

# Central bank independence and Systemic risk contribution

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Seminarul de Analiză și Cercetare Economică  
Banca Națională a României  
22 Februarie 2018



# Preamble & Motivation

- Prior to the financial crisis, a consensus had developed around the model of an ideal central bank: independent from government, with a focus on price stability through an inflation target, with primary responsibility for moderating macroeconomic fluctuations.
- This consensus was supported by theoretical and empirical evidence demonstrating that central bank independence was important in reducing inflation without a negative impact on growth or employment.
- Central banks in advanced and emerging economies converged upon this model of central bank independence, and in many countries, central banks' traditional responsibilities for financial supervision and stability were relocated to separate institutions to enable the central bank to focus on its core monetary policy responsibility.



# Preamble & Motivation

- In the wake of the global financial crisis, however, this model of a central bank is being challenged.
- The crisis demonstrated that a focus on price stability alone is too narrow: effective macroeconomic policy cannot ignore the financial sector, and requires coordination between monetary and fiscal policy when at the zero lower bound.
- New trade-offs have been revealed between stable inflation, full employment and financial stability. For some, central bank independence itself – designed to prevent inflation from becoming too high – may no longer be useful when monetary policy is constrained and the central challenge is inflation being too *low*.



# Preamble & Motivation

- Since the crisis, central banks have accumulated a much wider range of powers than was common at the time the consensus around central bank independence was built, in areas of unconventional monetary policy, crisis response and financial stability.
- Central banks' new financial stability goals and powers challenge the previous academic consensus that their independence is an unalloyed good.
- Unlike monetary policy, these new powers may require the central bank to coordinate closely with the government and other regulatory institutions, and to venture into politically treacherous areas with first-order distributional consequences such as housing policy.



# Preamble & Motivation

- One of the upshots of the recent global financial crisis is that in addition to maintaining price stability, central banks also have a key role in maintaining financial stability and in crisis management.
- This is not a completely new role, but it is one that has become much more central than in the past.
  - As pointed out by Das et al. (2003) many CBs are seeking – or have already obtained – a mandate to pursue financial stability, in addition to their monetary stability mandate.
  - In a BIS survey 2008, 90% of central banks considered that they had full or shared responsibility for financial stability policy and oversight of the financial system.



# Preamble & Motivation

- The great majority of central banks operate under the presumption that they have a policy responsibility for financial stability, but noticeably fewer than half of central bank statutes contain objectives relating to financial stability. Of 146 central bank laws, less than 20% have an explicit objective for financial stability per se (BIS 2009).
- In some of the small number of cases in which the central bank has an explicit legal objective for financial stability, the objective is broad-ranging and the central bank's responsibility apparently far-reaching.
  - In China, the People's Bank "shall ... prevent and mitigate financial risks, and maintain financial stability".
  - In Hong Kong, the powers of the Exchange Fund can be discharged "to maintain the stability of the monetary and financial systems".
  - In Thailand, "the Bank of Thailand's objectives are to carry out such tasks as pertain to central banking in order to maintain monetary stability, financial institution stability and payment systems stability", which covers a substantial range of financial stability considerations, if not their entirety.



# Preamble & Motivation

- However, in several other cases in which an objective is set down for the wider financial stability function, the language implies a more conditional degree of responsibility for outcomes, with the central bank being charged with “promoting” a safe, stable or sound financial system, or words to that effect (e.g. Singapore).
- In a number of cases, the central bank’s responsibility for overall financial stability is even more broadly defined as “contributing to” financial stability or to the actions of another authority pursuing a financial stability objective (e.g. Japan).
- In other cases, the stability of the banking system, rather than the financial system as a whole, is the legal focus (e.g. Oman).



# Preamble & Motivation

- This “new” role of central banks raises a number of questions. A crucial one among them is whether maintaining financial stability is helped or hindered by having a central bank that is independent.
- There are various arguments why CBI may matter for the stability of the financial system (Klomp and de Haan, 2009).
  - First, greater independence from outside political pressures implies that the central bank is less constrained in preventing financial distress, which should allow the bank to act earlier and more decisively before a crisis erupts (Klomp and de Haan, 2009).
  - Second, Cihák (2007) points out that there is a time inconsistency problem in financial stability policy-making that is similar to the time inconsistency problem in monetary policy-making.
  - Third, restraining the influence of politicians on the central bank policy removes the problem that a financial crisis can be used as an issue in the re-election campaign of the incumbent government Keefer (1999)



# Preamble & Motivation

- The relationship between central bank independence and financial stability is far from trivial.
  - In a long-term perspective, price stability can be seen as a key component of financial stability (e.g. Christl, 2005).
    - The relatively well documented relationship between central bank independence and price stability (e.g. Arnone et al., 2008) may well translate into a positive relationship with financial stability.
  - However, the relationship between price stability and financial stability is rather complex in the short- and medium-term, with potential tradeoffs between the two.
    - An independent central bank charged with maintaining financial stability is likely to end up with levels of inflation that are higher than those in similarly independent central banks that do not follow the financial stability objective (Bauducco et al., 2006).
- Central bank independence may foster financial stability.
  - However, as pointed out by Cihák (2007), the relationship between CBI and financial stability may not be straightforward as central banks have incomplete control over policy outcomes in the area of financial stability.
  - Unlike price stability, financial stability is rarely within the sole purview of the central bank, and it is usually shared with other agencies, including the ministry of finance, and often also a separate supervisory agency and a deposit protection fund.



# CBI and financial stability – Lit review

- Contrary to the large literature on the relationship between central bank independence (CBI) and inflation, the work on financial stability is limited (Berger and Kißmer, 2013).
- Cihák (2007) show that the countries with more independent central banks are less likely to experience a systemic crisis
- Doumpos et al. (2015) find that central bank independence exercises a positive impact on bank soundness, which in the case of smaller banks is enhanced during the crisis.
- Klomp and de Haan (2009) find a significant and robust negative relation between CBI and financial instability, which is mostly due to political independence.



# CBI and financial stability – Lit review

- Dincer and Eichengreen (2012) also support the view that supervisory independence can be beneficial, since they find a negative association with nonperforming loans (% GDP).
- Nonetheless, in another country-level study, Barth et al. (2002) find the relationship between supervisory independence and non-performing loans to be significant only at the 10% level and in specific estimations.
- Finally, the theoretical model of Berger and Kißmer (2013) predicts that the higher the central bank independence, the more likely it is to withhold the implementation of preemptive monetary tightening to maintain financial stability.
  - Thus, they challenge the idea of a positive relationship between CBI and financial stability.



# Aim and main findings

- Using a sample of commercial banks operating in various Asian countries over the period 2001–2015, this paper investigates whether and how systemic risk is influenced by the central bank independence.
- We find a significant and robust negative relation between central bank independence and systemic risk.
- Additionally, our results highlight the importance of other country, banking system and governance indicators in identifying the asymmetric effect of central bank independence on the systemic risk.

# Methodology

- Our dataset has a multi-level setting with individual banks being nested in countries over a number of years. Consequently, we employ a Hierarchical Linear Modeling (HLM) approach also known as multi-level modeling.
- By applying HLM to our research problem, we assume that observations across time are correlated amongst themselves, once they belong (i.e., are nested) to a given bank, therefore, generating a strong within-cluster correlation.
- This approach has been recently used in cross-country studies that examine firm performance, capital structure decisions, corporate risk-taking, and IPOs (see e.g. Kayo and Kimura, 2011) and bank soundness (see e.g. Doumpos et al., 2015 JBF)



# Methodology

- HLM is superior to OLS because it accounts for the fact that our data have different levels of aggregation and it provides error terms that control for the potential dependency due to nesting effects, which is not the case with OLS.
- In particular, by modeling simultaneously regressions at both the bank- and country-level, multilevel models consider that banks within a country are more similar to one another than banks from different countries.
- Furthermore, the HLM framework allows the separation of the variance in bank risk explained by the bank-level versus country-level attributes.



# Methodology

- The model is fitted using an iterative maximum likelihood algorithm in which the fixed and random effects are estimated simultaneously until the model converges. In its combined form the model can be written as follows:

$$Risk_{ijt} = \underbrace{\alpha + \beta CBI_{ijt-1} + \gamma X_{ijt-1} + \delta Z_{jt-1}}_{\text{fixed components}} + \underbrace{u_{ij} + e_j + \varepsilon_{ijt}}_{\text{random components}}$$

- where  $Risk_{ijt}$  is Risk measure (CoVaR or MES) for bank  $i$  in country  $j$  in year  $t$ ,  $CBI_{ijt-1}$  is Central Bank Independence level for country  $j$  in year  $t-1$ ,  $X_{ijt-1}$  is a vector of lagged bank-level control variables, and  $Z_{ijt-1}$  is a vector of lagged banking system and country-level variables.
- The random variables  $u_{ij}$  and  $e_j$  allow the intercept  $(\alpha + u_{ij} + e_j)$  to be random and unique to every bank and country.
- The term  $\varepsilon_{ijt}$  is the residual.

# CB Independence measures

- Classical measures of the degree of central bank independence are built using two different methodologies: i) de facto, and ii) de jure measures of independence.
  - *De facto indices* associate the independence of central banks to the autonomy of its governor, i.e. higher turnover rates of central bank governors are associated to a lower independence of the central bank.
  - *De jure indices* consists in the codification of central banks' statutes to obtain information concerning, among the others, the objective function of the central bank, the procedures for the appointment of the governor and of other board members, as well as the authority responsible for monetary policy and the procedures for the resolution of conflicts between the central bank and the government.
- The most extensively used indices of central bank independence are those of Grilli, Masciandaro and Tabellini (1991) and Cukierman, Webb and Neyapti (1992)



# CB Independence measures

- Cukierman, Webb and Neyapti (1992) proposed a measure of CBI based on the following sixteen criteria:
  - **Chief executive officer:** (i) length of governor's term; (ii) entity delegated to appoint him/her; (iii) provisions for dismissal; and (iv) ability to hold another office in the government.
  - **Policy formulation:** (v) whether the central bank is responsible for monetary policy formulation; (vi) rules concerning resolution of conflicts between the central bank and government; and (vii) the degree of central bank participation in the formulation of the government's budget.
  - **Objectives of the central bank:** (viii) monetary stability as one of the primary policy objectives.
  - **Limitations on central bank lending to the government:** (ix) advances and (x) securitized lending, (xi) authority having control over the terms (maturity, interest rate and amount) of lending, (xii) width of circle of potential borrowers from the central bank, (xiii) types of limitations on loans, where limits exist, (xiv) maturity of possible loans, (xv) limitations on interest rates applicable to lending (xvi) and prohibitions on central bank participation in the primary market for government securities.



# CB Independence measures

- Grilli, Masciandaro and Tabellini (1991) assessed political and economic autonomy of central banks
  - **Political autonomy** is defined as the ability of central banks to select the final objectives of monetary policy, based on the following eight criteria:
    - (1) governor is appointed without government involvement; (2) governor is appointed for more than five years; (3) board of directors is appointed without government involvement; (4) board is appointed for more than five years; (5) there is no mandatory participation of government representative(s) in the board; (6) no government approval is required for formulation of monetary policy; (7) central bank is legally obliged to pursue monetary stability as one of its primary objectives; and (8) there are legal provisions that strengthen the central bank's position in the event of a conflict with the government.
  - **Economic autonomy** aims at assessing the central bank's operational autonomy on the basis of the following seven criteria:
    - (1) there is no automatic procedure for the government to obtain direct credit from the central bank; (2) when available, direct credit facilities are extended to the government at market interest rates; (3) this credit is temporary; (4) and for a limited amount; (5) the central bank does not participate in the primary market for public debt; (6) the central bank is responsible for setting the policy rate; and (7) the central bank has no responsibility for overseeing the banking sector (two points) or shares responsibility (one point).



# CB Independence measures

- To capture the degree of central bank independence (CBI), we use yearly updated figures of the Cukierman et al. (1992) index updated by Bodea and Hicks (2016).
- As alternative measures we have used:
  - Cukierman, Webb and Neyapti (1992) subcomponents (Garriga, 2016):
    - Component 1: CB CEO / Component 2: CB objectives / Component 3: Policy formulation / Component 4: CB lending
  - Grilli, Masciandaro and Tabellini (GMT) Index of CBI (Romelli 2017)
    - GMT Index of Political CBI
    - GMT Index of Economic CBI
  - CB CEO turnover (Dreher et al., 2010)
  - Extended CBI Index – ECBI (Romelli 2017)
    - Apart from integrating CWT and GMT indices, the ECBI index captures good practices in central bank financial independence and accountability

# Risk measures

- Systemic Risk:
  - **Conditional Value at Risk (CoVaR)** (Adrian & Brunnermeier, 2016);
    - $\text{VaR}(\text{System}) \mid \text{VaR}(\text{Bank } i)$  - Loss in the tail of the aggregate systems' market capitalization distribution conditional on a bank's market capitalization loss.
  - **Marginal Expected Shortfall** (Acharya et al., 2017).
    - $\text{ES}(\text{Bank } i) \mid \text{ES}(\text{System})$  - Average losses in the tail of a bank's market capitalization distribution conditional on the system's market capitalization loss.

# Control variables

- **Bank characteristics:** Size, Credit risk, Profitability and Capitalization;
- **Market and macro controls:** Bank Competition; Financial intermediation level; GDP growth; Inflation; Rule of Law; Financial freedom; and Emerging economy

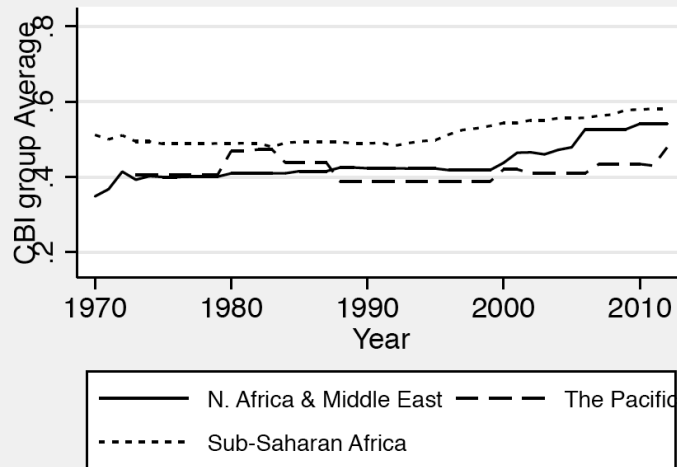
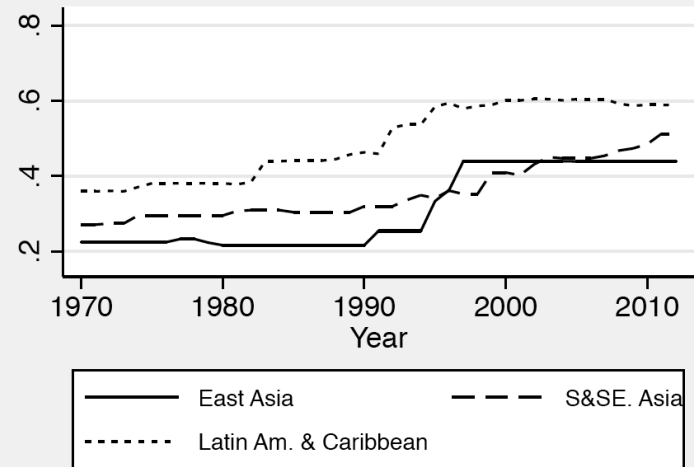
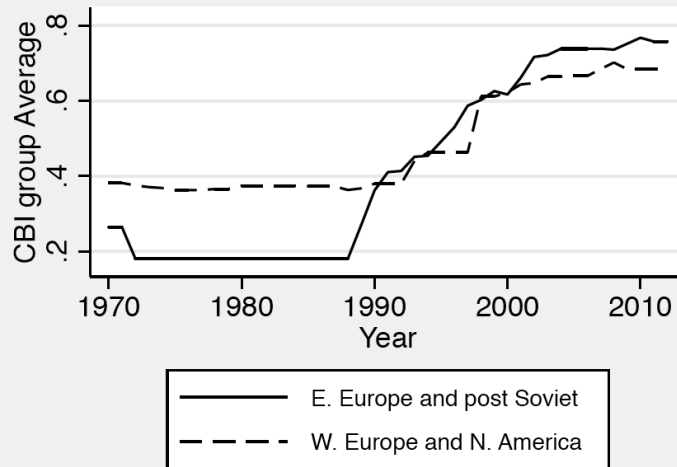
# Data

- Sample: 186 banks from 20 Asian countries.
  - banks included in World Datastream Bank
  - Bahrain 7; China 7; Hong Kong 4; Indonesia 8; Israel 6; Japan 20; Jordan 10; Kuwait 7; Malaysia 8; Oman 6; Pakistan 8; Philippines 8; Qatar 8; Singapore 3; South Korea 5; Sri Lanka 7; Taiwan 9; Thailand 4; United Arab Emirates 16; Vietnam 5
- Period: 2001-2015

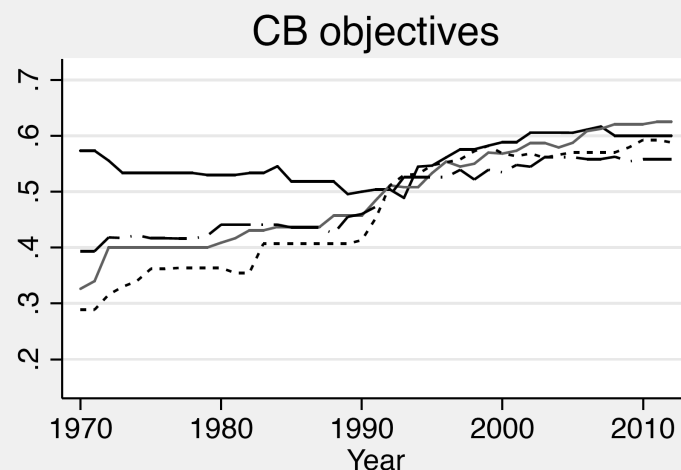
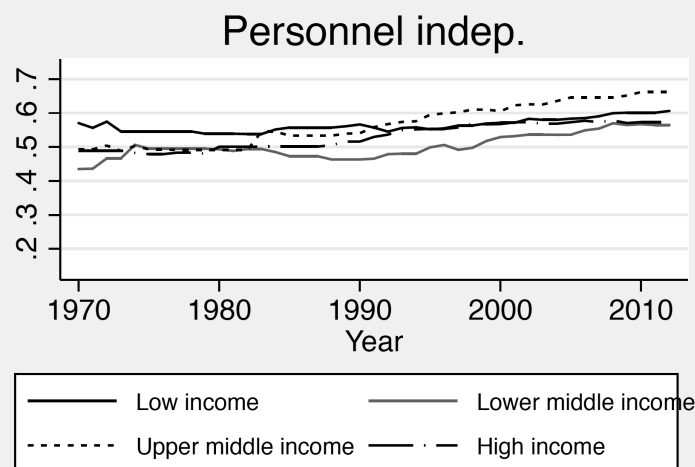
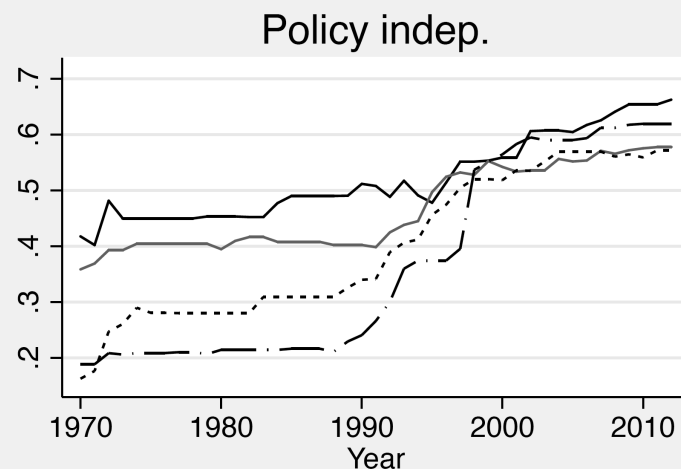
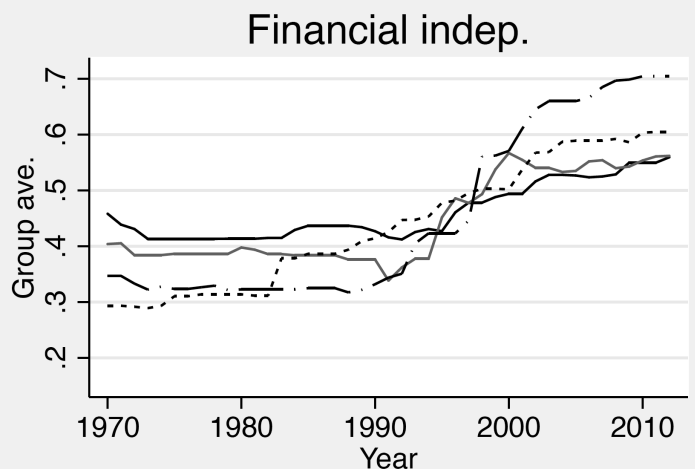
# Descriptive statistics

	Obs	Mean	Std. Dev.	Min	Max
<b>CoVaR (Conditional Value at Risk)</b>	2790	0,99	0,82	-0,41	3,55
<b>MES (Marginal Expected Shortfall)</b>	2790	1,15	0,93	-0,06	6,65
<b>Central Bank Independence</b>	2355	0,47	0,17	0,19	0,94
<b>Component 1: CB CEO</b>	2018	0,56	0,16	0	0,77
<b>Component 2: CB objectives</b>	2018	0,57	0,21	0	1
<b>Component 3: Policy formulation</b>	2018	0,55	0,23	0	1
<b>Component 4: CB lending</b>	2018	0,42	0,21	0,14	1
<b>GMT Index of Political CBI</b>	2700	0,32	0,19	0	0,62
<b>GMT Index of Economic CBI</b>	2700	0,35	0,24	0,13	1
<b>GMT Index of CBI</b>	2700	0,33	0,20	0,06	0,81
<b>Extended CBI Index - ECBI</b>	2700	0,48	0,15	0,14	0,86
<b>Size of bank (Natural logarithm of TA)</b>	2614	16,62	1,68	9,88	21,89
<b>Non-performing loans/Total loans</b>	2341	0,05	0,05	0	0,72
<b>Return on Assets</b>	2179	0,01	0,02	-0,26	0,13
<b>Common equity/Total assets</b>	2321	0,09	0,05	0,024	0,29
<b>Bank Concentration</b>	2131	0,63	0,21	0,37	1
<b>Domestic credit to private sector</b>	2132	1,03	0,62	0,16	2,34
<b>GDP growth</b>	2408	0,04	0,04	-0,07	0,26
<b>Inflation consumer prices</b>	2322	0,03	0,04	-0,05	0,23
<b>Rule of Law</b>	2534	0,58	0,72	-0,97	1,89
<b>Financial freedom Heritage</b>	2655	50,21	13,89	30	90
<b>Emerging economy</b>	2790	0,40	0,49	0	1

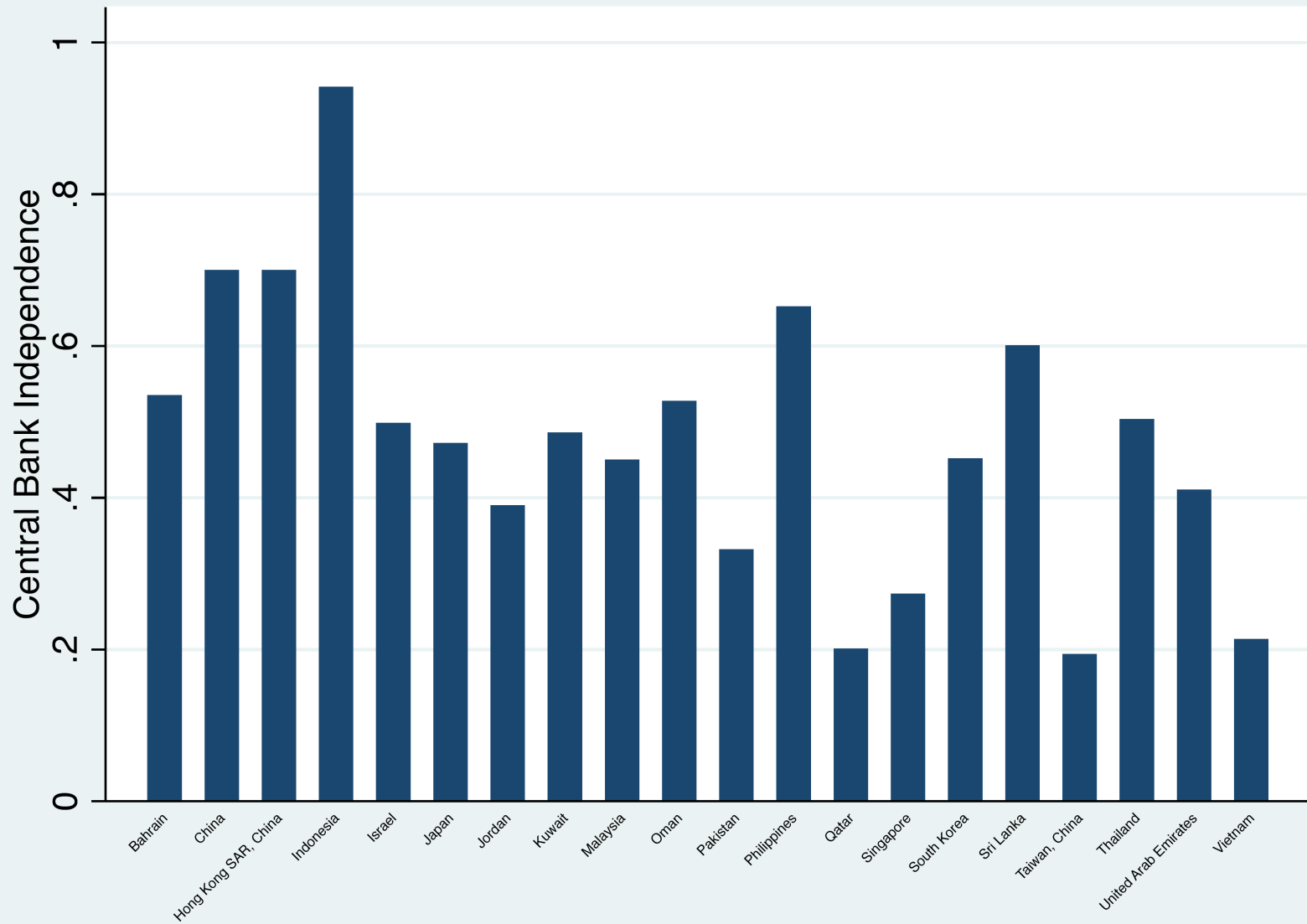
# CBI Regional averages



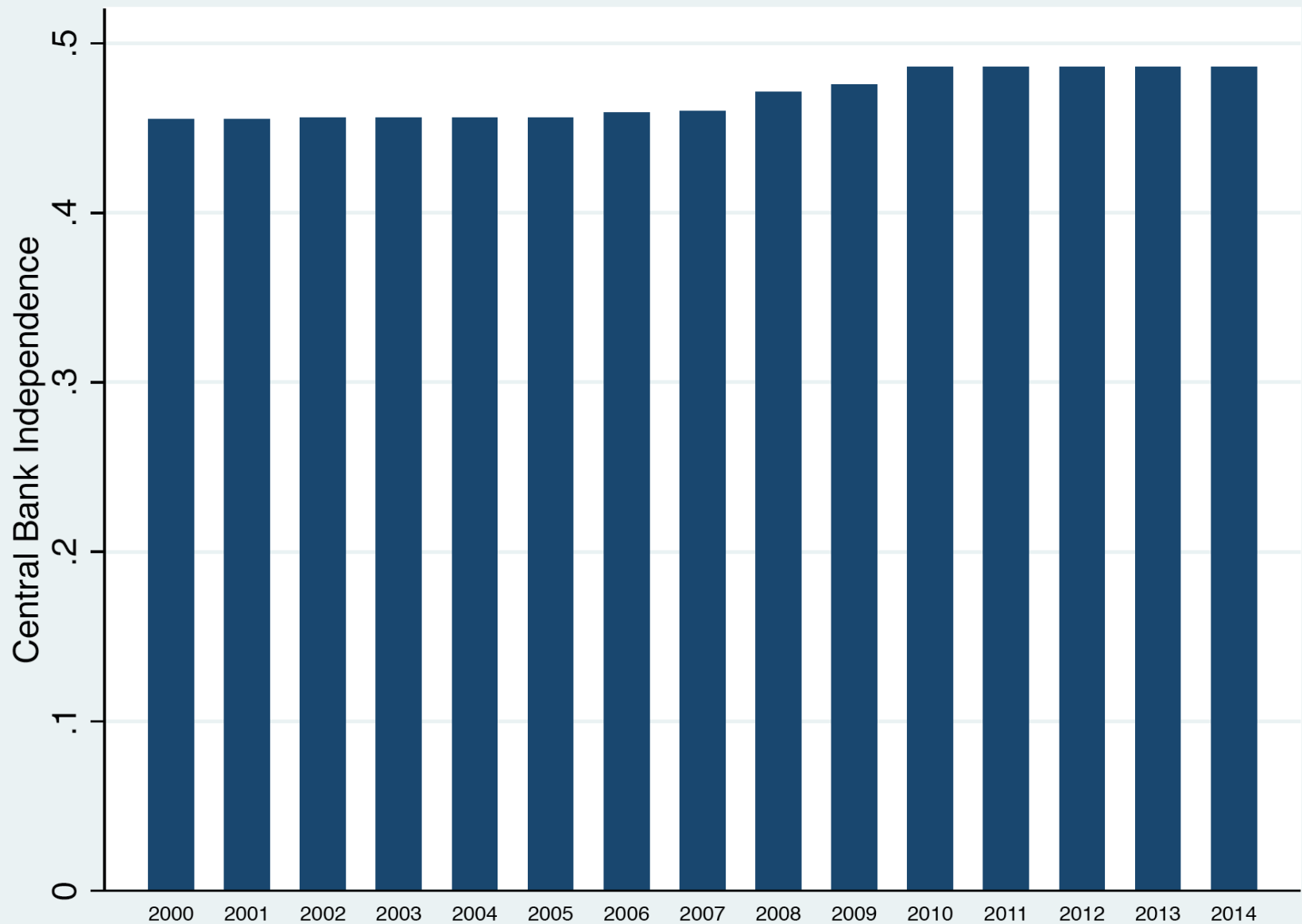
# CBI components, income group averages



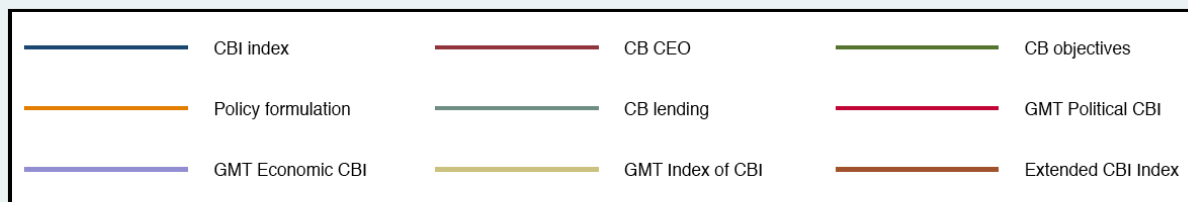
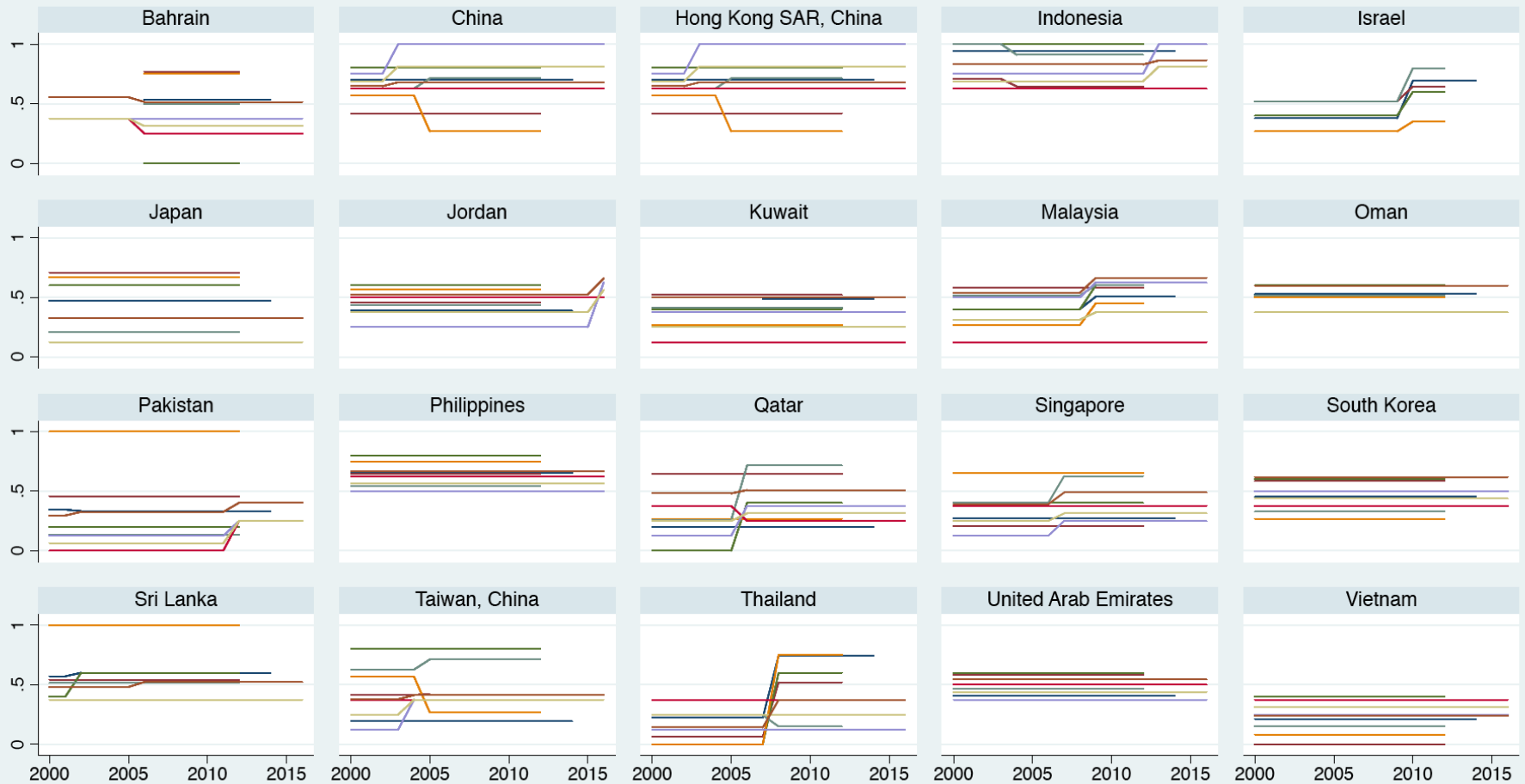
# Central Bank Independence by Country



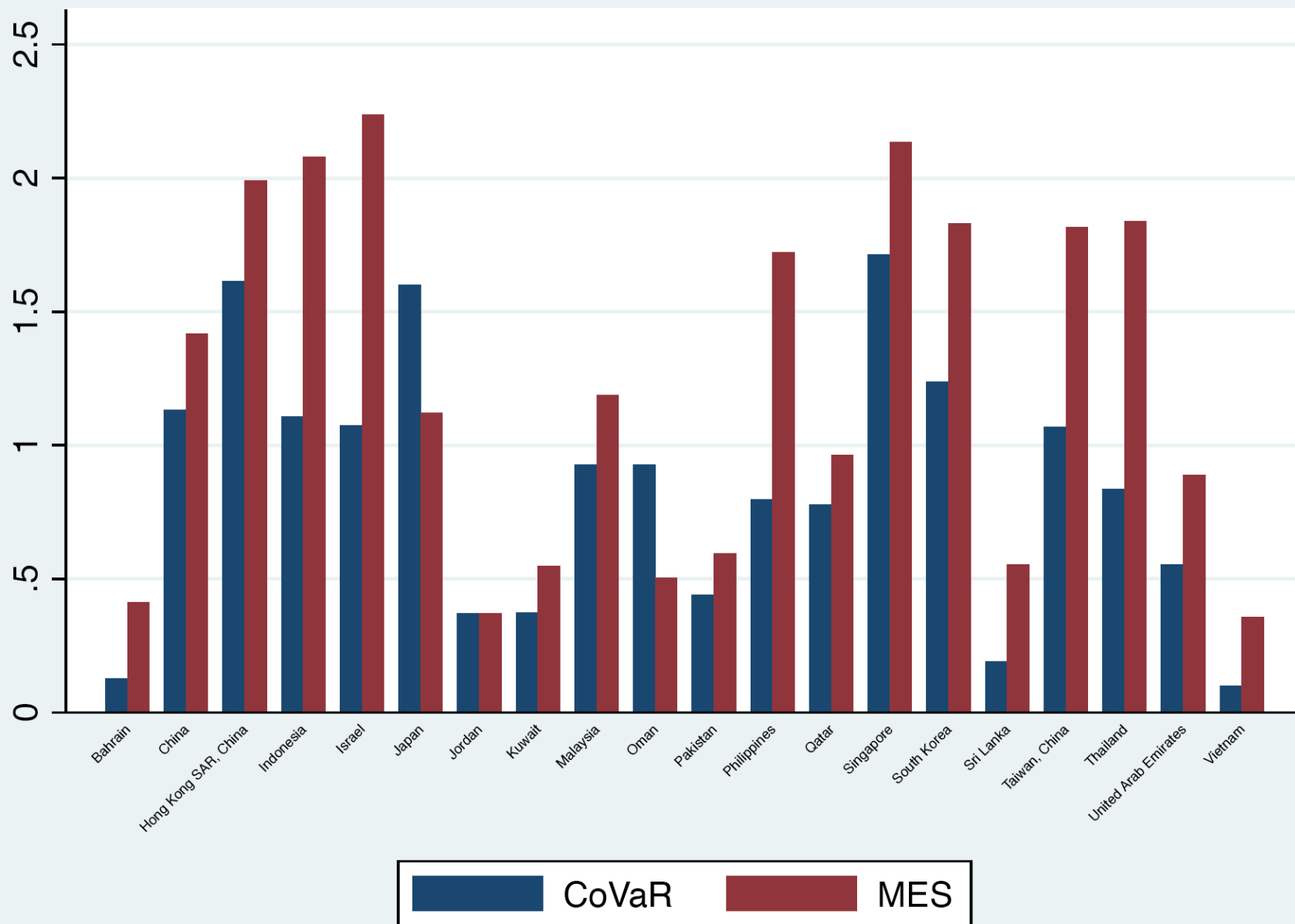
# Central Bank Independence by Year



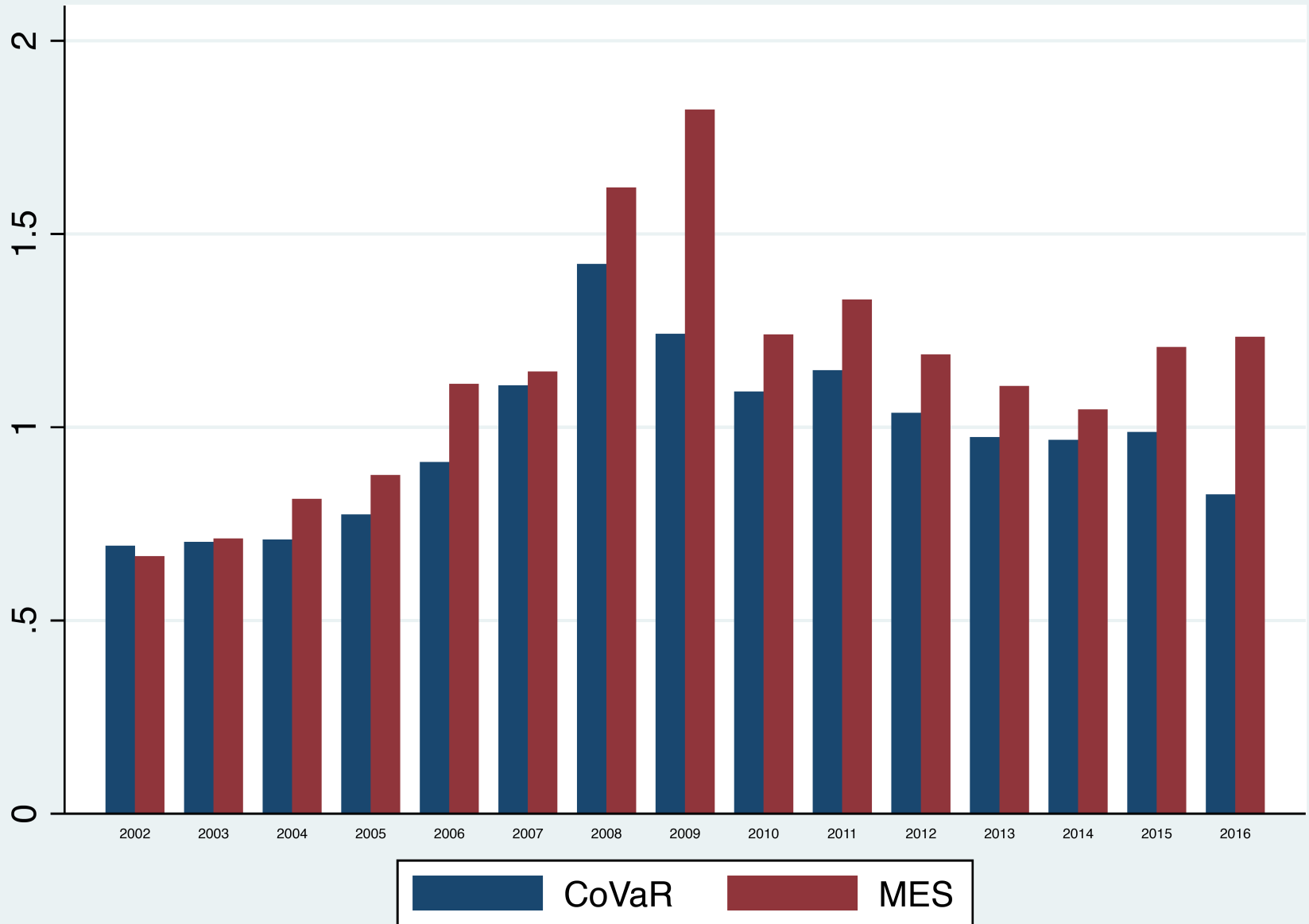
# CBI indices by Country



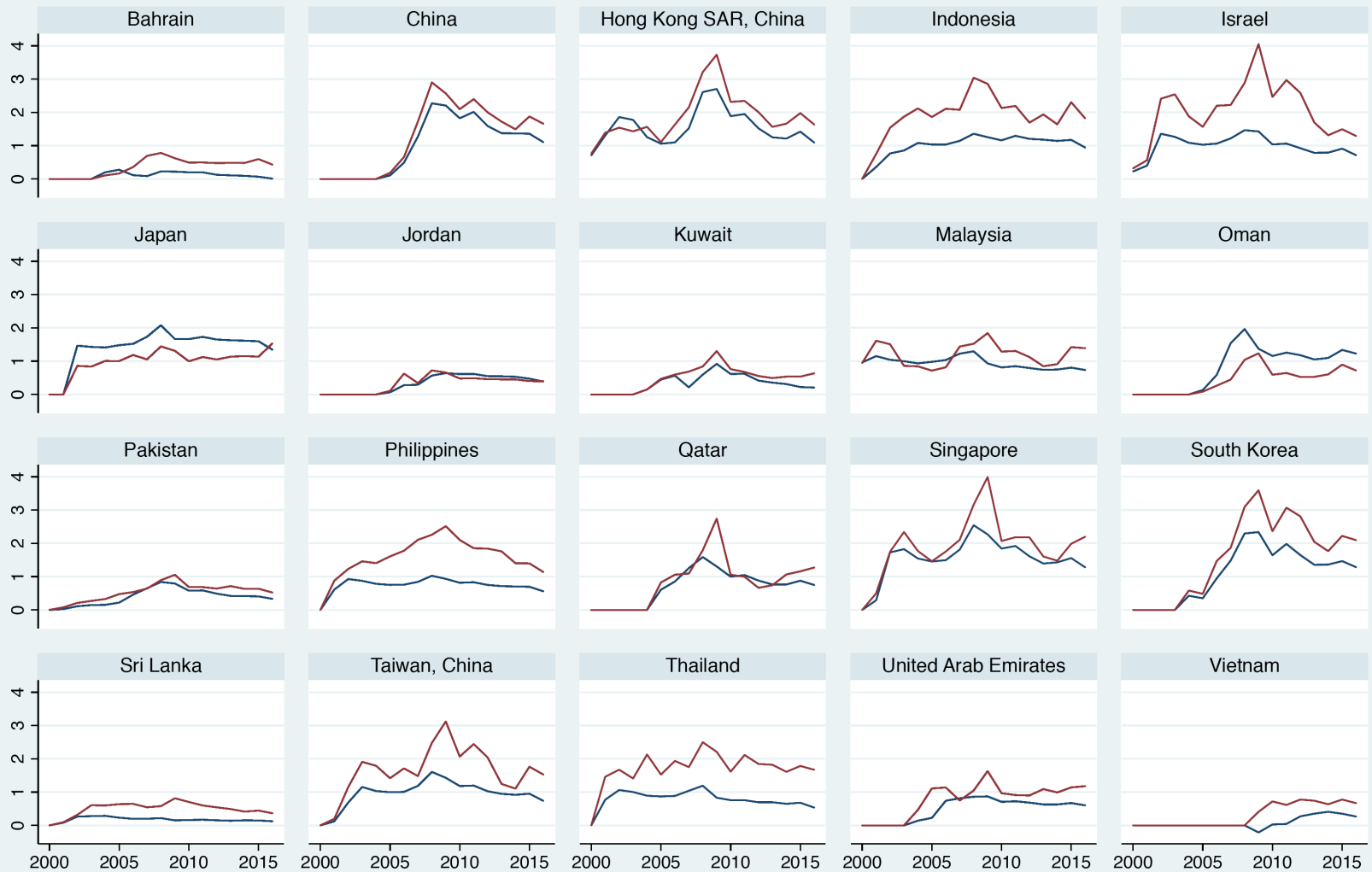
# Systemic risk by Country



# Systemic risk by Year



# Systemic risk by Year



Average level of cCoVaR by country and year



Average level of MES by country and year



# Results – Systemic Risk (CoVaR)

Dependent: CoVaR	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10
<i>Fixed-effects parameters</i>										
Central Bank Independence	<b>-1.0634***</b> (0.3270)									
Component 1: CB CEO		<b>-1.2513*</b> (0.7266)								
Component 2: CB objectives			-0.4040 (0.2754)							
Component 3: Policy formulation				<b>-2.5964***</b> (0.2556)						
Component 4: CB lending					0.1817 (0.2485)					
CB CEO turnover						<b>0.1550***</b> (0.0318)				
CBI - GMT Index							<b>-0.6613*</b> (0.4461)			
Political CBI - GMT Index								<b>-0.7756**</b> (0.3690)		
Economic CBI - GMT Index									-0.0954 (0.3171)	
Extended CBI Index										<b>-1.6167***</b> (0.5617)
Constant	1.0133* (0.5394)	-0.3618 (0.7300)	-1.1335* (0.6107)	1.2795* (0.6720)	-1.0118* (0.6066)	-0.1931 (0.5469)	0.7066 (0.5754)	0.9047 (0.5897)	0.6038 (0.5673)	1.1247* (0.5974)
Bank level controls	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Banking system level controls	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Macro level controls	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
<i>Random-effects parameters</i>										
Country-level variance	-0.5001** (0.2434)	-0.9490*** (0.2758)	-0.8537*** (0.2884)	-0.3731* (0.2211)	-0.9386*** (0.2935)	-0.8334*** (0.2702)	-0.3965 (0.2446)	-0.3631 (0.2401)	-0.4666* (0.2413)	-0.3864 (0.2421)
Bank-level variance	-0.4425*** (0.0680)	-0.4799*** (0.0682)	-0.4747*** (0.0686)	-0.4704*** (0.0686)	-0.4756*** (0.0685)	-0.4936*** (0.0679)	-0.4594*** (0.0690)	-0.4581*** (0.0690)	-0.4588*** (0.0689)	-0.4604*** (0.0691)
Residual variance	-1.0691*** (0.0205)	-0.9428*** (0.0219)	-0.9438*** (0.0219)	-0.9926*** (0.0218)	-0.9422*** (0.0219)	-0.9921*** (0.0208)	-0.9800*** (0.0203)	-0.9813*** (0.0203)	-0.9786*** (0.0203)	-0.9825*** (0.0203)
N. of cases	1330	1185	1185	1185	1185	1299	1355	1355	1355	1355
chi2	88.0350	71.7917	70.2255	174.8848	69.1415	89.3176	73.4629	76.0206	70.8006	79.9526
p	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000



# Results – Systemic Risk (MES)

Dependent: MES	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10
<i>Fixed-effects parameters</i>										
Central Bank Independence	<b>-0.8849**</b> (0.3900)									
Component 1: CB CEO		0.0034 (0.8769)								
Component 2: CB objectives			0.0615 (0.3211)							
Component 3: Policy formulation				<b>-3.2873***</b> (0.2988)						
Component 4: CB lending					<b>0.9669***</b> (0.2909)					
CB CEO turnover						0.0261 (0.0371)				
CBI - GMT Index							<b>-0.8234*</b> (0.4628)			
Political CBI - GMT Index								-0.1215 (0.4052)		
Economic CBI - GMT Index									<b>-0.9095***</b> (0.3430)	
Extended CBI Index										-0.0674 (0.6167)
Constant	-0.1169 (0.5837)	-1.6824** (0.8004)	-1.6808*** (0.6419)	1.0335 (0.7181)	-1.4636** (0.6484)	-0.6797 (0.5952)	-0.6644 (0.5669)	-0.4842 (0.5916)	-0.4634 (0.5740)	-0.5106 (0.6106)
Bank level controls	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Banking system level controls	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Macro level controls	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
<i>Random-effects parameters</i>										
Country-level variance	-0.5057** (0.2278)	-0.5977** (0.2377)	-0.6074** (0.2439)	-0.1767 (0.2119)	-0.5502** (0.2445)	-0.4980** (0.2308)	-0.6492** (0.2526)	-0.5153** (0.2583)	-0.5675** (0.2400)	-0.5387** (0.2436)
Bank-level variance	-0.7588*** (0.0744)	-0.8245*** (0.0761)	-0.8248*** (0.0761)	-0.7875*** (0.0746)	-0.8218*** (0.0760)	-0.8191*** (0.0737)	-0.7601*** (0.0755)	-0.7643*** (0.0754)	-0.7594*** (0.0756)	-0.7638*** (0.0754)
Residual variance	-0.8617*** (0.0205)	-0.7710*** (0.0219)	-0.7709*** (0.0219)	-0.8314*** (0.0219)	-0.7769*** (0.0219)	-0.8352*** (0.0208)	-0.8347*** (0.0203)	-0.8345*** (0.0203)	-0.8372*** (0.0203)	-0.8343*** (0.0203)
N. of cases	1330	1185	1185	1185	1185	1299	1355	1355	1355	1355
chi2	255.4633	262.0745	262.1243	411.3839	275.6285	260.8711	245.1772	242.8867	250.6348	242.5614
p	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000



# Results – Robustness

Dependent: CoVaR	Model 1	Model 2	Model 3	Model 3
<i>Fixed-effects parameters</i>				
Central Bank Independence	-1.1903*** (0.1841)	-1.0930*** (0.3437)	-0.4858** (0.2365)	-0.4884 (1.1170)
Constant	2.3680*** (0.1475)	1.0214* (0.5714)	0.4765 (0.7101)	-3.0121*** (0.9550)
Bank fixed effect	YES	NO	NO	NO
Country fixed effect	YES	NO	NO	NO
Year fixed effect	YES	NO	NO	NO
Bank level controls	NO	YES	YES	YES
Banking system level controls	NO	YES	YES	YES
Macro level controls	NO	YES	YES	YES
<i>Random-effects parameters</i>				
Country-level variance	-26.7851 (1367.1763)	-0.2850 (0.2365)		-0.6138** (0.2463)
Bank-level variance	-29.2181*** (1.4482)	-0.4541*** (0.0675)		-0.6062*** (0.0789)
Residual variance	-0.8300*** (0.0141)	-1.0225*** (0.0202)		-1.3927*** (0.0386)
Method	MLE	RMLE	OLS	MLE
N. of cases	2527	1381	1381	463
R-squared			0.2207	
chi2	7855.6319	93.0146	116.9678	59.9309
p	0.0000	0.0000	0.0000	0.0000

# Diff-in-Diff analysis

- We use the difference-in-difference methodology in order to assess if the impact of Central Bank Independence was amplified or diminished by different characteristics of banks or banking market conditions:

$$Risk_{ijt} = \underbrace{\alpha + \beta CBI_{ijt-1} + \zeta CBI_{ijt-1} \times W_{(i)jt-1} + \gamma X_{ijt-1} + \delta Z_{jt-1}}_{\text{fixed component}} + \underbrace{u_{ij} + e_j + \varepsilon_{ij}}_{\text{random component}}$$

- $W_{(i)j,t-1}$  reflects:
  - Macroeconomic conditions
  - Banks' characteristics
  - Banking systems characteristics
  - Banking systems governance
  - Country governance and culture



# Diff-in-Diff analysis

- Macroeconomic conditions
  - Crisis;
  - Emerging economy;
  - GDP growth



# Diff-in-Diff analysis

Dependent: CoVaR	Model 1	Model 2	Model 3
<i>Fixed-effects parameters</i>			
Central Bank Independence	-1.2791*** (0.3247)	-0.8567** (0.3540)	-0.8093** (0.3509)
CBI x Crisis	0.3562*** (0.0617)		
CBI x Emerging		-1.4074* (0.8125)	
CBI x GDP growth			-6.9538*** (2.2575)
Constant	2.5973*** (0.6014)	0.8747 (0.5627)	0.7623 (0.5643)
Bank level controls	YES	YES	YES
Banking system level controls	YES	YES	YES
Macro level controls	YES	YES	YES
<i>Random-effects parameters</i>			
Country-level variance	-0.4755* (0.2472)	-0.3855 (0.2493)	-0.3550 (0.2256)
Bank-level variance	-0.4162*** (0.0687)	-0.4421*** (0.0681)	-0.4572*** (0.0674)
Residual variance	-1.0855*** (0.0205)	-1.0715*** (0.0205)	-1.0305*** (0.0201)
N. of cases	1330	1330	1381
chi2	124.4136	92.1123	103.4487
p	0.0000	0.0000	0.0000



# Diff-in-Diff analysis

- Bank characteristics
  - Size of bank;
  - Distance to default;
  - Share of NPL;
  - Return on Assets;
  - Bank structure of capital;
  - Share of non-deposit funding in total liabilities

# Diff-in-Diff analysis

Dependent: CoVaR	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
<i>Fixed-effects parameters</i>						
Central Bank Independence	-15.1747*** (2.7222)	-0.4545 (0.3533)	-1.0079*** (0.3544)	-1.0090*** (0.3498)	-1.5027*** (0.3904)	-1.4311*** (0.3461)
CBI x Size of bank	0.8158*** (0.1564)					
CBI x Distance to default		-0.0316*** (0.0106)				
CBI x Share of NPL			-1.2851 (2.1521)			
CBI x Return on Assets				-7.3906 (9.9796)		
CBI x Bank structure of capital					7.1110** (3.1555)	
CBI x Share of non-deposit funding in total liabilities						1.8762*** (0.3937)
Constant	8.3574*** (1.5142)	3.1945*** (0.6053)	0.9664* (0.5562)	0.9133 (0.5639)	1.2773** (0.5706)	1.2521** (0.5727)
Bank level controls	YES	YES	YES	YES	YES	YES
Banking system level controls	YES	YES	YES	YES	YES	YES
Macro level controls	YES	YES	YES	YES	YES	YES
<i>Random-effects parameters</i>						
Country-level variance	-0.3482 (0.2235)	-0.2434 (0.2231)	-0.3939* (0.2284)	-0.3883* (0.2280)	-0.3870* (0.2276)	-0.2556 (0.2179)
Bank-level variance	-0.4499*** (0.0675)	-0.4307*** (0.0692)	-0.4552*** (0.0674)	-0.4573*** (0.0675)	-0.4469*** (0.0676)	-0.4375*** (0.0675)
Residual variance	-1.0383*** (0.0201)	-1.1278*** (0.0213)	-1.0267*** (0.0201)	-1.0266*** (0.0201)	-1.0294*** (0.0201)	-1.0385*** (0.0201)
N. of cases	1381	1245	1381	1381	1381	1381
chi2	122.6946	95.0525	93.2191	93.4609	98.4801	118.9433
p	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000



# Diff-in-Diff analysis

- Banking system characteristics
  - Explicit DGS;
  - Public Credit Registry;
  - Share of Government - controlled banks;
  - Share of Foreign - controlled banks;
  - Low Z-score;
  - Lower Competition - Boone Indicator;
  - Higher market power - Lerner Indicator;
  - Low Financial intermediation



# Diff-in-Diff analysis

[illegible]

# Diff-in-Diff analysis

- Banking system governance
  - Banking supervision in CB;
  - Sectoral supervision;
  - High Supervisory Power;
  - High Financial stability transparency;
  - Bank Transparency;
  - Macroprudential Index;
  - Macroprudential Borrower-Targeted Instruments;
  - Macroprudential Financial Institution-Targeted Instruments;
  - Exchange rate regime (more flexible);
  - Inflation-targeting framework



[illegible]

# Diff-in-Diff analysis

- Country governance
  - Low Political Stability;
  - Low Regulatory Quality;
  - Low Rule of Law;
  - Low Exchange Rate Stability;
  - Low Monetary Independence Index;
  - Low Financial Openness Index;
  - Low Overall globalization index;
  - Low Overall economic freedom score;
  - Low Financial freedom score;
  - Low Monetary freedom score

# Diff-in-Diff analysis

[illegible]

# Diff-in-Diff analysis

- Other country characteristics
  - Power distance index;
  - Individualism vs collectivism;
  - Muslim - Religion practised by largest proportion of the population;
  - Civil Law;
  - Low Creditor rights index

# Diff-in-Diff analysis

Dependent: CoVaR	Model 1	Model 2	Model 3	Model 4	Model 5
<i>Fixed-effects parameters</i>					
Central Bank Independence	-0.7690* (0.4145)	-3.6229*** (1.3829)	-0.9148*** (0.3355)	-1.0986*** (0.3300)	-1.1116 (0.9092)
CBI x Power distance index	-0.0164* (0.0087)				
CBI x Individualism vs collectivism		0.0482* (0.0269)			
CBI x Muslim			-1.2807** (0.6087)		
CBI x Civil Law				0.5955 (0.6776)	
CBI x Low Creditor rights index					0.0484 (0.8540)
Constant	1.3898** (0.6694)	1.3883** (0.6696)	1.1171** (0.5450)	0.8212 (0.5724)	1.0198* (0.5507)
Bank level controls	YES	YES	YES	YES	YES
Banking system level controls	YES	YES	YES	YES	YES
Macro level controls	YES	YES	YES	YES	YES
<i>Random-effects parameters</i>					
Country-level variance	-0.3291 (0.2784)	-0.3287 (0.2844)	-0.4595* (0.2514)	-0.5367** (0.2479)	-0.4996** (0.2434)
Bank-level variance	-0.5047*** (0.0742)	-0.5049*** (0.0742)	-0.4415*** (0.0681)	-0.4421*** (0.0680)	-0.4424*** (0.0680)
Residual variance	-1.0553*** (0.0216)	-1.0551*** (0.0216)	-1.0715*** (0.0205)	-1.0691*** (0.0205)	-1.0692*** (0.0205)
N. of cases	1188	1188	1330	1330	1330
chi2	78.9934	78.6062	93.1179	88.5813	88.0431
p	0.0000	0.0000	0.0000	0.0000	0.0000



# Preliminary findings

- We find a significant and robust negative relation between central bank independence and systemic risk.
- Additionally, our results highlight the importance of other country, banking system and governance indicators in identifying the asymmetric effect of central bank independence on the systemic risk.
- The results show that during the crisis the effect was reduced, but is augmented for emerging economies and during periods with higher economic growth

# Preliminary findings

- In the case of larger, well capitalized and less traditional banks, the effect of CBI is enhanced.
- The effect is amplified in the case of more developed, more stable and with a higher level of competition banking systems.
- Also, the impact on systemic risk is augmented in case of more transparent central bank and for countries where the CB is involved in banking supervision, but is reduced in case of CB with a higher supervisory power and countries with more flexible exchange rate regime and inflation targeting framework.
- The impact is reduced in case of countries which a tight macroprudential policy.

# Further steps

- Extend the sample
  - banks included in World Datastream Bank
  - 414 banks from 61 countries

# Further steps

- Similar to Balls et al. (2016), collect data and create an new index to reflect the role of the CB in implementing the macroprudential policies

## Scoring Breakdown:

### **1/ Macro-prudential tools**

*A. Are these tools housed within central bank? 1=YES, 0=NO*

*B. Is there a clear decision-making structure to account for tensions and complementarities between financial stability and monetary policy objectives? 1=Different committees; 0.5=some differentiation; 0=No differentiation*

*C. Is macro-prudential toolkit limited to banking sector? 1=NO, 0=YES*

### **Systemic risk monitoring**

*A. Is there a mechanism to coordinate all the relevant agencies? 1=YES; 0=NO*

*B. Do other agencies have the analytical firepower to challenge the central bank's view? 1=YES; 0=NO*

*C. Can the monitoring body issue binding recommendations? 1=YES; 0=NO*

### **Crisis management**

*A. Do crisis management mechanisms exist? 1=YES; 0=NO*

*B. Does the Ministry of Finance play a leading role? 1=YES; 0=NO*

*C. Can the central bank extend liquidity to non-banks in a crisis? 1=YES; 0=NO*

### **Monetary-debt management coordination**

*A. Do coordination mechanisms exist which are led by the central bank? 1=YES; 0.5=SOMEWHAT; 0=NO*

### **Monetary-fiscal coordination**

*A. Do coordination mechanisms exist? 1=YES; 0.5= Put in place on an ad hoc basis; 0=NO*

*B. Is there a procedure for the central bank or an independent body to initiate/recommend monetary-fiscal coordination? 1=YES, 0=NO*



Thank you!



# Systemic risk estimation

- **Total market-valued assets** for bank  $i$  at moment  $t$ :

$$AssetsMV_t^i = Assets(Book\ Value)_t^i \times \frac{Equity(Market\ Value)_t^i}{Equity(Book\ Value)_t^i}$$

- **Market-valued assets returns** at moment  $t$ :

- Bank “ $i$ ”:

$$R_{AssetsMV,t}^i = \frac{AssetsMV_t^i}{AssetsMV_{t-1}^i} - 1$$

- System/Group:

$$R_{AssetsMV,t}^{sys} = \sum_i \frac{AssetsMV_t^i}{\sum_i AssetsMV_t^i} R_{AMV,t}^i$$

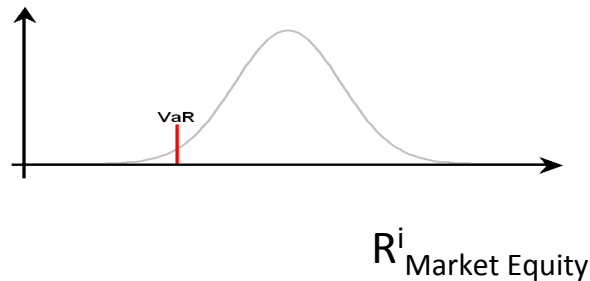
# Systemic risk estimation

- Value at Risk

$$q = \text{Prob}(R_{\text{AssetsMV},t}^i \leq \text{VaR}_{q,t}^i) = \int_{-\infty}^{\text{VaR}_{q,t}^i} f(x) dx$$

$\alpha=99\%$

Frequency



- Conditional Value at Risk: Adrian and Brunnermeier (AER, 2017)

$$\text{Prob}(R_{\text{AssetsMV},t}^{\text{sys}} \leq \text{CoVaR}_{q,t}^{\text{sys}} | R_{\text{AssetsMV},t}^i = \text{VaR}_{q,t}^i | R_{\text{AssetsMV},t}^i = \text{VaR}_{q,t}^i) = q$$

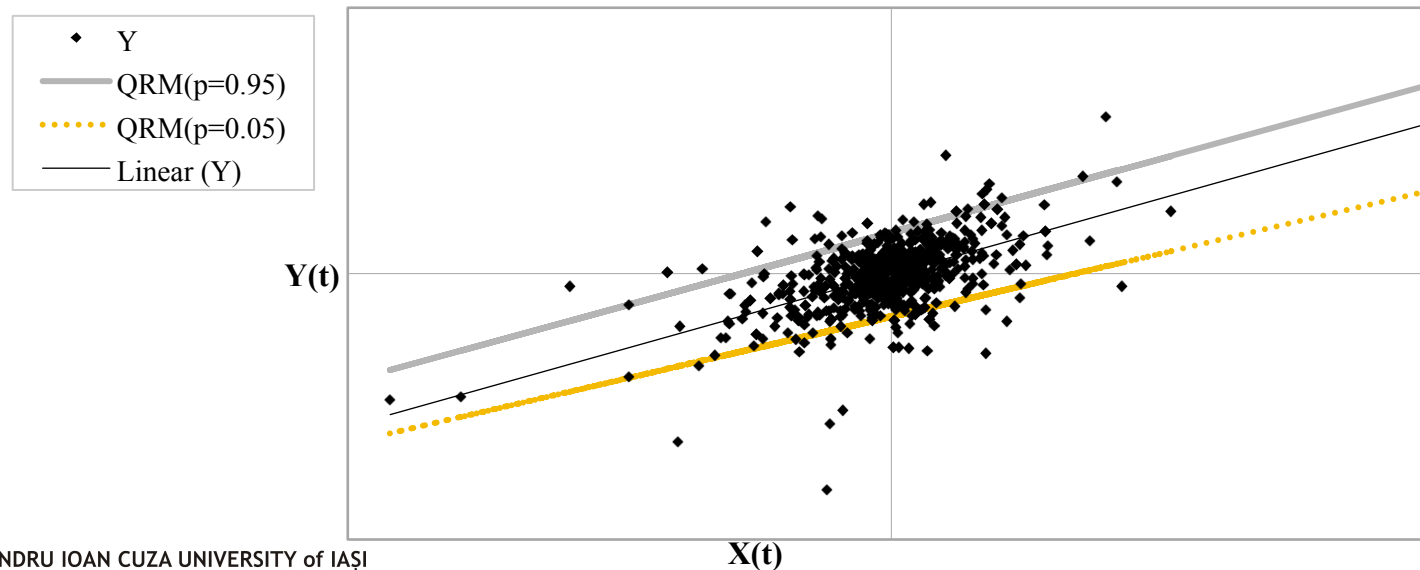
# Systemic risk estimation

- OLS:

$$\beta^{OLS} = \arg \min_{\beta} \sum_t (y_t - \alpha - \beta x_t)^2$$

- QR:

$$\beta^q = \arg \min_{\beta} \sum_t \begin{cases} q |y_t - \alpha - \beta x_t| & , \text{ if } y_t - \alpha - \beta x_t \geq 0 \\ 1 - q |y_t - \alpha - \beta x_t| & , \text{ if } y_t - \alpha - \beta x_t < 0 \end{cases}$$



# Systemic risk estimation

## Empirical strategy: Estimating Individual Risk (VaR)

- $\text{VaR}_t^{\text{bank } i} = f(\text{Market indices}_{t-1})$

$$R_{\text{AssetsMV},t}^i = \alpha^i + \sum_{j=1}^k (\beta_j^i \times I_{p,t-1}^j) + \gamma^i \text{Crisis} + \varepsilon^i$$

$$\widehat{\text{VaR}}_{q,t}^i = \hat{\alpha}^i + \sum_{j=1}^k (\hat{\beta}_j^i \times I_{p,t-1}^j) + \hat{\gamma}^i \text{Crisis}$$

# Systemic risk estimation

## Empirical strategy: Estimating SR (Asymmetric CoVaR)

- $\text{CoVaR}_t^{\text{system}} = f(\text{VaR}_{t-1}^{\text{bank } i}; \text{Market indices}_{t-1})$

$$R_{AssetsMV,t}^{sys|i} = \alpha^{sys|i} + \sum_{j=1}^k (\beta_j^{sys|i} \times I_{p,t-1}^j) + \delta^{sys|i(-)} \times R_{AssetsMV,t}^i \times I_{(R_{AssetsMV,t}^i < 0)} \\ + \delta^{sys|i(+)} \times R_{AssetsMV,t}^i \times I_{(R_{AssetsMV,t}^i \geq 0)} + \gamma^i Crisis + \varepsilon_t^{sys|i}$$

$$\widehat{ACoVaR}_{q,t}^{sys|i} = \widehat{\alpha}_q^{sys|i} + \sum_{j=1}^k (\widehat{\beta}_{j,q}^{sys|i} \times I_{p,t-1}^j) + \widehat{VaR}_{q,t}^i \times (\widehat{\delta}_q^{sys|i(-)} I_{(VaR_{q,t}^i < 0)} \\ + \widehat{\delta}_q^{sys|i(+)} I_{(VaR_{q,t}^i \geq 0)}) + \widehat{\gamma}_q^i Crisis$$

# Systemic risk estimation

- Contribution to systemic risk

$$cACoVaR_{q,t}^{sys|i} = ACoVaR_{q,t}^{sys|R_{AssetsMV,t}^i = VaR_{q,t}^i} - ACoVaR_{q,t}^{sys|R_{AssetsMV,t}^i = VaR_{50\%,t}^i}$$

