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The Macroeconomic Effects of Infrastructure
Financing: A Tale of two countries

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Macroeconomic Effects of Infrastructure Financing: A Tale of Two Countries

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Objectives

- Compare and contrast the experiences of PRC and India in financing infrastructure investment
- Quantify the macroeconomic impacts of public infrastructure investment
- Focus on the different modes of financing

Infrastructure Financing in India & PRC

	PRC	India
Decentralized revenue raising	Yes	No
Decentralized expenditure authority	Yes	In transition
Adequate retention of user fees	Yes	Yes
Private sector involvement	Very little	Very little
Foreign investment allowed/encouraged	Yes, but difficult	Somewhat

The Model

- Auerbach and Kotlikoff (1987) Overlapping Generations Model (OLG)
 - 72 generations with uncertain life expectancy
 - Include public infrastructure as a factor of private production
 - Explicitly specified international trade in goods and services

Production sector

- Cobb-Douglas function
 - Decreasing returns to private inputs
 - An economic profit is distributed to the private firm.
- Age-specific labor productivity
- Convex adjustment costs of investment
- Maximize the present value of firm
 - Tobin's q -type of investment behavior

Households sector

- 72 generations
 - corresponding to adult ages 18-89
- Intertemporal utility maximization
- CRRA within-period utility function
- Endogenous labor supply - labor-leisure choice
- Exogenous death possibility
- No annuity market
 - accident bequests are distributed as lump-sum transfers

Government

- Collect taxes, purchase goods and services, make investment and issue debt
- Provide infrastructure to firms
- Face no-Ponzi-game constraint

$$\lim_{T \rightarrow \infty} \left(D_T / \prod_t^T (1 + r_t) \right) \leq 0$$

- In the long run, government debt/GDP ratio is fixed, and tax rates or lump-sum transfer are endogenous to balance the budget constraint

$$R_t = (1 - \tau_t^r) F_K(K_t, L_t, \tilde{X}_t)$$

Foreign sector

- Following Armington structure to model international trade
- Exports in each region are demanded according to constant-elasticity demand curves
- Closed capital account
 - Net foreign capital flow is exogenous and it satisfies no-Ponzi-game constraint.

$$R_t = (1 - \tau_k) F_k(K_t, L_t, \tilde{X}_t)$$

Dynamic Equilibrium

- All commodity and factor markets clear
- The first order conditions of households and firm's decision problem are satisfied.
- The model is implemented in GAMS
- Assuming to reach steady state in 250 years
- Solving over 150K equations simultaneously

$$R_t = (1 - \tau_t^r) F_K(K_t, L_t, \tilde{X}_t)$$

Calibration

- Non-steady dynamic calibration
 - Assuming the economy in base year is a temporal equilibrium along a dynamic adjustment path
- Base year
 - PRC 2002
 - India 2003-4

Calibration

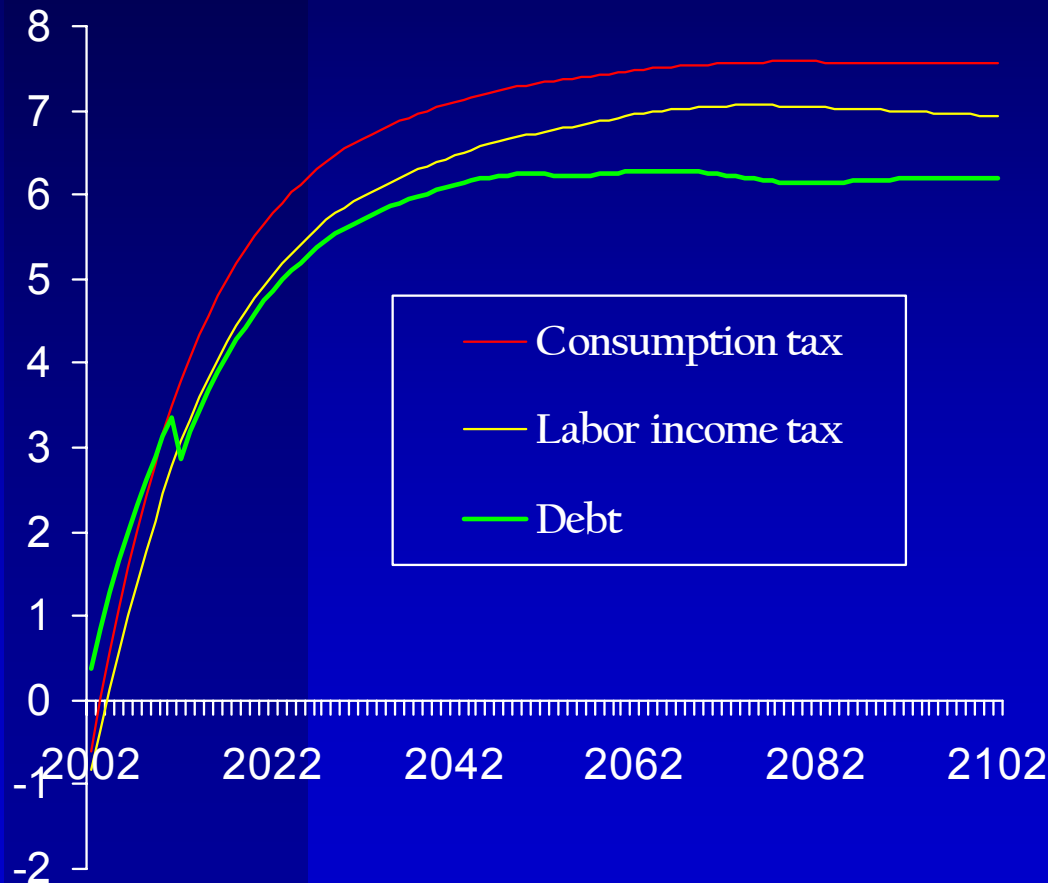
		PRC	India
<u>Extraneously specified parameters</u>			
$1/\gamma$	Intertemporal elasticity of substitution	0.33	0.33
ρ	Elas. of subs. between consumption and leisure	0.80	0.80
$1-\kappa-\theta$	Share parameter of public capital in production	0.07	0.07
σ	Elas. of subs. between imports and domestic goods	2.00	2.00
σ^e	Price elasticity of export demand	-6.00	-6.00
ψ	Capital adjustment cost parameter	2.00	2.00
δ	Depreciation rate	0.10	0.10
g	Long-term growth rate of effective labor	0.025	0.025
<u>Endogenously calibrated parameters</u>			
$(1-\beta)/\beta$	Long-term time preference rate	-0.048	-0.045
	Base year time preference rate	-0.107	-0.045
α	Utility weight on leisure	1.83	2.57
κ	Private capital share parameter in production	0.355	0.38
θ	Labor share parameter in production	0.575	0.55
τ_n	Labor income tax rate (%)	1.8	2.7
τ_k	Corporate income tax rate (%)	18.8	20.2
τ_c	Consumption tax rate (%)	41.5	11.0

Policy Experiments

- Double the public investment in infrastructure
 - PRC 2.55% -> 5.1%
 - India 2.35% -> 4.7%
- Alternative financing modes
 - Consumption tax
 - Labor income tax
 - Use debt to finance additional investment for 10 years, then use consumption tax

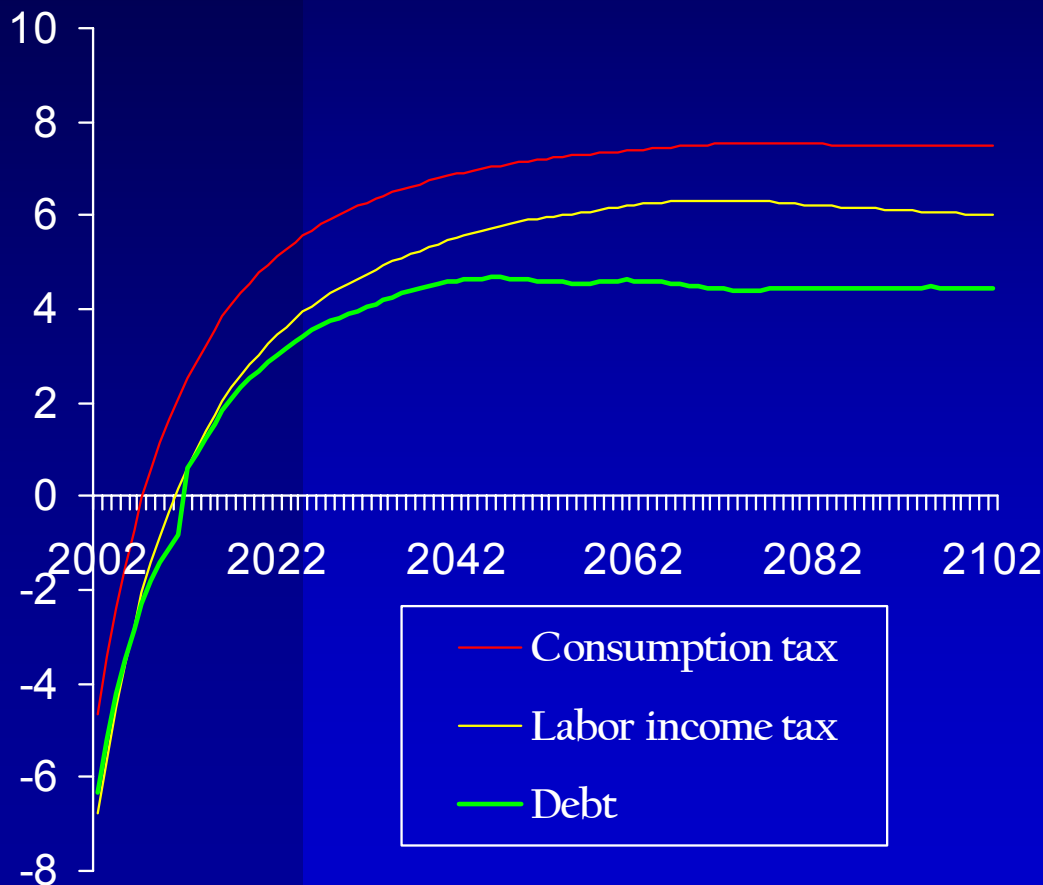
Effects on Output - PRC

(% change from baseline)



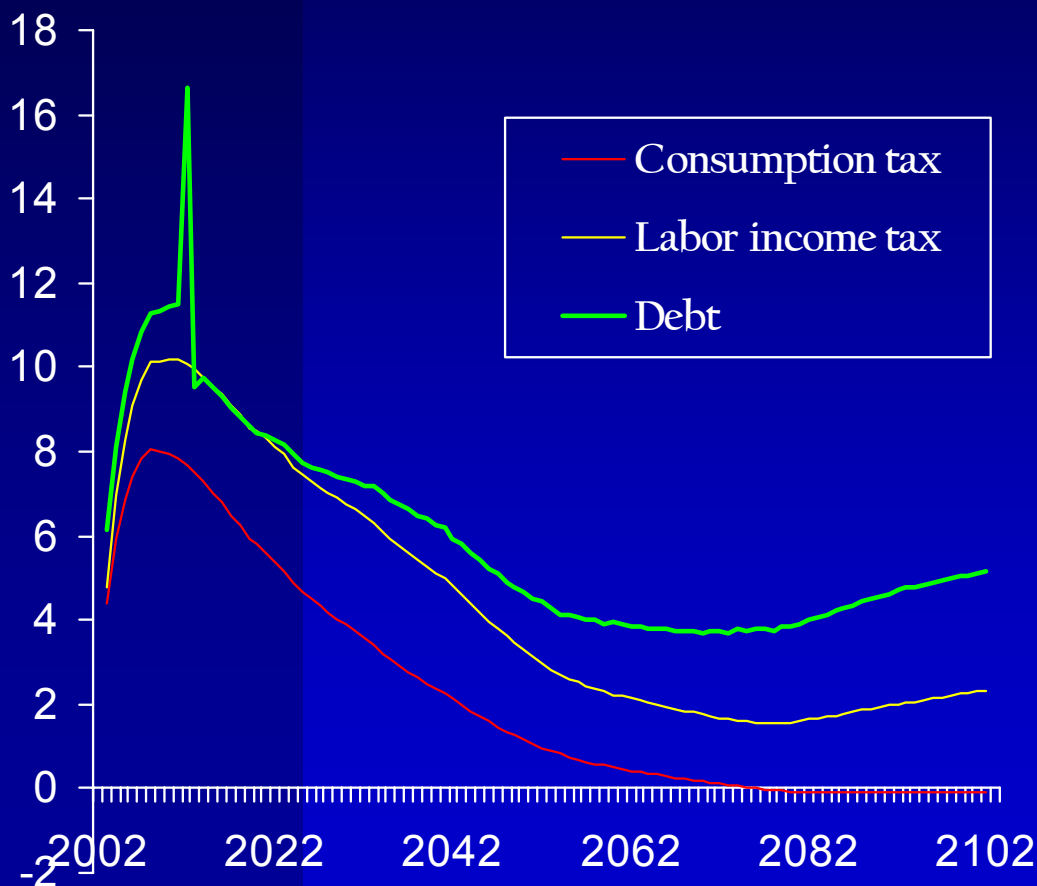
- Public infrastructure are important to long-term output
- The mode of financing does matter

Effects on Private Investment-PRC (% change from baseline)



- Crowd out private investment initially
- But stimulate private investment in the long run
- Long run investment rises most under consumption tax financing mode

Effects on Interest Rate-PRC (% change from baseline)



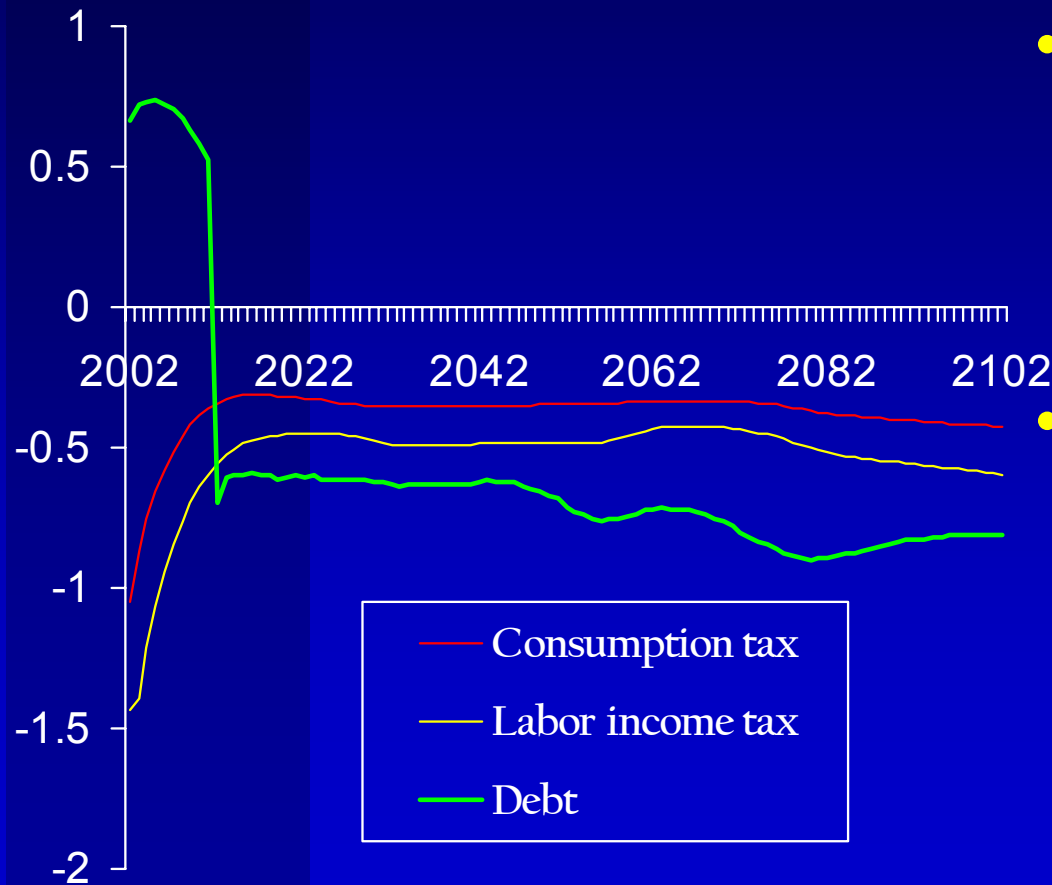
- Consumption tax financing redistributes wealth from the old to young, increasing total saving and restraining the rise of long term interest rate
- Debt financing crowds out private investment initially, leading to higher long term interest rate

Effects on Consumption -PRC (% change from baseline)



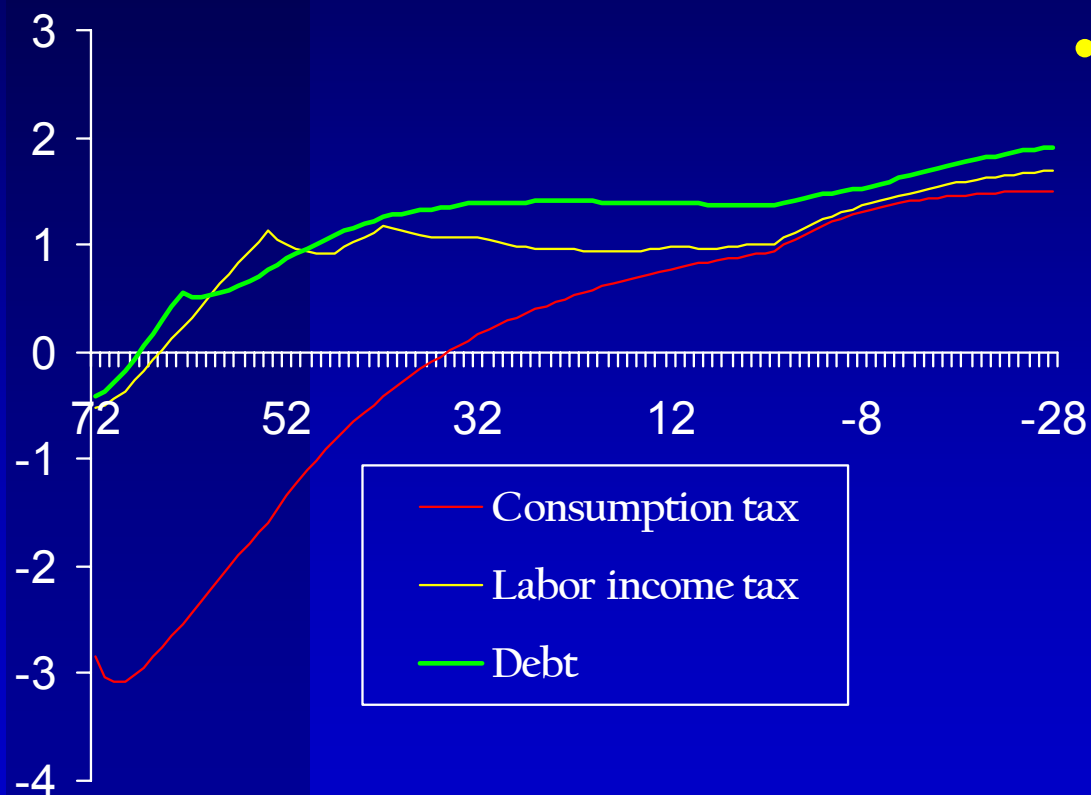
- Income effect associated with tax financing – reduce consumption initially
- Intertemporal subs. effect arising from higher interest rate - reduce consumption initially
- Intertemporal subs. effect arising from higher future price – increase consumption initially

Effects on Labor Supply -PRC (% change from baseline)



- Intratemporal subs. effects from higher tax reduce work efforts
- Under debt financing, intertemporal subs. effect dominates at the initial stage

Intergenerational Distribution Effects – PRC (EV as % lifetime wealth)



- Consumption tax financing redistributes the lifetime wealth from the older to younger generations

Years entering the adulthood before the base year

Is India different?

- The simulations for India show similar patterns about the effects of public infrastructure investment and the implications of alternative financing modes
- But quantitative differences between the two countries' results reveal their different underlying economic structure.

$$Z = \alpha P^{\alpha} R^{\beta} G^{\gamma}$$

Steady state effects -India v.s. PRC

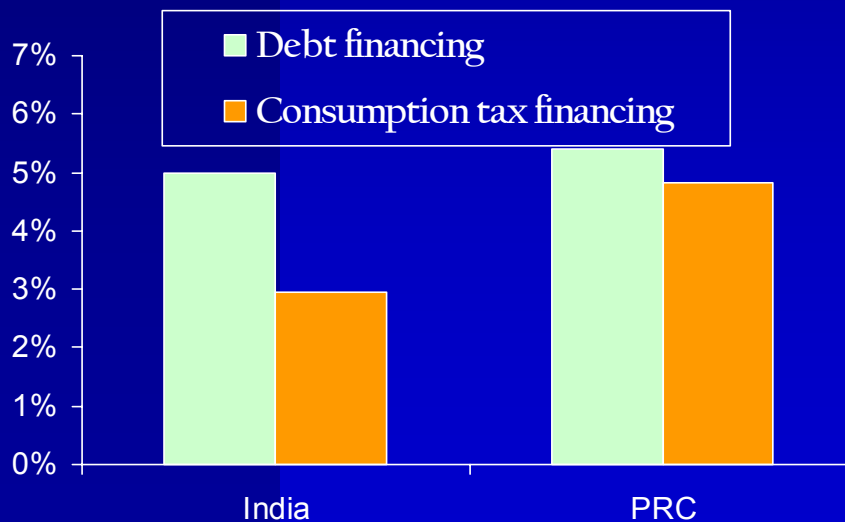
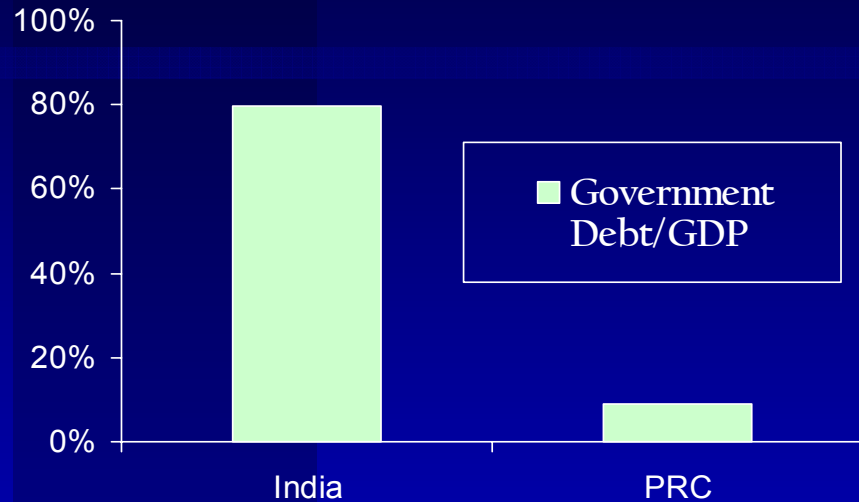
(% change from the baseline)

	PRC	India
<i>Output</i>		
Consumption tax	7.5	8.0
Labor income tax	6.9	7.0
Debt	6.2	5.8
<i>Consumption</i>		
Consumption tax	3.5	4.5
Labor income tax	3.4	4.0
Debt	3.2	3.3

The long term gains are generally bigger in India

- Smaller infrastructure stock and public infrastructure investment
 - Doubling investment requires less resources
- Lower investment to GDP ratio
 - Lower capital adjustment costs
- Lower saving rate
 - Similar increases in interest rate lead to larger increase in saving in India.

But debt financing is more costly for India



- Higher government debt in India results in stronger initial crowding-out effects on private investment
- Higher debt ratio translates into higher consumption tax rate in the long run, which discourages labor supply

Conclusions

- Public infrastructure plays an important role in long term output and investment.
- But its effects depend on the particular financing mode of public infrastructure investment.

Conclusions

- Consumption tax financing is the best option in terms of prompting long term output growth, but it involves larger short term costs for existing older generations.
- Debt financing is favorable for intergenerational equality, but may have undesirable long term effects.

Conclusions

- In general, India can benefit more from public infrastructure investment given its relative scarcity of public infrastructure
- Its high existing stock of government debt renders debt financing the least attractive

Limitations

- Key parameters
- Public-private partnerships
- Debt and taxation policies