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

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The views expressed herein are those of the authors and not necessarily those of the Federal Reserve Bank of Minneapolis or the Federal Reserve System.
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 $\Delta C$ to $\Delta p$ across cities.

- Issue: $\Delta C_{PE} \rightarrow \Delta w \rightarrow \Delta C_{Local\ GE}$.

- Key idea today: $\Delta C$ and $\Delta G$ lead to similar GE adjustments.

- Method in brief: $\Delta C_{PE} = \Delta C_{Local\ GE}/LFM$.

- Application of estimating system of simultaneous equations.
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:

  \[
  \begin{align*}
  \text{Home} \\
  Y &= C(w, p, T) + G \\
  Y &= N(w) \\
  H(w, p, s) &= 0
  \end{align*}
  \]

  \[
  \begin{align*}
  \text{Foreign} \\
  Y^* &= C(w^*, p^*, T) + G^* \\
  Y^* &= N(w^*) \\
  H(w^*, p^*, s^*) &= 0
  \end{align*}
  \]

- Fiscal union: same \( T \) in both regions.

- No trade in goods...relaxed in paper.

- Assume \( H_w = 0 \)...relaxed in paper.
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).
**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.


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

- Infinite horizon. Two regions, with rep. agent in each.
MODEL OVERVIEW

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- Consume home and foreign goods and housing services.
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Regional shocks to $G$, aggregate shocks to preference for housing.
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- Goods produced out of intermediates with sticky prices.
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Intermediates produced out of labor.
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- Goods produced out of intermediates with sticky prices.
- Intermediates produced out of labor.
- 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
SUPPLY CONSTRAINT INSTRUMENTS

![Graph showing supply and demand curves with supply shift from S to S*]
SHORT-RUN vs LONG-RUN SUPPLY CONSTRAINTS

Long Run

Short Run

Price vs Quantity graph showing the difference between short-run and long-run supply constraints.
Perfect foresight transitions last $T$ periods in linearized model.

Consumption function: \[ \hat{C} = \begin{pmatrix} \hat{C}_P \\ \hat{P} \\ \hat{Y} \end{pmatrix} = \begin{pmatrix} C_P \\ \hat{P} \\ \hat{Y} \end{pmatrix} \begin{pmatrix} T \\ T \times T \\ T \times T \end{pmatrix} \begin{pmatrix} T \times 1 \\ T \times 1 \\ T \times 1 \end{pmatrix} \]

Residential investment: $\hat{I} = I_P \hat{P}$.

Local fiscal multiplier: $M = (I - \Phi C_Y)^{-1}$.

Response of expenditure to home prices: $E = M (C_P + I_P)$.

PE housing wealth effect: $C_P = M^{-1} E - I_P$...“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

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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**

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

\[
\begin{align*}
\sigma &= 2 \\
\sigma &= 1
\end{align*}
\]
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