The Local Effects of Monetary Policy

Neville Francis Michael Owyang Tatevik Sekhposyan

UNC-Chapel Hill Federal Reserve Bank of St. Louis Bank of Canada

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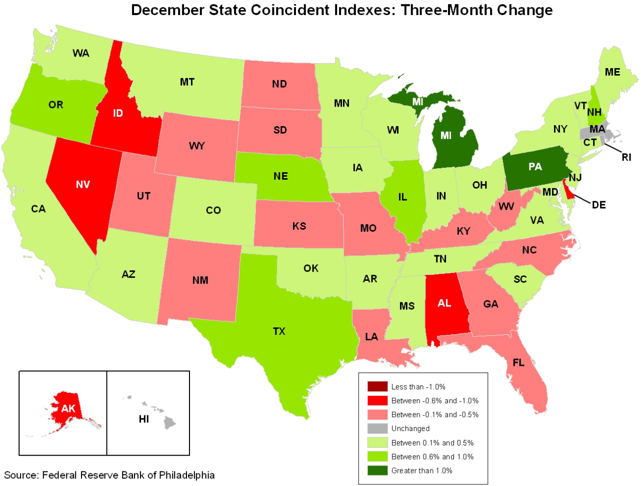
Motivation

Intranational business cycles are not harmonious.



Source: Federal Reserve Bank of Philadelphia

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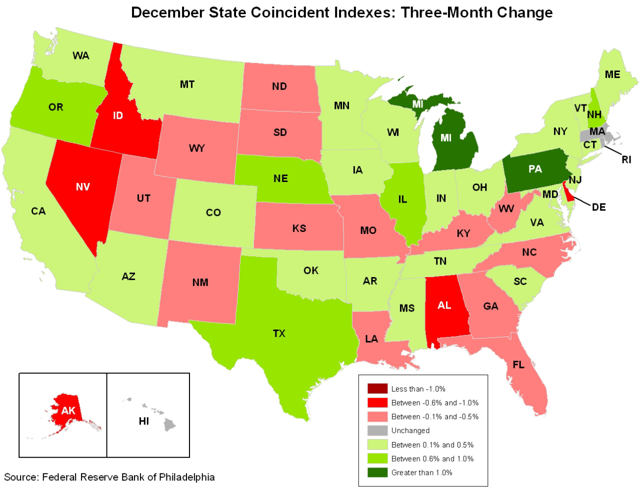

For the aggregate economy the change has been 0.7 percent.

Goal

Understand the monetary policy propagation mechanism through various regions of the US economy

- establish an empirical benchmark for regional propagation
- examine why certain regions are more sensitive to monetary policy interventions compared to others

Cities

choice for geographical disaggregation - *cities*

Why?

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Why?

cities provide *rich* yet *representative* overview of the aggregate

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Why?

cities provide *rich* yet *representative* overview of the aggregate

- population areas with high degree of economic and social integration
- comprise 83% of population and 89% of aggregate output
- richer data set for city level characteristics

Choice of Cities: Motivated by the Literature

- monetary literature
  considerable within region variations
  example, BEA regions in Carlino and DeFina (1998)

- economic growth literature
  high degree of economic integration within cities
  heterogeneity in the political and social structure across cities
  example, Glaeser, Scheinkman and Shleifer (1995)

- urban literature
  agglomeration economies lessen with distance
  cities are fairly unique
  example, human capital in Simon and Nardinelli (1996)
  agglomeration effects in Rosenthal and Strange (2003)

General Approach

- consider the differential effects of monetary policy on city level employment

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- consider the differential effects of monetary policy on city level employment

  estimate a large monetary vector autoregression

- use a set of covariates to explain the differences across city level responses

  conduct a model selection exercise

Empirical Model

Let

$$z_t = [\underbrace{y_{1,t},\ \ldots,\ y_{i,t},\ \ldots,\ y_{n,t}}_{loc_t'},\ \underbrace{y_t,\ p_t,\ lead_t,\ r_t,\ nbr_t,\ tr_t,\ m2_t}_{agg_t'}]',$$

where

$y_{i,t}$	- employment for city i
y_t	- real GDP
p_t	- core CPI
$lead_t$	- composite index of 10 leading indicators
r_t	- federal funds rate (effective)
nbr_t	- non-borrowed reserves of depository institutions
tr_t	- total reserves
$m2_t$	- M2 money stock

Empirical Model

Consider a structural VAR in the following form

$$Gz_t = C + \sum_{l=1}^{p} G_l z_{t-l} + \epsilon_t, \quad \forall t = 1, ..., T$$

where

$$z_t = \left[\begin{array}{cc} loc_t & agg_t \end{array} \right]'$$

and

loc_t is an $n \times 1$ vector of city-level variables
agg_t is an $m - n \times 1$ vector of aggregate variables

Identification Restrictions

$$z_t = \begin{bmatrix} loc_t \\ agg_t \end{bmatrix}, \quad G = \begin{bmatrix} D_n & 0_{m-n} \\ G_{21} & G_{22} \end{bmatrix}$$

Restrictions on the regional block

- regional shocks contemporaneously affect the region of origin only
- aggregate shocks affect the regional variables with a period lag

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Restrictions on the aggregate block

- aggregate variables respond to the regional variables contemporaneously
- the ordering within the regional block is recursive

Estimation

Data

- 105 cities with at least 200,000 in employment by the end of 2004
- data covers 1972:I - 2004:IV
- captures 63% of aggregate employment

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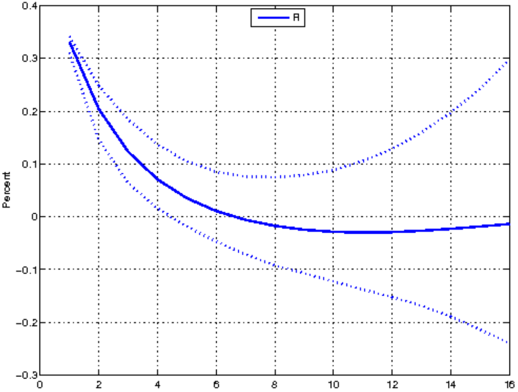
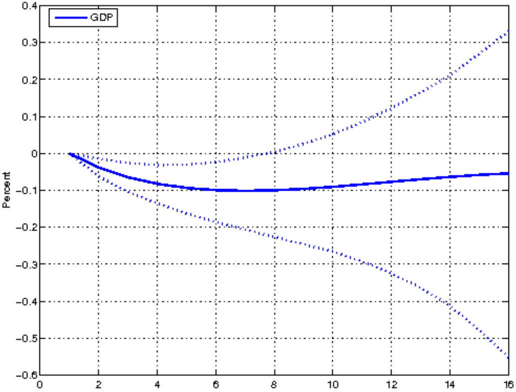
Implementation

- Mitigate the curse of dimensionality by estimating a Bayesian VAR Banbura, Giannone, and Reichlin (2008)
- operationalize it via
  - priors
    - Sims-Zha shrinkage prior
    - unit-root and co-integration "inexact priors"
  - Gibbs sampler as in Waggoner and Zha (2003)

Results: Shock to the Federal Funds Rate



Results: Aggregate Response to Policy



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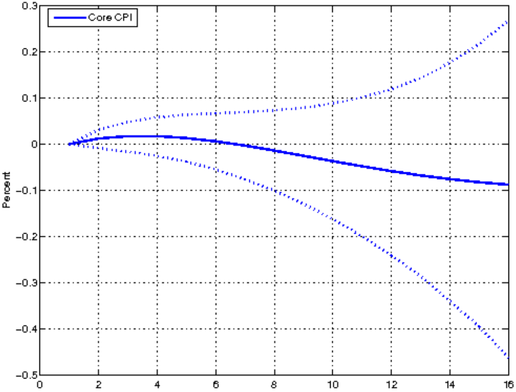

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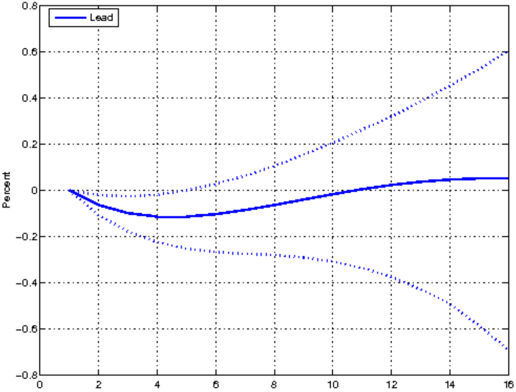

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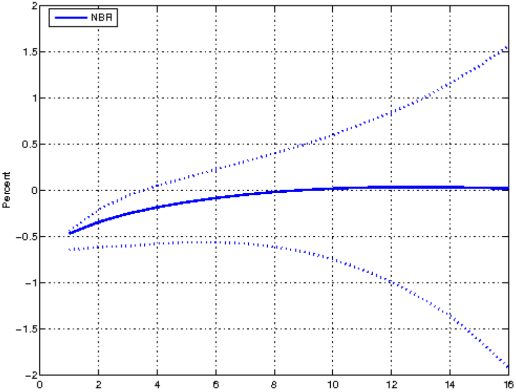

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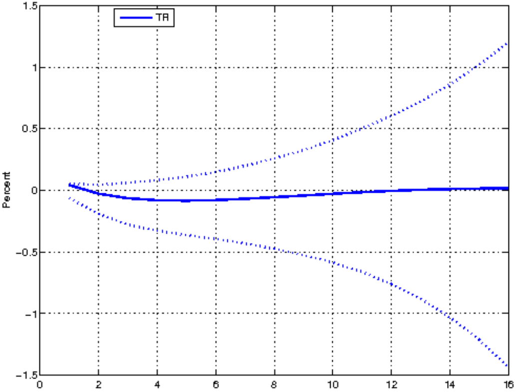

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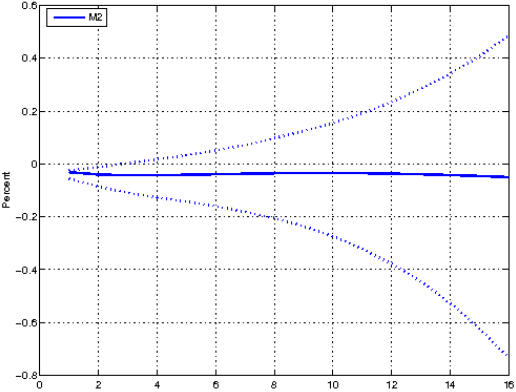

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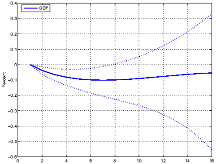
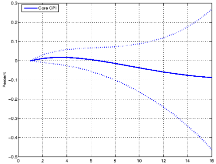
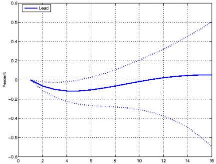


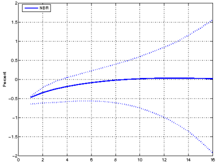
(a) output



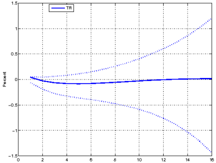
(b) prices



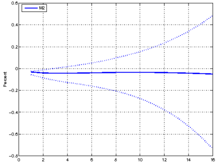
(c) leading indicators



(d) non-borrowed res

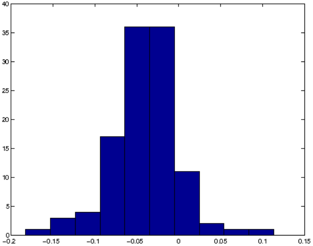


(e) total reserves

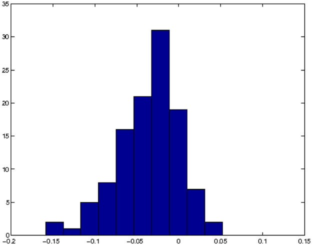


(f) M2

Results: Regional Employment Response to Policy

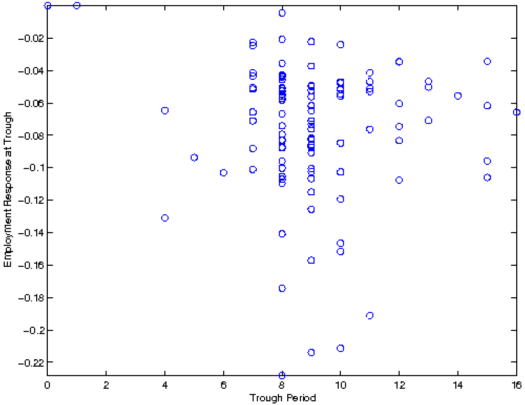


(b) Period 4



(c) Period 16

Results: Regional Employment Response to Policy

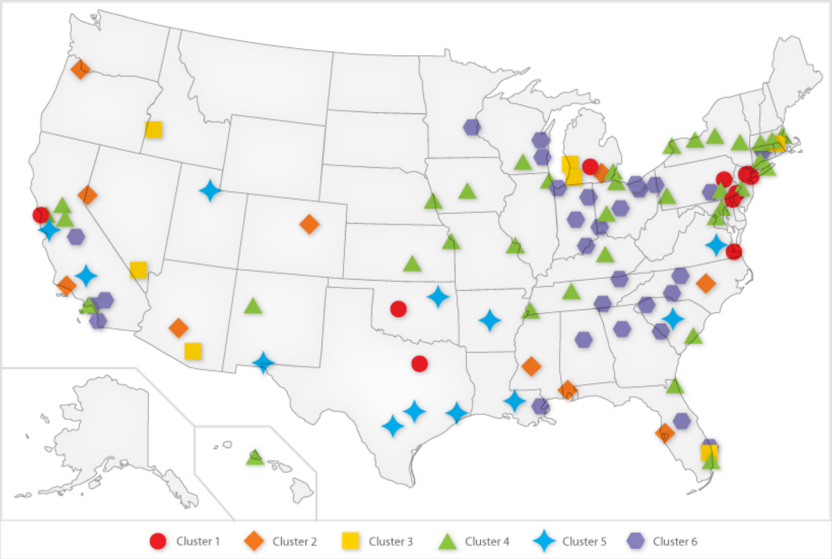


General Properties of the City Responses

	Max	Period	Total	Period 4	Period 8	Period 16
Group 1	-0.03	9.27	0.29	0.01	-0.01	-0.00
Group 2	-0.12	9.50	1.33	-0.06	-0.11	-0.08
Group 3	-0.19	9.29	2.15	-0.10	-0.18	-0.12
Group 4	-0.05	8.53	0.51	-0.03	-0.05	-0.01
Group 5	-0.07	13.00	0.67	-0.00	-0.05	-0.06
Group 6	-0.09	8.33	0.94	-0.06	-0.09	-0.04

Group 1-11%, Group 2-10%, Group 3-7%, Group 5-12%, Group 6-28%.

Geographical Location of the Cities in the Clusters



Why do Asymmetries Exist?

Cities vary with

- channels of monetary transmission - short run effects
- propagation effects - long run effects

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Approach

Consider a cross-sectional regression

$$ir = \alpha + x\beta + \upsilon,$$

where
ir - describes a certain property of the impulse response,
i.e. depth, total cost of the recession, etc.
x - is an $n \times k$ vector of k covariates for each city n

The Choice of Covariates: Methodology

$$ir = \alpha + x\beta + \upsilon, \quad \upsilon \propto N(0_n, h^{-1} I_n)$$

Priors: diffuse priors on h, α, and $\beta_r | h \propto N(0_{k_r},\ h^{-1}[g_r X_r' X_r]^{-1})$

Posterior model probability: $p(M_r | ir) \propto p(ir | M_r) p(M_r)$

Simulation:

- Markov Chain Monte Carlo Model Composition (MC3) algorithm - Madigan and York (1995)

Report:

- inclusion probability, posterior means and standard deviations

The Choice of Covariates

Covariate	Interest Rate	Equity	Ex Rate	Narrow Credit	Broad Credit	Prop
Demographic & General Socio-Economic						
Population						√
Population Density						√
Fr. with College Degree						√
Median Household Income		√				√
Fr. Below Poverty		√				√
Fr. No Wage/Salary		√				√
Fr. No Interest/Dividend		√				√
Crimes Known to Police						√

The Choice of Covariates

Covariate	Interest Rate	Equity	Ex Rate	Narrow Credit	Broad Credit	Prop
Industry Mix						
Finance, Ins, Real Estate					$\surd$	
Government						$\surd$
Manufacturing	$\surd$		$\surd$			
Services	$\surd$					$\surd$
Transport, Comm, etc.	$\surd$					$\surd$
Trade			$\surd$			
Housing						
HPI		$\surd$				
Fr. of Owner-Occ. Housing		$\surd$				
Banking						
HHI				$\surd$	$\surd$	
Banking Market Deposits				$\surd$	$\surd$	
Small Business Loans				$\surd$		

The Choice of Covariates

Covariate	Interest Rate	Equity	Ex Rate	Narrow Credit	Broad Credit	Prop
Industrial Organization						
Establishment Size				$\surd$	$\surd$	
Industrial Diversity Index						$\surd$
Union Membership						$\surd$
Fiscal Variables						
Government Revenue						$\surd$
Government Expenditures	$\surd$					

The Choice of Covariates

Covariate	Interest Rate	Equity	Ex Rate	Narrow Credit	Broad Credit	Prop
			Industrial Organization			
Establishment Size				$\surd$	$\surd$	
Industrial Diversity Index						$\surd$
Union Membership						$\surd$
			Fiscal Variables			
Government Revenue						$\surd$
Government Expenditures	$\surd$					

Total number of models: $2^{24} = 16,777,216$.

Testing the Transmission Hypothesis

MC3 results - at Trough

Covariate	Inclusion prob	Post. Mean	Post. St. Dev
Population	0.07	-0.00	0.0005
Population Density	1.00	0.02	0.0038
Fr. with College Degree	0.05	-0.00	0.0033
Median Household Income	0.05	0.00	0.0011
Fr. Below Poverty	0.04	-0.00	0.0035
Fr. No Wage/Salary	0.05	0.00	0.0041
Fr. No Interest/Dividend	0.04	-0.00	0.0020
Crimes Known to Police	0.06	-0.01	0.0087
Finance, Ins., Real Estate	0.10	0.02	0.0177
Government	0.90	0.23	0.0641
Manufacturing	0.10	-0.01	0.0062
Services	0.07	-0.01	0.0064
Transport, Comm, etc.	0.09	0.02	0.0187
Trade	0.05	0.00	0.0082

Testing the Transmission Hypothesis

MC3 results - at Trough

Covariate	Inclusion prob	Post. Mean	Post. St. Dev
HPI	0.13	0.01	0.0041
Fr. Owner-Occ. Housing	0.09	-0.00	0.0028
HHI	0.05	-0.00	0.0004
Banking Market Deposits	0.05	0.00	0.0001
Small Business Loans	0.33	-0.01	0.0019
Establishment Size	0.09	0.00	0.0028
Ind Diversity Index	0.04	-0.00	0.0010
Union Membership	0.11	0.01	0.0048
Gov Revenue	0.05	-0.00	0.0004
Gov Expenditures	0.05	-0.00	0.0004

Testing the Transmission Hypothesis

MC3 results - Total Cost of Recession

Covariate	Inclusion prob	Post. Mean	Post. St. Dev
Population	0.08	0.01	0.0062
Population Density	1.00	-0.25	0.0440
Fr. with College Degree	0.05	0.01	0.0345
Median Household Income	0.05	-0.01	0.0128
Fr. Below Poverty	0.04	-0.00	0.0422
Fr. No Wage/Salary	0.05	0.03	0.0506
Fr. No Interest/Dividend	0.04	0.00	0.0235
Crimes Known to Police	0.04	0.04	0.0750
Finance, Ins., & Real Estate	0.06	-0.13	0.1403
Government	0.58	-1.33	0.4821
Manufacturing	0.09	0.09	0.0619
Services	0.10	0.18	0.1082
Transport, Comm., etc.	0.07	-0.20	0.1842
Trade	0.05	0.04	0.0983

Testing the Transmission Hypothesis

MC3 results - Total Cost of Recession

Covariate	Inclusion prob	Post. Mean	Post. St. Dev
HPI	0.16	-0.10	0.0552
Fr. Owner-Occ. Housing	0.08	0.03	0.0278
HHI	0.05	0.00	0.0046
Banking Market Deposits	0.04	-0.00	0.0013
Small Business Loans	0.37	0.06	0.0250
Establishment Size	0.10	-0.05	0.0346
Industrial Diversity Index	0.05	0.00	0.0124
Union Membership	0.10	-0.08	0.0547
Gov. Revenue	0.04	-0.00	0.0040
Gov. Expenditures	0.05	0.00	0.0047

Testing the Transmission Hypothesis

Inclusion Probabilities

Covariate	Trough	Total	Pd 4	Pd 8	Pd 16
Population	0.07	0.08	0.06	0.06	0.18
Population Density	1.00	1.00	1.00	1.00	1.00
Fr. with College Degree	0.05	0.05	0.05	0.06	0.05
Median Household Income	0.05	0.05	0.05	0.05	0.05
Fr. Below Poverty	0.04	0.04	0.05	0.04	0.05
Fr. No Wage/Salary	0.05	0.04	0.20	0.06	0.05
Fr. No Interest/Dividend	0.04	0.04	0.04	0.04	0.04
Crimes Known to Police	0.06	0.04	0.05	0.07	0.06
Finance, Ins., & Real Estate	0.09	0.06	0.04	0.05	0.06
Government	0.90	0.58	0.54	0.91	0.07
Manufacturing	0.10	0.09	0.20	0.13	0.10
Services	0.07	0.10	0.06	0.09	0.45
Transport, Comm., etc.	0.09	0.07	0.05	0.14	0.04
Trade	0.05	0.05	0.07	0.05	0.05

Testing the Transmission Hypothesis

Inclusion Probabilities

Covariate	Max	Total	Period 4	Period 8	Period 16
HPI	0.13	0.16	0.07	0.12	0.20
Fr. Owner-Occ. Housing	0.09	0.08	0.28	0.05	0.05
HHI	0.05	0.05	0.09	0.06	0.05
Banking Market Deposits	0.05	0.05	0.06	0.05	0.06
Small Business Loans	0.33	0.37	0.18	0.25	0.16
Establishment Size	0.09	0.10	0.07	0.06	0.36
Industrial Diversity Index	0.04	0.05	0.07	0.04	0.07
Union Membership	0.11	0.10	0.05	0.05	0.77
Gov. Revenue	0.05	0.04	0.05	0.04	0.06
Gov. Expenditures	0.05	0.05	0.06	0.05	0.04

Conclusion

- Previous literature has documented the differential responses to monetary policy on a level of large regions, i.e. BEA, state.
- We promote the *city* as a better unit of measure.
- We find cross-city variations in monetary-induces recessions, expressed mainly in the level and persistence of a response.
- Contrary to the literature the role of interest rate, credit and equity channels of monetary policy are marginalized.
- City size, government employment share appear to be the most prominent determinants of cross-city variations for monetary induced recessions.

Sims-Zha (1998) shrinkage prior

Recall

$$z_t' A = C' + z_{t-1}' A_1 + \epsilon_t'$$

Consider a prior of a following form:

$$a_i \sim N(0, \bar{S}_i) \quad \text{and} \quad f_i | a_i \sim N(\bar{P}_i a_i, \bar{H}_i),$$

such that $\bar{H}_{i_{jj}} = \frac{\lambda_0 \lambda_1}{\sigma_j p^{\lambda_3}}$ and $\bar{S}_{i_{jj}}$ are defined by $\frac{\lambda_0}{\sigma_j}$

- prior hierarchical in nature
- shrinks the parameter space around random walk

λ_0	1	controls the overall tightness of the beliefs
λ_1	0.2	tightens the prior around a random walk
λ_3	1	rate of contraction with an increase in lag length
λ_4	1	controls the tightness of the constant

back

Inexact Priors: Theil (1971) mixed estimation technique

Govern the dynamics of the system as a whole

$$z_t' A = C' + z_{t-1}' A_1 + \epsilon_t'$$

Unit-Root prior

- for each variable add observations that would result from a unit-root process and assign weights to it (μ_5).
- mitigates the bias problem

Cointergration prior

- add an observations that would result if the variables were co-integrated and assign a weight to it (μ_6).

μ_5	5	governs the prior on the order of integration
μ_6	5	sets the prior belief on the presence of cointegration

back