

The Aggregate Implications of Regional Business Cycles

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From Regional to Aggregate

- ▶ Regional and aggregate economies differ:
 1. Shock **elasticities**
 2. Shock **realizations**
- ▶ Great Recession: cross-state patterns different than US aggregates.
- ▶ **Why?** Because of 1. and 2.
- ▶ But then...Can we learn anything about aggregates from regional data?
- ▶ **Yes!** Regional info + Theory \implies identify shocks driving aggregates.

What We Do

1. **Make wage and price indices at the state level. Document that:**

- ▶ Nominal and real wage growth were strongly positively correlated with economic activity across states.
- ▶ Aggregate wage growth, less so.

2. **Monetary Union Model**

- ▶ Regional v. aggregate shock elasticities.
- ▶ Use regional data to estimate structural parameters in NKWPC
- ▶ Impose those restrictions in aggregate DSGE model.
- ▶ Shock decomposition for the Great Recession

Some Take Aways...

- ▶ Estimate that wages are fairly flexible (from cross-region variation).



Hard to get “*demand shocks*” as THE drivers of aggregate employment.

- ▶ A modest role in the early part of the recession. None in the recovery.
- ▶ But, regional business cycles are mainly driven by local demand shocks. Remember Mian and Sufi (2014)

Part 1:

Regional and Aggregate Business Cycles

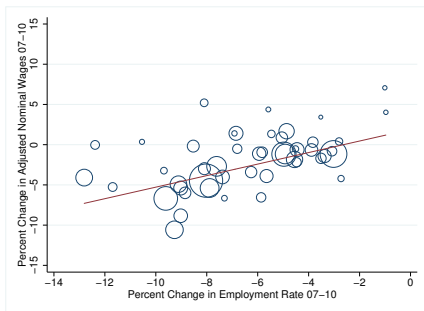
Wage Data

- ▶ Data from the 2000 Census and 01-12 American Community Surveys.
- ▶ Hourly wage \equiv earnings per hour for workers with ≥ 30 hrs. per week.
- ▶ Examine patterns for unadjusted and “adjusted” wages.
- ▶ To adjust wages, we regress log wage rate on age, education, citizenship, black, and usual hours worked dummies.
 - ▶ Do this separately for each year.
 - ▶ Take residuals from regression. Add constant back. Average by state.
- ▶ Regional patterns for adjusted and unadjusted wages are very similar.

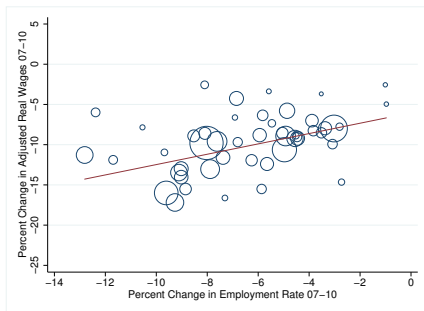
Data: *Nielsen's Retail Scanner Database*

- ▶ Data from first week of January 2006 through last week of December 2011.
- ▶ Data at level of UPC*store*week. Includes number of units sold and average price per unit during week.
- ▶ Each store can be matched to a specific location (county, MSA, state) and to a specific chain.
- ▶ 75 billion unique observations (UPC*store*week)!
- ▶ In 2011, ≈ 36000 participating stores and 86 participating chains (97 percent of sales come from grocery, drug, and mass merchandising stores).
- ▶ **In 2011, \$236 billion dollars worth of sales (≈ 30 percent of food expenditures and ≈ 2 percent of total expenditures).**
- ▶ **Large geographic coverage: Data from about 86 percent of U.S. counties.**

Figure: State Employment Growth vs. State Wage Growth



PANEL A: NOMINAL WAGES



PANEL B: REAL WAGES

- ▶ 1 pp diff in Δ emp growth \Rightarrow 0.64 (0.72) pp diff in real (nominal) wage growth. [▶ QEW](#)

Table: Time Series Estimates of Wage Elasticities During the Great Recession

	CPS Data	ACS Data
Panel A: Nominal Wages		
De-Trended Nominal Wage Growth, 2007-2010	-3.9 percent	-4.1 percent
Nominal Wage Elasticity, 2007-2010	0.51	0.54
Panel B: De-Trended Real Wages		
De-Trended Real Wage Growth, 2007-2010	-2.6 percent	-2.8 percent
Real Wage Elasticity, 2007-2010	0.34	0.37

- ▶ Smaller time series elasticities compared to regional ones

Part 2: A Monetary Union Model

Purpose

1. Highlight differences in aggregate v. regional shock elasticities.
2. Specify a structural equation. Wage setting.
3. Identify shocks in a state-of-the-art DSGE.

Model

- ▶ Economy composed of islands.
- ▶ Agents: households, firms and monetary authority.
- ▶ 2 sectors: final good and intermediates.
- ▶ One asset: one-period nominal bond.
- ▶ Sticky prices and wages a-la-Calvo
- ▶ 7 shocks with an island and aggregate level component
- ▶ DSGE bells-and-whistles: habits, investment adj. cost, etc.

Equilibrium characterization

- ▶ Log-linearize around zero inflation SS.
- ▶ **Claim 1:** Log-linearized economy aggregates.
- ▶ **Claim 2:**
 - ▶ Island economies in log-deviation from aggregates are stationary.
 - ▶ Behave like independent small open economies.
- ▶ Can write $c_{kt} = c_t + \tilde{c}_{kt}$.
- ▶ Study aggregate and local economies separately.

Aggregate v regional NKWPC

- Write the Regional New Keynesian Wage Phillips Curve as:

$$\tilde{\pi}_{kt}^W = \beta \mathbb{E}_t [\tilde{\pi}_{kt+1}^W] + \kappa_w \nu \tilde{n}_{kt} - \kappa_w \tilde{w}_{kt} + \iota_w (\tilde{\pi}_{kt-1} - \beta \tilde{\pi}_{kt}) + \frac{\kappa_w}{1-h} (\tilde{c}_{kt} - h \tilde{c}_{kt-1}) + \tilde{\varphi}_{kt}$$

" ~ " represent island variables in log-deviations from aggregates

- Furthermore, the slope of Regional New Keynesian Phillip's curve is:

$$\kappa_w \equiv \frac{(1 - \beta \xi_w)(1 - \xi_w)}{\xi_w} \frac{\lambda_w - 1}{\lambda_w(1 + \nu) - 1}$$

where $1 - \xi_w$ is the fraction of wages that re-set every period

- The Aggregate New Keynesian Wage Phillips Curve is:

$$\hat{\pi}_t^W = \beta \mathbb{E}_t [\hat{\pi}_{t+1}^W] + \kappa_w \nu \hat{n}_t - \kappa_w \hat{w}_t + \iota_w (\hat{\pi}_{t-1} - \beta \hat{\pi}_t) + \frac{\kappa_w}{1-h} (\hat{c}_t - h \hat{c}_{t-1}) + \hat{\varphi}_t$$

" ^ " represent aggregate variables in log-deviations from BGP.

Aggregate v. Local responses

- ▶ Simplified model: no habits, no capital, etc. and perfectly rigid prices
- ▶ Derive responses on impact to discount factor shock

$$\frac{d\hat{n}_0}{d\hat{b}_0} = \frac{1}{1-\alpha} \frac{1-\rho_b}{1-\rho_b+\varphi_y}$$

$$\frac{d\tilde{n}_{k0}}{d\tilde{b}_{k0}} = \frac{1-\rho_b}{1-\rho_b+\frac{1}{\beta}-a_{\tilde{\beta}\tilde{\beta}}}$$

$$\frac{d\hat{w}_0}{d\hat{n}_0} = \frac{\kappa_w(1-\alpha+\nu)}{1-\beta(1-a_{ww}-\rho_b)+\kappa_w}$$

$$\frac{d\tilde{w}_{k0}}{d\tilde{n}_{k0}} = \frac{\kappa_w(1+\nu)}{1-\beta(1-a_{ww}-\rho_b)+\kappa_w} \frac{1+\beta(1-a_{ww})+\kappa_w-\frac{1}{\beta}}{1+\beta(1-a_{ww})+\kappa_w-a_{\tilde{\beta}\tilde{\beta}}}$$

- ▶ Differences come from:
 - ▶ Monetary policy
 - ▶ Openness

Part 3:

The US Great Recession: From Regions to Aggregate

Estimation

- ▶ Iterative procedure with aggregate and regional data.
 1. Fix β, ν, ι_w, h . Estimate κ_w from Regional NKWPC using regional data only.
 - ▶ Need to instrument for expectations and also all other variables because of $\tilde{\phi}_{kt}$
 - ▶ To deal with expectations, we are gonna do GMM. Use lagged variables outside the equation (e.g., unemployment, output)
 - ▶ To deal with endogenous regressors, use current and lagged house prices (Mian and Sufi (2014)).
 2. Estimate aggregate model with aggregate data, but restricting κ_w .
 3. Obtain new β, ν, ι_w, h . Iterate until convergence.

Table: Fit of Aggregate model and Regional NKWPC

	$\xi_w = 0.24 (\vartheta = 0)$	$\xi_w = 0.5 (\vartheta = 2)$
Aggregate model log-marginal likelihood	-592	-590
Mean-squared error of regional NKWPC	0.0002	0.0146

Note: The first line is the aggregate model fit to the aggregate time-series data, as measured by the log-marginal likelihood. The second line is the mean squared error of the regional NKWPC. $\vartheta = 0$ uses regional data only for NKWPC estimation. $\vartheta = 2$ uses aggregate data only.

Figure: Distinguishing between high and low wage stickiness models: the role of demand and labor supply shocks

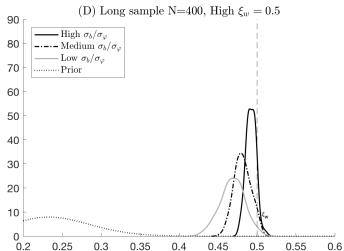
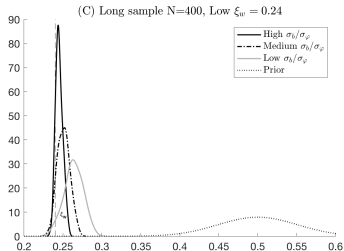
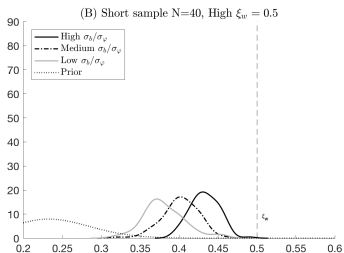
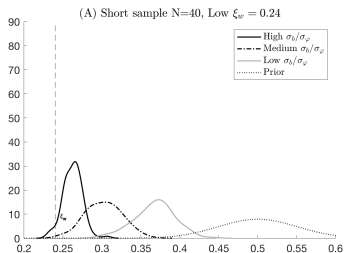


Table: Predicted $\frac{d\log(w^{agg})}{d\log(n^{agg})}$ during the Great Recession in Response to Various Shocks

	Shocks		
	b	b and μ	$b, \mu,$ and φ
Benchmark	0.97	0.83	0.31
Aggregate data alone	0.39	0.40	0.25

Figure: Employment Response to 2007-2010 Household Demand shocks

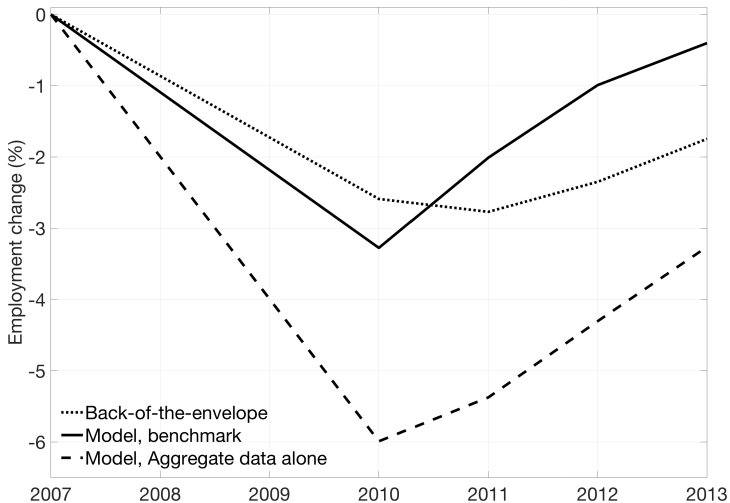
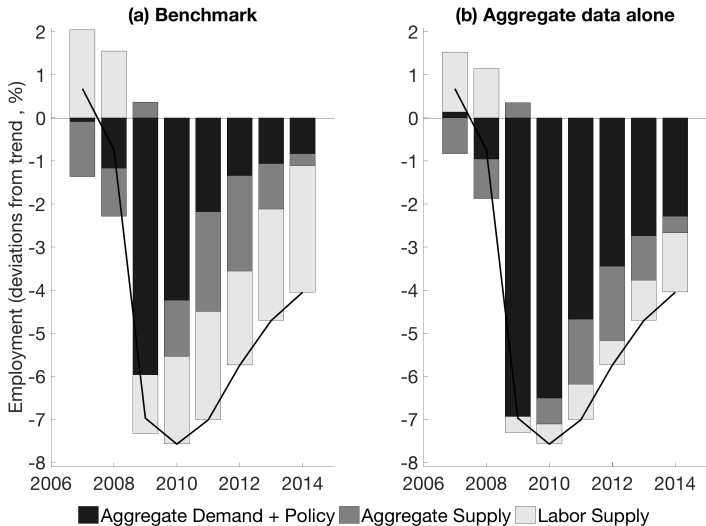


Figure: Employment shock decomposition



Conclusions

- ▶ Most of the lit. estimates business cycle models with aggregate data only
 - ▶ Ignores regional data that can discipline hard-to-pin-down mechanisms
- ▶ A separate literature extrapolates from regional elasticities to aggregates
 - ▶ Misses channels/shocks that differ between regional and agg. economies
- ▶ Combine both regional and aggregate data to estimate a DSGE model
 - ▶ Demand shocks main driver of regional employment in the Great Recession
 - ▶ Yet, wage rigidity necessary for demand shocks to explain persistence in aggregate employment after the Great Recession is inconsistent with observed flexibility of wages across regions
 - ▶ Instead, aggregate labor supply shocks—which are differenced out when exploiting cross-region variation—are important