How Connected are Australia's Major Housing Markets?

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Real Estate Symposium
6 September, 2016

Questions

To what degree are Australia's main housing markets affected by common shocks?

Are idiosyncratic shocks arising in one Australian city's housing market transmitted to other cities?

Hard questions to answer convincingly

Shocks are unobserved and require some identifying assumptions to be estimated

Use a methodology due to Diebold and Yilmaz (2009)

Measuring Spillovers and Connectedness

Diebold and Yilmaz (2009)

Use the forecast error variance decomposition (FEVD) from a VAR model to estimate:

- Spillovers (across markets)
- Connectedness (of one or more markets)

VAR Model

$$Y_t = \Pi_0 + \Pi_1 Y_{t-1} + \cdots + \Pi_p Y_{t-p} + U_t$$

Y_t is *(n×1)* vector of variables

Need some theoretical assumptions to convert reduced-form errors U_t into structural shocks (i.e. can be given a *ceteris paribus* interpretation).

$$\mathrm{E}_t = D U_t$$

D is *(n×n)* matrix of parameters

E_t is *(n×1)* vector of structural (uncorrelated) shocks

Forecast Error Variance Decomposition

FEVDs estimate contribution of each shock to an individual variables forecast error variance

Diebold and Yilmaz focus on the FEV for the entire system (all n variables)

- How large are spillovers or degree of connectedness among variables?

- What is the direction of the spillovers or connectedness? **From** which variables **to** which variables?

Information is contained in conventional FEDV

Forecast Error Variance Decomposition

n = 3, h = forecast horizon

Percent contribution to FEV for y_i from

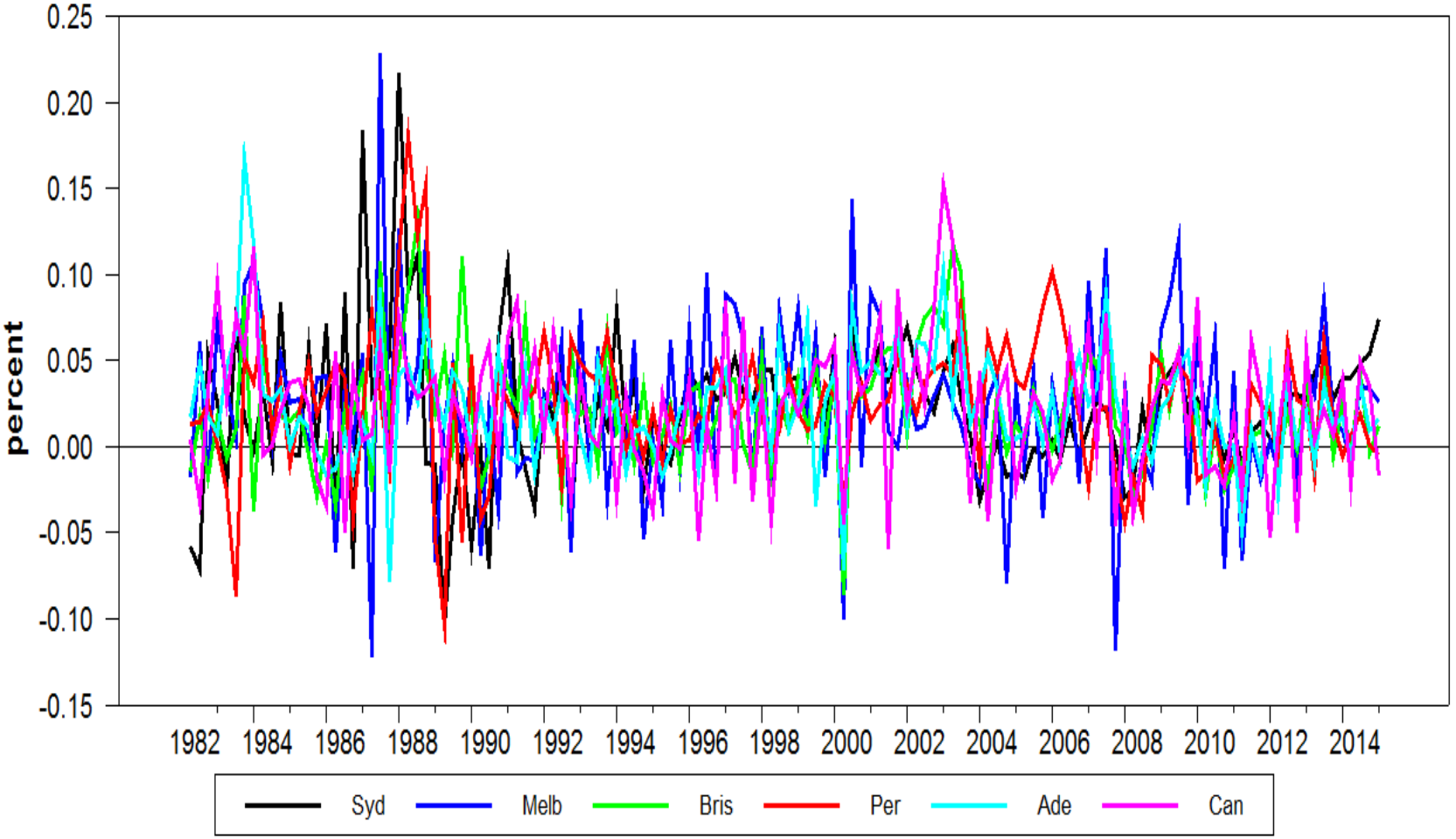
	e1	*e2*	*e3*	*Sum*
y1				
h=1	**75**	15	10	100
h=2	85	10	5	….
y2				
h=1	25	**60**	15	100
h=2	20	50	30	…..
y3				
h=1	30	40	**30**	
h=2	25	20	55	

Spillover Matrix (h=1)

		FROM			
		y1(=e1)	y2(=e2)	y3=(e3)	**From Others**
	y1	**75**	15	10	25
TO	y2	25	**60**	15	40
	y3	30	40	**30**	**70**
To Others		55	55	25	135
All		130	115	55	300

Spillover Index = 0.45 = 135/300

Real Returns to Housing in Australia's Capital Cities



Data Sources

Real Estate Institute of Australia (REIA)

Quarterly median prices and rents for houses and units in Australia's eight capital cities

Sample Periods

	6 biggest cities	8 cities
Houses	1982:2 – 2015:2	1994:1 – 2015:2
Units	1988:1 – 2014:2	1997:4 – 2014:2

Real Returns to Housing

$$r_t^h = log\left(\frac{p_{t+1}^h + v_{t+1}^h}{p_t^h}\right)$$

p^h = median house price (or unit price) for a city divided by the city's CPI

v^h = quarterly median rent on a three bedroom house (or two bedroom unit) in a city divided by the city's CPI.

Average Returns

Ex-post average quarterly gross real return

Broadly similar average returns

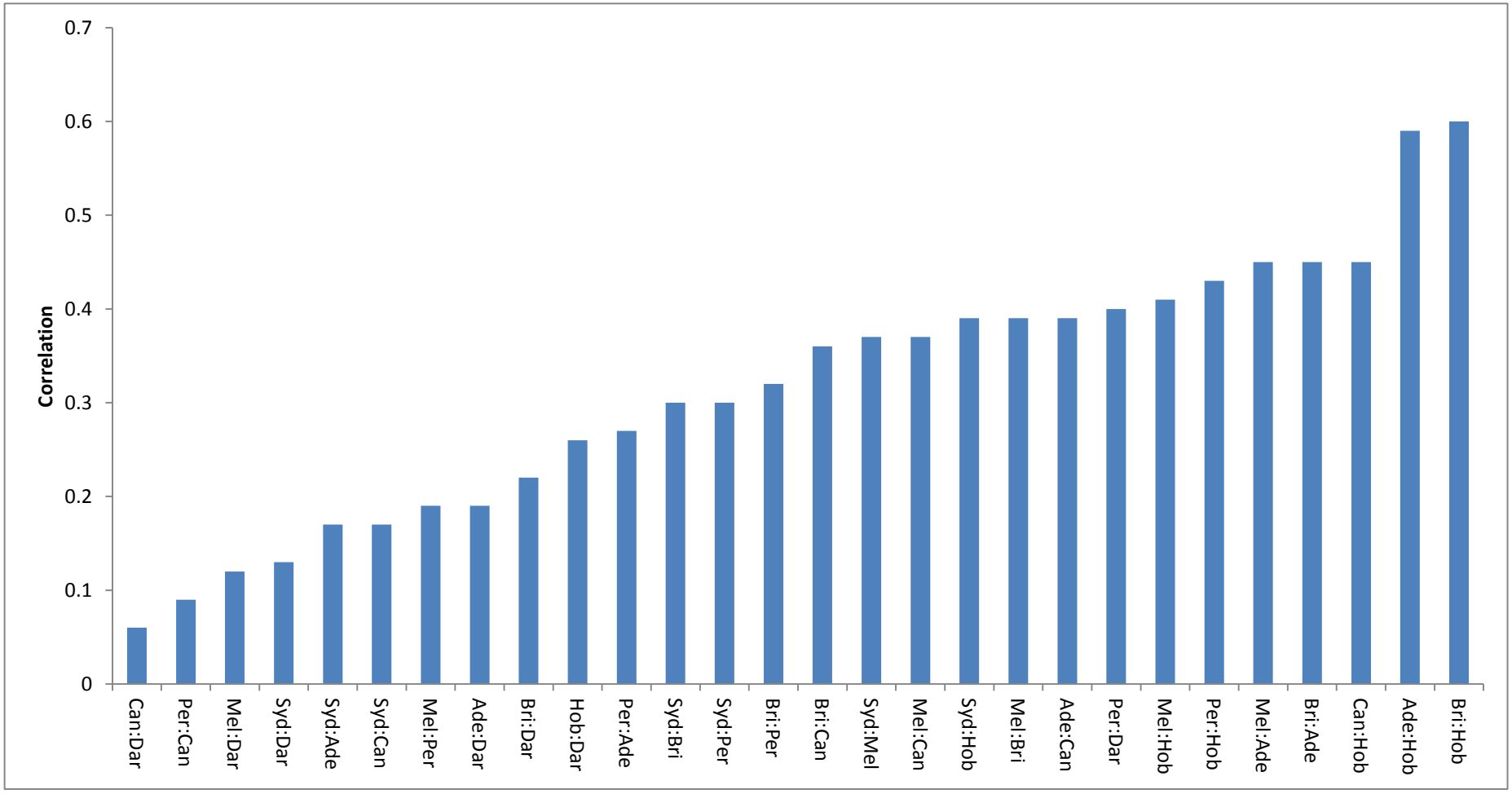
Houses

8 cities = 2.3% {Darwin = 2.5 Sydney = 2.1}

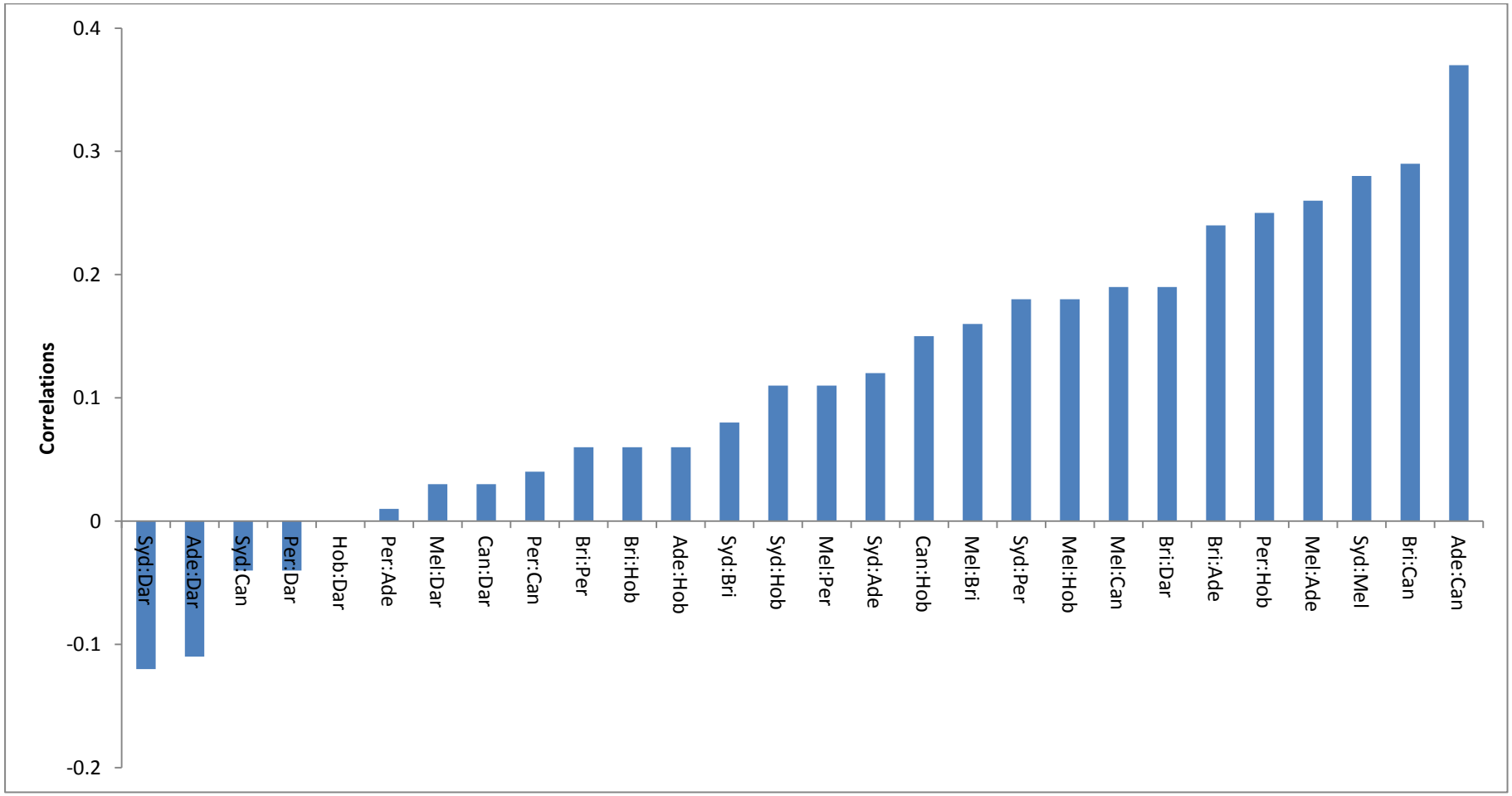
Units

8 cities = 2.4% {Darwin/Perth = 2.7 Adelaide = 2.2}

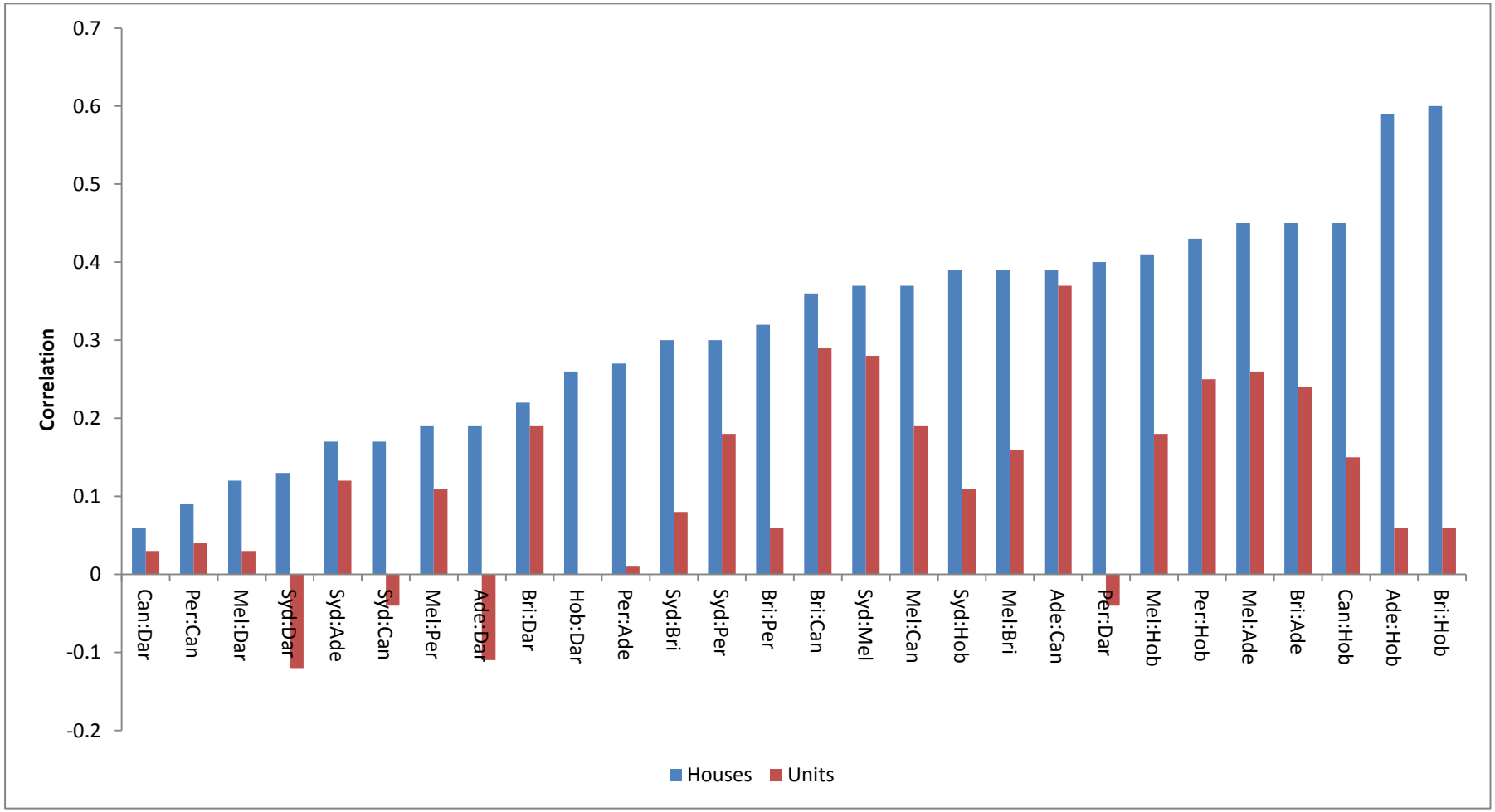
Pair-wise Correlations



Pair-wise Correlations



Pair-wise Correlations



Econometric Analysis

Baseline Model

VAR model: 4 lags

Data on real returns for 6 cities (excludes Hobart and Darwin)

Separate models for Houses and Units

Identification of city-specific shocks

Recursive structural ordering based on current population levels

Spillover Table for Real Returns to Houses – 1 Year Ahead Forecast

1982-2015

		From						
		Syd	*Mel*	*Bri*	*Per*	*Ade*	*Can*	***Total***
To	*Syd*	*80*	*4*	*6*	*3*	*2*	*6*	***20***
	Mel	*16*	*77*	*1*	*1*	*5*	*1*	***23***
	Bri	*19*	*8*	*65*	*2*	*2*	*5*	***35***
	Per	*16*	*3*	*4*	*72*	*3*	*1*	***28***
	Ade	*8*	*13*	*6*	*5*	*63*	*3*	***37***
	Can	*5*	*11*	*7*	*2*	*7*	*69*	***31***
	Total	***64***	***39***	***25***	***13***	***17***	***16***	***174***
	All	***144***	***117***	***89***	***85***	***81***	***85***	***29%***

Bit less than 1/3 of variance in house returns is due to spillovers

Spillover Table for Real Returns to Units – 1 Year Ahead Forecast

1988-2015

		From						
		Syd	*Mel*	*Bri*	*Per*	*Ade*	*Can*	***Total***
To	*Syd*	*81*	*1*	*2*	*3*	*4*	*1*	***19***
	Mel	*7*	*84*	*2*	*3*	*4*	*1*	***16***
	Bri	*10*	*4*	*74*	*4*	*1*	*7*	***26***
	Per	*7*	*2*	*1*	*85*	*1*	*3*	***15***
	Ade	*4*	*13*	*3*	*3*	*74*	*3*	***26***
	Can	*14*	*10*	*6*	*1*	*17*	*53*	***47***
	Total	***42***	***29***	***14***	***17***	***31***	***16***	***149***
	All	***123***	***113***	***88***	***103***	***105***	***70***	***25%***

About 1/4 of variance in unit returns is due to spillovers

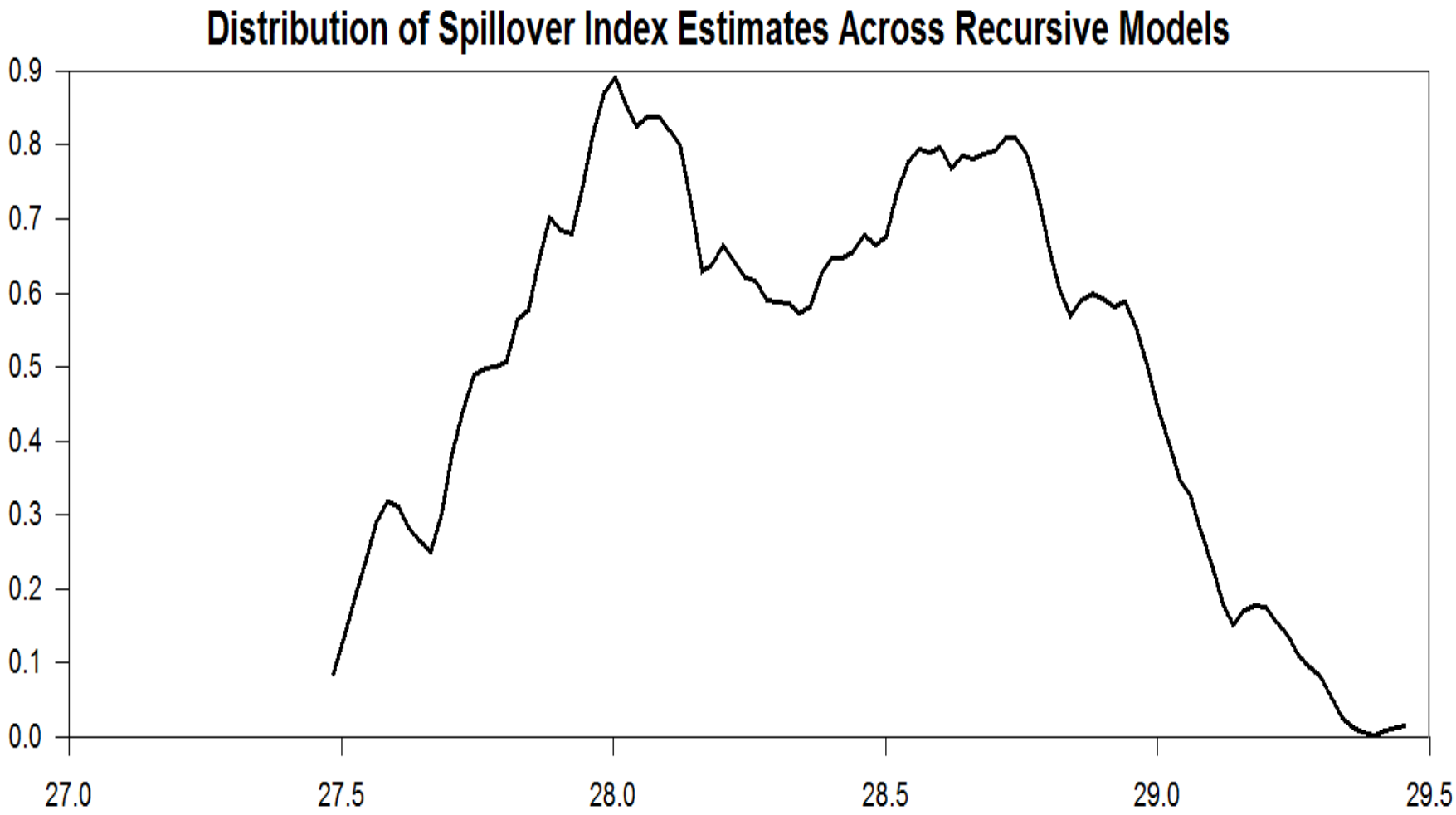
Identification Assumptions

Results are based on a particular recursive ordering for cities

- A Canberra-specific shock does not have any effect on larger cities in the same quarter (reasonable)
- A Melbourne-specific shock does not have any effect on Sydney in the same quarter (debatable)

For “small” systems it is feasible to estimate the spillover index for all possible recursive orderings

6 major cities imply 6! = (720) possible recursive models


Distribution of Spillover Index Estimates Across Recursive Models
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
27.0
27.5
28.0
28.5
29.0
29.5

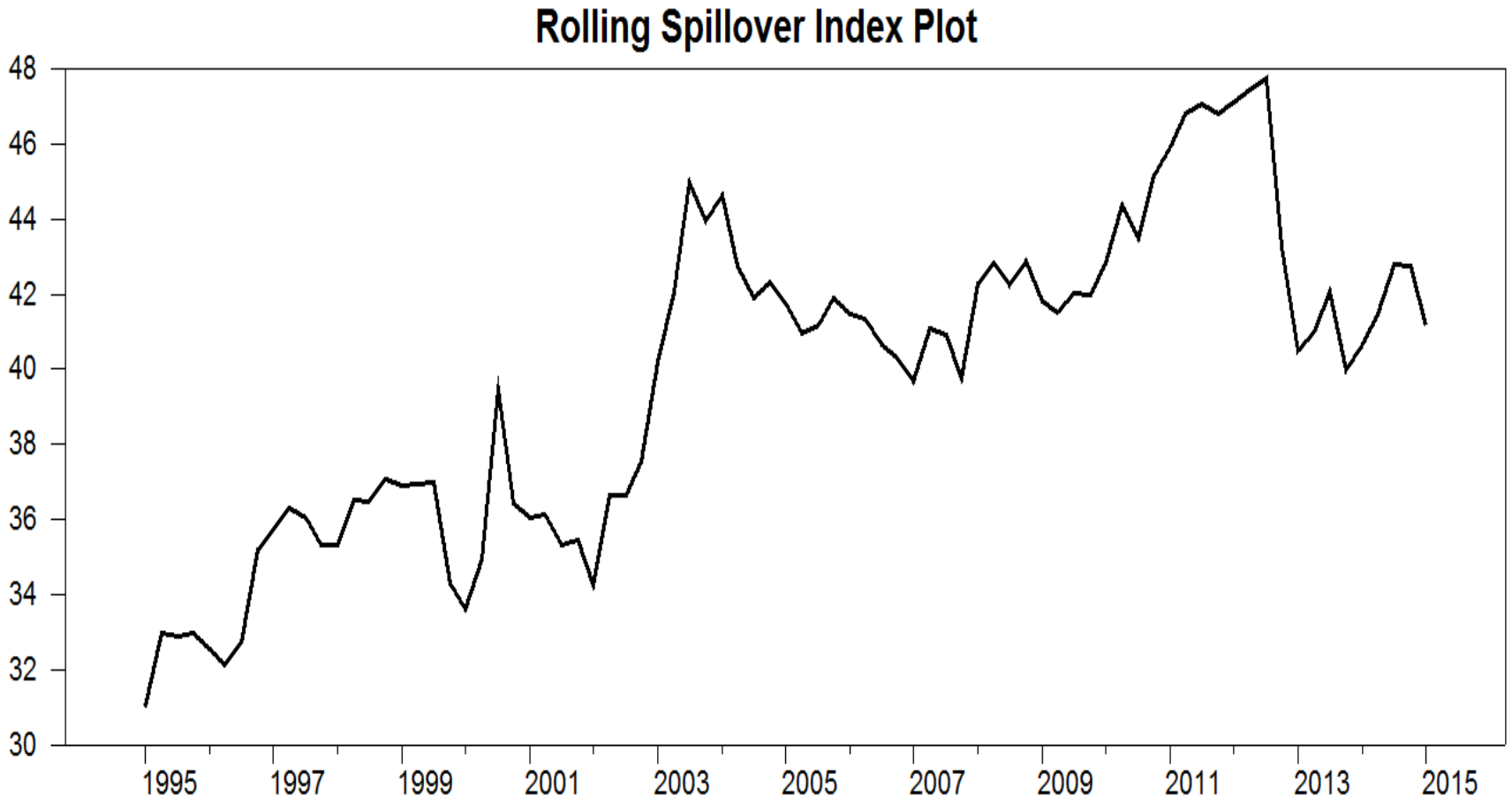
Time-Varying Spillovers

Does the degree of return spillovers vary over time?

Rolling window of 50 observations

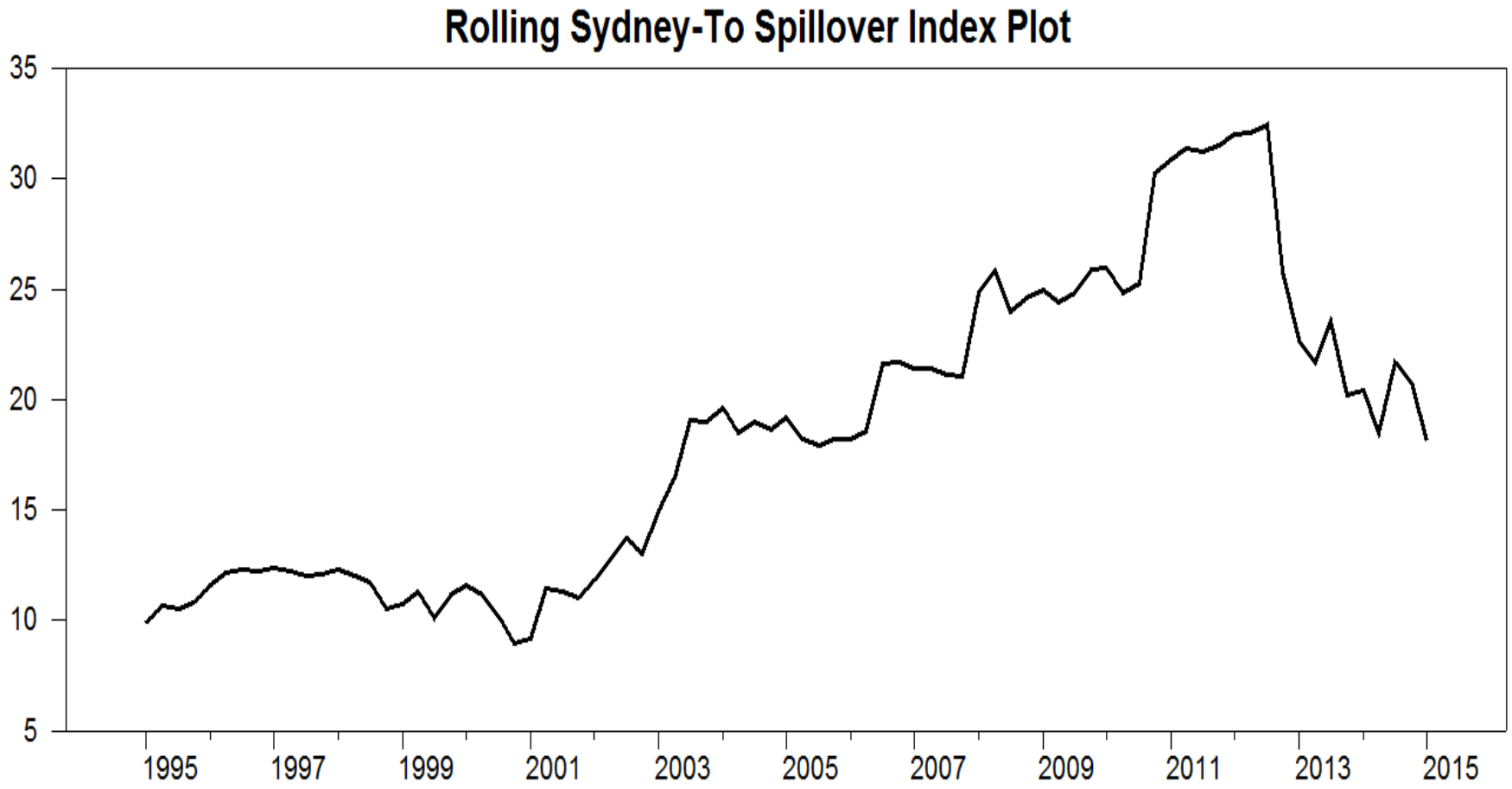
VAR(2) instead of VAR(4)

Houses



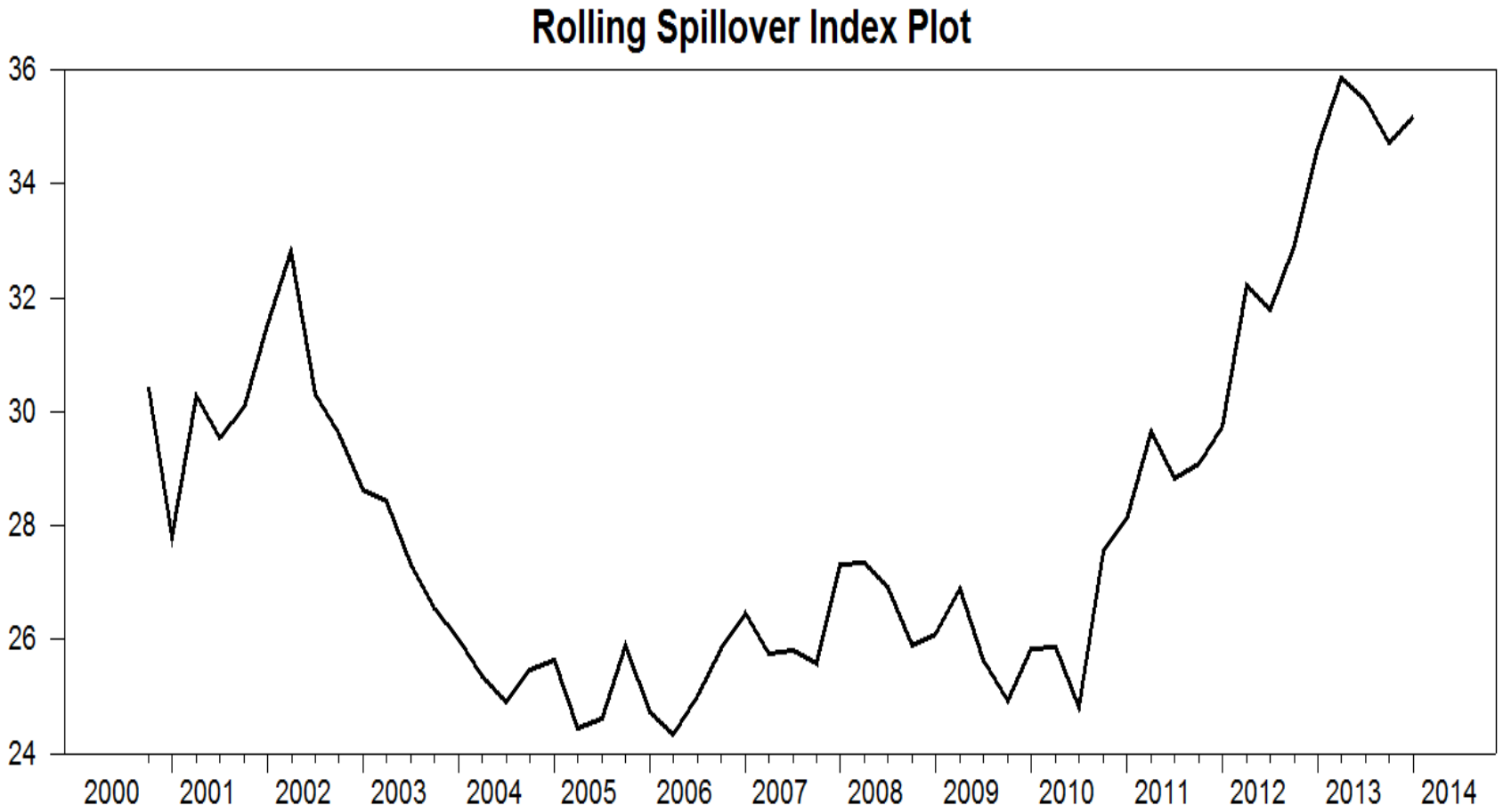
Spillovers are time-varying and have increased over time

Houses

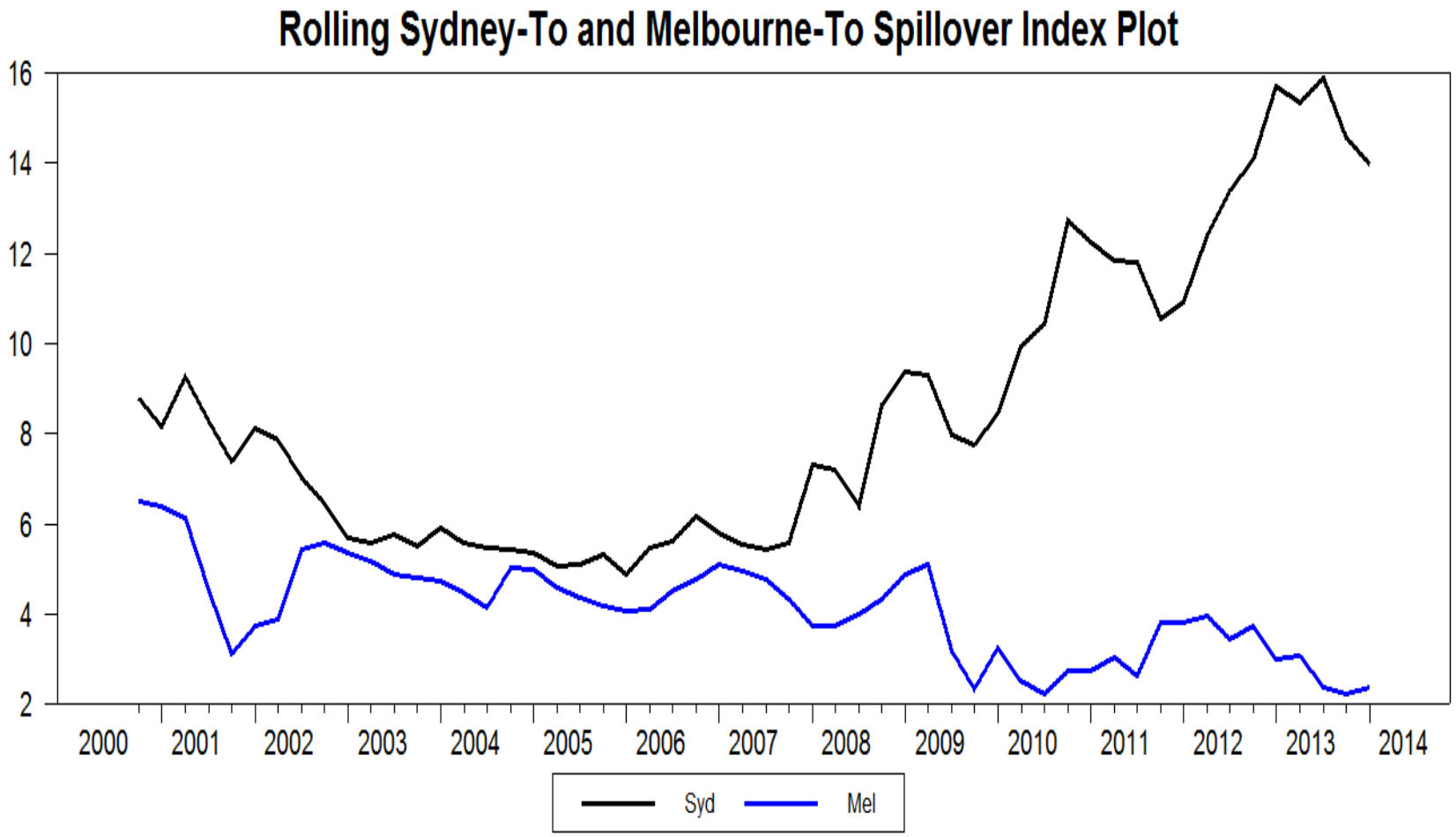


Driven by increased contribution from Sydney-specific shocks

Units


Rolling Spillover Index Plot
36
34
32
30
28
26
24
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014

Units


Rolling Sydney-To and Melbourne-To Spillover Index Plot
16
14
12
10
8
6
4
2
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Syd
Mel

Controlling for Potential Macroeconomic Factors

Add to VAR model

- Real GDP growth rate
- (Ex-post) real cash rate

Spillover Table for Real Returns to Houses – 1 Year Ahead Forecast

1982-2015

		From								
		GDP	*Cash*	*Syd*	*Mel*	*Bri*	*Per*	*Ade*	*Can*	***Total***
To	*GDP*	*83*	*0*	*7*	*1*	*1*	*3*	***4***	*1*	***18***
	Cash	*3*	*76*	*2*	*2*	*0*	*1*	*13*	*3*	***24***
	Syd	*1*	*6*	*72*	*4*	*5*	*4*	*2*	*7*	***28***
	Mel	*1*	*2*	*15*	*77*	*1*	*1*	*4*	*1*	***23***
	Bri	*5*	*3*	*17*	*11*	*54*	*2*	*3*	*5*	***46***
	Per	*5*	*2*	*12*	*3*	*6*	*67*	*2*	*5*	***33***
	Ade	*2*	*1*	*9*	*17*	*6*	*5*	*59*	*1*	***41***
	Can	*4*	*3*	*5*	*13*	*8*	*1*	*6*	*61*	***39***
	Total	***20***	***17***	***67***	***51***	***26***	***16***	***33***	***22***	***253***
	All	***102***	***93***	***139***	***128***	***80***	***84***	***91***	***83***	***32%***

Macroeconomics factors have little effect on spillover estimates

Results for all Eight Capital Cities

Shorter Samples

Houses: 1994:1 – 2015:2

Units: 1997:4 – 2014:2

Spillover Table for Real Returns to Houses – 1 Year Ahead Forecast

1994-2015

		From								
		Syd	*Mel*	*Bri*	*Per*	*Ade*	*Can*	*Hob*	*Dar*	***Total***
To	*Syd*	*71*	*4*	*4*	*1*	*6*	*4*	*4*	*6*	***29***
	Mel	25	59	*5*	*5*	*3*	*1*	*3*	*1*	***41***
	Bri	*25*	*9*	*47*	*1*	*9*	*3*	*3*	*4*	***53***
	Per	*17*	*3*	*7*	*62*	*5*	*4*	*1*	*2*	***38***
	Ade	*13*	*21*	*7*	*2*	*50*	*2*	*1*	*3*	***49***
	Can	*11*	*21*	*13*	*2*	*5*	*45*	*1*	*1*	***54***
	Hob	*9*	*16*	*11*	*3*	*11*	*4*	*41*	*6*	***59***
	Dar	*6*	*7*	*5*	*7*	*1*	*3*	*3*	*68*	***32***
	Total	***106***	***81***	***52***	***21***	***39***	***19***	***17***	***21***	***356***
	All	***177***	***140***	***99***	***84***	***89***	***65***	***58***	***89***	***44%***

Spillover Table for Real Returns to Units – 1 Year Ahead Forecast

1997-2014

		From								
		Syd	*Mel*	*Bri*	*Per*	*Ade*	*Can*	*Hob*	*Dar*	***Total***
To	*Syd*	*81*	*3*	*3*	*1*	*4*	*1*	*2*	*5*	***19***
	Mel	*28*	*59*	*2*	*3*	*4*	*2*	*2*	*1*	***41***
	Bri	*17*	*3*	*48*	*1*	*8*	*18*	*1*	*3*	***52***
	Per	*6*	*2*	*3*	*65*	*8*	*5*	*3*	*9*	***35***
	Ade	*18*	*19*	*7*	*3*	*43*	*6*	*1*	*3*	***57***
	Can	*25*	*4*	*6*	*2*	*13*	*49*	*0*	*1*	***51***
	Hob	*10*	*6*	*5*	*12*	*10*	*16*	*30*	*11*	***70***
	Dar	*4*	*1*	*9*	*3*	*3*	*14*	*3*	*63*	***37***
	Total	***107***	***39***	***34***	***24***	***50***	***61***	***14***	***32***	***361***
	All	***189***	***98***	***82***	***89***	***93***	***110***	***44***	***95***	***45%***

Other Issues

- Non-recursive identifying restrictions
- Generalised FEVD
- Volatility spillovers

Summary

Housing markets in Australia's major cities appear to be connected by quantitatively important spillover effects from city-specific shocks.

Spillover effects have been generally increasing over time

Since mid-1990s spillover shocks account for about 40-50 percent of the variance in one-year forecast errors for returns to houses and to units

The Sydney housing market appears to be the most important generator of shocks that transmitted to other cities

Summary

The housing markets for Perth and Darwin are found to be the least affected by shocks in other markets

At a one year horizon returns to houses in Canberra and Hobart are predominately affected by shocks arising in other cities

At a one year horizon returns to units in Brisbane and Hobart are predominately affected by shocks arising in other cities

Hobart's housing market appears to be the most affected by shocks originating in other capitals