Optimal Inflation and the Phillips Curve

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Is there a Phillips curve?

- **Inflation follows a seemingly exogenous process, unrelated to measures of slack. E.g.,**
  - ✓Atkeson and Ohanian (2001)
  - ✓Stock and Watson (2007, 2009)
  - ✓Hall (2011)
  - ✓Dotsey, Fujita and Stark (2017),
  - ✓Cecchetti, Feroli, Hooper, Kashyap, and Schoenholtz (2017)
  - ✓Forbes, Kirkham and Theodoridis (2017)
  - ✓Uhlig (2018)

- **The Phillips Curve has flattened (or even disappeared). E.g.,**
  - ✓Ball and Mazumder (2011)
  - ✓IMF (2013)
  - ✓Blanchard, Cerutti and Summers (2015)
  - ✓Summers (2017)
  - ✓Andolfatto (2017)
  - ✓Blinder (2018)

- **Critical for the conduct of monetary policy**
  - ✓Draghi (2017)
  - ✓Carney (2017)
  - ✓Powell (2018)

Stock taking by (some) academics

Harald Uhlig, 2018 *(based on empirics + quantitative models a la* Smets and Wouters, 2007):

"Inflation, in essence, dances to its own music"

Bob Hall, 2013:

"Prior to the recent deep worldwide recession, macroeconomists of all schools took a negative relation between slack and declining inflation as an axiom. Few seem to have awakened to the recent experience as a contradiction to the axiom."

- This disconnect between inflation and slack poses a challenge to New Keynesian models, for which the Phillips curve is a key building block.

If there is no Phillips curve…

- This disconnect between inflation and slack poses a challenge to New Keynesian models, for which the Phillips curve is a key building block.

Does the disconnect pose a challenge to the NK model?

- On the contrary: this disconnect is exactly what a New Keynesian model with a welfare-optimizing Central Bank would predict

A simple model of optimal inflation and the PC

Galí (2008); Woodford (2003); Clarida, Galí and Gertler (1999)

$$Loss = E_0 \sum_{t=0}^{\infty} \beta^t (\pi_t^2 + \lambda x_t^2)$$

Under discretion

$$\min \pi_t^2 + \lambda x_t^2$$

s.t.:

$$\pi_t = \beta E_t \pi_{t+1} + \kappa x_t + u_t \quad \text{(PC)}$$

Solution: Targeting rule

$$\pi_t = -\frac{\lambda}{\kappa} x_t \quad \text{(TR)}$$

Optimal inflation and the PC

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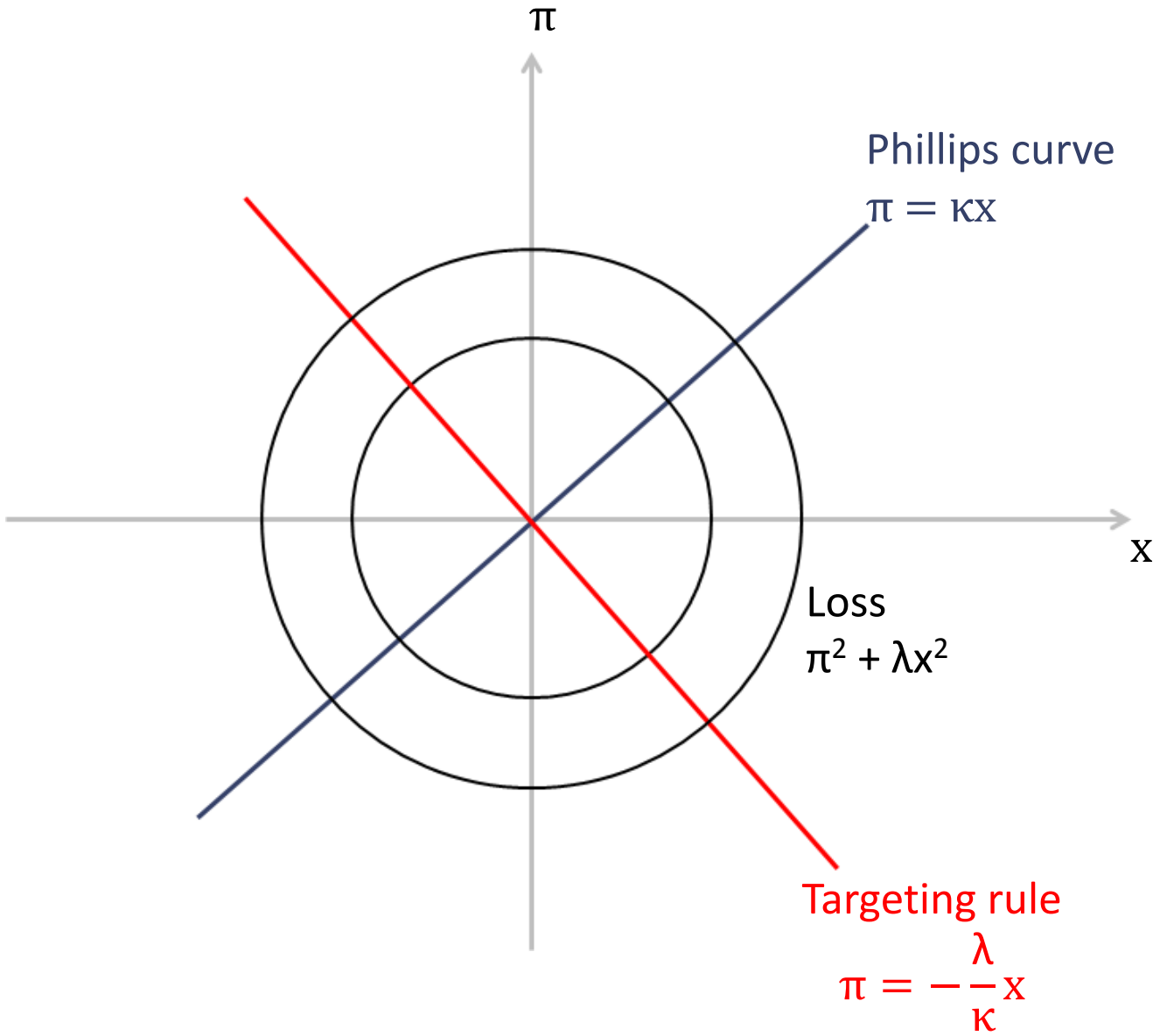

Identification

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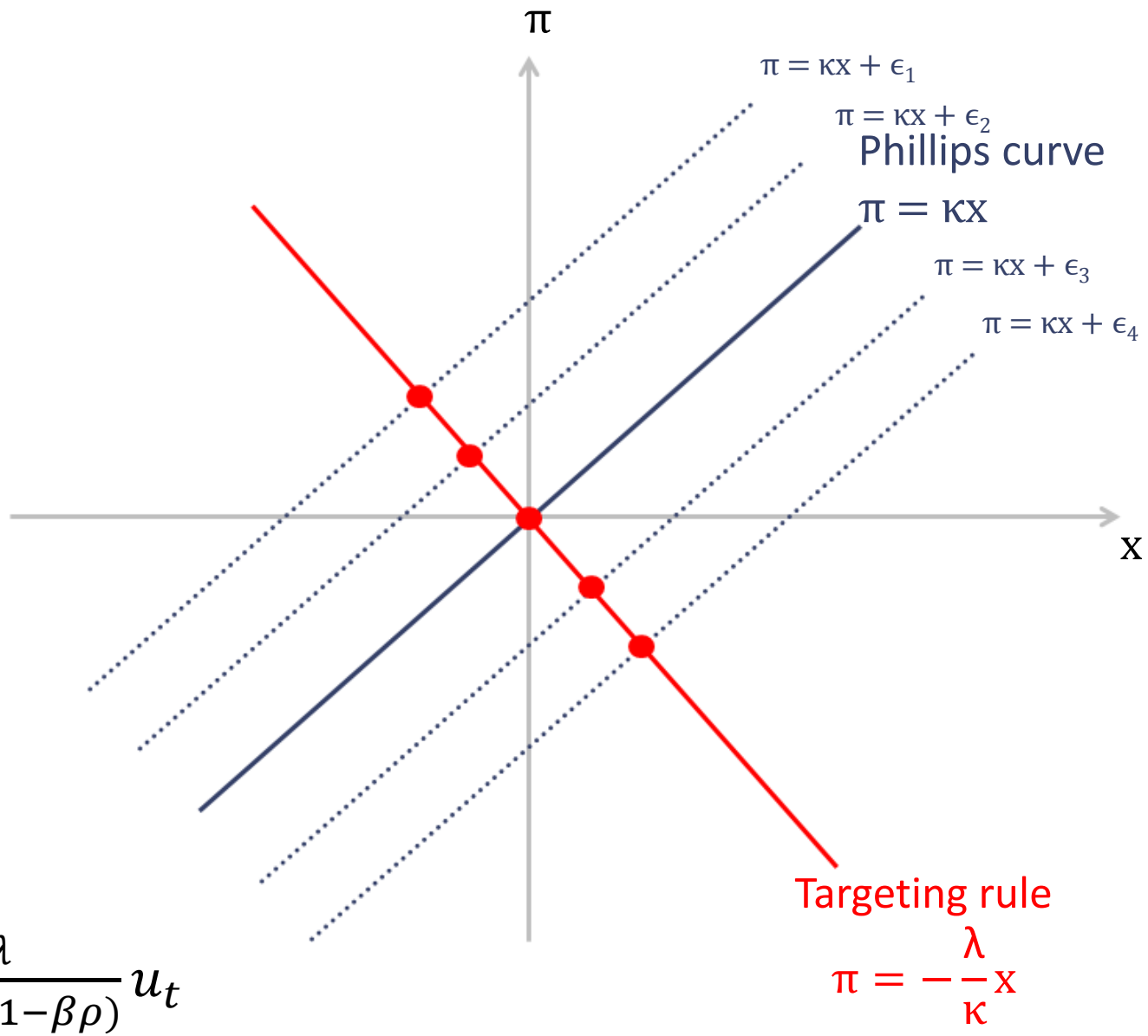
Observed Inflation inherits properties of exogenous shock process:

$$\pi_t = f(u_t)$$

$$If\ u_t = \rho u_{t-1} + v_t, \qquad \pi_t = \frac{\lambda}{\kappa^2 + \lambda(1-\beta\rho)} u_t$$



Identification under commitment

Under commitment:

$$\min E_0 \sum_{t=0}^{\infty} \beta^t (\pi_t^2 + \lambda x_t^2)$$

s.t.:

$$\pi_t = \beta E_t \pi_{t+1} + \kappa x_t + u_t \quad \text{(PC)}$$

Solution: Targeting rule

$$p_t = -\frac{\lambda}{\kappa} x_t \quad \text{(TR)}$$

Observed inflation: inherits properties of exogenous shock process:

$$\pi_t = f(u_t, u_{t-1}, u_{t-2} \ldots)$$

Remarks

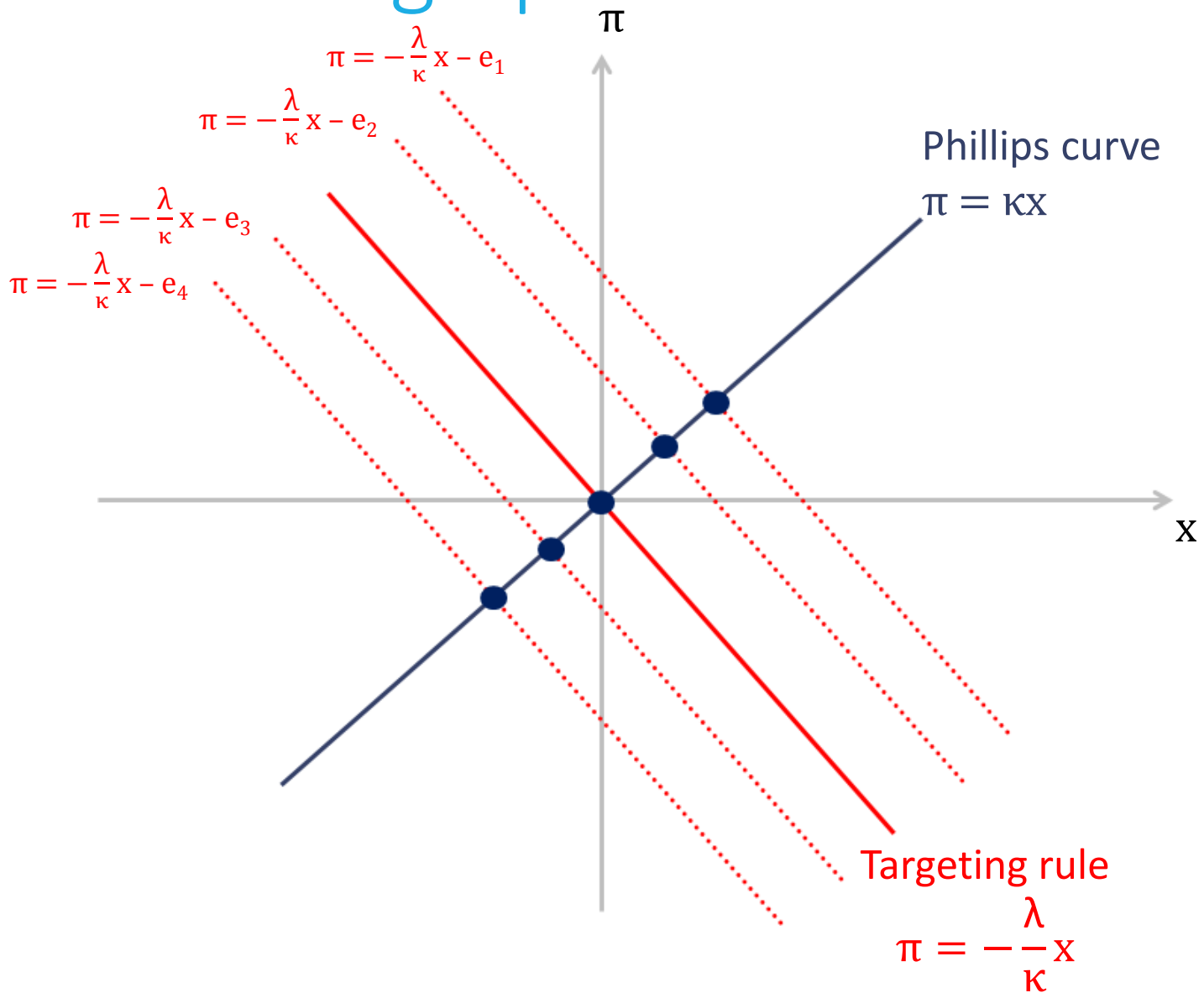
- Framework implies that equilibrium inflation rates should be uncorrelated with slack, as long as central banks are doing a sensible job
- Challenge for econometricians, not for the model
- Our point is distinct from most articulations of the "Fed view" on why the Phillips curve flattened (e.g. Williams, 2006; Mishkin, 2007; Bernanke, 2007, 2010).
  - They focus on the anchoring of inflation expectations weakening the reduced-form correlation between slack and inflation.
  - This paper: even in a setting in which expectations play no role, the structural relationship between slack and inflation can be masked by the conduct of monetary policy.
  - This is not to say that Fed policymakers were not aware of our point too, of course!
- Formulas: Barro and Gordon (1983)
- Interestingly, many papers on the PC flattening do not mention monetary policy. If they do, only to the extent that it affects expectations. E.g. Coibion and Gorodnichenko (2015).

Identification in graphs

$$\pi_t = -\frac{\lambda}{\kappa} x_t - e_t \quad \text{(TR)}$$

Identification improves as

$$\frac{\text{Var}(e_t)}{\text{Var}(u_t)} \; increases$$

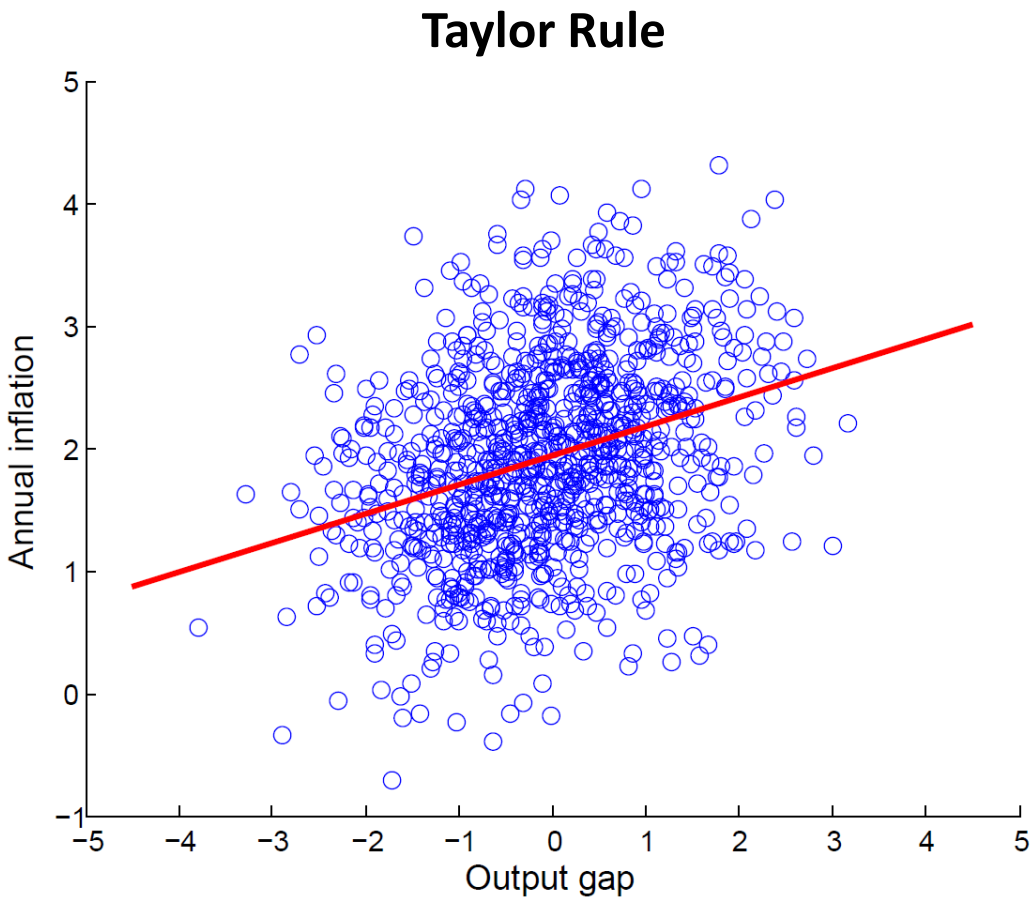


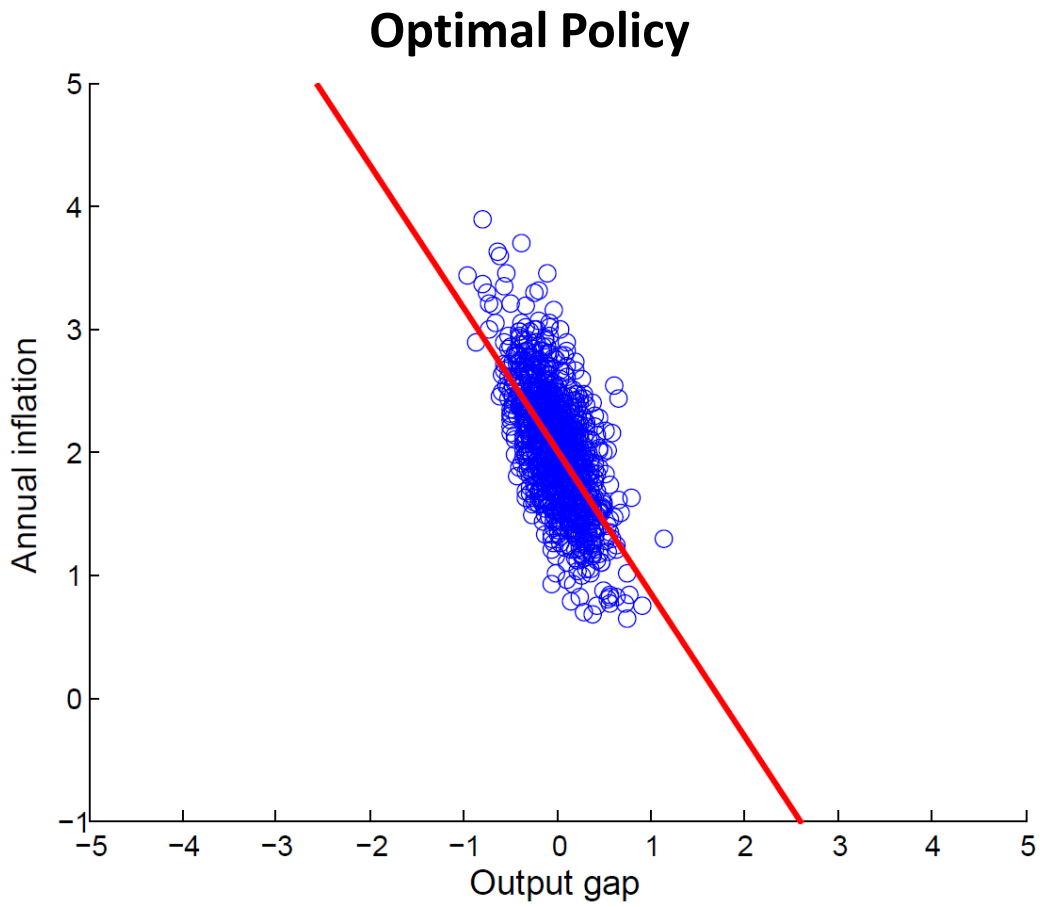
Identification in a big NK Model (COMPASS)

- **Big NK model at the BoE**
- There is no single structural PC relation between inflation and slack. Multiple PC.
  - ✓Still helpful for a policy maker to think about an average PC relation following demand shocks.
  - ✓There is an underlying structural aggregate supply relation in the larger model.
  - ✓The average PC gets closer to the underlying structural supply relation in a way that is more robust to model specification.
- Within COMPASS, run a stochastic simulation using all (18) shocks in the model.
- Exercise: Naïve estimation of the Phillips curve
- Two possibilities: i) (estimated) Taylor rule

  ii) discretionary optimal monetary policy (minimises loss function)

Naïve Phillips Curve in a big NK Model (COMPASS)





Phillips Curve in a big NK Model (COMPASS)

- Big NK model economy.
- Two assumptions on monetary policy
- **Separately conditioning on demand or supply shock**

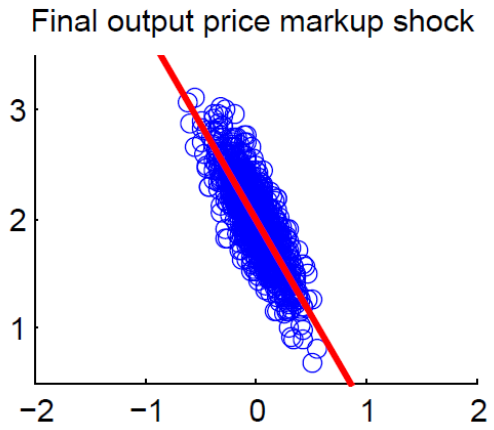
	Taylor Rule	Optimal Monetary Policy
Supply Shock		
Demand Shock		

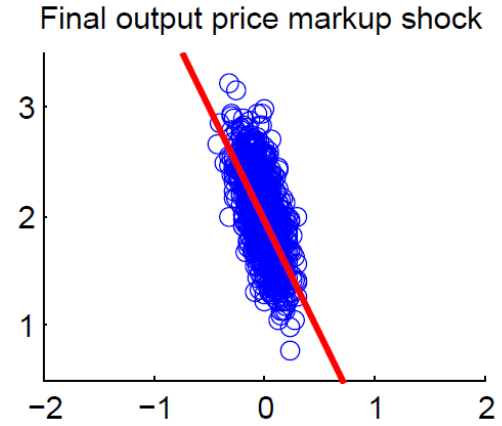
Naïve Phillips Curve in a big NK Model (COMPASS)

Taylor Rule

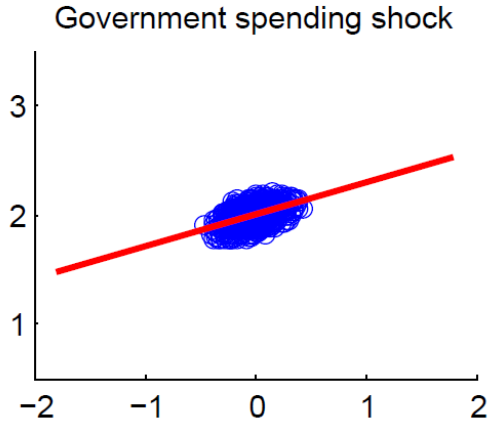
Optimal Policy

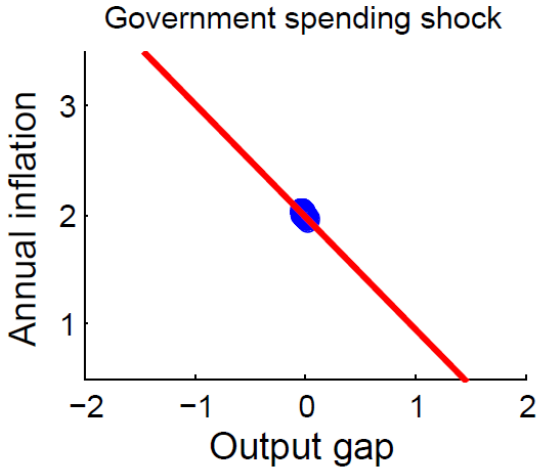
Supply shock





Demand shock





Identification strategies

❑ Control for supply shocks (Gordon, 1982)

✓Neither simple nor sufficient

❑ Instrumental variables

✓ Lagged variables as instruments

✓ Monetary policy shocks (Christiano, Eichenbaum and Evans, 1999; Romer and Romer, 2004)

- Structural PC correlation can be recovered (Barnichon and Mesters, 2019)
- MP shocks ideal IV: move output gap; not fully undone by MP. But some limitations (Boivin and Giannoni 2006, Ramey 2016).

❑Regional data (Fitzgerald and Nicolini, 2014; Kiley, 2015; Babb and Detmeister, 2017)

✓MP does not offset regional demand shocks, so each region finds itself in a different segment of the PC.

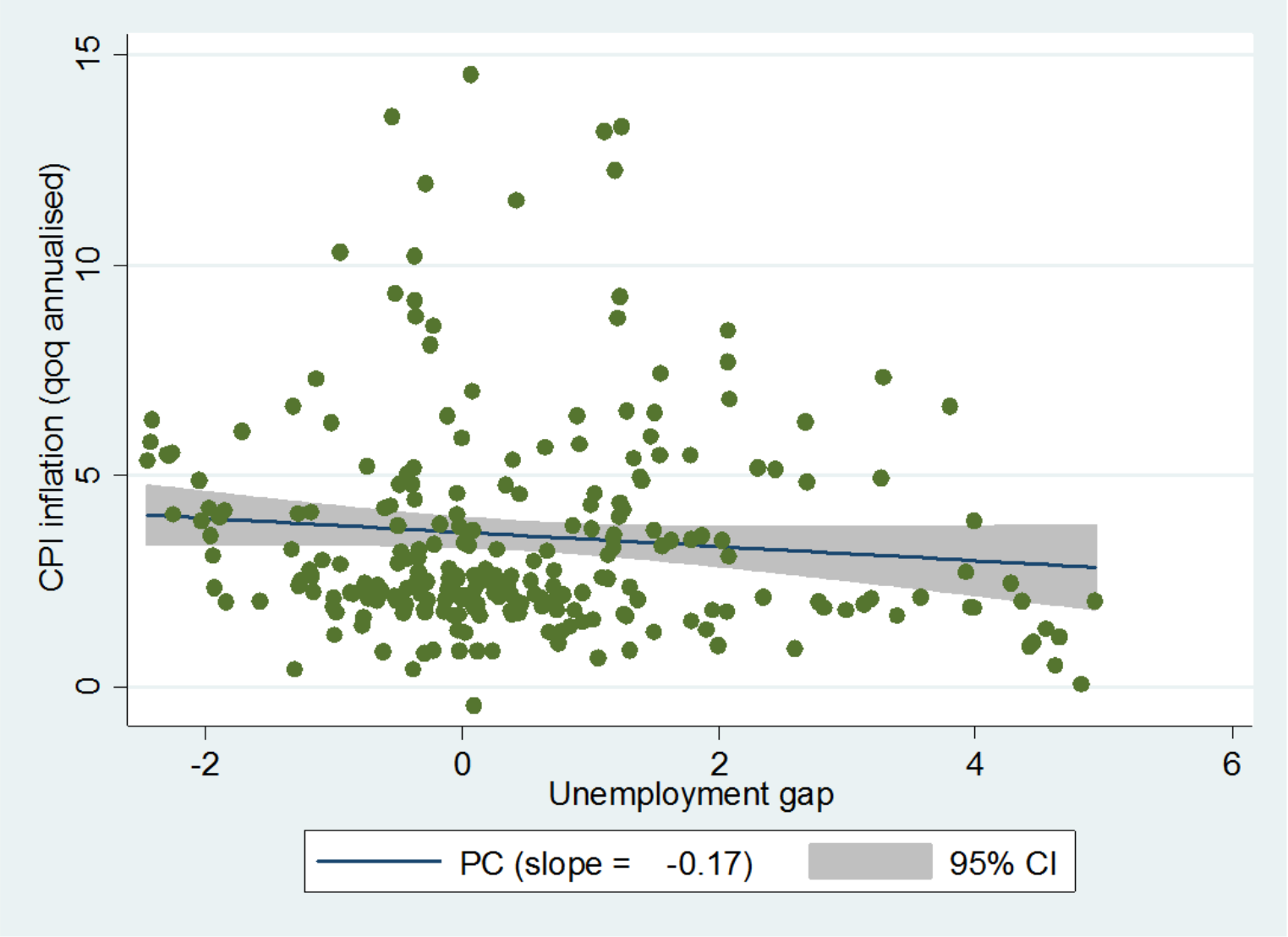
✓Time-FE can absorb aggregate demand and supply shocks (e.g., oil shocks) and area-FE, regional diffs.

From model to data

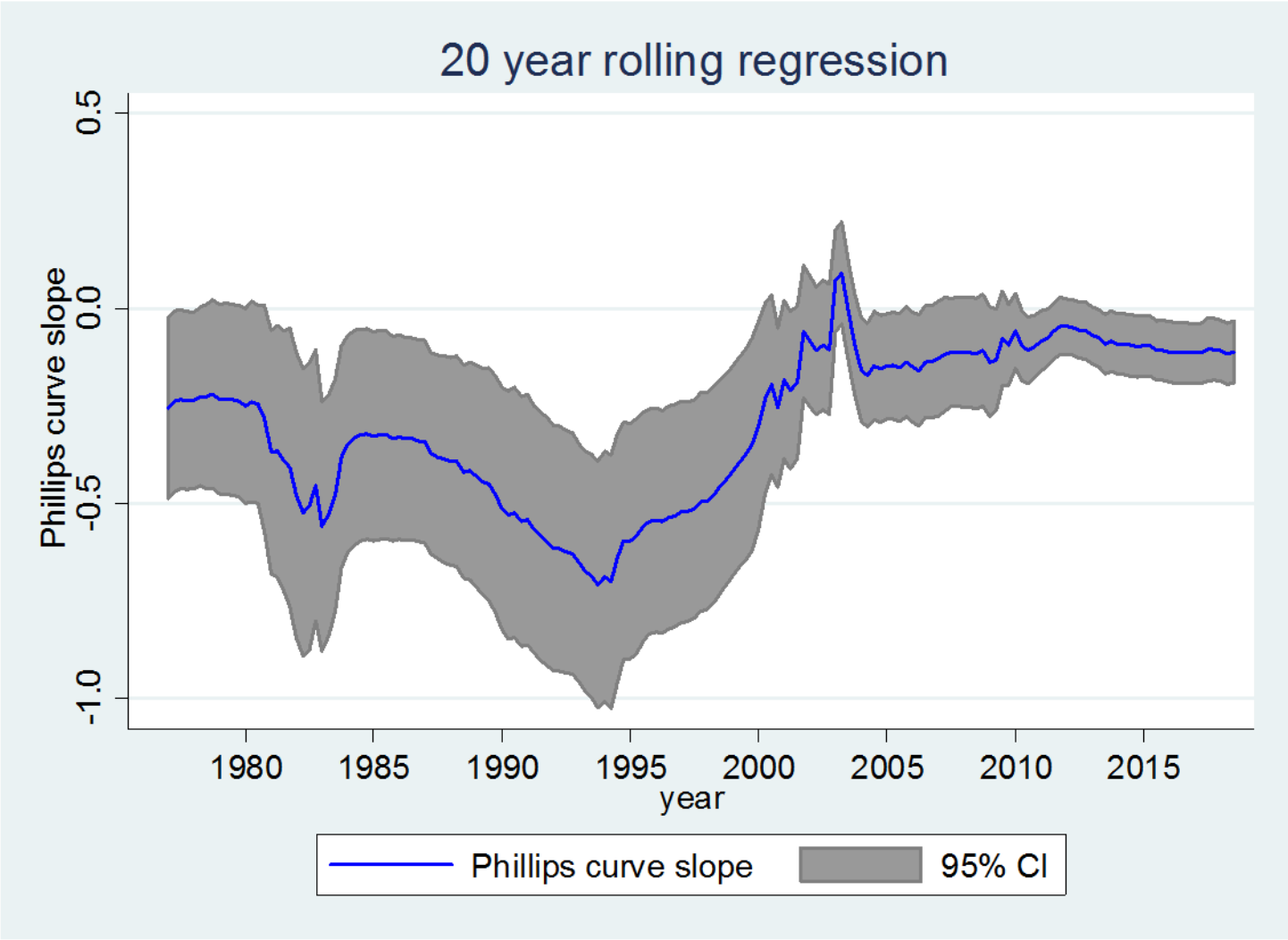
Note: unemployment gap instead of output gap.

PC in U_t is negatively sloped $U_t - U_t^* = -\theta x_t$

The PC: Aggregate US Data (1957-2018)



The PC: Standard OLS estimates suggest flattening



OLS equation: $\pi_t = \alpha + \boldsymbol{\beta}(U_t - U_t^*) + \sum_{i=1}^{3} \gamma_i \pi_{t-i} + \xi_t$

Regional panel data

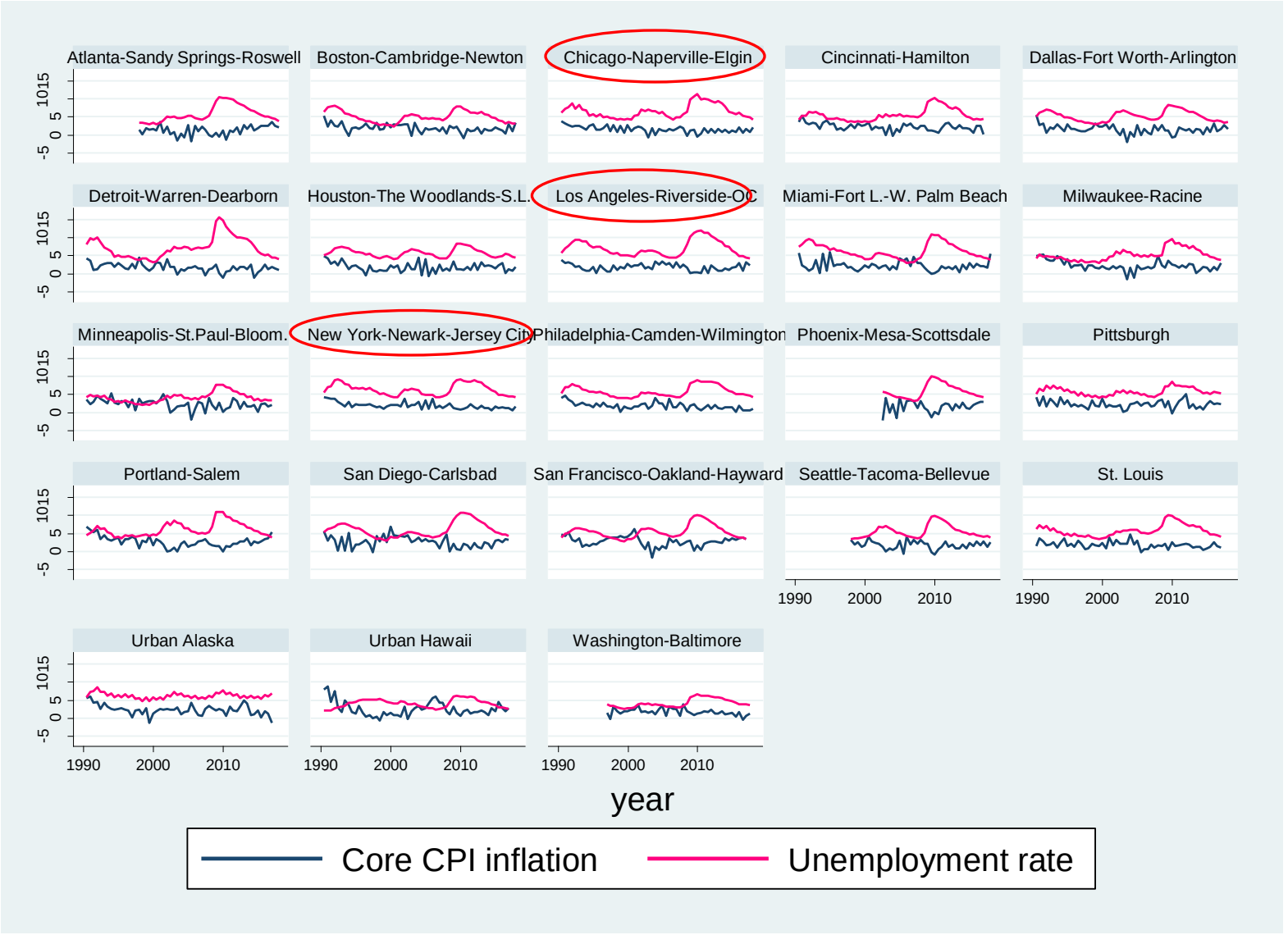
- Use data on US cities: 23 metro areas; see also Kiley (2013); Babb and Detmeister (2017).

- Semi-annual sample from 1990 H1 to 2018 H1 for most metro areas.

Data series	Description (and source)	Comments
Core inflation	Log change in CPI less food and energy (BLS via FRED).	NSA. Monthly data averaged over each half a year.
Unemployment rate	Unemployed as percentage of civilian labour force (BLS).	NSA. Monthly data averaged over each period. Some discrepancies in metro area definitions with CPI data.
Inflation expectations	12-month ahead price inflation expectations (Michigan Consumer Survey)	Geographical split into only 4 regions (North-Central, Northeast, South and West). Cities' expectations assumed to be equal to the region average.

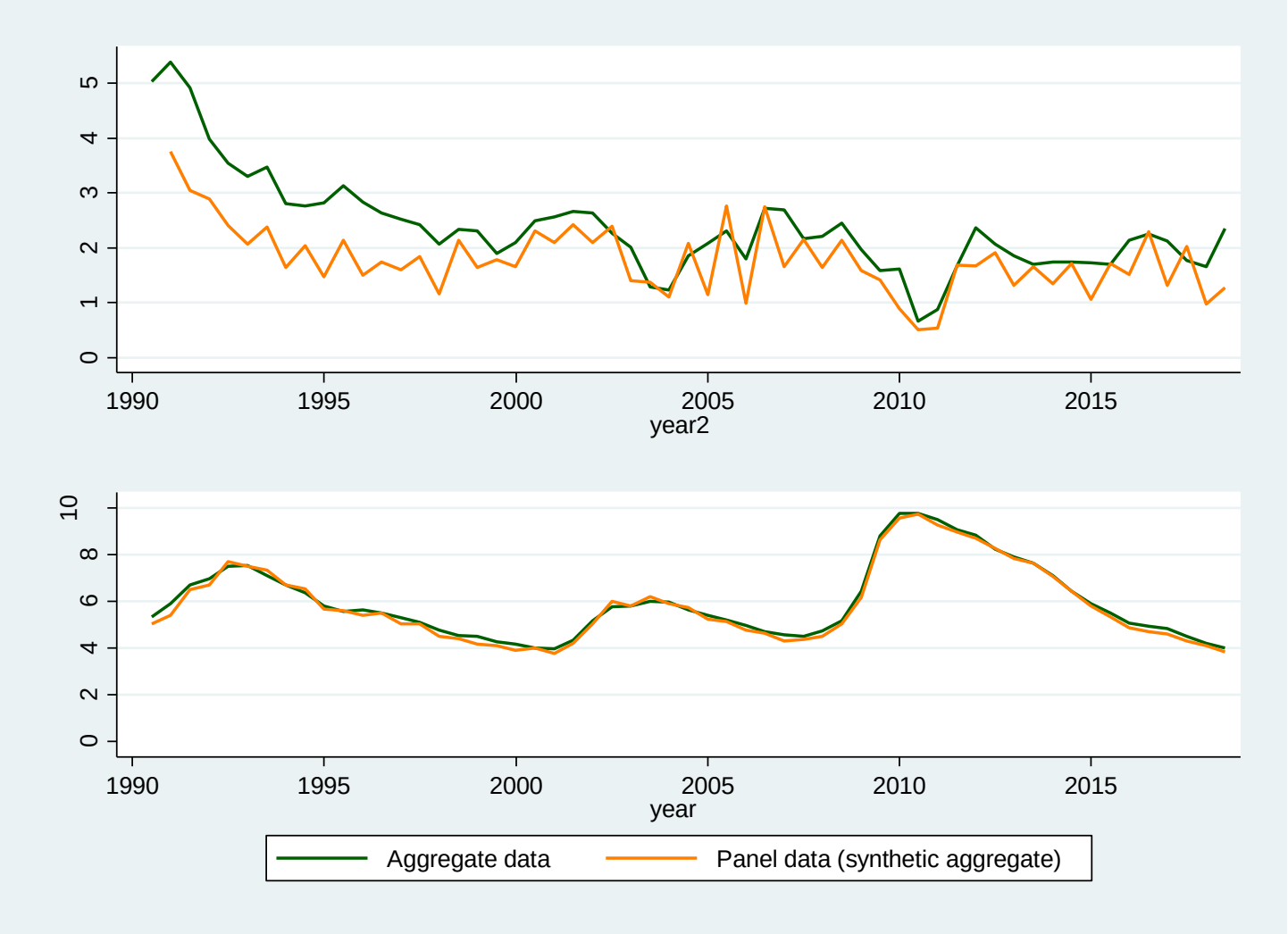
Data I – inflation and unemployment

- Largest three metro areas make up 35% of the labour-force in the sample:
  - New York - 16%
  - Los Angeles - 11%
  - Chicago - 8%



Data II – panel versus aggregate

- Sample of cities covers around **one-third** of the US population (Babb and Detmeister, 2017).
- Weighted by labour force, the aggregated panel data broadly match up to the true aggregate.



Regional

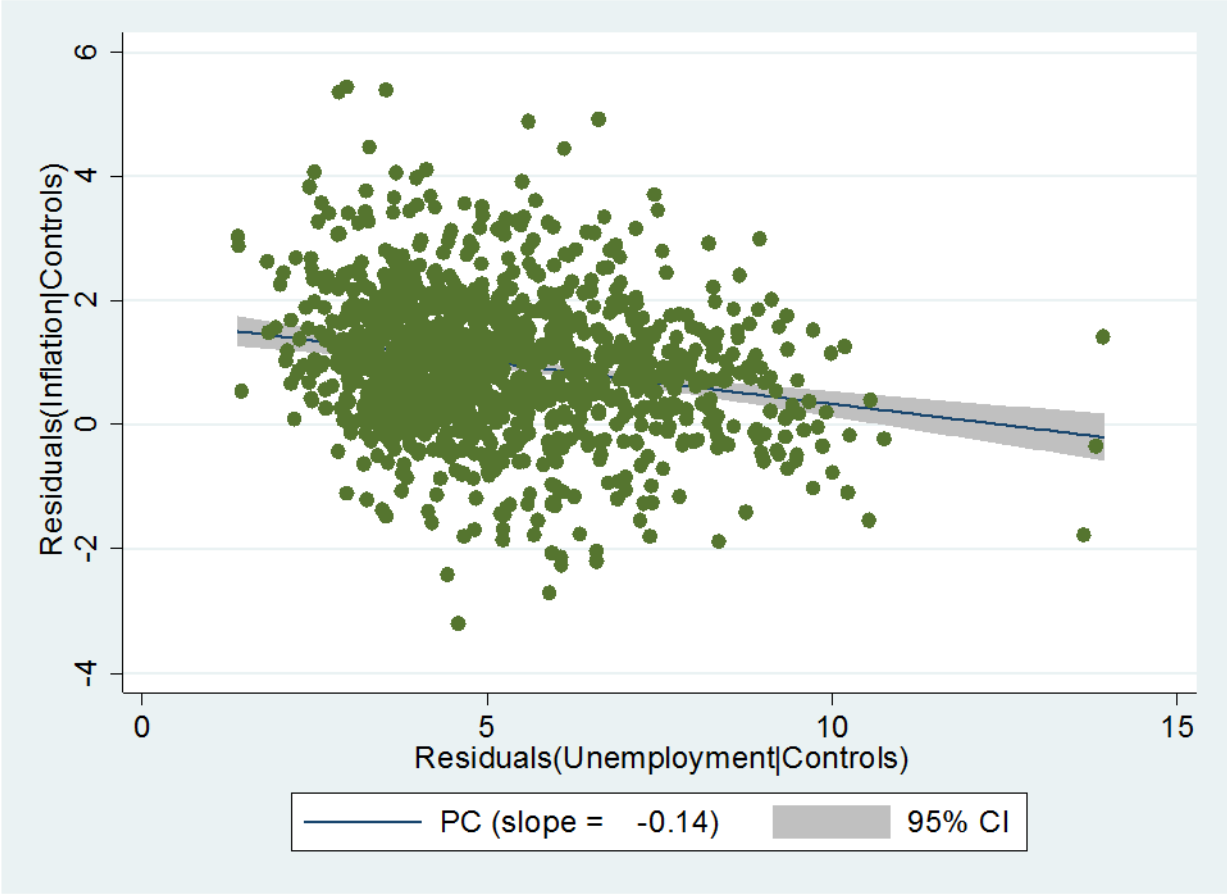
Table 3: *US Metro area Phillips curve: 1990-2018*

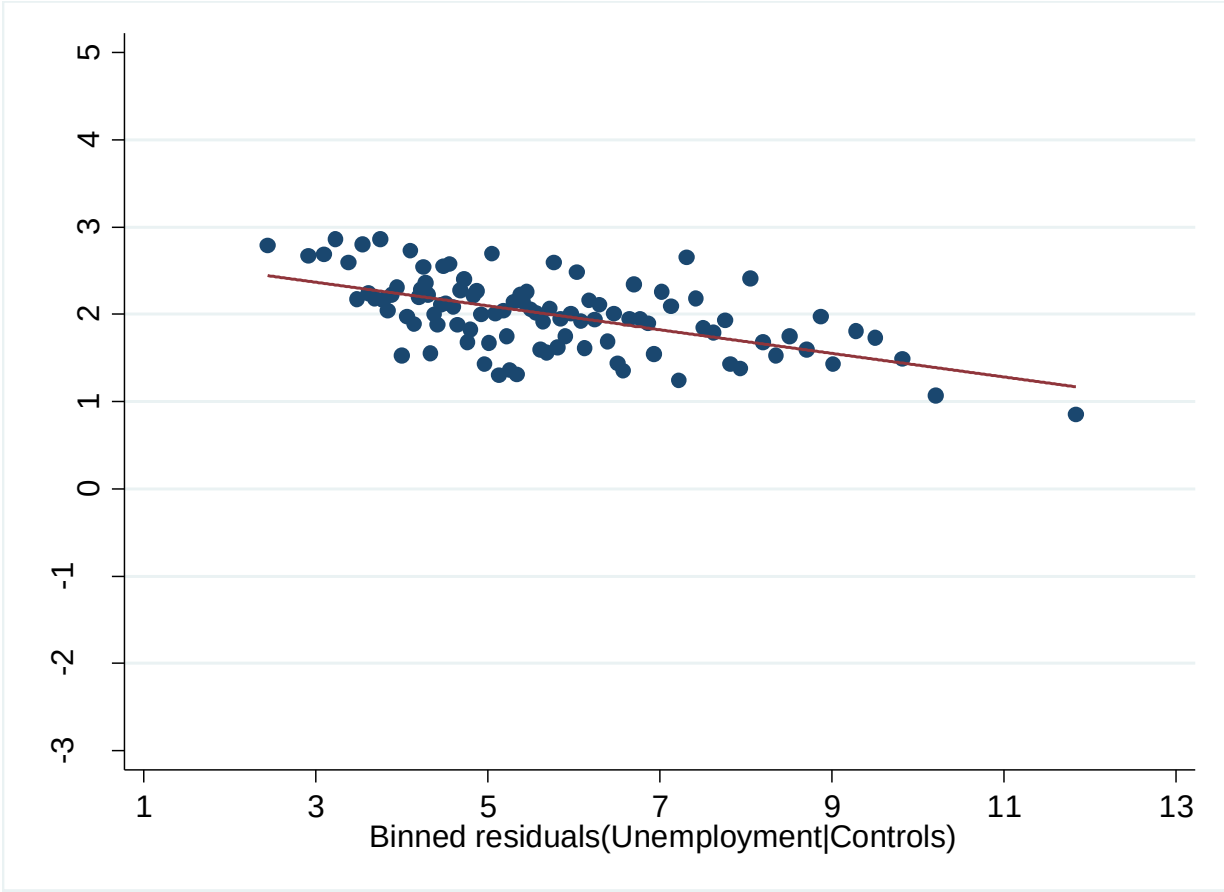
Regression	(1) Pooled OLS	(2) Metro area FE only	(3) Year FE only	(4) Year and Metro area FE
Unemployment rate	-0.136***	-0.148***	-0.271***	-0.367***
	[0.022]	[0.025]	[0.043]	[0.066]
Constant	1.708***	1.911***	5.435***	6.655***
	[0.277]	[0.296]	[0.606]	[0.776]
Inflation expectations	0.278***	0.273***	-0.027	-0.067
	[0.064]	[0.065]	[0.155]	[0.145]
Core CPI inflation				
First lag	0.280***	0.270***	0.110**	0.073
	[0.048]	[0.051]	[0.049]	[0.050]
Observations	1,174	1,174	1,174	1,174
R-squared	0.260	0.298	0.359	0.410
Metro area FE	No	Yes	No	Yes
Year FE	No	No	Yes	Yes
Seasonal dummies	Yes	Yes	Yes	Yes

Robust standard errors (clustered by metro area) in brackets
*** p<0.01, ** p<0.05, * p<0.1

- Pooled OLS suggests flat Phillips curve.

Pooled data





- Pooled OLS gives more precision than aggregate data (Kiley, 2013), but slope still flat.

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- Metro area FE (different U* across regions).

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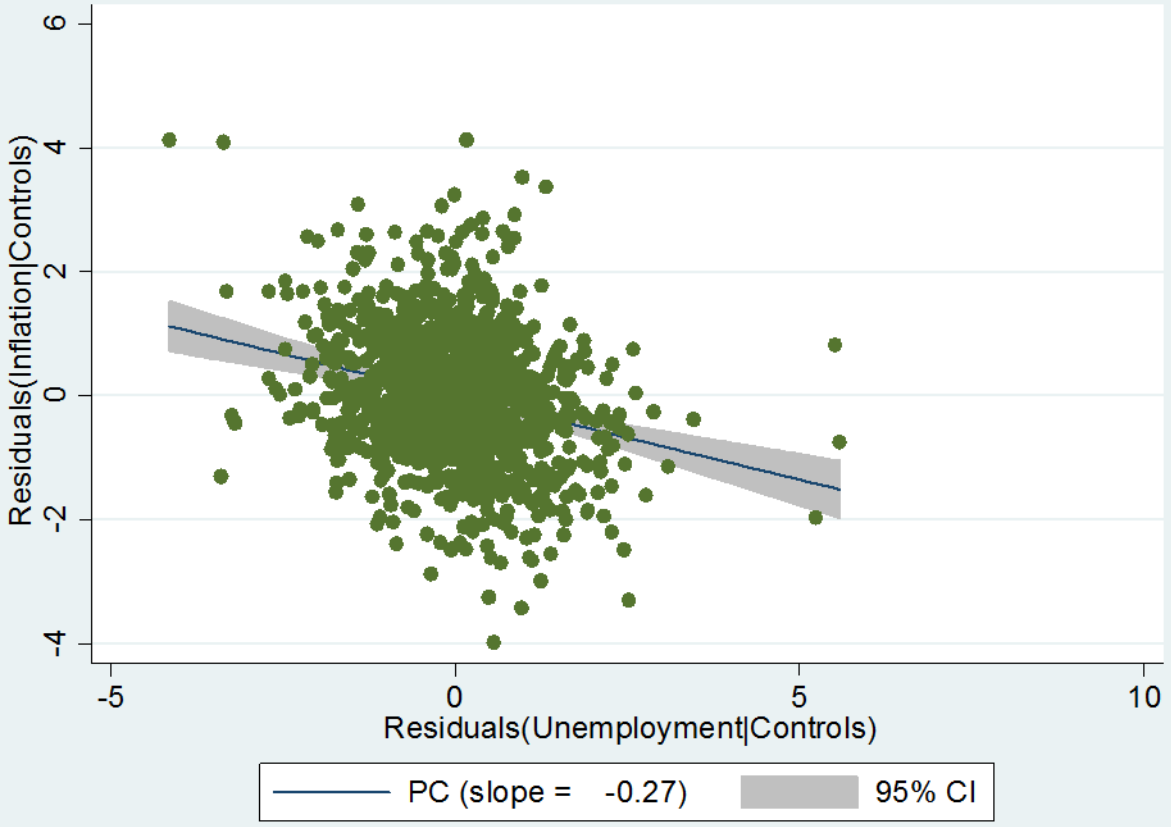
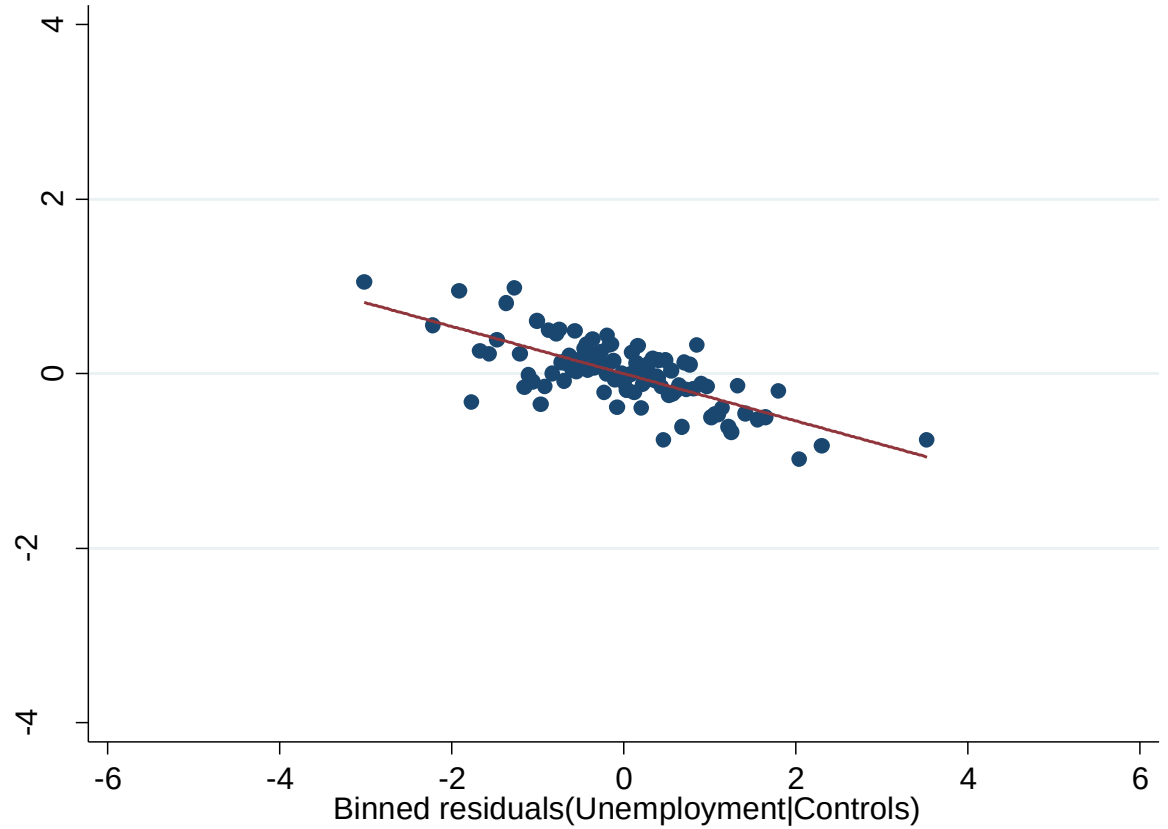
- Year FE: aggregate shocks.

Pooled with Time FE





- Steeper slope with year FE: controlling for aggregate monetary policy and supply shocks.

Regional

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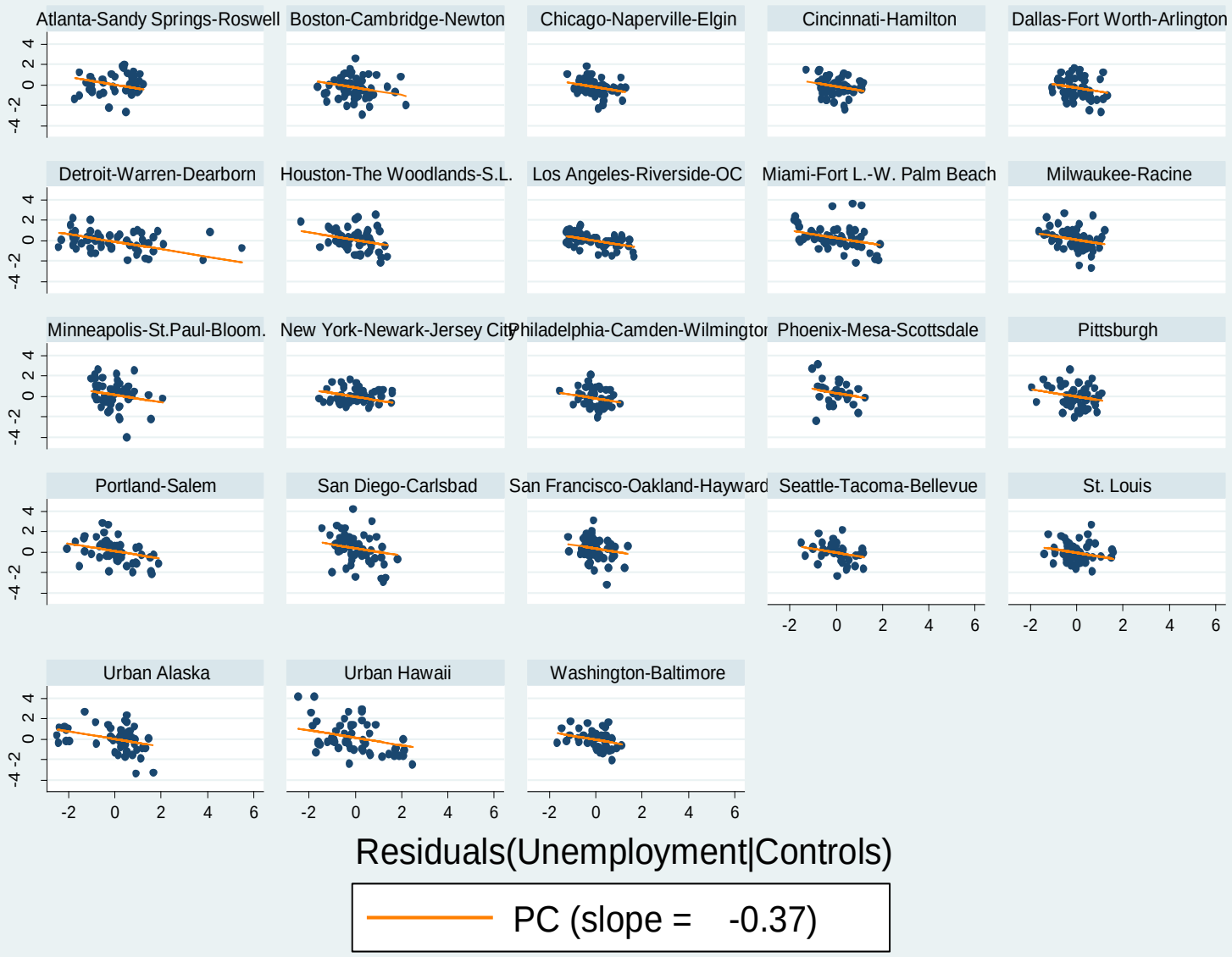
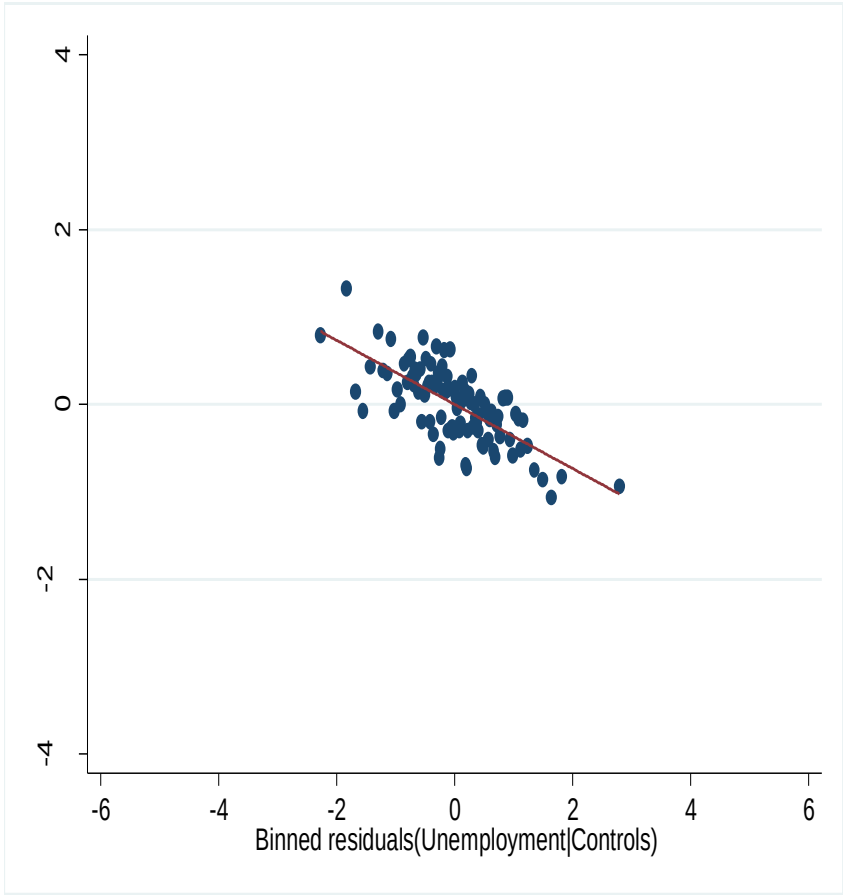
- Nearly **3 times** the naïve slope once area and time FE are included.

Time and metro-area FE



- Slope higher still with metro area fixed effects.
- Need both sets to also control for cross-sectional variation in U*.



Conclusions

- Of course everyone knows that the reduced-form PC depends on the mix of supply and demand shocks, and that monetary policy is one key factor that affects that mix.

- But much of the policy and academic discussion in recent years has ignored that, and estimated the PC by OLS. This led to unwarranted criticisms of the existing framework.

- Our paper is a call for a more careful identification that takes into account the endogenous monetary policy response.

- Encouragingly, new work doing so, e.g., Barnichon and Mesters; Galí and Gambetti; Jordà and Nechio.