Asian Economic Integration Report 2017

Online Annex 2: Theme Chapter
The Era of Financial Interconnectedness: How Can Asia Strengthen Financial Resilience

2.A: Vulnerability Indicators

Economy/Variable	Current Account/GDP				External Debt/GDP				Short-term External Debt/Reserves				Foreign Liabilities/Foreign Assets[1]				Fiscal Balance/GDP[2]		
	pre-AFC	pre-GFC	Latest		pre-AFC	pre-GFC	Latest		pre-AFC	pre-GFC	Latest		pre-AFC	pre-GFC	Latest		pre-AFC	pre-GFC	2016
Bangladesh	–	1.4	-0.6	(2016)	30.8	25.3	17.4	(2015)	8.9	31.0	24.5	(2015)	–	104.1	125.2	(Jul 2017)	–	-3.4	-3.1
Brunei Darussalam	–	56.4	11.0	(2016)	–	–	–		–	–	–		–	6.7	0.9	(Jul 2017)	–	22.0	-21.0
Cambodia	-5.3	-3.3	-8.9	(2016)	50.0	39.3	51.6	(2015)	0.1	0.0	19.5	(2015)	–	17.0	152.3	(Feb 2017)	–	-2.7	-0.3
China, People's Republic of	–	7.2	1.7	(Q2 2017)	–	12.3	12.7	(2016)	–	17.6	28.7	(2016)	122.7	27.2	34.8	(Jun 2017)	–	-1.0	-3.8
Hong Kong, China	–	6.1	2.6	(Q2 2017)	–	281.3	414.4	(2016)	–	251.7	237.2	(2016)	95.1	57.9	79.3	(Apr 2017)	–	3.9	3.7
India	–	–	-0.6	(Q1 2017)	–	17.0	20.2	(2016)	–	13.3	24.6	(2016)	14.3	0.6	1.5	(Jun 2017)	–	-5.4	-2.9
Indonesia	–	–	-2.0	(Q2 2017)	–	36.4	34.1	(2016)	–	28.9	35.8	(2016)	–	65.4	190.5	(Apr 2017)	–	-0.9	-2.5
Japan	1.3	3.2	3.4	(Q2 2017)	–		69.0	(2016)	–	116.9	213.5	(2016)	–	63.1	61.5	(May 2017)	-4.0	-0.7	-4.1
Kazakhstan	–	-1.1	-4.2	(Q2 2017)	–	91.2	118.8	(2016)	–	78.2	34.1	(2016)	–	209.2	53.8	(Jun 2017)	–	0.8	-1.6
Korea, Republic of	-3.4	-0.4	4.4	(Q2 2017)	24.2	22.6	27.0	(2016)	163.8	43.2	28.7	(2016)	–	149.3	76.3	(May 2017)	-1.3	0.6	-0.0
Kyrgyz Republic	–	-4.6	-11.5	(Q2 2017)	–	–	–		–	–	–		–	80.2	65.5	(Aug 2017)	-9.3	-2.5	-4.6
Lao PDR	–	-11.3	-18.0	(2016)	120.5	110.2	80.9	(2015)	0.1	31.1	69.1	(2015)	46.1	55.7	91.2	(Dec 2012)	–	-6.8	-5.9
Malaysia	–	13.0	2.9	(Q2 2017)	39.3	43.0	68.9	(2016)	–	–	90.3	(2016)	–	210.5	129.6	(May 2017)	–	-3.2	-3.1
Myanmar	–	6.8	-7.0	(2016)	5.1	0.3	11.4	(2015)	159.8	68.9	19.8	(2015)	–	210.4	52.8	(May2017)	–	-2.0	-4.6
Pakistan	–	-4.5	-1.2	(2016)	–	24.2	23.1	(2015)	513.6	11.5	23.2	(2015)	–	18.6	125.0	(Jul 2017)	–	-4.0	-4.6
Philippines	–	6.5	-0.3	(Q1 2017)	–	50.1	24.5	(2016)	–	–	19.8	(2016)	–	62.3	70.4	(May 2017)	–	-1.0	-2.4
Singapore	13.1	24.9	20.0	(Q2 2017)	–	469.6	432.2	(2016)	–	449.3	390.3	(2016)	123.2	92.5	112.3	(Jul 2017)	–	-0.02	1.3
Sri Lanka	–	-4.5	-5.5	(2016)	–	42.4	57.3	(2016)	25.4	23.3	141.6	(2016)	113.4	118.1	420.4	(Mar 2016)	–	-7.0	-5.6
Taipei,China	2.7	4.4	12.8	(Q2 2017)	–	22.1	32.4	(2016)	–	27.3	37.3	(2016)	–	75.4	37.3	(Aug 2017)	–	-0.7	-0.3
Thailand	–	-4.2	6.9	(Q2 2017)	–	31.1	32.5	(2016)	–	47.5	32.8	(2016)	–	46.5	85.9	(Jun 2017)	–	1.2	-2.7
Viet Nam	–	-5.6	-2.8	(Q1 2017)	–	30.7	40.3	(2015)	216.3	18.2	42.4	(2015)	106.0	33.5	62.7	(Mar 2017)	–	-1.1	-4.4

2.A: Vulnerability Indicators (continued)

Economy/Variable	Public Sector Debt/GDP			Loans/Deposits of Banks[3]				Bank-Lending Growth[4]				LCY Bonds Outstanding (% of GDP)			NPL Ratio (%)		
	pre-AFC	pre-GFC	2015	pre-AFC	pre-GFC	Latest		pre-AFC	pre-GFC	Latest		pre-AFC	pre-GFC	Q2 2017	pre-AFC	pre-GFC	2016
Bangladesh	46.2	39.6	31.7	–	69.9	78.2	(Jul 2017)	10.8	16.0	11.9	(Jul 2017)	–	–	–	–	12.8	8.4
Brunei Darussalam	–	1.0	2.8	–	66.5	52.9	(Jul 2017)	–	–	–		–	–	–	–	–	3.7
Cambodia	30.2	32.9	32.5	–	66.0	107.2	(Feb 2017)	–	–	–		–	–	–	–	–	2.6
China, People's Republic of	21.3	25.4	42.9	–	–	90.9	(Jun 2017)	–	15.6	13.2	(Aug 2017)	–	41.7	66.3	–	7.1	1.7
Hong Kong, China	–	1.2	0.1	92.5	53.6	58.8	(Apr 2017)	-1.8	7.1	15.7	(Aug 2017)	19.7	48.1	72.5	–	1.1	0.9
India	66.0	77.1	69.1	66.6	74.3	72.1	(Feb 2017)	–	17.8	8.6	(Jul 2017)	–	–	–	–	3.5	7.6
Indonesia	27.5	35.8	27.3	–	66.0	96.5	(Apr 2017)	–	13.7	7.8	(Jul 2017)	–	20.7	17.9	–	5.9	3.0
Japan	102.3	186.0	248.0	–	79.9	59.3	(May 2017)	–	2.9	3.4	(Aug 2017)	–	158.7	211.4	–	1.8	1.5
Kazakhstan	12.7	6.7	21.9	–	159.9	103.1	(Jun 2017)	–	-43.7	25.3	(Jun 2017)	–	–	–	–	2.4	7.9
Korea, Republic of	6.8	29.3	37.9	–	119.6	120.1	(May 2017)	12.6	11.3	4.7	(Jul 2017)	12.9	87.3	127.5	–	0.8	–
Kyrgyz Republic	51.7	72.5	66.0	–	54.7	52.1	(Aug 2017)	–	49.9	13.9	(Aug 2017)	–	–	–	–	6.2	7.1
Lao PDR	119.8	68.4	61.9	74.9	43.2	71.1	(Dec 2010)	–	–	–		–	–	–	–	–	–
Malaysia	33.2	40.2	57.4	–	–	88.8	(Apr 2017)	–	–	5.9	(Aug 2017)	–	74.3	96.2	–	8.5	1.7
Myanmar	–	90.6	34.3	–	59.8	56.7	(May 2017)	–	–	–		–	–	–	–	–	–
Pakistan	65.5	53.9	63.6	–	77.0	49.2	(Jul 2017)	–	–	16.7	(Aug 2017)	–	–	–	–	7.3	11.1
Philippines	54.7	51.6	34.8	–	56.7	71.2	(May 2017)	–	-0.1	20.4	(Aug 2017)	–	37.4	34.2	–	7.5	2.0
Singapore	69.8	87.9	104.7	122.0	86.9	104.8	(Jul 2017)	18.3	5.6	4.7	(Aug 2017)	25.4	64.9	82.7	–	2.8	1.1
Sri Lanka	90.2	87.9	76.0	97.2	91.2	84.0	(Mar 2016)	27.3	33.8	19.4	(May 2017)	–	–	–	–	–	3.0
Taipei,China	–	33.1	36.5	–	67.0	64.0	(Aug 2017)	6.9	4.5	4.6	(Aug 2017)	–	–	–	–	–	–
Thailand	14.8	38.5	42.7	–	101.0	102.8	(Jun 2017)	–	9.0	5.6	(Aug 2017)	9.7	44.1	74.2	–	8.1	2.9
Viet Nam	94.4	38.4	58.3	131.1	93.9	90.3	(Mar 2017)	22.6	21.4	20.1	(Mar 2017)	–	6.9	21.8	–	–	3.4

– = unavailable, AFC = Asian financial crisis, GDP = gross domestic product, GFC = global financial crisis, Lao PDR = Lao People's Democratic Republic, NPLs = nonperforming loans.
[1] Foreign liabilities and assets of banking institutions, deposit money banks, and other depository corporations.
[2] Difference between central government revenues and expenditures as share of GDP at current prices. For Thailand, it is a cash balance composed of the budgetary and non-budgetary balances.
[3] Loans to private sector and non-financial institutions and deposits (demand, time, savings, foreign currency, bond, and money market instruments—where available) of banking institutions, deposit money banks, and other depository corporations of each economy.
[4] Data for People's Republic of China refer to financial institution loans; Hong Kong, China to domestic credit; Indonesia to commercial bank loans; Kazakhstan to loans of other depository corporations; Republic of Korea to loans of commercial and specialized banks; Malaysia to commercial bank loans and advances; Philippines to commercial and universal bank loans net of reverse repurchase arrangements; Singapore to loans and advances of domestic banking units; Taipei,China to domestic banks' loans and advances; Thailand to commercial bank loans; and Viet Nam to claims on private sector of banking institutions.

Notes: Pre-AFC corresponds to June 1996 for monthly data, Q2 1996 for quarterly data, and 1996 for annual data; pre-GFC corresponds to June 2006 for monthly data, Q2 2006 for quarterly data, and 2006 for annual data. Bank lending growth corresponds to the year-on-year growth rate.

Sources: ADB calculations using data from CEIC; national sources; Asian Development Outlook 2017, Asian Development Bank; International Financial Statistics, World Economic Outlook and Historical Public Debt Database, International Monetary Fund; World Development Indicators, World Bank.

2.B: Capital Flows ($ billion) and Exchange Rate Dynamics during Past Crises

Economy/Variable	Net Capital Flows, $ billion		Net Portfolio Investment, $ billion		Net FDI Flows, $ billion		Net Other Investment, $ billion		Exchange Rate, % change (+ = appreciation)	
	AFC	GFC	AFC	GFC	AFC	GFC	AFC	GFC	AFC	GFC
Bangladesh	0.1	-0.2	-0.002	0.002	-0.1	-0.3	0.3	0.0	-2.0	0.04
Brunei Darussalam	–	-0.2	–	-0.02	–	-0.1	–	-0.1	-6.7	-4.6
Cambodia	-0.1	0.0	–	0.003	-0.05	-0.2	-0.04	0.01	-0.1	-0.2
China, People's Republic of	–	98.2	–	-32.9	–	-28.1	–	56.9	0.1	0.2
Hong Kong, China	–	10.1	–	-26.6	–	-5.5	–	36.5	0.1	0.4
India	-0.8	-6.4	-0.5	1.3	-0.8	-5.6	-0.1	-2.0	-0.7	-7.7
Indonesia	-3.1	-2.4	-0.6	-0.1	-1.4	-1.9	0.2	-0.4	-25.6	-3.0
Japan	33.7	29.7	0.8	20.8	6.2	14.1	23.1	-13.4	-4.6	0.02
Kazakhstan	-0.7	1.2	-0.1	1.4	-0.5	-5.6	-0.3	4.1	-0.1	0.6
Korea, Republic of	-3.7	-3.0	-5.5	9.5	0.6	2.6	3.8	-2.2	-2.6	-13.3
Kyrgyz Republic	0.0	0.1	0.001	-0.04	-0.01	-0.1	-0.002	0.1	-0.3	-1.0
Lao PDR	-0.1	-0.1	–	–	-0.02	-0.1	-0.05	-0.04	0.0	1.5
Malaysia	–	9.1	–	15.8	–	5.9	–	-3.1	-22.2	-5.0
Myanmar	-0.1	0.004	–	–	-0.1	-0.2	-0.02	-0.03	5.5	0.0
Pakistan	-0.4	-4.4	-0.1	0.2	-0.2	-1.1	-0.3	-0.3	-0.1	-12.6
Philippines	-2.8	-1.9	0.4	-0.3	-0.2	0.1	-2.7	-1.7	-22.5	-4.3
Singapore	4.2	8.1	4.9	-7.4	-4.3	-0.6	1.7	17.6	-6.5	-5.2
Sri Lanka	0.0	-1.2	0.003	-0.2	-0.3	-0.2	-0.01	-0.5	-1.9	-0.4
Taipei,China	4.8	6.3	4.6	11.0	0.7	1.2	-0.5	-5.9	-2.7	-5.7
Thailand	-1.2	0.2	-2.4	2.5	-1.2	-2.2	4.3	-0.6	-32.6	-1.2
Viet Nam	-0.6	-2.7	–	0.2	-0.7	-3.0	-0.04	-0.5	-0.3	0.7

–= unavailable, AFC = Asian financial crisis, FDI = foreign direct investment, GFC = global financial crisis, Lao PDR = Lao People's Democratic Republic.
Notes: AFC corresponds to 1997Q3, GFC corresponds to 2008Q3. Exchange rate % change corresponds to % appreciation within the given quarter.

Sources: ADB calculations using data from Bloomberg and Balance of Payments, International Monetary Fund.

2.C: Capital Flows (% of GDP) during Past Crises

Economy/Variable	Net Capital Flows, % of GDP		Net Portfolio Investment, % of GDP		Net FDI Flows, % of GDP		Net Other Investment, % of GDP	
	AFC	GFC	AFC	GFC	AFC	GFC	AFC	GFC
Bangladesh	0.7	-0.8	-0.01	0.01	-0.6	-1.3	2.3	-0.1
Brunei Darussalam	-	-5.7	-	-0.6	-	-2.4	-	-2.6
Cambodia	-9.2	-1.0	-	0.1	-5.5	-7.0	-4.1	0.5
China, People's Republic of	-	8.1	-	-2.7	-	-2.3	-	4.7
Hong Kong, China	-	18.0	-	-47.6	-	-9.9	-	65.3
India	-0.7	-1.9	-0.4	0.4	-0.7	-1.7	-0.1	-0.6
Indonesia	-5.3	-1.7	-1.1	-0.04	-2.4	-1.3	0.4	-0.3
Japan	3.0	2.5	0.1	1.8	0.6	1.2	2.1	-1.1
Kazakhstan	-10.2	3.0	-0.9	3.8	-7.7	-14.6	-4.8	10.6
Korea, Republic of	-2.4	-1.1	-3.6	3.6	0.4	1.0	2.5	-0.8
Kyrgyz Republic	-	8.0	-	-2.0	-	-3.0	-	6.7
Lao PDR	-18.0	-10.0	-	-	-4.7	-4.0	-10.9	-3.1
Malaysia	-	14.9	-	25.7	-	9.6	-	-5.1
Myanmar	-0.3	0.0	-	-	-0.4	-0.01	-0.05	-0.003
Pakistan	-	-9.4	-	0.4	-	-2.4	-	-0.6
Philippines	-12.8	-4.3	2.0	-0.7	-1.1	0.2	-12.4	-3.9
Singapore	16.4	16.3	19.0	-14.8	-16.8	-1.1	6.6	35.3
Sri Lanka	-	-10.7	-	-1.6	-	-1.7	-	-4.3
Taipei,China	6.3	6.1	6.0	10.6	0.9	1.1	0.7	-5.6
Thailand	-3.4	0.3	6.7	3.4	3.4	-3.0	12.2	-0.8
Viet Nam	-	-11.3	-	0.6	-	-12.7	-	-2.3

− = unavailable, AFC = Asian financial crisis, FDI = foreign direct investment, GDP = gross domestic product, GFC = global financial crisis, Lao PDR = Lao People's Democratic Republic.
Notes: AFC corresponds to 1997Q3, GFC corresponds to 2008Q3.

Source: ADB calculations using data from CEIC; national sources and Balance of Payments, International Monetary Fund.

2.D.1: Domestic Credit (average % growth) and Loan-to-Deposit Ratios (average)

| Economy/Variable	Pre-AFC (Q1 1995–Q1 1997)		AFC (Q2 1997–Q4 1998)		Pre-GFC (Q1 2005–Q2 2008)		GFC (Q3 2008– Q4 2009)		QE (Q4 2010–Q4 2013)		2014–latest	
	Domestic credit	Loan-to-Deposit ratio	Domestic credit	Loan-to-Deposit ratio	Domestic credit	Loan-to-Deposit ratio	Domestic credit	Loan-to-Deposit ratio	Domestic credit	Loan to-Deposit ratio	Domestic credit[1]	Loan-to-Deposit ratio[2]
Brunei Darussalam	-	-	-	-	4.2	72.6	2.1	67.3	0.1	52.4	0.9	55.4
Cambodia	-	-	-	-	53.3	68.3	35.5	92.6	28.8	88.0	27.1	103.0
China, People's Republic of	24.6	-	18.5	-	13.6	-	22.7	72.4	17.5	75.4	17.7	87.2
Hong Kong, China	15.3	91.3	10.3	94.8	6.8	52.6	2.1	48.7	15.4	60.8	5.9	59.4
India	18.0	66.8	13.6	61.8	26.2	72.9	17.9	72.4	17.9	76.6	9.3	76.2
Indonesia	-	-	-	-	23.0	68.4	22.3	79.0	23.2	91.0	11.3	98.9
Japan	-	-	-	-	-2.4	79.5	-3.1	72.6	-0.1	64.8	1.1	61.5
Korea, Republic of	-	-	-	-	11.7	121.1	11.7	127.4	4.9	121.4	6.7	119.1
Lao PDR	31.4	75.5	73.2	68.3	21.5	37.4	82.3	57.6	43.4	74.6	-	-
Malaysia	-	-	-	-	7.5	-	9.0	78.4	11.0	81.9	8.4	87.6
Myanmar	-	-	-	-	25.1	55.1	19.2	41.0	58.5	42.8	36.9	53.1
Philippines	-	-	-	-	9.2	58.4	11.2	59.1	15.3	65.6	16.0	66.7
Singapore	17.9	120.1	9.1	120.3	7.4	86.0	9.9	82.0	12.4	89.9	6.0	105.3
Thailand	-	-	-	-	5.1	100.3	5.4	96.8	14.3	98.7	5.1	102.7
Viet Nam	21.9	133.8	21.3	111.8	37.1	98.1	32.0	101.8	16.5	99.3	16.7	88.9
United States	-	-	-	-	9.6	-	-5.7	-	1.1	-	6.3	-
Taipei,China	-	80.3	10.1	81.2	6.7	67.0	-0.7	63.2	6.0	62.8	5.1	62.8

AFC = Asian financial crisis, GFC = global financial crisis, Lao PDR = Lao People's Democratic Republic, QE = quantitative easing.
1 Latest data refer to February 2017 for Cambodia; March 2017 for Viet Nam; April 2017 for Hong Kong, China; May 2017 for Japan, Republic of Korea, Malaysia, Myanmar, the Philippines; June 2017 for the People's Republic of China (PRC), India, and Thailand; July 2017 for Brunei Darussalam and Singapore; August 2017 for Taipei,China.
2 Latest data refer to February 2017 for Cambodia and India; March 2017 for Viet Nam; April 2017 for Hong Kong, China; Indonesia, and Malaysia; May 2017 for Japan, Republic of Korea, Myanmar and the Philippines; June 2017 for the PRC and Thailand; July 2017 for Brunei Darussalam and Singapore; August 2017 for Taipei,China.
Source: ADB calculations using data from CEIC; International Monetary Fund International Financial Statistics. www.imf.org/en/Data; and national sources (all accessed October 2017). Extended from Villafuerte (2017).

2.D.2: Corporate Leverage Ratio in Selected Emerging Asian Economies (Debt to EBITDA Ratio)
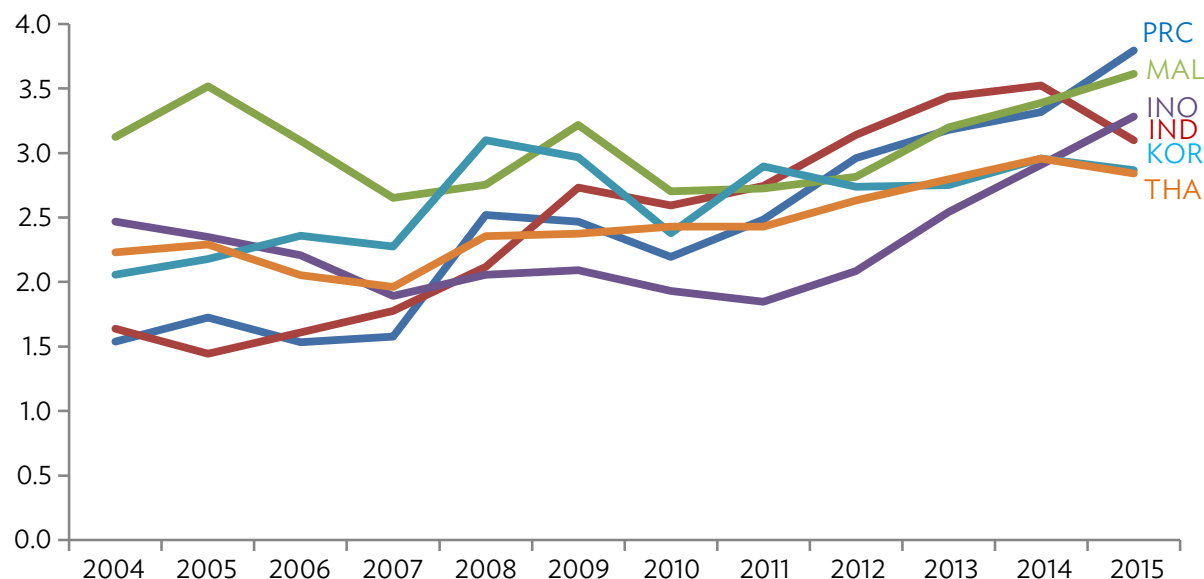
EBITDA = earnings before interest, tax, depreciation, and amortization; IND = India; INO = Indonesia; KOR = Republic of Korea; MAL = Malaysia; PRC = People's Republic of China; THA = Thailand.
Source: Claessens (2017) using data from S&P Capital IQ.

2.E: Linkages of Financial Markets

Vertex	All Phases		Phase 1		Phase 2		Phase 3		Phase 4		Phase 5		Phase 6	
	Out	In	Out	In	Out	In	Out	In	Out	In	Out	In	Out	In
Argentina	4	7	2	9	18	5	4	4	5	3	35	12	0	3
Australia	13	18	4	4	4	7	4	7	5	9	1	14	7	13
Austria	13	14	3	5	5	10	7	6	11	4	12	9	8	8
Belgium	7	11	6	9	6	3	1	5	7	6	17	12	0	7
Brazil	19	11	3	10	6	9	4	8	8	5	12	14	14	0
Canada	24	11	6	4	12	5	16	6	11	1	1	15	9	10
Chile	6	12	11	7	9	7	11	6	2	3	2	10	8	7
China, People's Republic of	16	6	1	4	4	3	1	2	0	3	8	8	23	4
Czech Republic	10	15	4	1	9	11	4	9	3	6	7	9	9	10
Denmark	6	9	10	6	10	9	6	4	10	9	4	9	3	6
Egypt	7	9	7	0	3	6	2	5	0	5	10	7	9	6
Finland	7	12	6	2	2	9	5	10	1	4	5	10	13	11
France	19	10	5	6	1	10	3	5	4	7	33	9	1	5
Germany	9	11	4	5	15	14	3	2	8	4	11	5	13	5
Greece	18	7	4	4	7	1	1	4	3	6	6	7	11	10
Hong Kong, China	8	17	7	9	11	9	1	8	7	6	3	15	3	13
Hungary	9	12	7	5	3	13	1	5	1	7	8	10	1	5
India	6	11	3	3	0	5	0	3	5	6	4	8	10	6
Indonesia	28	15	3	7	13	6	4	5	2	4	27	9	5	11
Ireland	29	10	1	4	22	10	7	4	2	5	15	7	2	10
Italy	9	9	4	9	1	5	3	5	5	7	17	8	1	5
Japan	29	13	6	1	15	6	15	4	6	7	5	12	12	5
Korea, Republic of	9	18	2	4	6	4	4	7	2	11	2	14	21	11
Malaysia	6	15	2	6	6	10	4	3	2	7	18	8	7	11
Mexico	37	5	7	5	10	8	14	4	17	0	22	8	4	5
Netherlands	7	10	4	6	0	7	4	8	16	5	0	11	23	9
New Zealand	6	9	4	4	4	8	1	5	3	10	1	4	0	5
Pakistan	5	6	1	3	13	3	3	4	0	3	2	1	1	5
Philippines	2	10	3	3	4	6	0	4	10	5	0	12	2	10
Poland	4	15	1	5	1	12	2	10	5	6	0	6	4	9
Portugal	1	13	3	6	7	6	7	8	1	5	22	8	4	6
Singapore	8	13	4	4	7	4	4	3	1	12	6	9	1	8
South Africa	7	14	3	5	4	12	5	8	2	7	5	8	3	8
Spain	7	13	9	7	5	7	4	5	3	6	9	11	3	5
Sri Lanka	0	6	8	0	7	0	1	2	0	4	3	8	1	2
Sweden	4	9	1	9	5	12	2	4	4	4	2	8	6	8
Switzerland	5	14	12	8	1	6	2	3	5	7	3	7	5	10
Taipei,China	13	13	3	1	5	4	11	1	10	6	4	10	8	7
Thailand	12	16	3	5	2	9	5	6	1	3	2	12	14	7
Turkey	7	11	3	3	6	7	4	5	4	8	2	5	2	4
United Kingdom	11	14	8	7	20	8	6	3	14	7	11	11	1	11
United States	37	10	22	5	16	9	28	4	31	4	32	9	34	5

Notes: In-degree represents the number of links directionally pointing towards a node, out-degree is the number of links pointing away from each other. Results are based on equity returns–based network data.

Sources: ADB calculations using data from Bloomberg (accessed February 2017). Methodology based on Dungey et al. (2017a).

2.F: The Usefulness of High Frequency Data in Assessing a Financial Network

One issue in the existing literature is whether networks can be estimated more clearly with higher frequency (intra-daily) data using daily realized variance. Realized variance measures can take advantage of the higher frequency data available in modern markets and have been shown to be more effective measures of market volatility. In comparison to the returns analysis used in Section 4.4, realized volatility allows direct examination of the transmission of volatility—arguably as important as the transmission of returns due to its role in derivatives markets.

The differences using higher frequency data rather than returns data are examined here. Fifteen markets are included, with a sample running from 1 January 2006 to 31 December 2016. These are divided into three sub-samples: the first is the build-up to the global financial crisis (GFC) and runs from 1 January 2006 to 14 September 2008 (Phase A4); the second and third correspond to the GFC (15 September 2008-31 March 2010) and post-GFC (1 April 2010-30 December 2016) periods and are denoted as Phases A5 and A6, respectively. It is important to note that the statistics presented here differ from those in the main report (Chapter 8) due to the reduced scope of the network.

The differences between the two datasets are evident in the box figure below. The realized volatility sample generally exhibits greater completeness and more edges than the returns sample—there is more connectedness. Also, the average strength of links tends to exceed that of the equity returns network. However, the overall measures of the evolution of the network are not particularly different. Differences appear in the role of particular nodes. For instance, India plays a role as a spreader of shocks (the in-degree is lower than the out-degree) in the returns analysis, but not in the realized volatility analysis. Thus, India may be regarded as spreading sentiment but not volatility. The role of New Zealand as an absorber of shocks is more pronounced using the volatility network than the returns network, which may be interpreted as New Zealand absorbing more volatility than sentiment.

Consequently, using high frequency data in analysing the evolution of financial networks can reveal important information. Especially while analysing crises, higher frequency data can add important information needed to pin down causes and transmission mechanisms. Higher financial interconnectedness also leads to faster transmission of risks and crises, which can unravel within a very short time. Therefore, high frequency intra-day data of financial markets can significantly add to crisis analysis.

2.F.1: Statistics Used in the Analysis of Realized Variance-based Network Structures

	Formed					Removed	
	Phase A4	Phase A5	Phase A6	A4 to A5	A5 to A6	A4 to A5	A5 to A6
Average Strength	0.0605	0.0623	0.0521	0.0573	0.0409	0.0459	0.0525
Number of edges	33	71	40	59	25	21	56
Completeness	0.2643	0.4866	0.2984	0.3715	0.1466	0.1275	0.3232

Notes: The average link strength is estimated from the connectedness of each respective network. The number of edges was calculated using bivariate Granger causality tests between network nodes (entities).

Source: ADB calculations using data from Bloomberg (accessed February 2017). Methodology based on Dungey et al. (2017a).

2.F: The Usefulness of High Frequency Data in Assessing a Financial Network continued

2.F.2: Comparison: Networks Based on Realized Volatility versus Returns
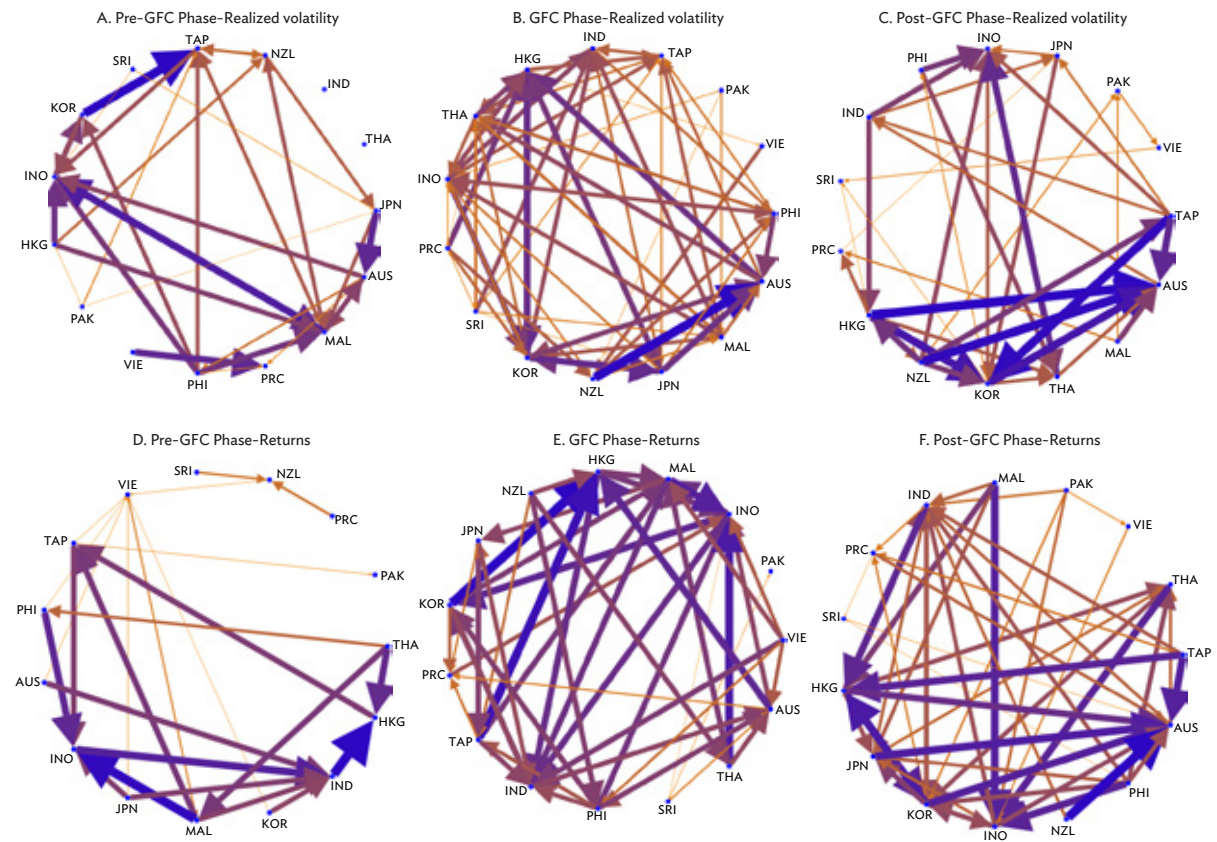
AUS = Australia; GFC = global financial crisis; HKG = Hong Kong, China; IND = India; INO = Indonesia; JPN = Japan; KOR = Republic of Korea; MAL = Malaysia; NZL = New Zealand; PAK = Pakistan; PHI = Philippines; PRC = People's Republic of China; SRI = Sri Lanka; TAP = Taipei,China; THA = Thailand; VIE = Viet Nam.

Notes: The figure displays the networks based on realized volatility (A–C) and on returns (D–F) for phases A4 to A6 from 1 January 2006 to 30 December 2016. Edges were calculated with bivariate Granger causality tests between markets (nodes) at the 5% level of significance.

Source: Methodology based on Dungey et al. (2017a).

This section is based on Dungey et al. (2017a).

2.G: Impact of Direct and Indirect Exposures of Foreign Claims on Capital Outflows during the Global Financial Crisis

Variables	(1) Outflow	(2) Outflow	(3) Outflow	(4) Outflow
Direct exposure of foreign claims	0.247 [0.421]	0.284 [0.277]	0.315 [0.377]	0.284 [0.277]
Indirect exposure of foreign claims			1.775** [0.856]	0.804 [0.749]
Increase in current account deficit (2004–2007)		-0.002 [0.005]		-0.003 [0.005]
Average change in real exchange rate (% annual, 2004–2007)		-0.896*** [0.275]		-0.865*** [0.275]
Increase in credit to GDP ratio (2004–2007)		0.000 [0.002]		-0.000 [0.002]
GDP growth (% annual, 2007)		0.027*** [0.009]		0.025** [0.009]
Inflation rate (2007)		-0.013** [0.006]		-0.011 [0.007]
Chinn-Ito Index (2007)		0.064 [0.060]		0.069 [0.061]
S&P Sovereign Local Currency Credit Rating (2007)		-0.023*** [0.007]		-0.023*** [0.007]
Observations	62	49	62	49
R-squared	0.011	0.507	0.062	0.515

*** = significant at 1%, ** = significant at 5%, * = significant at 10%, GDP = gross domestic product. Robust standard errors in brackets.
Notes: The dependent variable is the rate of capital outflows from each emerging economy during the global financial crisis. The rate of capital outflows is measured using the difference between the maximum and the minimum levels of foreign claims on an emerging economy during the period from the first quarter (Q1) of 2007 to Q4 2009. Measures of direct and indirect exposures are calculated using consolidated banking statistics on immediate counterparty basis. A decrease in the real exchange rate refers to an appreciation of the local currency. See Park and Shin (2017) for more detailed data descriptions.
Source: Park and Shin (2017).

2.H: Impact of Direct and Indirect Exposures of Short-Term International Borrowings on Capital Outflows during the Global Financial Crisis: Consolidated Banking Statistics on Immediate Counterparty Basis

Variables	(1) Outflow	(2) Outflow	(3) Outflow	(4) Outflow
Direct exposure of short-term maturities	0.612***	0.279	0.553***	0.262
	[0.199]	[0.204]	[0.206]	[0.184]
Indirect exposure of short-term maturities			1.977	1.264
			[1.430]	[1.247]
Increase in current account deficit, 2004–2007		-0.002		-0.003
		[0.005]		[0.005]
Average change in real exchange rate (% annual, 2004–2007)		-0.878***		-0.943***
		[0.291]		[0.300]
Increase in credit to GDP ratio (2004–2007)		0.001		0.001
		[0.002]		[0.002]
GDP growth (% annual, 2007)		0.028***		0.026***
		[0.009]		[0.008]
Inflation rate (2007)		-0.011*		-0.013**
		[0.007]		[0.006]
Chinn-Ito Index (2007)		0.064		0.065
		[0.058]		[0.059]
S&P Sovereign Local Currency Credit Rating (2007)		-0.021***		-0.020**
		[0.007]		[0.007]
Observations	62	49	62	49
R-squared	0.116	0.520	0.142	0.530

*** = significant at 1%, ** = significant at 5%, * = significant at 10%, GDP = gross domestic product. Robust standard errors in brackets.
Notes: The dependent variable is the rate of capital outflows from each emerging economy during the global financial crisis. Measures of direct and indirect exposures are calculated using short-term international borrowings based on consolidated banking statistics on immediate counterparty basis. A decrease in the real exchange rate refers to an appreciation of the local currency. See Park and Shin (2017) for more detailed data descriptions.
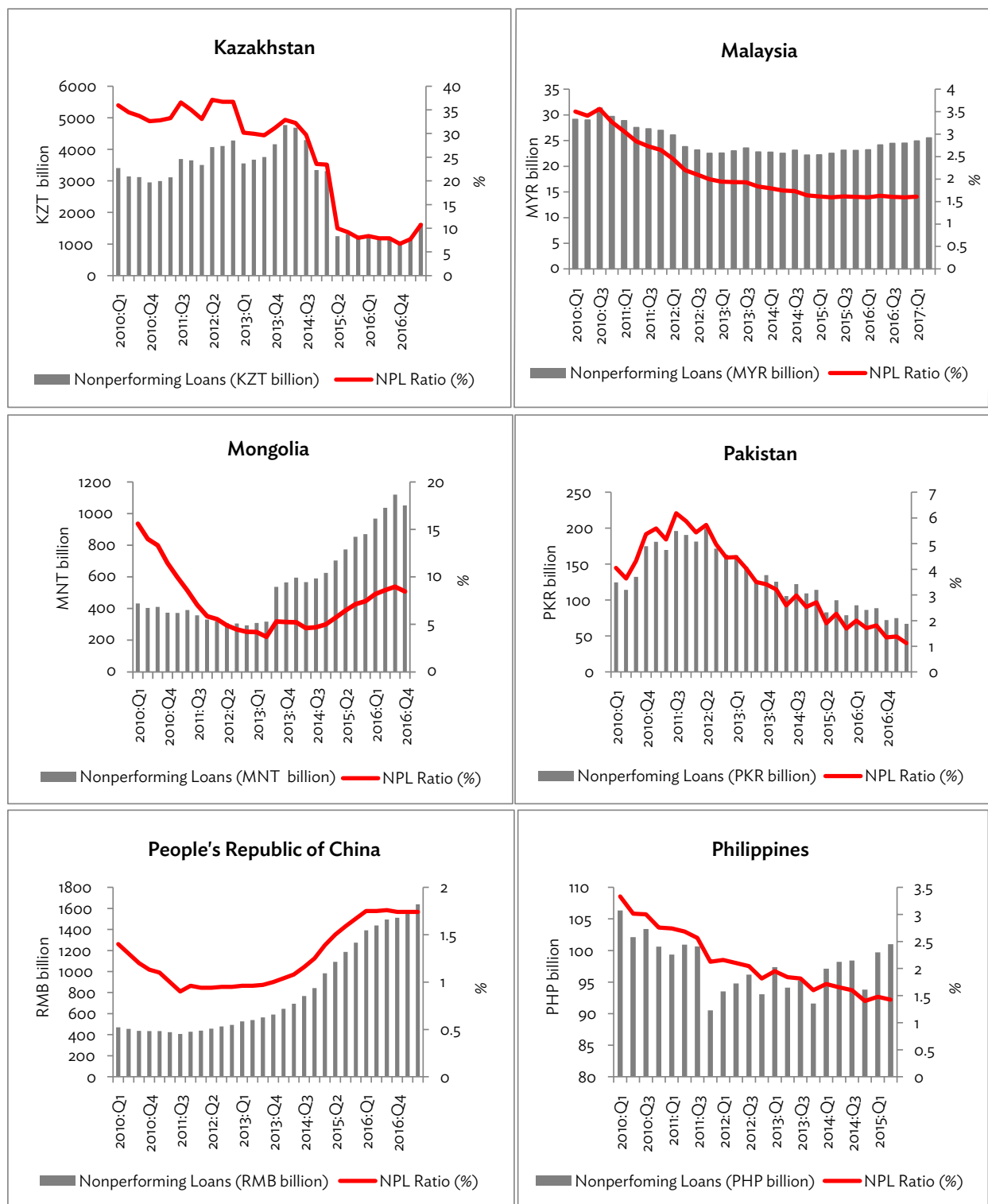Source: Park and Shin (2017).

## 2.I: Evolution of the Level of NPLs and NPL Ratios in Selected Asian Economies
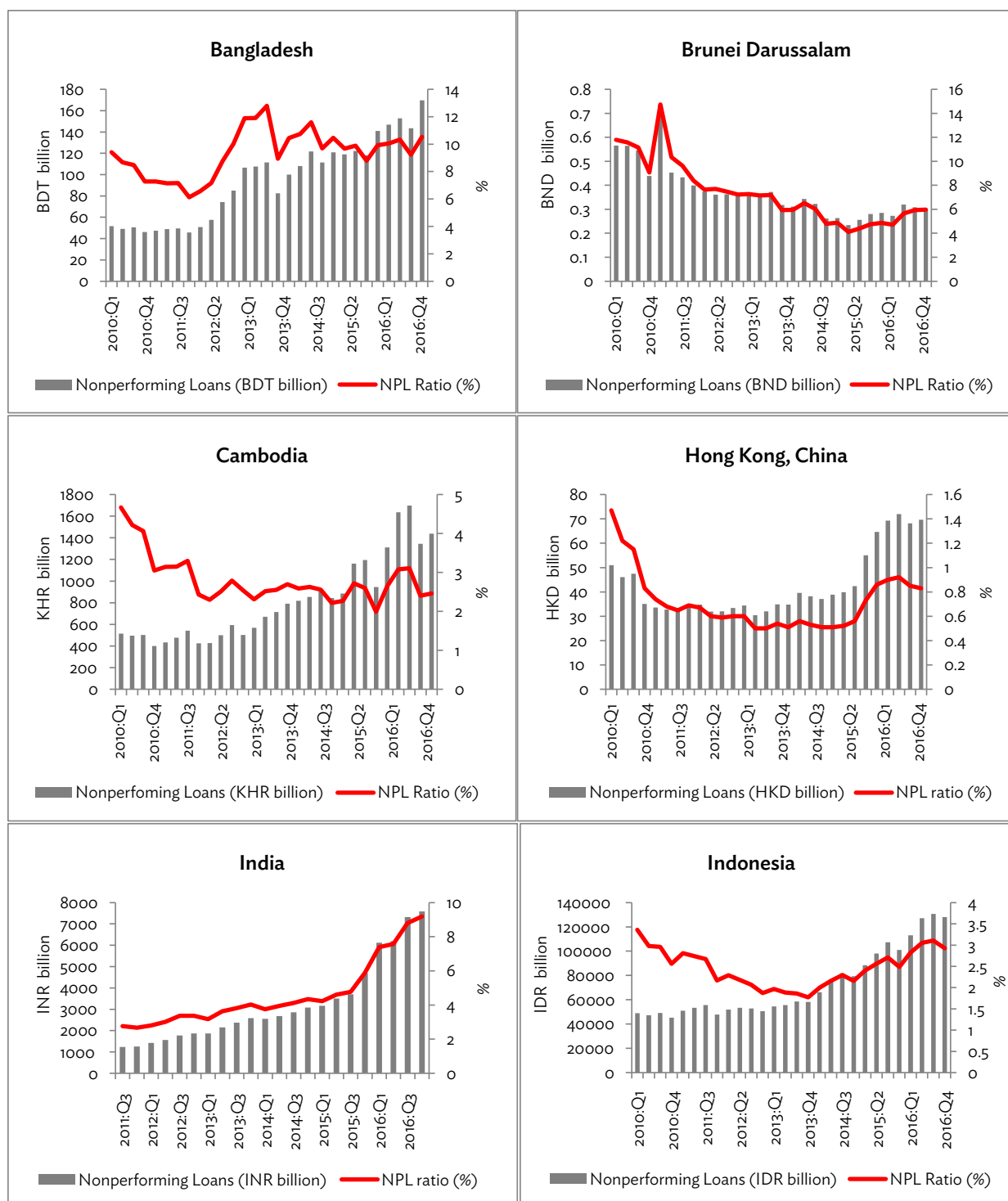

BDT = Bangladeshi taka; BND = Brunei dollars; HKD = Hong Kong, China dollars; IDR = Indonesian rupiah; INR = Indian rupee; KHR = Cambodian riel; NPL = nonperforming loan.
Sources: ADB staff calculations using data from CEIC, Haver Analytics, and IMF Financial Soundness Indicators. http://data.imf.org/ (accessed October 2017).

2.I: continued

Kazakhstan

Nonperforming Loans (KZT billion)　　NPL Ratio (%)

Malaysia

Nonperforming Loans (MYR billion)　　NPL Ratio (%)

Mongolia

Nonperforming Loans (MNT billion)　　NPL Ratio (%)

Pakistan

Nonperfoming Loans (PKR billion)　　NPL Ratio (%)

People's Republic of China

Nonperforming Loans (RMB billion)　　NPL Ratio (%)

Philippines

Nonperfoming Loans (PHP billion)　　NPL Ratio (%)

KZT = Kazakhstani tenge; MNT=Mongolian togrog; MYR=Malaysian ringgit; NPL = nonperforming loan; PHP=Philippine peso; PKR=Pakistani rupee; RMB = Chinese yuan.

Sources: ADB staff calculations using data from CEIC, Haver Analytics, and IMF Financial Soundness Indicators. http://data.imf.org/ (accessed October 2017).

2.I: continued

Republic of Korea

Singapore

Sri Lanka

Thailand
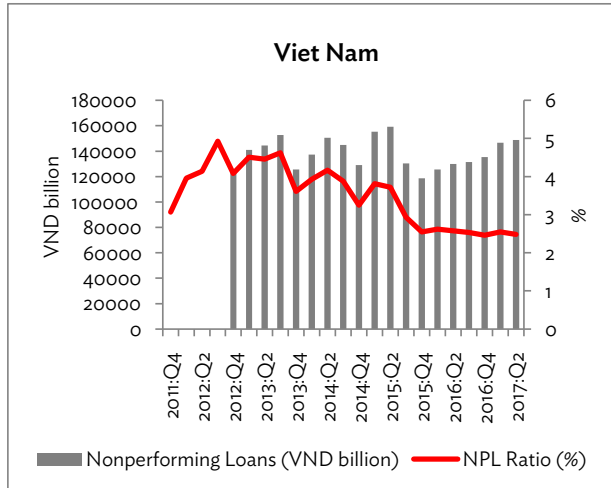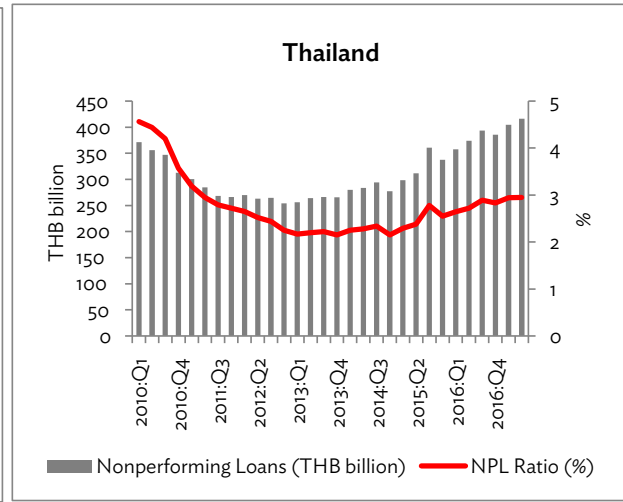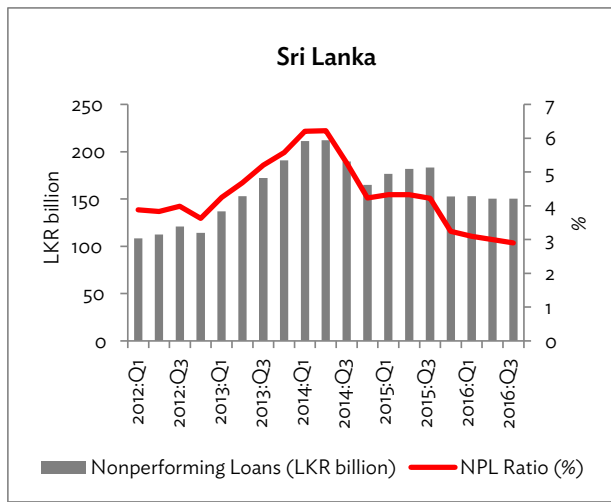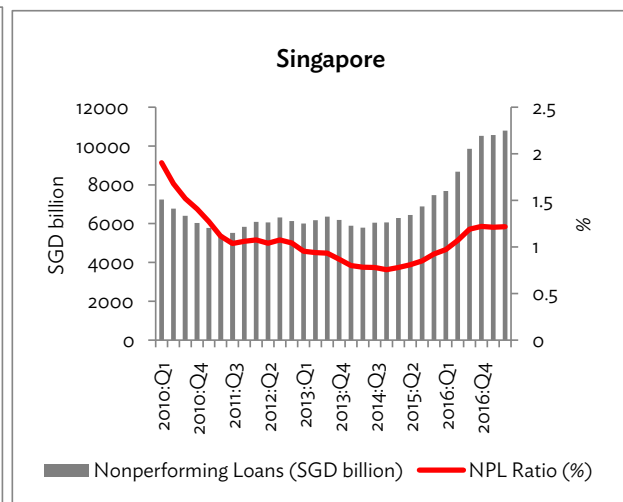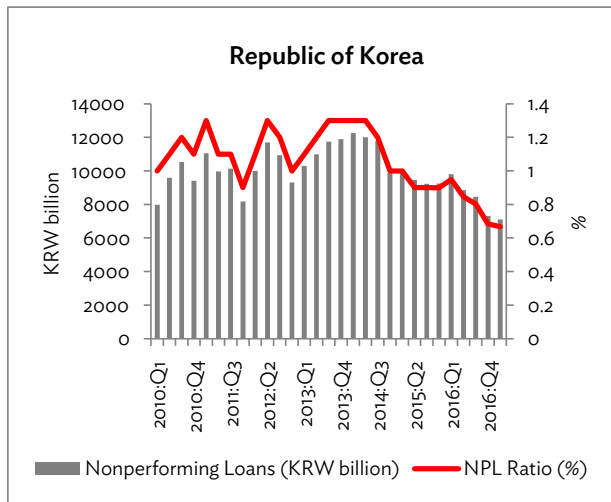
Viet Nam

KRW = South Korean won; LKR=Sri Lankan rupee; NPL = nonperforming loan; SGD=Singapore dollar; THB=Thai baht; VND=Vietnamese dong.
Sources: ADB staff calculations using data from CEIC, Haver Analytics, and IMF Financial Soundness Indicators. http://data.imf.org/ (accessed October 2017).