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RESEARCH ARTICLE

Emerging Market Economies' Challenge: Managing the Yield Curve in a Financially Globalized World

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Abstract
In a financially globalized world, managing long-term interest rates through short-term interest rates can be difficult. In this paper, we examine whether net capital inflows contribute to weakening the link between short- and long-term interest rates. We find that more financially open economies or those with more developed financial markets tend to have a greater negative relationship between net capital inflows and short- to long-term interest rate pass-through. We also examine whether macroprudential policies can affect the extent of interest rate pass-through and find that broad-based capital macroprudential tools are effective in retaining control of interest rate pass-through.

Keywords Financial liberalization · Yield curve · Trilemma · Macroprudential policy

1 Introduction

Recently, many researchers have argued that financial globalization has made domestic financial markets more vulnerable to developments in the major economies, namely the United States, the European Union, and lately China. Rey (2013) argues that in the financially globalized world, countries are vulnerable to the "global financial cycle" of capital flows, asset prices, and credit growth. In such an environment, non-major economies are subject to the center countries' monetary policy unless the former decides to curtail capital mobility.[1]

[1] In her view, the famous monetary trilemma – countries can achieve only two of the three open macro policy goals of monetary independence, exchange rate stability, and financial openness to the full extent – reduces to a dilemma between monetary independence and financial openness. For the trilemma

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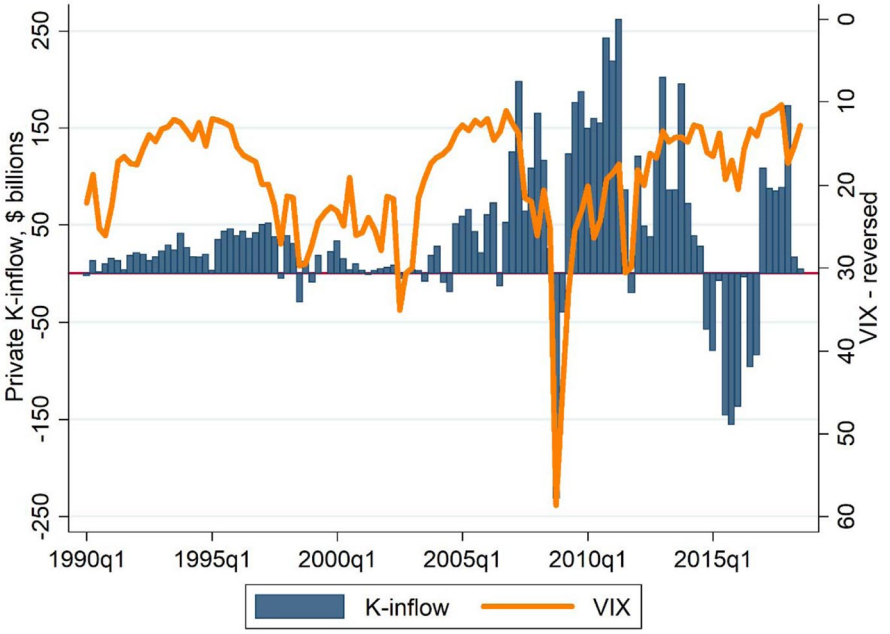

Fig. 1 VIX and Net Capital Flows to EMGs. VIX is a measure of the implied volatility of U.S. S&P 500 index options. Both VIX and net capital flows are shown as four-months moving averages. The VIX index is a measure of uncertainty or risk aversion of the markets. The scale for the VIX index (on the right-hand side) is reversed so that it can be seen as a measure of investor risk appetite

Figure 1 makes it clear that the volume of capital flows to emerging market economies (EMGs)[2] tends to rise when risk appetite, measured by the reversed VIX index, is higher[3]. When "risk is on," investors' risk appetite would rise and capital would flow to where the yields are higher, which was the case for EMGs when industrialized countries (IDCs) implemented extremely low interest rate policies in the late 2000s through the mid-2010s. When "risk is off" or when the interest rates are expected to rise in IDCs, capital would leave EMGs for IDC's markets. Thus, capital flows to EMGs only passively react to the conditions of the major economies.

Footnote 1 (continued)
vs. dilemma debate, refer to Aizenman, et al. (2016), Klein and Shambough (2015), Ricci and Shi (2016), and Han and Wei (2018).

[2] Emerging market economies (EMGs) are those classified as either emerging or frontier in 1980–1997 by the International Financial Corporation, plus Hong Kong and Singapore. This group of economies is a subset of the group of less developed countries (LDC). The industrialized countries (IDC) refer to traditional Organization of Economic Cooperation and Development (OECD) member countries whose IMF numerical codes are below 186 plus Australia and New Zealand.

[3] The VIX measures the implied volatility of U.S. S&P 500 index options and is available from the Chicago Board Options Exchange. For the analyses on the factors that affect cross-border capital flows to EMGs, see Ahmed and Zlate (2013), Forbes and Warnock (2012), Ghosh, et al. (2012), Griffin, et al. (2004), and Fratzscher (2012) among many others.

If domestic financial markets are more susceptible to international factors, that could make domestic monetary policy management more difficult because the behavior of the long-term rates does not necessarily reflect policymakers' intention that appears as a manipulation of the short end of the yield curve. Hence, even if they had a good grip over the short-term interest rates, policymakers might be less capable of dealing with shocks emanating from the center economies.

The "Greenspan conundrum" is a good example of the disconnect between the short- and the long-term interest rates. In the mid-2000s, when the U.S. Federal Reserve Board raised the federal funds rate to rein in the overheated economy, the longer-end of the yield curve turned out to be unresponsive. According to the widely received "global saving glut" argument (Bernanke 2005; Clarida 2005; Greenspan 2005a, b), a massive amount of capital flew from countries with excess saving such as China and other East Asian EMGs to the United States where financial markets are well-developed and supported by sophisticated legal systems and institutions (Caballero et al. 2008, 2016, 2017). Warnock and Warnock (2009) estimate that if there had been no foreign purchase of U.S. Treasury and agency bonds, U.S. long-term interest rates would have been 80 basis points higher. Byrne et al. (2010) find evidence for the disconnect of short- and long-term interest rates not just in the U.S., but also in other IDCs. Pradhan et al. (2011) and Peiris (2010) find that among major EMGs, a one percentage point increase in nonresident purchases of local bonds would lead to a 5–6 basis points reduction in long-term yields.

Thus, as financial globalization proceeds, the pricing of financial assets becomes more affected by foreign capital flows. When the central bank raises the short-term policy rate, for example, that could attract more capital inflows because longer-term bonds and other financial assets appear relatively inexpensive. That would lead in turn to a surge in the demand for long-term bonds, and thereby their prices will rise while their yields fall. That means while the rise in the short-term rate creates an upward pressure on the long-term rate, it could also create a downward pressure. The extent of the downward pressure depends on how open the domestic market is toward cross-border capital flows. Conversely, the opposite is true for policymakers implement an expansionary monetary policy.

Given this background, we investigate whether and how the extent of exposure to cross-border capital flows affects the relationship between short- and long-term interest rates. We take a two-step approach. First, we examine to what extent long-term interest rates respond to short-term interest rates by regressing the change in the yield of long-term government bonds on the change in the short-term policy rate. Using the estimates as the measure of the extent of interest rate pass-through, we investigate its determinants, focusing on the impact of net capital inflows.

We also examine whether "macroprudential policies" have any impact on the interest rate pass-through. When many EMGs experienced an influx of capital in the aftermath of the Global Financial Crisis (GFC) of 2008, some of them implemented policies to preempt financial overheat and its resultant financial instability. Such "macroprudential policies" and their efficacy have been debated in the academic and policy circles.[4] We join the debate by examining whether macroprudential policies

[4] See Akinci and Olmstead-Rumsey (2017), Buch and Goldberg (2017), Cerutti et al. (2017a, b), Ghosh et al. (2014, 2015), Ostry et al. (2012), among many others.

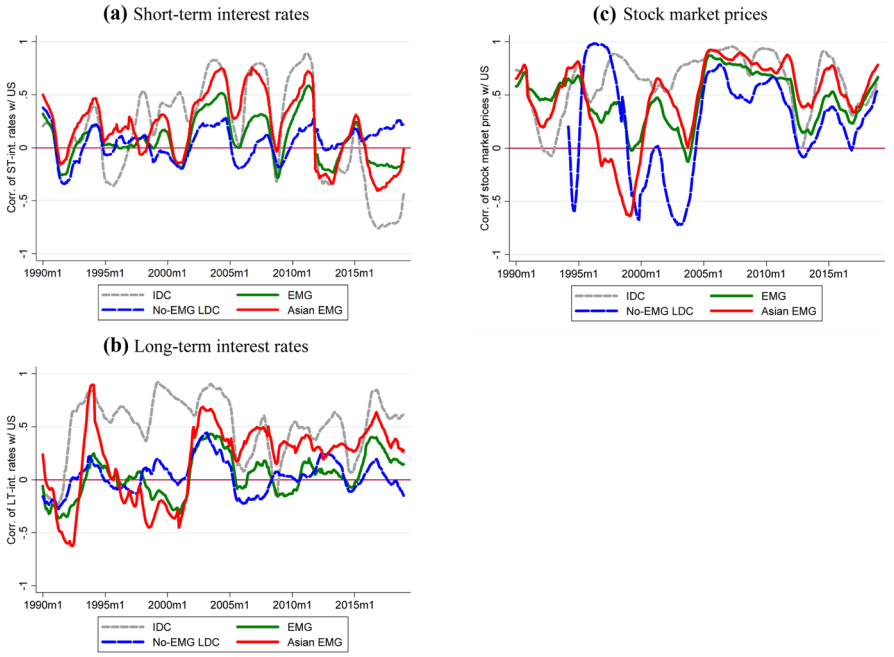

Fig. 2 36-month Rolling Correlations of Financial Variables with the U.S.

can have any impact on the interest rate pass-through. If these policies prudentially prevent financial exuberance, policymakers may facilitate a steadier pass-through of interest rates via appropriate selections of macroprudential measures. We will empirically test the effectiveness of macroprudential policies.

In what follows, Sect. 2 illustrates the trend of the short- and long-term interest rates of our sample economies vis-à-vis the U.S. as the center economy. In Sect. 3, we empirically investigate whether net capital inflows have any impact on the extent of interest rate pass-through. In Sect. 4, we also examine whether and how macroprudential policies impact the extent of interest rate pass-through. Section 5 presents our concluding remarks.

2 Observations of the Interest Rate Pass-through from the Center Country

Panel (a) of Fig. 2 illustrates that the (36-month rolling) correlations between the domestic and the U.S. money market rates are relatively high from 2003 through 2011, except for 2005 and the time of the global financial crisis.[5] Interestingly, IDCs

[5] The two dips in the correlations correspond to the time when the U.S. Federal Reserve changed its policy rate rapidly. The Federal Reserve raised the federal fund rate target from 1.00% in June 2004 to 5.25% in June 2006. It lowered the target from 5.25% in September 2007 to the 0.00–0.25 by December 2008.

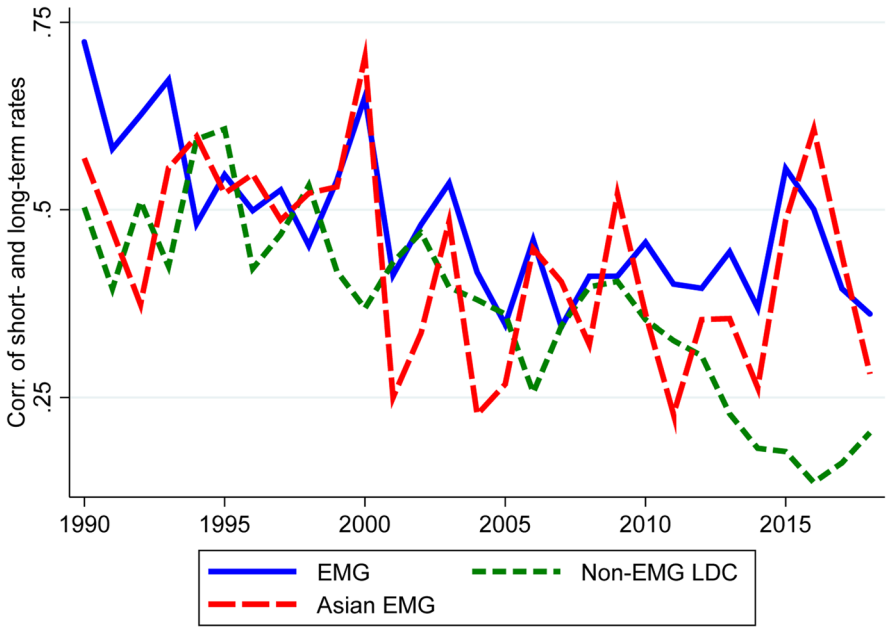

Fig. 3 Correlations between Short- and Long-term Interest Rates among Developing Economies

tend to have their short-term rates more highly correlated with that of the U.S. compared to EMGs and non-emerging developing economies (Non-EMG LDC). After 2011, the short-term interest rates of EMGs are not highly or positively correlated with that of the U.S., indicating that these economies retained moderately high levels of monetary independence in these years.

The correlation of the long-term interest rates with that of the U.S. is rather consistently high for Emerging Asia in much of the last decade (Panel (b)) despite the GFC and the rapid decline in the correlations of the short-term interest rates we saw in panel (a). Combining panels (a) and (b), we observe that since the late 2000s, the short-term interest rates seem to be decoupled from the long-term interest rates.

Since the late 2000s, all the country groups have maintained high levels of correlations of stock market price indexes with the U.S. stock market (Panel (c)). This is in contrast to the case of the correlation of the short-term interest rates. Both long-term interest rates and stock market price indexes are more correlated with those of the U.S., a finding consistent with Jordà et al. (2019) who attribute the synchronization of financial cycles to fluctuations in risk premiums. The longer-term interest rates and stock market prices reflect more of risk premiums, thus less connected with the short-term interest rates.

As discussed above, even if the short-term rate is under the control of domestic monetary authorities, the longer-end of the yield curve can be more exposed to global financial cycles so that policymakers may not have a good grip on the

longer-end of the yield curve. The correlation between the short- and long-term yields has been in a moderately declining trend for developing economies (Fig. 3).

3 Estimation on the Determinants of the Yield Curve

Let us now investigate whether and to what extent greater exposure to international financial markets might affect interest rate pass-through.

3.1 Baseline Analysis

We first examine to what extent long-term interest rates respond to short-term interest rates by running the following estimation. The estimated coefficient $\hat{\beta}_i$ will be regarded as a measure of the interest rate pass-through from the short-term interest rates ($i_{STi,t}$) to the long-term interest rates ($i_{LTi,t}$).

$$\triangle i_{LTi,t} = \alpha + \beta_i \triangle i_{STi,t} + \varepsilon_{i,t} \tag{1}$$

The estimation is done with 36-month rolling windows for each of our sample 132 countries. The use of rolling windows allows us to obtain time-variant measures of interest rate pass-through for each country ($\widehat{\beta_{i,t}}$).

Once we obtain $\widehat{\beta_{i,t}}$, we will investigate its determinants using the following estimation model:

$$\widehat{\beta}_{i,t} = \varphi_0 + \varphi_1 KFlow_{i,t} + X'\phi + u_{i,t} \tag{2}$$

KFlow is net capital inflows as a share of GDP.[6] *X* is a vector of other determinants including the variables for relative income (to the U.S.), inflation volatility, output volatility, financial development, and the dummy for financial crisis.[7]

For the second stage estimation, we build non-overlapping three-year panels by averaging the explanatory variables in each of the panels starting in 1978 (except for the volatility variables) and sample the estimated beta from the first stage estimation as of December of the last year of each three-year panel. We apply the Ordinary Least Squares (OLS) method (with robust standard errors) to the sample of 132 countries in 1978 through 2016, though we focus on the sample of 109 developing countries (LDC), out of which 38 are EMGs.[8]

In the LDC sample, the estimate on net capital flows is significantly negative, suggesting that a country that receives more net capital inflows tends to have a weaker link between short-term and long-term interest rates (Table 1), though it is not the case for the EMGs.

[6] Negative values mean capital outflows.
[7] For data sources and theoretical predictions of the variables, refer to Appendix 1.
[8] See Appendix 1 for country groups.

Table 1 Determinants of the Short to Long-term Interest Rate Pass-through: OLS, 1978 – 2016

Dep. Var.: Est. beta	LDC	EMG
	(1)	(2)
K-inflow	-0.415	0.402
	(0.134)***	(0.422)
Relative income	-0.113	-0.218
	(0.304)	(0.299)
Inflation volatility	0.524	1.023
	(0.213)**	(0.411)**
Output gap	-0.541	-0.162
	(0.311)*	(0.930)
Output volatility	-0.843	-2.357
	(0.503)*	(1.312)*
Financial development	0.167	0.290
	(0.096)*	(0.165)*
Financial crisis	0.084	0.086
	(0.053)	(0.092)
Adjusted R^2	0.53	0.40
N	658	254
# of countries	108	38

The constant term and yearly fixed effects are included in the estimation, though their estimates are note reported in the table

*$p<0.1$, **$p<0.05$, ***$p<0.01$

The rest of the control variables appears consistent with theoretical predictions. Larger uncertainty associated with higher inflation volatility may require an increase in risk premium on longer maturity assets to compensate investors for their risk-taking for both LDCs and EMGs.[9] Also, higher output volatility impedes smooth transmission of monetary policy by increasing future economic and policy uncertainty. The significantly positive estimate on financial development indicates that more developed financial sectors could help central bank gain better control of the longer-end of the yield curve.

In this kind of exercise, we need to be concerned about the possibility that other right-hand side variables can affect net capital inflows, or endogeneity arising from bilateral causality of the estimation model. Hence, we also employ the two stage least square (2SLS) estimation method. First, we regard the volume of net capital inflows (as a percentage of GDP) as a function of the domestic country's per capita income level; the level of the country's financial development; that of de jure financial openness (*KAOPEN* or the Chinn-Ito index); and output gap.[10] We also include

[9] This result is consistent with Cottarelli and Kourelis (1994), Mojon (2000), and Sander and Kleimeier (2004).

[10] KAOPEN is based on information regarding restrictions in the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER), and is constructed as the first standardized principal component of the variables indicating the presence of multiple exchange rates, restrictions on current account transactions, restrictions on capital account transactions, and the requirement of the surrender of export proceeds. Chinn and Ito (2006, 2008) explain the index in great details.

Table 2 Determinants of the Effectiveness of Monetary Policy – 2SLS

Dep. Var.: Est. beta	LDC	EMG
	(1)	(2)
K-inflow	-1.210	-1.082
	(0.487)**	(0.627)*
Inflation Volatility	0.559	1.030
	(0.190)***	(0.381)***
Output Volatility	-0.971	-3.366
	(0.617)	(1.440)**
Adjusted R^2	0.47	0.17
N	650	253
# of countries	107	38

The constant term and yearly fixed effects are included in the estimation, though their estimates are not reported in the table. The variable for net capital inflows is instrumented with the domestic country's level of financial development and de jure financial openness (the Chinn-Ito index); the dummy for financial centers; output gap; and the dummy for financial crisis

*p<0.1, **p<0.05, ***p<0.01

the dummy for "financial centers," i.e., the city states such as Hong Kong and Singapore or the countries with large open financial centers (such as The Bahamas) because of their unique roles in global finance.[11] Since financial crisis should affect capital inflows more directly than the measure for the extent of interest rate pass-through, we also include the dummy for financial crisis in the first estimation. We continue to include the time fixed effects to capture global common shocks in both stages.[12]

With the two-stage estimation, the magnitude of the estimate for net capital inflows increases for the sample of developing countries, and the estimate becomes significantly negative for both samples (Table 2). A one percentage point increase in net capital inflows, which happened between 2005–07 and 2011–13 among LCDs on average, would lead to a 1.2 percentage point decrease in the short- and long-term rate pass-through. Considering that the actual correlation of this group of countries dropped by 3.5 percentage points during the period, one third of the decline can be attributed to the rise in net capital inflows, which is not insignificant. Hence, the estimate is not just econometrically, but also economically significant.

While we have focused on the negative impact of net capital inflows, which is specific about the direction of capital flows (i.e., whether inflows or outflows), one may wonder is not just net capital inflows that matter, but also outflows. A country experiencing large capital outflows could also have a weaker link between the short- and the long-term interest rates.

[11] For more on "financial centers," see Lane and Milesi-Ferretti (2017).

[12] Hence, in the second stage, the time fixed effects capture global financial cycles and the effects of the center economies' monetary or financial shocks, i.e., "push factors.".

Table 3 Determinants of the Effectiveness of Monetary Policy – 2SLS

Dep. Var.: Est. beta	LDC (1)	EMG (2)	LDC (3)	EMG (4)	LDC (5)	EMG (6)
Absolute values of net K-inflows	-4.055	2.899				
	(2.138)*	(3.797)				
Gross financial flows			-0.331	-0.565		
			(0.313)	(0.570)		
Stock of external assets and liabilities					-0.020	0.011
					(0.009)**	(0.021)
Inflation Volatility	0.336	0.918	0.485	1.105	0.466	1.023
	(0.236)	(0.398)**	(0.210)**	(0.326)***	(0.166)***	(0.365)***
Output Volatility	1.521	-3.759	-0.303	-2.705	-0.041	-2.416
	(1.357)	(2.454)	(0.546)	(1.205)**	(0.459)	(1.150)**
Adjusted R^2	0.29	0.36	0.10	0.15	0.56	0.20
N	669	254	536	231	685	255
# of countries	113	38	97	36	107	38

The constant term and yearly fixed effects are included in the estimation, though their estimates are not reported in the table. The alternative variable for capital flows or stocks is instrumented with the domestic country's level of financial development and de jure financial openness (the Chinn-Ito index); the dummy for financial centers; output gap; and the dummy for financial crisis

*p<0.1, **p<0.05, ***p<0.01

When we include the variable for net capital inflows in absolute values, its estimate is significantly negative but only for the LDC group (Table 3, columns (1) and (2)).[13] This suggests that we have somewhat weak evidence that the gross openness of the financial account negatively affects the interest rate pass-through.

Borio and Disyatat (2011, 2015), Obstfeld (2012) and Shin (2012) argue that global financial vulnerabilities could only be understood in terms of gross financial flows, not of net flows. To test this argument, we include the sum of credit and debit of financial accounts (from the balance of payments) divided by GDP instead of net capital flow. Its estimate, however, is negative but not significant for either LDC or EMG group (columns (3) and (4)).

Also, we test the openness of financial markets by focusing on the stock of external assets and liabilities. Using Lane and Milessi-Ferretti's (2001, 2007, 2017) database, we include the sum of external assets and liabilities divided by GDP in the estimation. We find its estimate significantly negative for the LDC group.

These results suggest that generally speaking, economies more exposed to capital flows, regardless of its direction, tend to experience weaker connectivity between short- and long-term interest rates. However, the statistical results are not as robust as when we include the net capital flow variable.

[13] We continue to use the 2SLS estimation method for the rest of the paper.

Table 4 Determinants of Interest Rate Passthrough for Different Regimes, 1980 – 2016 2SLS

	LDC-KA-OPEN (1)	EMG-KA-OPEN (2)	LDC-KA-CLOSE (3)	EMG-KA-CLOSE (4)	LDC-FD-HIGH (5)	EMG-FD-HIGH (6)	LDC-FD-LOW (7)	EMG-FD-LOW (8)
Net K Flow	-2.664	-1.875	-1.957	-4.613	-1.107	-0.346	-0.704	-0.748
	(0.734)***	(0.805)**	(1.197)	(5.565)	(0.459)**	(0.608)	(0.947)	(1.833)
Output Volatility	1.093	1.618	0.459	0.406	1.211	1.293	0.366	0.439
	(0.435)**	(0.351)***	(0.219)**	(1.018)	(0.227)***	(0.322)***	(0.228)	(1.272)
Inflation Volatility	-3.099	-9.302	-0.489	-5.044	-1.880	-1.819	-0.600	-2.210
	(1.843)*	(3.212)***	(0.699)	(5.512)	(0.957)**	(1.653)	(0.714)	(2.269)
Adjusted R2	-	0.20	0.55	-	0.12	0.17	0.64	0.50
N	232	112	418	141	298	184	352	69
# of countries	54	26	84	29	59	33	69	14
	LDC-DEBT-HIGH (9)	EMG-DEBT-HIGH (10)	LDC-DEBT-LOW (11)	EMG-DEBT-LOW (12)	LDC w. K-inflows (13)	EMG w. K-inflows (14)	LDC-w. K-outflows (15)	EMG w. K-outflows (16)
Net K Flow	-1.687	-1.799	-1.854	1.600	-2.103	-4.613	-0.694	-1.252
	(0.480)***	(0.794)**	(1.256)	(1.691)	(1.226)*	(3.284)	(0.884)	(1.029)
Output Volatility	0.409	0.228	0.651	0.726	0.289	0.549	1.075	1.908
	(0.391)	(0.953)	(0.357)*	(0.369)**	(0.205)	(0.531)	(0.416)***	(0.687)***
Inflation Volatility	0.202	-2.460	-2.886	-1.073	0.966	3.832	-2.158	-4.538
	(0.927)	(2.451)	(1.533)*	(2.487)	(0.890)	(2.830)	(0.961)**	(2.137)**
Adjusted R2	0.47	0.24	0.56	0.27	0.27	0.03	0.62	0.24
N	214	75	277	123	442	160	208	93
# of countries	65	22	75	29	99	33	75	29

The constant term and yearly fixed effects are included in the estimation, though their estimates are not reported in the table. The variable for net capital inflows is instrumented with the domestic country's level of de jure financial openness (the Chinn-Ito index) and financial development; output gap; the dummy for financial city states; and the dummy for financial crisis

*$p<0.1$, **$p<0.05$, ***$p<0.01$

Table 5 Estimates of Net Capital Inflow for Different Trilemma Regimes, 1980 – 2016

	Exchange rate stability	**Exchange rate stability**
	High	**Low**
	(1)	(2)
Financial openness	-1.620	-2.999
High	(0.662)***	(1.068)***
	N = 123	N = 109
	# of countries = 38	# of countries = 31
	(3)	(4)
Financial openness	-1.014	-0.179
Low	(0.736)	(1.383)
	N = 253	N = 165
	# of countries = 61	# of countries = 52

The 2SLS estimation method is used

*p<0.1, **p<0.05, ***p<0.01

3.2 Further Analysis

The effect of net capital inflows on interest rate pass-through may be affected by other third factors.

First, although we have included *de jure* (i.e., regulatory) financial openness as an instrument for net capital inflows, we suspect whether the impact of capital inflows on the interest rate pass-through also differs depending upon whether the country of concern is in a financially open or closed regime (in de jure sense).

In the first four columns of Table 4, we divide the samples of LDC and EMG into "open" or "closed" subgroups each depending on whether their de jure measure of financial openness is above or below the median.

In Columns (1) through (4), we see that for both LDC and EMG groups, only financially open regimes have significantly negative estimates for net capital inflows. That indicates if an LDC or EMG is highly open to cross-border capital flows (in terms of removal of regulatory capital controls) and actually receives a greater amount of capital inflows, its monetary policy authorities would have a weaker control over long-term interest rates.

We also divide the samples depending on the level of exchange rate stability pursued by the sample countries, using the trilemma index of Aizenman, et al. (2013). We do not find any difference between countries with greater exchange rate stability and those with lower exchange rate stability (not reported). However, the theorem of the monetary trilemma suggests that the impact of the exchange rate regime may differ depending on the extent of financial openness. When a country achieves the highest level of financial openness and exchange rate stability (e.g., the Euro area, Hong Kong), such a country cannot retain any monetary autonomy. However, if it pursues a combination of complete financial autarky and exchange rate fixity, or a combination of full financial openness and floating exchange rate, the country would retain monetary independence.

Following this, we divide the sample into four groups and run the regression for each of the groups and report the results in Table 5 (only with the estimated coefficient of the net capital inflow variable). Based on the trilemma, panel (1) is the group composed of country-year's with open financial markets and exchange rate stability (i.e., weaker monetary independence), panels (2) and (3) are of country-year's with greater monetary autonomy, and (4) of country-year's with greater monetary autonomy.[14]

Again, we find that the estimate on net capital inflows is significantly negative only when the country of concern pursues greater de jure financial openness. However, the magnitude of the estimate is greater for the regime of greater financial openness and greater exchange rate *flexibility*, though the estimates from panels (1) and (2) are not statistically different from each other. This means, as Rey (2013) contends, the type of exchange rate regime does not matter. As long as a country imposes fewer capital controls, capital flows would make the link between the short- and long-term rates weaker. Particularly, the result in panel (2) indicates that even if a developing country retains monetary policy autonomy, as long as it has open access to international financial markets, the degree of interest rate pass-through would be smaller when it receives capital inflows.

In Columns (5) through (8) of Table 4, we divide the LDC and EMG subsamples depending on whether the level of financial development (FD) is "high" or "low." If FD is greater than the median level of a particular year, it is regarded as "high" financial development. "Low" is for the level of FD below the annual median.

According to the regression results, only LDCs with developed financial markets tend to have a negative correlation between net capital inflows and the degree of interest rate pass-through. That is, having more developed financial markets may, ironically, make it harder for policymakers to control the longer-end of the yield curve. While greater financial development and openness would raise the substitutability between domestic and foreign financial bonds, the substitutability between government bonds and other financial assets plays an important role in the transition mechanism (He and McCauley 2013).[15] Hence, financial markets with high substitutability among different asset types would lead to a higher counteracting elasticity of capital inflows with respect to the interest rate pass-through.

In Columns (9) through (12), we divide the samples based on the level of gross national debt. Significantly negative correlation between higher volumes of capital inflows and the extent of interest rate pass-through is observed only among the high-debt country groups. This finding can be interpreted in the same way as the findings for countries with highly developed financial markets. If a country issues

[14] In the case of panel (4), the trilemma will not be 'binding.' Given that the three policy goals must be linearly related, when both financial openness and exchange rate stability are at low levels, that means policymakers are not optimizing their objective function, which means an inefficient outcome (Ito and Kawai 2014). However, that must indicate the level of monetary independence is higher.

[15] From a slightly different angle, it could be argued that the lack of financial development could lead to high risk premia on the side of emerging markets and make their securities highly correlated with U.S. financial markets because highly leveraged investors may try to recover their losses from investing in risky securities in the U.S. markets. Thought this is not what the estimation results show, it is an important point. We thank Hwee Kwan Chow for raising this point.

more national debt, that means it offers more financial instruments for international investors to purchase. Again, higher degrees of substitutability would strengthen a counterforce to a rate change.

Lastly, in Columns (13) through (16), we divide the samples depending upon whether the economy of concern is experiencing capital in- or out-flows. We see that developing countries with net capital inflows tend to have the negative estimate on the net capital inflow variable. The estimate for the EMG group is also negative, but only marginally significant. Hence, the findings we have in Table 2 are mainly driven by countries with net capital inflows, which may explain why we had rather weak results in Table 3. The direction of capital flows seems to matter.

3.3 Analysis of the Impact of Macroprudential Policies

In the aftermath of the GFC of 2008, IDCs implemented enormous monetary expansion, eventually causing massive capital flow to EMGs in search for higher yields. Facing the influx of capital threatening to bring out financial overheat or instability, several EMGs, such as Brazil, Indonesia, Korea, Russia, and Thailand, implemented macroprudential policies.[16]

Here, we are interested in whether macroprudential policies can impact the extent of interest rate pass-through. In a financially globalized world, foreign capital could keep flowing in even when the risks to financial instability start mounting. When an economy experiences a financial bubble the pricing of financial assets may not occur properly – an influx of capital can exacerbate the overpricing of assets including longer-term bonds, leading capital inflows to depress the longer-end of the yield curve and thereby letting the bubble situation linger.

Once capital flight occurs, the same financial openness that allowed for capital inflows now makes it harder for monetary authorities to stop the capital flight. Thus, whether monetary authorities want to alleviate capital inflows or stop capital flights, they have weaker grips on the yield curve in a financially open world.

When monetary authorities find it hard to retain the control of the yield curve, macroprudential policies may help to mitigate the influx of capital and prevent financial instability. For example, countercyclical reserve requirements are designed to put limits on excess credit growth by adjusting central banks' reserve requirements countercyclically. Loan-to-value measures or debt-to-income ratios are meant to mitigate excess growth in new bank loans or households' indebtedness, respectively.

Now, we investigate whether macroprudential policies help monetary authorities to have a better grip on the longer-end of the yield curve.

We include a variable that reflects the implementation of macroprudential policies in the following estimation model (Eq. (3)). If macroprudential policies are effective and allow monetary authorities to have a better control on the short- and long-term interest rate link, the variable should have a positive coefficient (i.e., $\varphi_2 > 0$).

[16] Balakrishnan et al. (2012), IMF (2012), and Pradhan et al. (2011) provide comprehensive reviews and analyses pertaining to macro prudential policies implemented in EMGs.

$$\widehat{\beta}_{i,t} = \varphi_0 + \varphi_1 KFlow_{i,t} + \varphi_2 MPI_{i,t} + X'\phi + u_{i,t} \quad (3)$$

where MPI is an index that represents the extensity of the implementation of macroprudential policies. For the index, we use the macroprudential policy dataset developed by Cerutti et al. (2017a, 2017b).

MPI is based on a comprehensive survey conducted by the International Monetary Fund (IMF), called Global Macroprudential Policy Instruments (GMPI). The IMF sent its member countries' central banks this survey composed of questionnaires regarding the use and effectiveness of 18 macroprudential policy instruments. Cerruti et al. (2017a) focus on 12 policy instruments and compile a panel dataset with dummy indicators on the usage of each instrument for 119 countries during the period 2000–2017.

MPI is the sum of the following 12 dummies variables, each of which takes the value of unity when the policy instrument of concern is implemented by the country of concern.[17]

- Loan-to-value ratio cap (*LTV_CAP*);
- Debt to income ratio (*DTI*);
- Dynamic Loan-loss Provision (*DP*);
- Countercyclical capital buffer/requirement (*CTC*);
- Leverage (*LEV*);
- Capital surcharges on Systematically Important Financial Institutions (*SIFI*);
- Limits on interbank exposures (*INTER*);
- Concentration limits (*CONC*);
- Limits on foreign currency loans (*FC*);
- FX and/or countercyclical reserve requirements (*RR_REV*);
- Limits on domestic currency loans (*CG*); and
- Levy/tax on financial institutions (*TAX*).

We regard *MPI* as the measure of the *extensity* of macroprudential policy implementation. Cerruti, et al. (2017b) make it clear that each of the 12 dummies does not "capture the intensity [or stringency] of the measures and any changes in intensity over time."[18] However, aggregating the 12 dummies should reflect the extensity of the macroprudential measures.

Obviously, there is no "one-size-fit-all" macroprudential policy framework. Instead, a broad range of macroprudential policy tools have been in use in many countries with different policy objectives. Some policy tools are intended to build up buffers against accumulating systematic risks so that boom-bust cycles can be mitigated. Other tools are meant to deal with and attenuate the influence of external factors or of interlinkages between different financial markets.

Thus, as policy authorities strengthen defenses against financial instability, the set of policy tools would necessarily expand. In other words, an extensive use of

[17] For more details on the dataset, refer to Appendix 2 as well as Cerruti et al. (2017b).
[18] The authors also argue that codifying the degree of intensity would involve a certain degree of subjective judgements.

Table 6 Estimates of Net Capital Inflow and Macroprudential Policies, 1999 – 2016

Dep. Var.: Est. beta	(1)	(2)	(3)	(4)
Net K-inflow	-1.690	-1.680	-1.922	-1.418
	(0.601)***	(0.605)***	(0.649)***	(0.527)***
MPI	0.026			
	(0.017)			
Capital tools		0.091		
		(0.044)**		
Asset-side tools			0.008	
			(0.031)	
Liquidity-related tools				0.000
				(0.001)

The 2SLS estimation method is used

*p<0.1, **p<0.05, ***p<0.01

macroprudential policies should be warranted to make the aggregate set of policy instruments more effective. Therefore, focusing on the extensity of macroprudential measures could capture the intensity of overall macroprudential policies. Hence, we examine whether the level of macroprudential policy extensity affects the extent of interest rate pass-through.

Since macroprudential policy tools can vary in terms of their purposes and targets, the macroprudential policies contained in MPI can be categorized macroprudential policies into (1) (broad-based) capital tools; (2) asset-side (sectorial capital) tools; and (3) liquidity-related tools (IMF-FSB-BIS, 2016) as the IMF, the Financial Stability Board (FSB), and the Bank for International Settlements (BIS) do.

According to this categorization, we can disaggregate MPI into *CAPITAL*, which is the sum of *DP*, *CTC*, *SIFI*, and *INTER*; *ASSET*, which is the sum of *LTV_CAP*, *DTI*, *LEV*, and *CONC*; and *LIQUIDITY* which is the sum of *FC*, *RR_REV*, *CG*, and *TAX* (see Appendix 2). The policy tools included in *CAPITAL* aim at increasing the resilience of the financial system while maintaining the supply of credit navigating through adverse conditions, while those in *ASSET* seek to break the procyclical feedback between asset prices and credit in the mortgage lending market. Tools in *LIQUIDITY* are aimed at managing the build-up of liquidity and foreign exchange risks associated with lending booms.

Column (1) of Table 6 reports the results from the regression of Eq.(3) for the sample of developing economies.[19] While the estimate on net capital inflows remains significantly negative (with a greater magnitude), the estimate on MPI is found to be positive, but only marginally significant (with the p-value of 13%).[20]

[19] The variables for inflation and output volatilities as well as the constant term and yearly fixed effects are included in the estimation, though their estimates are not reported in the table to conserve space.

[20] For the EMG subsample, the estimate on the MPI is found to be significantly positive with the p-value of 1%. However, the estimate of net capital inflows becomes insignificant.

When we restrict our sample to that of country-year's only with net capital inflows, the estimate of MPI becomes significantly positive with the p-value of less than 5% though the estimate of net capital inflows becomes insignificant (not reported).

As previously described, the MPI index can be disaggregated into (broad-based) capital tools, (sectorial) asset-side tools, or liquidity-related tools. We replace MPI with each of these components and reports the estimation results in columns (2) through (4). Only the variable for capital-based measures is found to be significantly positive. Capital-tools, or broad-based tools, are intended to provide a cushion of protection for economies against unexpected losses or capital flight so as not to disrupt the transmission of their monetary policy control.

We extend our analysis further and examine the effects of each of the 12 individual macroprudential policies instead of MPI (results reported in Appendix 3). The significantly positive estimate of the (broad-based) capital tools reflects the positive contributions of loan loss-provision and limits on interbank exposure.

However, the requirement for systematically important financial institutions (SIFI) to hold additional capital is found to have a *negative* impact on the extent of interest rate pass-through. One explanation would be that capital surcharge requirement results in an increase in fixed costs for major financial institutions and magnifies the uncertainty of the financial system, which might contribute to impeding the interest rate pass-through.

Besides the (broad-based) capital tools, limiting foreign currency loans strengthens the interest rate pass-through. Considering that developing countries often experience currency mismatch, the positive effect of this policy tool makes sense. The estimate on the dummy for limiting domestic currency loan is found to be significantly negative, though it is somewhat counterintuitive. In this sample (composed of 83 developing countries), only Argentina, Bangladesh, Ecuador, and Pakistan persistently implemented this policy.

When the 12 dummies are jointly estimated, all the variables that are found statistically significant when tested individually, retain almost the same levels of magnitudes and statistical significance.

4 Concluding Remarks

It has been increasingly argued that financial globalization has been playing a bigger role in determining domestic asset prices and interest rates. In such an environment, even with greater monetary autonomy, monetary authorities may not be able to keep controls of financial markets and the real economy as Rey (2013) argues. In fact, in recent years, the correlation of long-term interest rates between EMGs, especially those in East Asia, and the United States has been rising while the correlation of short-term rates does not show such a trend. In other words, Rey's (2013) view of global financial cycles affecting domestic monetary policy – in which policymakers face a dilemma between monetary autonomy and free capital mobility – may be applicable to long-term interest rates, though not to the short-term interest rates.

We examine whether receiving net capital inflows can contribute to weakening the link between the short- and long-term interest rates, i.e., the interest rate pass-through. Our estimation results suggest that a country receiving more net capital inflows tends to have a weaker interest rate pass-through. When we instrument net capital inflows with its potential determinants to control for potential endogeneity, we find that both the magnitude and the statistical significance of the estimate for net capital inflows increase.

Now, what do all these findings mean to the emerging and developing economies?

First, as for the economies that has further room to become more open toward cross-border capital flows, policymakers need to be aware of the possibility that receiving more capital flows may lead to a weaker link between the short- and long-term interest rates, making it more difficult to manage macroeconomic and financial stability.

Second, as Aizenman et al. (2016) and others show, we still live in the world dictated by the trilemma. However, even if a developing economy retains monetary independence in terms of short-term interest rate (along with a flexible exchange rate and full capital mobility), the markets for longer-term bonds and other financial assets can be closer to the world Rey (2013) contends. Our estimation suggests for a developing country of concern with more open financial markets, its longer-term assets can be more vulnerable to shocks emanating from the center economy, i.e., the U.S., regardless of the exchange rate regime. In such a world, asset markets with longer maturity can be more synchronized by risk premium, and it can be difficult to have autonomous influence on the longer-end of the yield curve.

Furthermore, the conspicuous influence of capital inflows on the yield curve of financially developed emerging economies implies that these countries may face another dilemma. That is, while the benefits of financial integration are apparent (e.g., risk sharing, efficient capital accumulation), higher extent of financial market openness might hinder the effectiveness of monetary policy in terms of retaining control over longer-term interest rates. Policy makers must be aware of this challenge.

Last, our empirical tests show that imposing macroprudential policies may help a developing country to retain control of the longer-end of the yield curve. Among many measures with different purposes, we find broad-based capital tools, especially those that require loan loss provision, that put limits on interbank exposure, and that limit foreign currency loans, are effective.

In the highly globalized world where EMGs are susceptible to the ebbs and flows of capital determined by the center economy, not all the countries that experience massive capital inflows would experience a financial crisis. To the same extent global factors matter, domestic factors such as their economic and institutional characteristics do matter for the allocation of global capital. Understanding the link between financial globalization and the extent of interest pass-through will help us to identify the potential channels and linkages of how the globalized world affects the domestic economy of concern.

Appendix 1 Data Descriptions and Country Groups

Theoretical Predictions and Data Sources

KFlow – Net capital flows as a share of GDP. The data are extracted from the International Monetary Fund's *Balance of Payments* database. Positive values of net capital inflows mean capital inflows while negative values mean capital outflows.

Relative income – The more developed a country of our concern is, the more smoothly the interest rate channel of monetary transmission should take place, i.e., the linkage between short-term and long-term interest rates gets stronger. Higher per capita income also reflects better institutional development, which can also contribute to smoother monetary transmission. We measure the level of economic development by using the per capita income data from Penn World Table 9.1 and normalizing it as a ratio to the U.S. per capita income level.

Inflation volatility – measured as the 5-year standard deviations of CPI-inflation. High inflation volatility, on the one hand, introduces uncertainty into the market signals that potentially reduces the effectiveness of the monetary policy transmission. Therefore, the coefficient may appear to be negative. On the other hand, more frequent episodes of high inflation volatility may also cause the risk premium to climb in order to incentivize borrowers to hold a risky asset. Consequently, we could also observe the longer end of the yield curve mounting to higher levels in the presence of inflation volatility. In other words, the term risk makes the yield curve often upward sloping. That instead suggests a positive coefficient.

Output volatility – measured as the 5-year standard deviations of real GDP growth rates. To a lesser extent, the same explanation may apply to output volatility, though it seems more reasonable to assume that greater output stability might lead to greater effectiveness of monetary policy due to increased predictability of both economic conditions and economic policy management, leading to smaller risk premium.

Output gap – the difference between the actual real GDP and the Hodrick-Prescott filtered GDP. Output gap may serve as a good proxy for a country's level of policy rate, indicating whether the economy is on the state of rising or falling policy rate. Given the tendency of the yield curve to be upward sloping, a fall in the policy rate leads to a smaller response in the longer-term interest rate compared to when the policy rate is rising, which suggests that the coefficient on the output gap variable be negative.

Financial crisis – The dummy for a financial crisis is constructed based on Laeven and Valencia's (2018) database on the occurrences of currency, banking and sovereign crises. The dummy takes the value of one if either or both of currency and banking crisis happen. This dummy might capture noise in the dependent variable since the policy rate disproportionally changes with respect to long-term interest rates in the case of a financial crisis.

Financial development – Financial development may matter for the interest rate pass-through since obviously more developed financial markets should facilitate monetary transmission. To measure the level of financial development, we use Svirydzenka's (2016) "index of financial development" which is the first principal component of two

sub-indexes, one that captures the development of financial markets (*FM*) and the other that reflects the development of financial institutions (*FI*).

Country List

Industrialized countries (IDC):

Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, Malta, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, United States.

Emerging Market Economies (EMEs):

Argentina, Bangladesh, Botswana, Brazil, Brunei, Bulgaria, Cote d'Ivoire, Cambodia, Chile, China, Colombia, Czech Republic, Ecuador, Egypt, Arab Rep., Ghana, Hong Kong, China, Hungary, India, Indonesia, Israel, Jamaica, Jordan, Kenya, Korea, Rep., Lithuania, Malaysia, Mauritius, Mexico, Morocco, Nigeria, Pakistan, Peru, Philippines, Poland, Russian Federation, Singapore, Slovak Republic, Slovenia, South Africa, Sri Lanka, Thailand, Trinidad and Tobago, Tunisia, Turkey, Venezuela, RB, Vietnam, Zimbabwe.

Emerging Asia:

China, Hong Kong, China, India, Indonesia, Korea, Rep., Malaysia, Philippines, Singapore, Thailand, Vietnam.

Appedix 2: Macroprudential Policy Index

Variable	Variable Name	Definition
Broad-based capital tools (CAPITAL)		
DP	Time-Varying/Dynamic Loan-Loss Provisioning	Dummy for the use of a policy that requires banks to hold more loan-loss provisions during upturns
CTC	General Countercyclical Capital Buffer/Requirement	Dummy for the use of a policy that requires banks to hold more capital during upturns
SIFI	Capital Surcharges on Systematically Important Financial Institutions	Dummy for the use of a policy that requires Systematically Important Financial Institutions to hold a higher capital level than other financial institutions
INTER	Limits on Interbank Exposures	Dummy for the use of a policy that limits the fraction of liabilities held by the banking sector
Sectoral capital and asset-side tools (ASSET)		

Variable	Variable Name	Definition
LTV_CAP	Loan-to-Value Ratio	Dummy for the use of LTV measures used as a strict cap on new loans as opposed to a loose guideline or merely an announcement of risk weights
DTI	Debt-to-Income Ratio	Dummy for the use of a policy that constrains household indebtedness by enforcing or encouraging a limit
LEV	Leverage Ratio	Dummy for the use of a policy that limits banks from exceeding a fixed minimum leverage ratio
CONC	Concentration Limits	Dummy for the use of a policy that limits the fraction of assets held by a limited number of borrowers
Liquidity-related tools (LIQUIDITY)		
FC	Limits on Foreign Currency Loans	Dummy for the use of a policy that reduces vulnerability to foreign-currency risks
RR_REV	FX and/or Countercyclical Reserve Requirements	RR is a policy that limits credit growth. It can also be targeted to limit foreign-currency credit growth. RR_REV is a subset of RR that restricts to reserve requirements which i) imposes a specific wedge on foreign currency deposits or are adjusted countercyclically
CG	Limits on Domestic Currency Loans	Dummy for a policy that limits credit growth
TAX	Levy/Tax on Financial Institution	Dummy for taxes on the revenue of financial institutions
MPI	Macroprudential Policy Index (0 – 12)	LTV_CAP + DTI + DP + CTC + LEV + SIFI + INTER + CONC + FC + RR_REV + CG + TAX

Source Table 1 of Cerutti et al. (2017a, b), IMF-FSB-BIS (2016), Aizenman et al. (2017)

Appendix 3: Estimates of Net Capital Inflow and Macroprudential Policies, 1999 – 2016

Dep. Var.: Est. beta	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Net K-inflow	-1.925	-1.814	-2.226	-1.678	-1.931	-2.014	-1.800
	(0.580)***	(0.612)***	(0.665)***	(0.605)***	(0.688)***	(0.601)***	(0.611)***

Dep. Var.: Est. beta	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Loan loss-provision	0.190						
	(0.085)**						
Countercyclical		-0.148					
k-requirements		(0.108)					
K-surcharge on			-0.408				
SIFI			(0.151)***				
Limits on interbank exposure				0.118			
				(0.053)**			
Loan-to-value ratio					-0.009		
					(0.063)		
Debt-to-income ratio						-0.017	
						(0.075)	
Leverage ratio							-0.015
							(0.080)
Concentration limits							
Limits on foreign currency loan							
Countercyclical reserve requirements							
Limits on domestic currency loan							
Levy on financial institution							
Adjusted R^2	0.39	0.39	0.35	0.41	0.38	0.37	0.39

Dep. Var.: Est. beta	(8)	(9)	(10)	(11)	(12)	(13)
Net K-inflow	-1.734	-1.510	-1.891	-1.762	-1.769	-2.245
	(0.608)***	(0.546)***	(0.636)***	(0.594)***	(0.595)***	(0.678)***
Loan loss-provision						0.161
						(0.080)**
Countercyclical						-0.118
k-requirements						(0.144)
K-surcharge on						-0.413
SIFI						(0.202)**
Limits on interbank exposure						0.129
						(0.056)**
Loan-to-value ratio						0.017
						(0.068)
Debt-to-income ratio						-0.098
						(0.068)

Dep. Var.: Est. beta	(8)	(9)	(10)	(11)	(12)	(13)
Leverage ratio						0.030
						(0.072)
Concentration limits	0.052					-0.000
	(0.044)					(0.049)
Limits on foreign currency loan		0.177				0.158
		(0.073)**				(0.081)**
Countercyclical reserve requirements			0.074			0.053
			(0.069)			(0.070)
Limits on domestic currency loan				-0.149		-0.218
				(0.080)*		(0.089)**
Levy on financial institution					0.082	0.031
					(0.106)	0.108
Adjusted R^2	0.40	0.43	0.38	0.40	0.39	0.40

The variables for inflation and output volatilities as well as the constant term and yearly fixed effects are included in the estimation, though their estimates are not reported in the table to conserve space

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