What Do We Learn From Cross-Regional Empirical Estimates in Macroeconomics?

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Interpreting Regional Evidence in Macro

- Aggregate GE effects absorbed by time fixed effects.
- Differences in outcomes across regions reflects both the PE effects of shocks plus indirect effects from local GE.
- This paper: method to recover PE effect from regional evidence by removing local GE effects.
  - PE effect has a clearer theoretical interpretation.
  - Can be calculated in one-region model.
  - See also Wolf (2019) and Chodorow-Reich, Nenov, and Simsek (2020).

Application to Housing Wealth Effect

- Empirical specifications relate ΔC to Δp across cities.
  Mian, Rao, and Sufi, 2013; Mian and Sufi, 2014; Guren et al., 2020.
- Issue: $\Delta C_{PE} \to \Delta w \to \Delta C_{Local\ GE}$.
- Key idea today: ΔC and ΔG lead to similar GE adjustments.
- Method in brief: $\Delta C_{PE} = \Delta C_{Local\ GE}/LFM$.
- Application of estimating system of simultaneous equations.

Outline

- Static model: relationship between comparative statics.
- Dynamic model: relationship between impulse response functions.
- Monte Carlo: apply static formula to data from dynamic model.

Static Model

Static Model of Housing Wealth Effect

- Two symmetric regions:

Home	Foreign
$Y = C(w, p, T) + G$	$Y^* = C(w^*, p^*, T) + G^*$
$Y = N(w)$	$Y^* = N(w^*)$
$H(w, p, s) = 0$	$H(w^*, p^*, s^*) = 0$

- Fiscal union: same T in both regions.
- No trade in goods...relaxed in paper.
- Assume $H_w = 0$...relaxed in paper.

Measured and PE Housing Wealth Effect

- Differentiate and difference across regions.
- Local fiscal multiplier:

$$\frac{d\hat{Y}}{dG} = (1 - C_Y)^{-1},$$

  where $C_Y \equiv C_w/N_w$.

- Measured housing wealth effect (IV estimate using instrument s):

$$\frac{d\hat{Y}/ds}{d\hat{p}/ds} = C_p (1 - C_Y)^{-1}.$$

- Taking the ratio yields C_p (PE housing wealth effect keeping w fixed).

Add Residential Investment

- Modify model:

$$Y = C(w, p, T) + I(p) + G$$

- Measured housing wealth effect:

$$E \equiv \frac{d\hat{Y}/ds}{d\hat{p}/ds} = (1 - C_Y)^{-1} (C_p + I_p) .$$

- PE effect on consumption:

$$C_p = \frac{E}{d\hat{Y}/dG} - I_p.$$

Interpreting Empirical Estimates

- IV estimate of dC/dp from Guren et al.: 0.033.
- Estimate of dI/dp using same methods: 0.013.
  - Use construction employment as proxy for residential investment.
- Estimate of dY/dG from Nakamura-Steinsson (2014): 1.5.

$\Rightarrow C_p = \frac{0.033+0.013}{1.5} - 0.013 = 0.018.$

Simultaneous Equations Perspective

- This approach is an application of simultaneous equation estimation.
  - Related to identification of structural VARs.
- Simultaneous equation models require restrictions for identification.
- Without G shocks, order condition fails.

  $\Rightarrow$ G shocks needed to identify consumption function.
- Several other applications in appendix.

Dynamic Model

- Model is similar to Nakamura-Steinsson (2014) but with housing.
- Want model to roughly match empirical strategies and evidence on quantity responses to house prices.

Model Overview

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- Housing produced out of goods and land.

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- Housing produced out of goods and land.
- Regions differ in long-run land supply elasticity.

Supply Constraint Instruments

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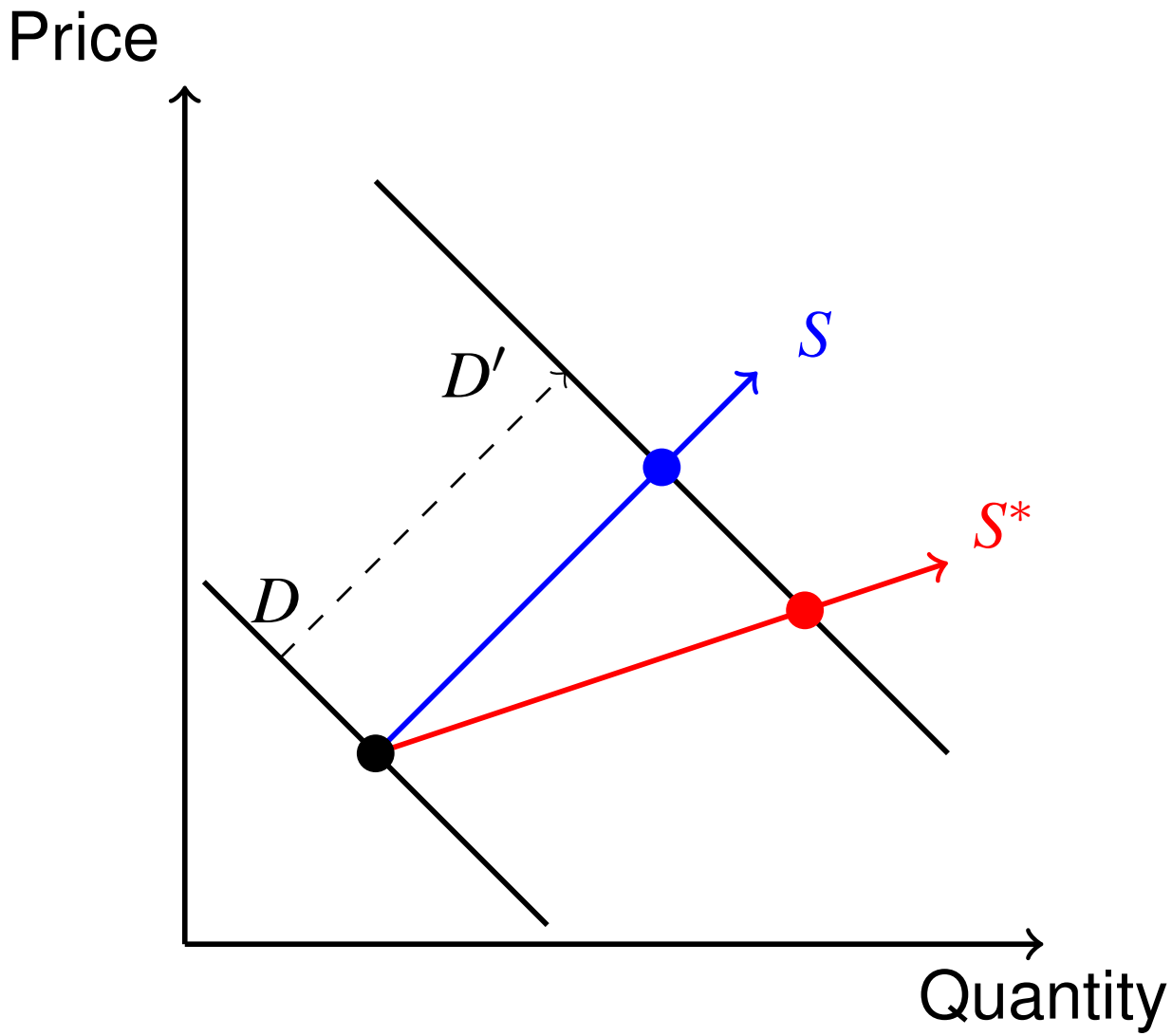
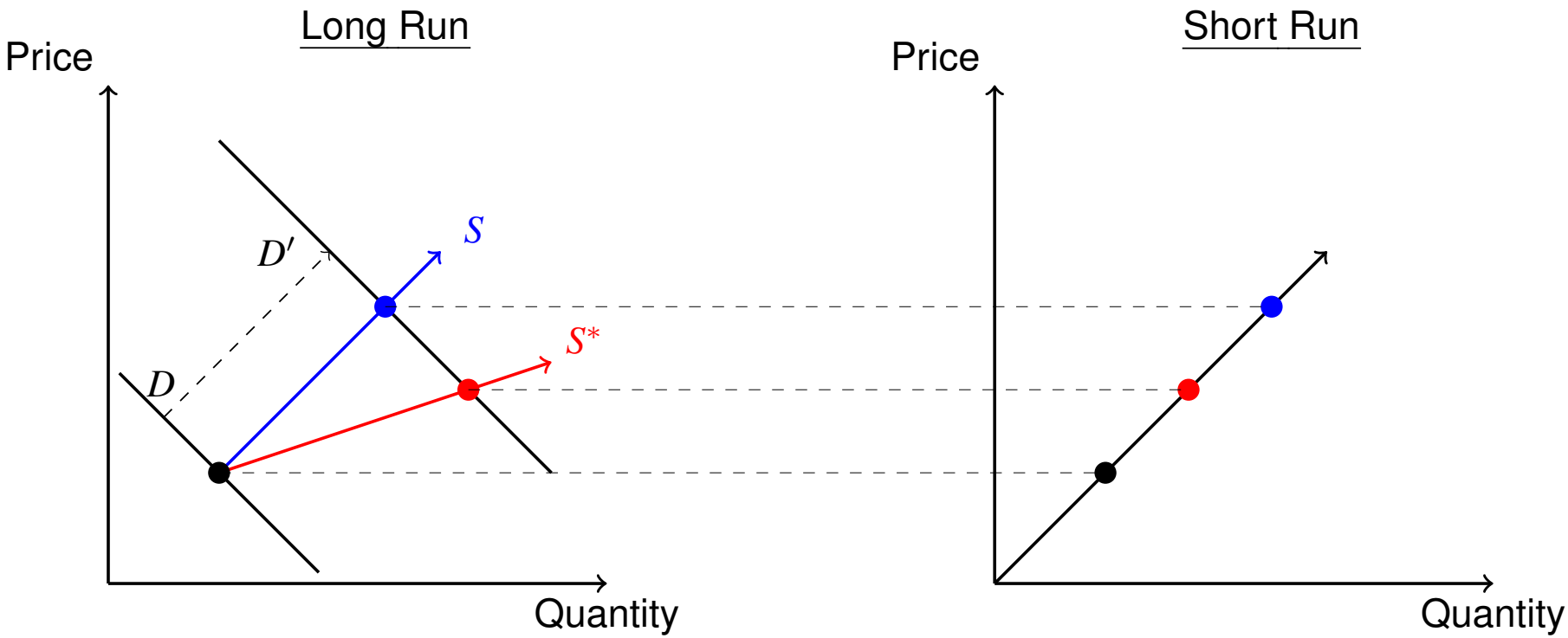


Short-Run vs Long-Run Supply Constraints



Dynamic Relationships

- Perfect foresight transitions last T periods in linearized model.
- Consumption function: $\underbrace{\hat{C}}_{T\times 1} = \underbrace{\mathbf{C}_P}_{T\times T}\underbrace{\hat{P}}_{T\times 1} + \underbrace{\mathbf{C}_Y}_{T\times T}\underbrace{\hat{Y}}_{T\times 1}$.
- Residential investment: $\hat{I} = \mathbf{I}_P\hat{P}$.
- Local fiscal multiplier: $\mathbf{M} = (I - \Phi\mathbf{C}_Y)^{-1}$.
- Response of expenditure to home prices: $\mathbf{E} = \mathbf{M}(\mathbf{C}_P + \mathbf{I}_P)$.
- PE housing wealth effect: $\mathbf{C}_P = \mathbf{M}^{-1}\mathbf{E} - \mathbf{I}_P$...“same” as in static model.

Monte Carlo Analysis

- How well does static formula work in dynamic model?

TABLE: Monte Carlo Analysis of Housing Wealth Elasticity

	(i)	(ii)	(iii)
Complete Markets	✓		
Rigid Prices	✓	✓	
Construction			✓
Long-Run Housing Supply Het.			✓
Measured Housing Wealth Effect			
Local Fiscal Multiplier			
Construction Response			
Implied P.E. Housing Wealth Effect			
Actual P.E. Housing Wealth Effect			
Relative Error			

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	(i)	(ii)	(iii)
Complete Markets	✓		
Rigid Prices	✓	✓	
Construction			✓
Long-Run Housing Supply Het.			✓
Measured Housing Wealth Effect	0.022		
Local Fiscal Multiplier	1.48		
Construction Response	0.00		
Implied P.E. Housing Wealth Effect	0.015		
Actual P.E. Housing Wealth Effect	0.015		
Relative Error	0%		

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Complete Markets	✓		
Rigid Prices	✓	✓	
Construction			✓
Long-Run Housing Supply Het.			✓
Measured Housing Wealth Effect	0.022	0.12	
Local Fiscal Multiplier	1.48	1.50	
Construction Response	0.00	0.000	
Implied P.E. Housing Wealth Effect	0.015	0.081	
Actual P.E. Housing Wealth Effect	0.015	0.063	
Relative Error	0%	31%	

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Construction			✓
Long-Run Housing Supply Het.			✓
Measured Housing Wealth Effect	0.022	0.12	0.14
Local Fiscal Multiplier	1.48	1.50	1.47
Construction Response	0.00	0.000	1.61
Implied P.E. Housing Wealth Effect	0.015	0.081	0.072
Actual P.E. Housing Wealth Effect	0.015	0.063	0.041
Relative Error	0%	31%	30%

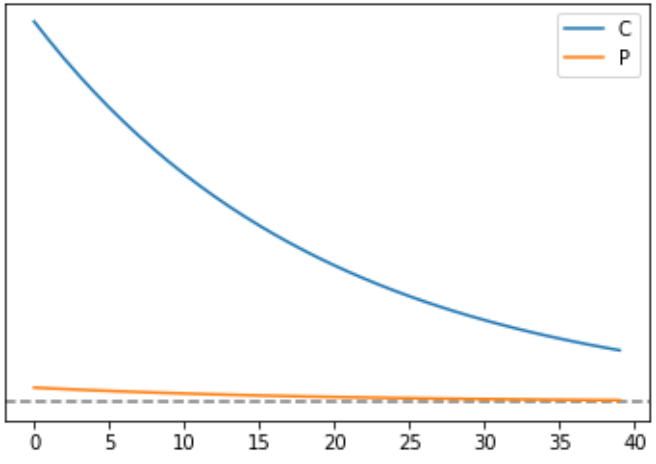
Conclusion

- Simultaneous equations approach to combine reduced-form estimates from regional evidence to remove local GE effects.
- Local fiscal multiplier is informative about the strength of local GE.
- Simple approach of dividing by fiscal multiplier works pretty well.

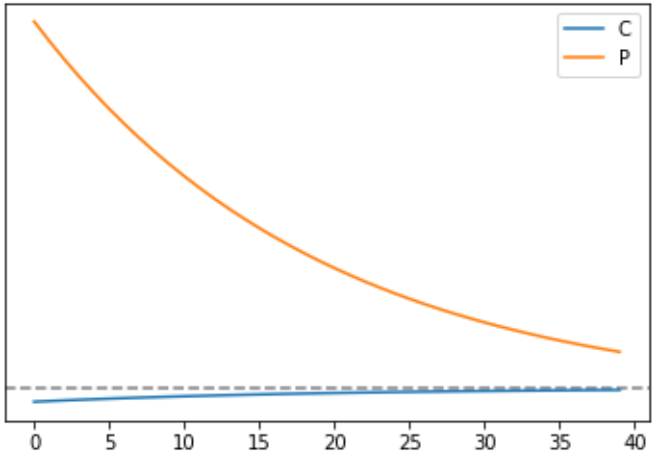
Aggregate Time Series HWE

- $u(C,N,H;\Omega) = \frac{1}{1-\sigma}\left[\left(C - \frac{N^{1+\nu}}{1+\nu}\right)^{\kappa}(H-\Omega_t)^{1-\kappa}\right]^{1-\sigma}$.
- Ω_t is aggregate housing demand shock.
- With $\sigma = 2$, Ω raises u_C and stimulates consumption.
- Alternative with additively separable preferences behaves very differently in aggregate time series.
- In cross-section, direct effect of Ω is differenced out across regions.

$\sigma = 2$



$\sigma = 1$



Aggregate Time Series HWE

Table: Monte Carlo Analysis of Housing Wealth Elasticity

		(i)	(ii)
	σ	2.0	1.0
(1)	Measured Housing Wealth Effect	0.14	0.26
(2)	Local Fiscal Multiplier	1.47	1.47
(3)	Construction Response	1.61	1.61
(4)	Income Elasticity of Home Prices	0.17	0.17
(5)	Implied P.E. Housing Wealth Effect	0.072	0.15
(6)	Actual P.E. Housing Wealth Effect	0.041	0.11
(7)	Relative Error	0.30	0.29