium frequency component, 32-200 qtr	
	Data	Model	Data	Model	Data	Model
Output	4.23	4.46 (2.99,6.46)	2.30	2.05 (1.59,2.61)	3.61	3.91 (2.28,6.05)
Consumption	3.34	3.62 (2.36,5.37)	1.30	1.43 (1.11,1.80)	3.12	3.28 (1.92,5.20)
Hours	3.75	3.42 (2.31,4.87)	1.78	1.57 (1.23,1.97)	3.41	3.00 (1.76,4.59)
Investment	12.35	10.61 (7.24,15.64)	8.05	5.86 (4.33,7.92)	9.35	8.65 (5.09,14.24)
TFP	2.46	2.17 (1.57,2.44)	1.52	1.16 (0.93,1.44)	1.95	1.80 (1.10,2.65)

- Infrequent switches between steady states generate medium frequency fluctuations (Comin and Gertler, 2006)

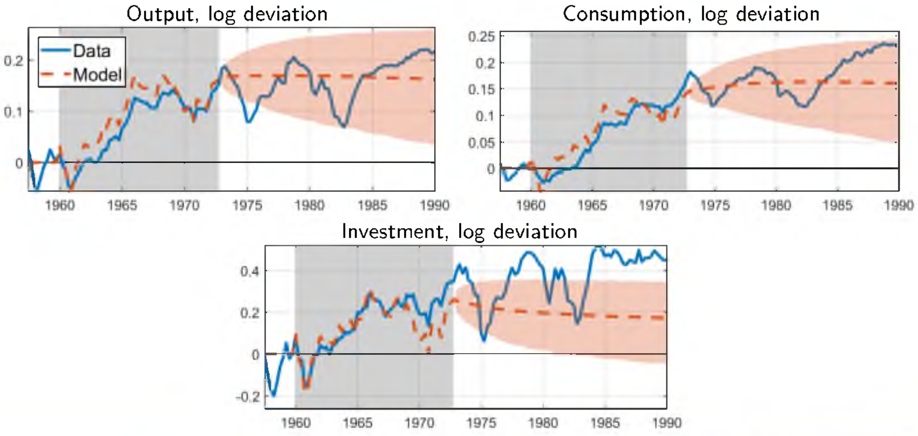
IV. Case Studies

Can GI shocks in the 1960s explain S-dynamics of the macroeconomy?

1960s Highway Construction

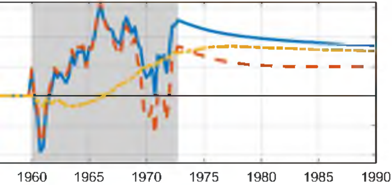
Transition Paths

- Extract GI shocks from the data: 1960Q1 – 1972Q4
- Productivity shocks backed out through the residual approach (measured TFP)

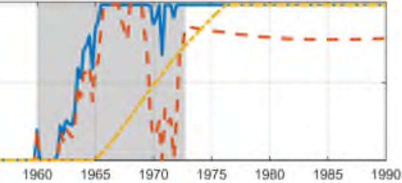


Milder Depreciation?

Investment, log deviation

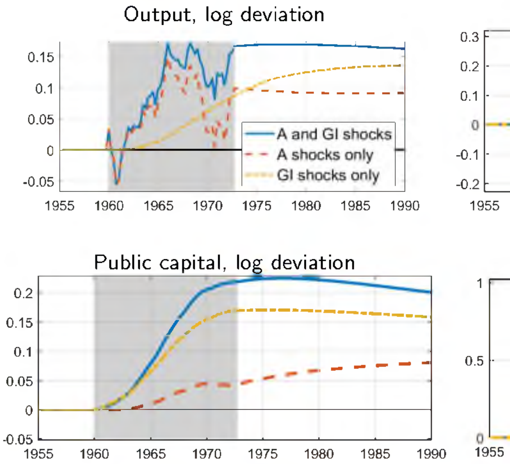


Mass of H firms



1960s Highway Construction

Decomposition: Roles of TFP and GI Shocks



"Another republican president, Dwight D. Eisenhower, initiated the last truly great national infrastructure program – the building of the interstate highway system. The time has come for a new program of national rebuilding."

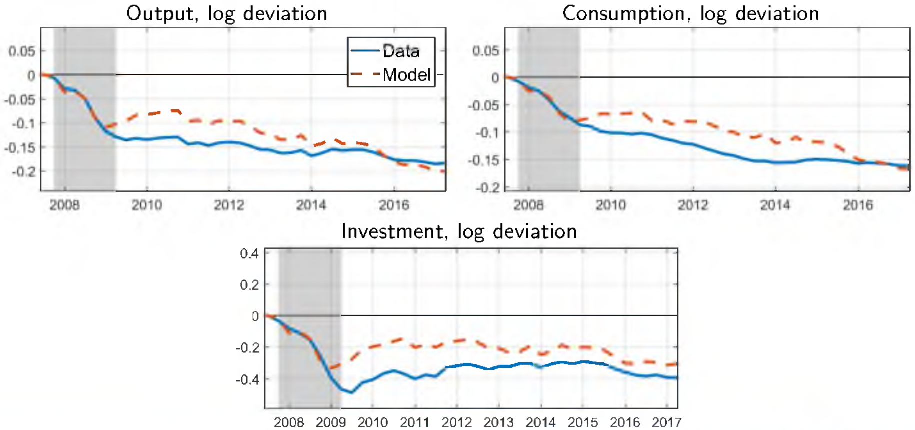
- Donald J. Trump's Speech to the Congress, Feb 28, 2017

Would a large GI shock have helped the US economy to recover from the crisis?

The Slow Recovery

Transition Paths

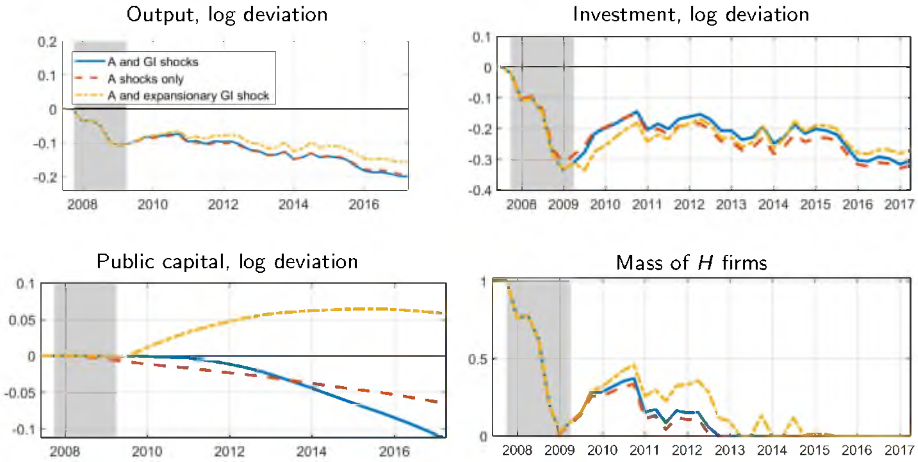
- Extract GI shocks from the data: 2007Q4 – 2017Q2.
- Productivity shocks backed out through the residual approach (measured TFP)



The Slow Recovery

Decomposition: Roles of TFP and GI Shocks

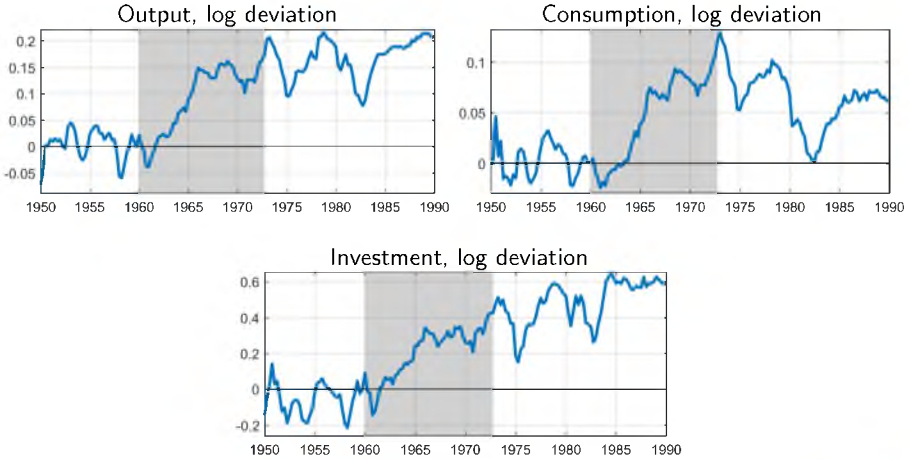
- Yellow lines: a counterfactual increase in GI starting at 2009Q3 of roughly 1 trillion 2009 dollars



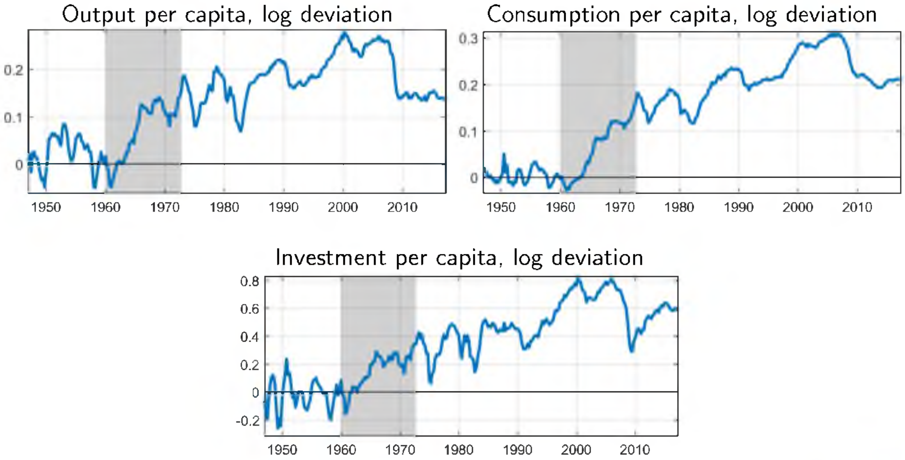
Conclusion

- We document S-shaped dynamics of US macroeconomy around the construction of the Interstate Highway System in the 1960s
- We built an RBC model with multiple s.s. to capture such a non-linear effect of a large GI
- In a "depressed" economy, a temporary GI program can create a permanent scale-up
- Infrequent switches between steady states can generate medium term cycles as in the postwar US data
- Exogenous productivity shocks play crucial roles

Gross Macro Series



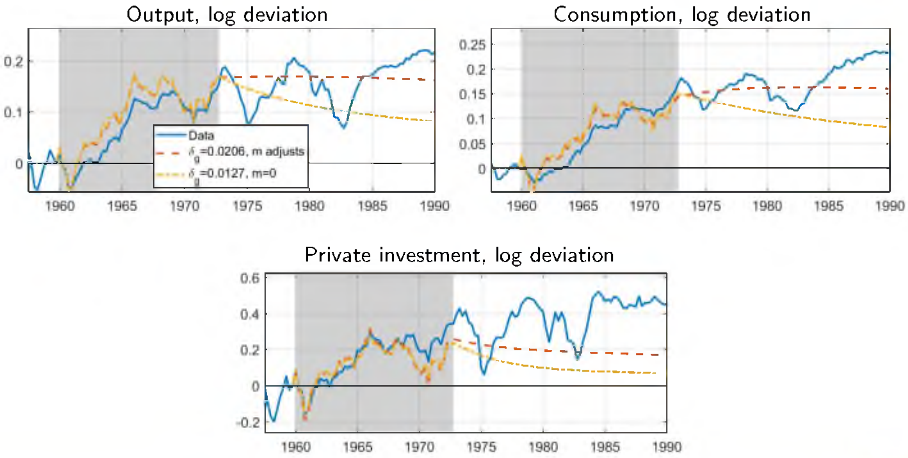
Full Sample



Output per capita, log deviation
0.2
0.1
0
1950
1960
1970
1980
1990
2000
2010
Consumption per capita, log deviation
0.3
0.2
0.1
0
1950
1960
1970
1980
1990
2000
2010
Investment per capita, log deviation
0.8
0.6
0.4
0.2
0
-0.2
1950
1960
1970
1980
1990
2000
2010

A Lower Depreciation Rate

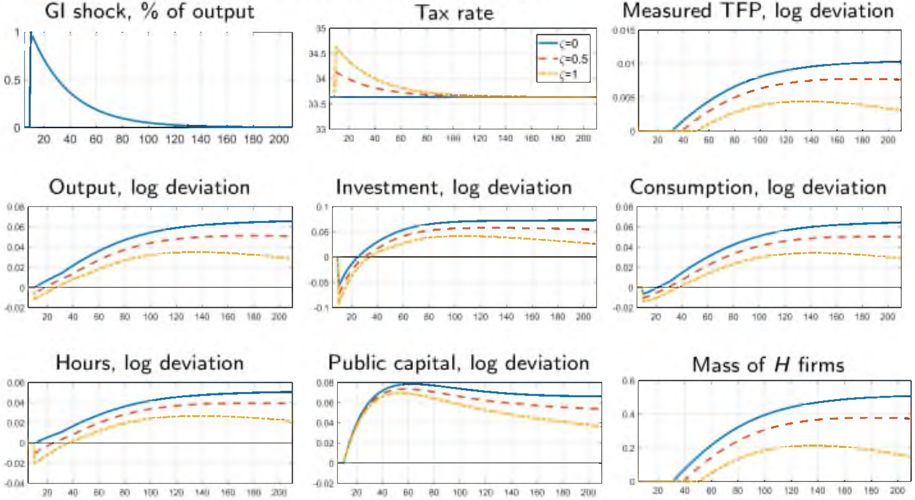
- Can a plain vanilla RBC model with a lower depreciation rate rationalize series around 1960s?
- Set the annual depreciation rate of public capital to 5%.



Back

Role of Financing

- $\zeta \in [0, 1]$ fraction of GI shock is financed through tax rate change
- An increase in τ can overturn transition



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