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Meta-analysis of Chinese Business Cycle Correlation

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Motivation

- China is ever-larger part of the global economy, in 2016 second largest GDP ($ 11.4 bn.) and world's largest exporter
- Important to understand China's position in the global economy
- Given China's importance, its business cycle developments vis-à-vis other countries is interesting, both intellectually and from the policy point of view
- Consequently, relatively large strand of literature assessing China's business cycle synchronization has sprung up
- Intention is to examine this literature with the help of meta-analysis techniques

Brief literature survey 1

- Synchronization of business cycles received renewed interest in the run-up to the introduction of the euro and its subsequent enlargement(s); Bayoumi and Eichengreen (1993) etc.
- Some papers develop different metrics for assessing business cycle correlations, others try also ascertain reasons for business cycle convergence (e.g. Frankel and Rose, 1998)
- In recent years also many papers on business cycle synchronization among countries of other areas, e.g. Asia and Persian Gulf, sometimes linked to proposals for common currency

Brief literature survey 2

- Papers concentrating on the synchronization of China's business cycle with other countries started to profiliterate in early 2000s, both in English and Chinese languages
- Researchers looked at various indicators of business cycles: GDP, industrial production, inflation, supply and demand shocks
- Most papers are concerned with China's business cycle synchronization with at least its immediate neighbors (Hong Kong, Taiwan, Japan), often also with the US as well as other Asian countries; other countries added to the sample depending on the purpose of the paper

Brief literature survey 3

- Meta-analysis is a technique used to summarise results from a large number of studies concentrating on the same topic; has been common for years e.g. in medicine and engineering, but is becoming more popular in economics (Stanley 2001)
- The idea is to collect a large number of studies on the same topic and 1) estimate (possibly weighted) coefficient(s) of interest, 2) examine the objective factors influencing the reported coefficients, as well as 3) assess distribution of reported coefficients (possible publication bias)

Brief literature survey 4

- Fidrmuc and Korhonen (2006) perform similar meta-analysis on the business cycle correlation of the euro area vis-à-vis the new EU members of Central and Eastern Europe
- Wide variety of meta-analyses in economics: money demand functions (e.g. Knell and Stix, 2005), link between financial liberalization and growth (Bumann et al., 2012), alcohol's price and income elasticities (Nelson, 2013), misalignment of the renminbi (Korhonen and Ritola, 2011)

Look at the data I

- We collected all in all 40 Chinese and 31 English language papers
- The Chinese-language papers were collected from 中国知网 (CNKI, www.cnki.net), which is the largest publication database online in China (中国知网)

东亚	经济周期	协动	中国
East Asia	Business cycle	Synchronisation	China
货币联盟	经济一体化	东盟	同步性
Monetary Union	Economic integration	ASEAN	Co-movement

- Difference between Chinese ‘core journals’ and others

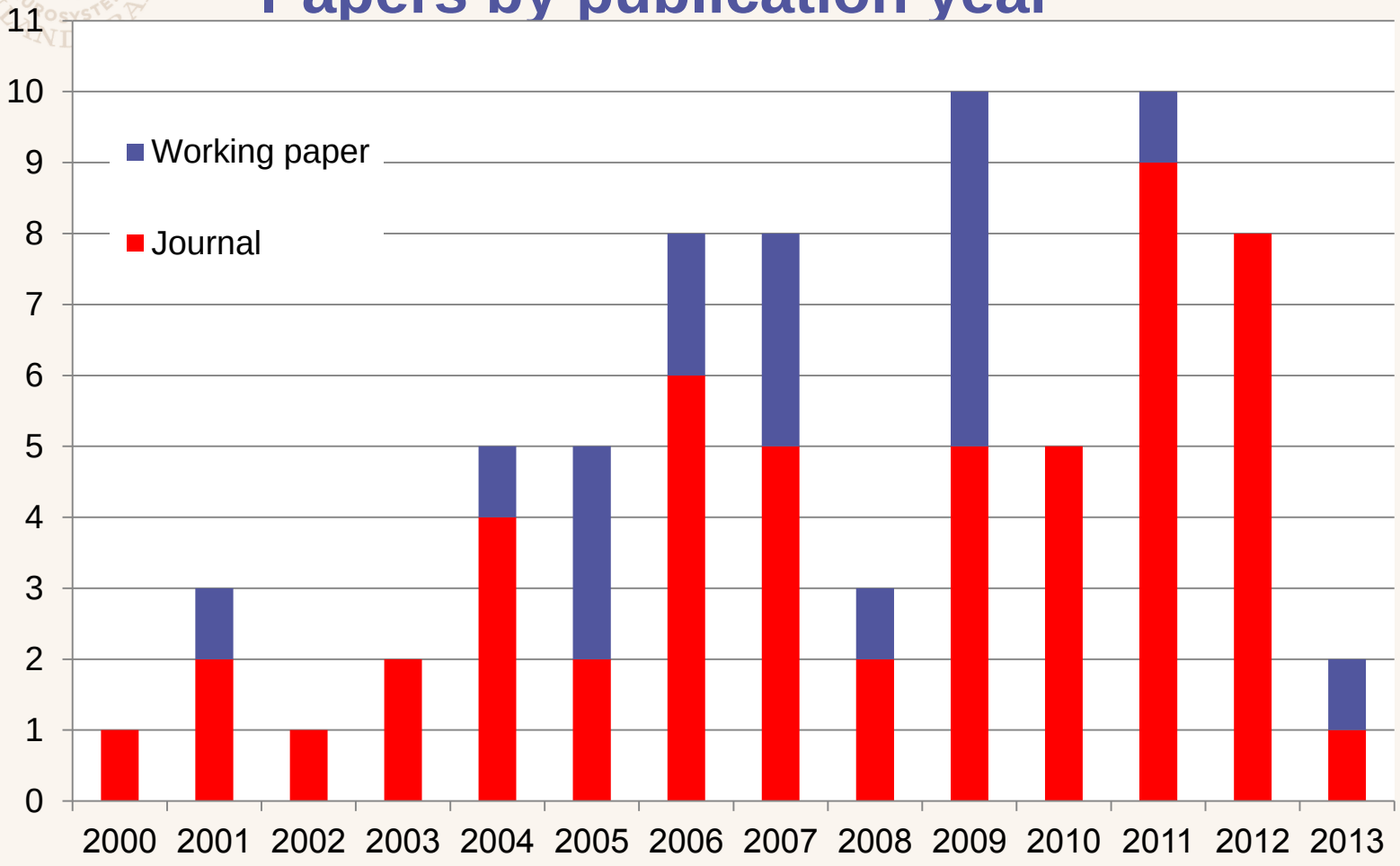
Look at the data II

- English-language papers were searched in *Google Scholar*, *IDEAS* and *ScienceDirect*. Key words included: business cycle, correlation, Asian monetary union, SVAR, China, synchronisation, co-movement, and different variations of those
- All papers report correlation coefficients for their chosen variables and countries
- Almost all papers look at business cycle correlation with respect to several countries

Examples of papers

1. Gary George Madden, Scott James and Andrew McDonald: **Assessing the Economic Preconditions for a Yen Bloc** (Australian Economic Papers, 2000)
2. Soyoung Kim, Jong-Wha Lee and Cyn-Young Park: **Emerging Asia: Decoupling or Recoupling** (World Economy, 2011)
3. Grace H.Y. Lee and Sharon G.M. Koh: **The prospects of a monetary union in East Asia** (Economic Modelling, 2012)
4. Dong He and Wei Liao: **Asian business cycle synchronization** (Pacific Economic Review, 2012)
5. Chi Gong and Soyoung Kim: **Economic Integration and Business Cycle Synchronization in Asia** (Asian Economic Papers, 2012)

Papers by publication year



Descriptive statistics

	Chinese-language	English-language	Total
Number of papers	40	31	71
Number of observations	996	898	1894
Author with Chinese affiliation	100%	29%	70%
Journal papers	38	15	53
Business cycle correlation, all papers	0.160	0.087	0.125
	(0.410)	(.275)	(0.354)
Business cycle correlation, authors with Chinese affiliation	0.160	0.109	0.146
	(0.410)	(0.286)	(0.380)
Business cycle correlation, journal papers	0.157	0.102	0.138
	(0.408)	(0.284)	(0.372)

Meta-statistics

	Number of papers	Number of observations	Share of observ. in Chinese publications	Mean correlation
United States	24	132	63%	0.245
Hong Kong	40	187	44%	0.172
Japan	49	178	50%	0.056
Taiwan	31	144	49%	0.146
Korea	48	185	50%	0.121
Singapore	50	193	52%	0.157
Philippines	48	183	50%	0.029
Indonesia	51	187	51%	0.088
Malaysia	51	190	52%	0.143
Thailand	48	182	51%	0.139
Brunei	4	20	100%	-0.002
Cambodia	5	20	80%	0.101
Myanmar	6	26	77%	-0.052
Laos	7	26	77%	0.140
Vietnam	7	27	78%	0.316
Germany	2	2	100%	0.378
Russia	1	1	100%	0.226
Australia	2	5	0%	-0.082
New Zealand	3	6	0%	0.313

Metaregressions

- We use Fisher transformation of the reported correlation coefficients as the dependent variable

$$\frac{1}{2}\log\left(\frac{1+\rho_{ij}}{1-\rho_{ij}}\right) = \tilde{\rho}_i + \sum_{k=1}^{K} \beta_{ijk} D_{ijk} + \varepsilon_{ijk}$$

- Country dummies ρ_i tell the average correlation coefficient for country i, controlling for K factors (e.g. publication year, variable, methodology, sample size, frequency, author affiliation, journal or not) in publication j

Possible determinants of reported correlation coefficients

1. Related to publication: Year of publication, part of PhD thesis, journal, Chinese core journal, non-China focus
2. Related to authors: Chinese affiliation, central bank affiliation
3. Related to estimation method: simple correlation, time series method, Blanchard-Quah, HP and other filters
4. Related to variable studied: GDP, industrial production, demand shock, supply shock, inflation

	(1) publication	(2) author	(3) method	(4) variable	(5) preferred
obsydm	-0.002**				
	(0.001)				
nocntrdm	-0.008				
	(0.007)				
ydm	0.025***				0.022***
	(0.003)				(0.003)
phd	0.017				
	(0.099)				
thesis	0.130*				
	(0.070)				
journal	0.045				
	(0.038)				
jcn	0.054*				0.085***
	(0.027)				(0.029)
wp	-0.025				
	(0.045)				
noncn	-0.081*				-0.132***
	(0.039)				(0.037)
west		0.011			
		(0.017)			
Chinese		0.024			
		(0.022)			
cnlang		0.092***			
		(0.014)			
univ		-0.052			
		(0.033)			
cbank		-0.125**			
		(0.046)			
quarterly			-0.006		
			(0.020)		
cor			0.064		
			(0.038)		
tser			0.219**		0.186***
			(0.087)		(0.063)
bandq			0.066		
			(0.058)		
filter			0.095		
			(0.071)		
gdp				-0.005	
				(0.029)	
indprod				0.097	
				(0.072)	
demand				-0.067**	
				(0.031)	
supply				-0.008	
				(0.028)	
infl				-0.274***	-0.170***
				(0.049)	(0.047)

	(1) publication	(2) author	(3) method	(4) variable	(5) preferred
USA	0.196***	0.263***	0.208***	0.290***	0.285***
	(0.055)	(0.036)	(0.049)	(0.019)	(0.019)
Hong Kong	0.240***	0.204***	0.136**	0.231***	0.308***
	(0.043)	(0.036)	(0.050)	(0.021)	(0.027)
Taiwan	0.192***	0.167***	0.106*	0.196***	0.251***
	(0.043)	(0.036)	(0.051)	(0.021)	(0.025)
Philippines	0.086**	0.046	-0.018	0.077***	0.144***
	(0.037)	(0.036)	(0.050)	(0.021)	(0.032)
Thailand	0.202***	0.163***	0.101*	0.196***	0.261***
	(0.037)	(0.036)	(0.049)	(0.021)	(0.031)
Indonesia	0.148***	0.110***	0.048	0.142***	0.207***
	(0.037)	(0.036)	(0.049)	(0.021)	(0.031)
Malaysia	0.223***	0.181***	0.119**	0.214***	0.280***
	(0.036)	(0.036)	(0.049)	(0.021)	(0.031)
Japan	0.112***	0.075**	0.010	0.107***	0.172***
	(0.037)	(0.035)	(0.048)	(0.021)	(0.029)
Korea	0.184***	0.149***	0.086*	0.181***	0.247***
	(0.037)	(0.036)	(0.049)	(0.021)	(0.030)
Singapore	0.230***	0.189***	0.128**	0.223***	0.287***
	(0.036)	(0.036)	(0.049)	(0.021)	(0.030)
Brunei	-0.037	-0.077*	-0.082*	-0.007	0.021
	(0.032)	(0.038)	(0.044)	(0.026)	(0.025)
Cambodia	0.120***	0.066*	0.038	0.125***	0.184***
	(0.029)	(0.036)	(0.044)	(0.022)	(0.032)
Myanmar	-0.040	-0.088**	-0.118**	-0.032	0.021
	(0.029)	(0.037)	(0.044)	(0.023)	(0.028)
Laos	0.248***	0.203***	0.173***	0.259***	0.307***
	(0.030)	(0.037)	(0.044)	(0.023)	(0.028)
Vietnam	0.451***	0.411***	0.382***	0.467***	0.511***
	(0.030)	(0.037)	(0.043)	(0.023)	(0.027)
Germany	0.366***	0.342***	0.249***	0.411***	0.344***
	(0.038)	(0.038)	(0.073)	(0.029)	(0.033)
Australia	0.056	-0.008	-0.161***	-0.081***	0.079**
	(0.033)	(0.042)	(0.045)	(0.012)	(0.036)
New Zealand	0.481***	0.419***	0.272***	0.350***	0.510***
	(0.032)	(0.039)	(0.044)	(0.013)	(0.036)
Russia	0.189***	0.166***	0.011	0.235***	0.117**
	(0.040)	(0.038)	(0.087)	(0.029)	(0.051)
No of observations	1,894	1,894	1,894	1,894	1,894
R^2	0.174	0.134	0.125	0.132	0.174

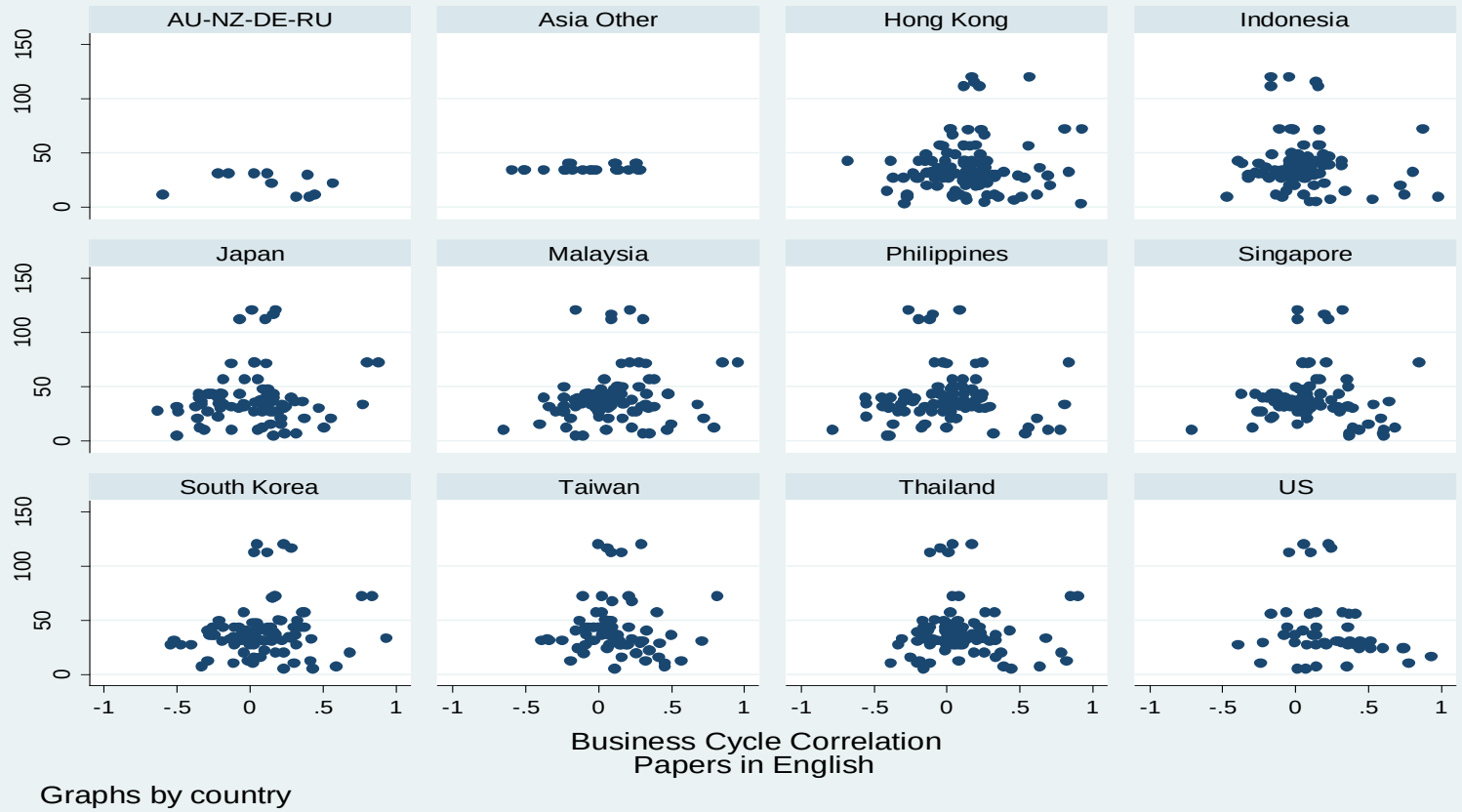
Robustness check - methods

	(1) RFE	(2) WLS	(3) REML	(4) MR	(5) RR	(6) SRE
ydm	0.022***	0.022***	0.022***	0.016***	0.017***	0.026***
	(0.003)	(0.004)	(0.004)	(0.003)	(0.003)	(0.006)
jcn	0.085***	0.015	0.084***	0.027	0.018	0.039
	(0.029)	(0.024)	(0.027)	(0.022)	(0.020)	(0.055)
noncn	-0.132***	-0.189***	-0.141***	-0.123***	-0.155***	-0.154***
	(0.037)	(0.037)	(0.027)	(0.026)	(0.021)	(0.052)
tser	0.186***	0.232**	0.191***	0.102	0.090*	-0.039
	(0.063)	(0.101)	(0.068)	(0.074)	(0.050)	(0.067)
infl	-0.170***	-0.153***	-0.169***	-0.117***	-0.143***	-0.190***
	(0.047)	(0.053)	(0.063)	(0.033)	(0.047)	(0.027)
USA	0.285***	0.348***	0.292***	0.096	0.104	0.162***
	(0.019)	(0.025)	(0.043)	(0.197)	(0.347)	(0.045)
Hong Kong	0.308***	0.353***	0.313***	0.067	0.061	0.202***
	(0.027)	(0.027)	(0.039)	(0.193)	(0.346)	(0.027)
Taiwan	0.251***	0.277***	0.258***	-0.000	-0.000	0.145***
	(0.025)	(0.024)	(0.042)	(0.196)	(0.347)	(0.031)
Philippines	0.144***	0.219***	0.154***	-0.052	-0.094	0.025
	(0.032)	(0.033)	(0.041)	(0.196)	(0.346)	(0.039)
Thailand	0.261***	0.315***	0.271***	-0.005	0.004	0.140***
	(0.031)	(0.033)	(0.041)	(0.194)	(0.346)	(0.023)
Indonesia	0.207***	0.260***	0.215***	-0.040	-0.045	0.090**
	(0.031)	(0.033)	(0.041)	(0.193)	(0.346)	(0.044)
Malaysia	0.280***	0.349***	0.287***	-0.001	-0.004	0.163***
	(0.031)	(0.033)	(0.040)	(0.194)	(0.346)	(0.023)
Japan	0.172***	0.221***	0.177***	-0.028	-0.093	0.054*
	(0.029)	(0.032)	(0.040)	(0.194)	(0.346)	(0.030)
Korea	0.247***	0.323***	0.256***	0.003	-0.008	0.144***
	(0.030)	(0.033)	(0.041)	(0.194)	(0.346)	(0.028)
Singapore	0.287***	0.325***	0.296***	0.014	0.041	0.171***
	(0.030)	(0.032)	(0.040)	(0.194)	(0.346)	(0.026)
Brunei	0.021	0.108***	0.016	-0.148	-0.141	-0.021
	(0.025)	(0.030)	(0.105)	(0.207)	(0.354)	(0.058)
Cambodia	0.184***	0.184***	0.193*	0.008	0.025	0.130**
	(0.032)	(0.034)	(0.105)	(0.225)	(0.354)	(0.064)
Myanmar	0.021	0.143***	0.048	-0.160	-0.185	-0.016
	(0.028)	(0.032)	(0.093)	(0.215)	(0.352)	(0.081)
Laos	0.307***	0.265***	0.312***	-0.049	-0.067	0.258*
	(0.028)	(0.032)	(0.093)	(0.224)	(0.352)	(0.154)
Vietnam	0.511***	0.510***	0.522***	0.221	0.262	0.467***
	(0.027)	(0.032)	(0.091)	(0.273)	(0.352)	(0.115)
Germany	0.344***	0.387***	0.346	0.324*	0.187	0.267***
	(0.033)	(0.060)	(0.327)	(0.194)	(0.420)	(0.044)
Australia	0.079**	0.111***	0.085	-0.215	-0.147	-0.050**
	(0.036)	(0.035)	(0.204)	(0.279)	(0.378)	(0.020)
New Zealand	0.510***	0.523***	0.516***	0.284	0.277	0.384***
	(0.036)	(0.035)	(0.186)	(0.226)	(0.373)	(0.072)
Russia	0.117**	0.128	0.122			
	(0.051)	(0.108)	(0.463)			
Constant				0.208	0.248	0.160***
				(0.194)	(0.346)	(0.045)
No of observations	1,894	1,894	1,894	1,894	1,894	1,894
R^2	0.174	0.205	-	0.046[a]	0.128	0.076[b]

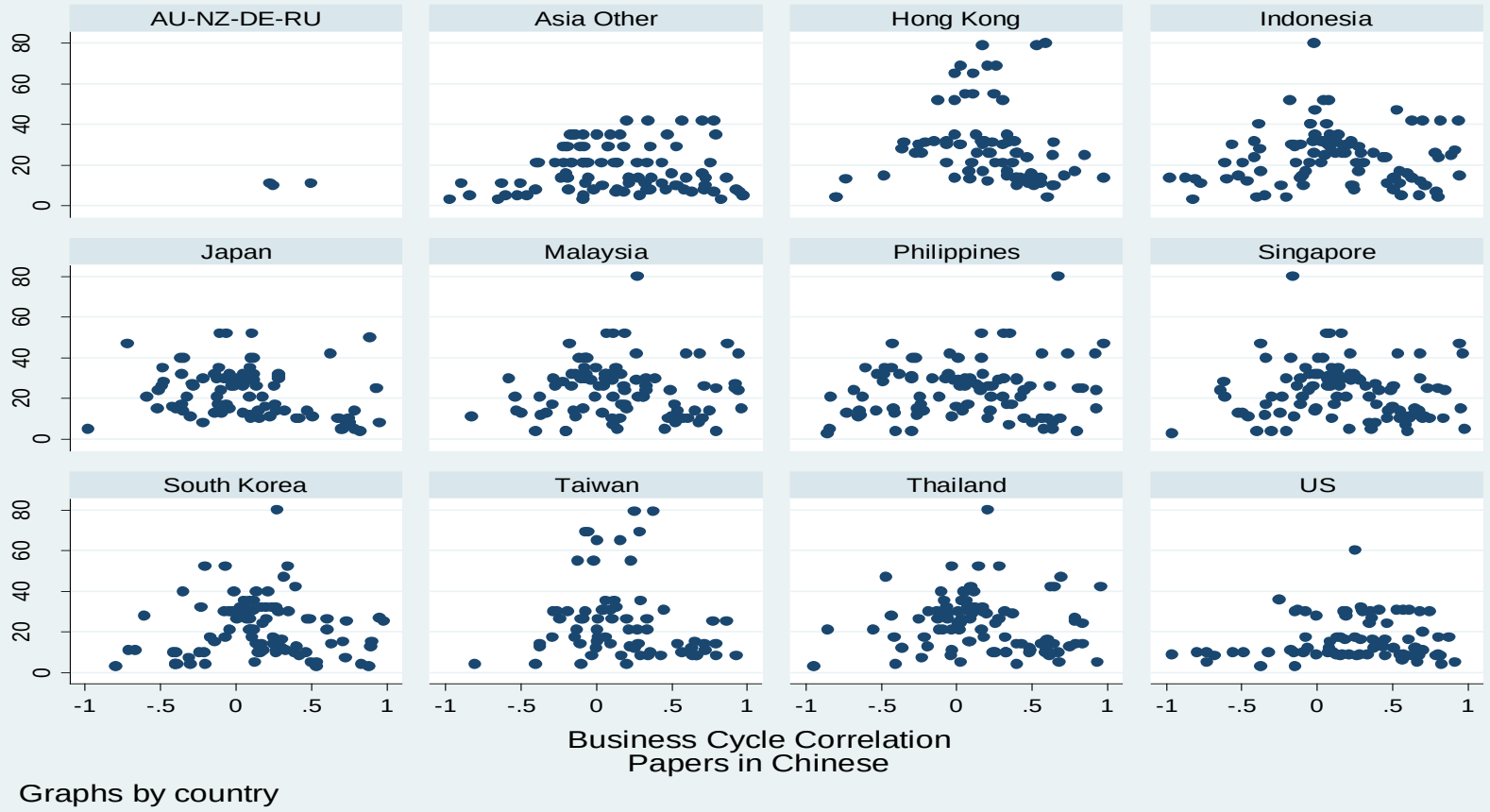
Robustness check – just GDP

	(1) RFE	(2) WLS	(3) REML	(4) MR	(5) RR	(6) SRE
ydm	0.030***	0.023***	0.029***	0.029***	0.030***	0.035***
	(0.006)	(0.005)	(0.008)	(0.007)	(0.006)	(0.006)
jcn	0.129**	0.069	0.129**	0.019	0.028	0.036
	(0.051)	(0.052)	(0.051)	(0.046)	(0.041)	(0.072)
noncn	-0.050	-0.134***	-0.058	-0.151***	-0.149***	-0.091
	(0.050)	(0.040)	(0.048)	(0.043)	(0.038)	(0.062)
tser	0.213*	0.263**	0.216	0.290	0.263	0.157***
	(0.119)	(0.118)	(0.208)	(0.184)	(0.167)	(0.056)
USA	0.284***	0.333***	0.291***	0.324*	0.318	0.262***
	(0.064)	(0.050)	(0.071)	(0.188)	(0.481)	(0.056)
Hong Kong	0.295***	0.362***	0.299***	0.338*	0.342	0.317***
	(0.070)	(0.055)	(0.076)	(0.189)	(0.482)	(0.037)
Taiwan	0.196***	0.255***	0.207**	0.239	0.256	0.233***
	(0.068)	(0.049)	(0.090)	(0.196)	(0.484)	(0.045)
Philippines	-0.068	0.034	-0.059	-0.061	-0.066	-0.045
	(0.095)	(0.092)	(0.083)	(0.193)	(0.483)	(0.081)
Thailand	0.191**	0.225***	0.203**	0.224	0.267	0.210***
	(0.085)	(0.061)	(0.082)	(0.190)	(0.482)	(0.042)
Indonesia	0.088	0.139**	0.096	0.132	0.143	0.111
	(0.097)	(0.066)	(0.082)	(0.193)	(0.483)	(0.113)
Malaysia	0.161**	0.218***	0.168**	0.174	0.169	0.184***
	(0.077)	(0.068)	(0.080)	(0.190)	(0.482)	(0.042)
Japan	0.059	0.093	0.061	0.099	0.081	0.048
	(0.087)	(0.073)	(0.076)	(0.190)	(0.482)	(0.060)
Korea	0.136*	0.234***	0.143*	0.248	0.160	0.158***
	(0.073)	(0.054)	(0.076)	(0.189)	(0.481)	(0.046)
Singapore	0.236***	0.272***	0.247***	0.251	0.260	0.258***
	(0.090)	(0.072)	(0.078)	(0.189)	(0.482)	(0.035)
Brunei	-0.071	0.039	-0.082	0.040	0.028	0.037
	(0.155)	(0.100)	(0.154)	(0.225)	(0.494)	(0.067)
Cambodia	0.101	0.162**	0.110	0.158	0.164	0.194***
	(0.116)	(0.076)	(0.172)	(0.234)	(0.498)	(0.039)
Myanmar	-0.018	0.158	0.014	0.071	0.024	0.088
	(0.232)	(0.105)	(0.148)	(0.223)	(0.493)	(0.084)
Laos	0.416**	0.390***	0.427***	0.327	0.250	0.508***
	(0.201)	(0.122)	(0.148)	(0.223)	(0.493)	(0.171)
Vietnam	0.556***	0.705***	0.576***	0.741***	0.766	0.652***
	(0.202)	(0.152)	(0.144)	(0.220)	(0.492)	(0.163)
Germany	0.269***	0.317***	0.272	0.324***	0.309	0.303***
	(0.078)	(0.080)	(0.410)	(0.094)	(0.558)	(0.019)
New Zealand	0.509***	0.584***	0.516	0.597***	0.573	0.511***
	(0.050)	(0.041)	(0.554)	(0.183)	(0.658)	(0.026)
Russia	-0.014	0.039	-0.007			
	(0.124)	(0.122)	(0.596)			
Constant				0.013	0.035	0.069
				(0.184)	(0.480)	(0.048)
No of	735	735	735	735	735	735
R^2	0.160	0.194	-	0.081[a]	0.158	0.070[b]

Publication bias?



Publication bias?



Funnel asymmetry test

- Coefficient β gives the so-called publication bias: If estimates are distributed symmetrically around the true effect $\tilde{\rho}_i$, β should be zero

$$\frac{1}{2}\left(\frac{1+\rho_{ij}}{1-\rho_{ij}}\right) = \tilde{\rho}_i + \beta\frac{1}{T} + \varepsilon_{ij}$$

No systematic publication bias?

A. OLS Estimation

	(1) All observations	(2) English language	(3) Chinese language	(4) Core Chinese journals	(5) GDP bus. cycles	(6) USA
$1/T$	0.261	0.756	-0.312	-0.393	-0.045	-0.211
	(0.378)	(0.463)	(0.495)	(0.510)	(0.486)	(0.890)
No of obs.	1,894	898	996	398	735	132
R^2	0.122	0.135	0.139	0.208	0.131	0.001

B. Weighted Least Squares

	(7) All observations	(8) English language	(9) Chinese language	(10) Core Chinese journals	(11) GDP bus cycles	(12) USA
$1/T$	0.659**	-0.292	0.327	1.760***	0.767**	1.038
	(0.321)	(0.526)	(0.438)	(0.525)	(0.388)	(0.854)
No of obs.	1,894	898	996	398	735	132
R^2	0.134	0.140	0.154	0.196	0.162	0.010

Note: *, **, and *** stand for significance at the 10%, 5%, and 1% level, respectively. Roust standard errors are in parentheses. Regional fixed effects are not reported.

Source: Own estimations.

Concluding remarks

- We can see that Chinese business cycle has been synchronized with business cycles of other countries
- Correlation is high also for large economies like the US, in addition to China's smaller neighbors in Asia
- However, reported correlation coefficients are obviously influenced by many factors relating to the variables chosen, methodology as well as focus of the paper
- Nevertheless, the same result holds in various different robustness checks
- We can't say that there is publication bias in the literature