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Managing the Yield Curve in a Financially Globalized World*

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Abstract

It has been increasingly argued that highly globalized financial markets have been playing a bigger role in determining domestic asset prices and long-term interest rates. Rey (2013) argues that global financial cycles essentially dictate the movements of domestic financial markets to such an extent that policy makers have to decide between either retaining monetary autonomy by imposing capital controls, or retaining free capital mobility but relinquishing monetary independence. In such a world, managing long-term interest rates through manipulating short-term interest rates can be difficult. In this paper, we empirically examine whether net capital inflows contribute to weakening the link between short-term and long-term interest rates. We find that economies open to cross-border capital flows or with more developed financial markets tend to have a greater negative relationship between net capital inflows and 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 short- to long-term interest rate pass-through.

Keywords: Financial liberalization, Yield curve, Trilemma, Macroprudential policy
JEL classification: F32, F41

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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. The most representative work of this view is the paper by Rey (2013), who argues that financial globalization has made countries' macroeconomic conditions more sensitive to the "global financial cycle" in capital flows, asset prices, and credit growth. In the markets where capital is freely mobile, Rey argues, other countries' national monetary policies are subject to the center countries' monetary policy unless the former decides to curtail capital mobility.[1]

Figure 1 makes it clear that the volumes of capital flows to emerging market economies (EMG) tend to rise when risk appetite, which we measure by using the reversed VIX index, is higher.[2] When "risk is on," risk appetite would rise and capital would flow to where the yields are higher, which was the case for EMGs when advanced economies implemented extremely low interest rate policies in the late 2000s through the mid-2010s. Either when "risk is off," i.e., perceived risk is rising, or when the interest rates are expected to rise in advanced economies, capital would leave emerging markets for the markets in advanced economies. Thus, capital flows to emerging markets appear only passively reacting to the conditions of the major economies or the global economy.

If domestic financial markets are more susceptible to international factors, that could make domestic monetary policy management more difficult. While short-term interest rates are under direct control of policy makers, long-term rates, which affect both financial and real activities directly, reflect many factors including global ones. In other words, the behavior of the long-term rates may not necessarily reflect policy makers' intention of manipulating the shorter end of the yield curve. Hence, policy makers are not only vulnerable to shocks emanating from the center economies when managing the short-term interest rates (Aizenman, et al. 2015, 2016), but also possibly less capable of controlling long-term interest rates even if they need to deal with

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[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, or in her words, a "irreconcilable duo." For the trilemma vs. dilemma debate, refer to Aizenman, et al. (2015, 2016), Klein and Shambough (2015), Ricci and Shi (2016), and Han and Wei (2016).

[2] The VIX is available from the Chicago Board Options Exchange (CBOE) and measures the implied volatility of U.S. S&P 500 index options. For the analyses on the factors that affect cross-border capital flows to emerging market economies, see Ahmed and Zlate (2013), Chuhan, et al. (1993), Forbes and Warnock (2010), Ghosh, et al. (2012), Griffin, et al. (2004), and Fratzscher (2011), and Taylor and Sarno (1997) among many others.

macroeconomic challenges or financial stability.

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 was raising the federal funds rate to rein in the economy, the longer-end of the yield curve turned out to be less responsive. A widely received argument to explain the conundrum was the "global saving glut" view (Bernanke, 2005; Clarida, 2005; Greenspan, 2005a,b). According to this view, the lack of sophisticated financial assets or other investment opportunities in countries with excess saving, namely, China, Japan, other East Asian economies, and oil exporters, had led to massive capital flows to the United States where financial markets are well-developed and sophisticated, and legal systems and institutions support smooth financial transactions (Caballero, et al., 2008, 2016, 2017). Warnock and Warnock (2009) estimate that if there were no foreign purchase of U.S. Treasury and agency bonds, U.S. long-term interest rates would have been 80 basis points higher. In a cross-sectional context, Byrne, et al. (2010) provided empirical evidence that the disconnect of short- and long-term interest rates is not just happening to the U.S. but also to other industrialized countries.

The "Greenspan conundrum" has also been pointed for emerging market economies where the impact of globalization can be even stronger. Both Pradhan, et al. (2010) 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 and foreign investors affect pricing of financial assets more, policy makers, especially in non-center economies, would find themselves struggling to get a grip on the longer-end of the yield curve. When the central bank implements contractionary monetary policy, the short-term policy rate would rise, but that could attract more capital inflows because other financial assets including long-term bonds can appear relatively inexpensive. This would lead in turn to a surge in the demand of long-term bonds, and thereby their prices will rise while their yields fall. That means while the increase in the short-term rate creates an upward pressure on the long-term rate (through the expectations theory), it could also face a downward pressure. The extent of the downward pressure should depend on how open the domestic market is toward international investors. Conversely, when the central bank implements expansionary monetary policy, while both the short- and long-term rates face downward pressure, capital can flow out of the domestic market, creating upward pressure on the long-term rate.

Given this background, we investigate whether the extent of exposure to cross-border capital flows affects the relationship between short-term 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 running the regression of 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 short-to-long term rate link. When many emerging market economies were experiencing an influx of capital in the aftermath of the Global Financial Crisis of 2008, some of them also implemented policies to prudently prevent financial overheat that can afterwards turn into financial instability. Such "macroprudential policies" have received much attention and their efficacy has been debated.[3] We join the debate by examining whether macroprudential policies can have any impact on the short-to long-term interest rate pass-through. If these policies work in a way that prevents financial exuberance, it is possible for policy makers to 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, Section 2 illustrates the trend of the short- and long-term interest rates between our sample economies and the U.S. as well as the relationship between the short- and long-term interest rates. In Section 3, we empirically investigate whether net capital inflows have any impact on the extent of interest rate pass-through. In Section 4, we also examine whether we can find any impact of macroprudential policies on interest rate pass-through. Section 5 presents our concluding remarks.

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

Let us see how the interest rates are behaving with respect to the U.S., the most dominant key economy, and among different markets.

Panel (a) of Figure 2 illustrates the 36-month rolling correlations of domestic money market rates with the U.S. money market rate for different country groups, that of industrialized

[3] See Akinci and Olmstead-Rumsey (2017), Buch and Goldberg (2017), Cerutti, et al., (2015), Ghosh, et al. (2014, 2015), Lim, et al. (2011), Ostry, et al. (2012), among many others.

countries (IDC), emerging market economies (EMG), non-emerging developing economies (Non-EMG LDC), and Asian EMG, the last of which we include since these economies are especially integrated with international financial markets.

The figure shows that from 2003 through 2011, the correlation between domestic and the U.S. interest rates appears relatively high except for 2005 and the time of the global financial crisis.[4] Interestingly, economies with higher income on average tend to have their short-term rates more highly correlated with that of the United States. As far as the time period after 2011 is concerned, the short-term interest rates of developing economies, especially EMGs, are not highly and positively correlated with that of the U.S., indicating that these economies retained moderately high levels of monetary independence in these years.

According to panel (b) of Figure 2, 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 despite the global financial crisis 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. That may suggest that policy makers find it difficult to control macroeconomic and financial conditions through maneuvering short-term interest rates.

Panel (c) illustrates that since the late 2000s until recently, all the country groups had maintained high levels of correlations of stock market price indexes with the U.S. stock market. This is in contrast to the case of the correlation of the short-term interest rates, which tends to be more cyclical and low in the last several years.

The correlations of both long-term interest rates and stock market price indexes being more correlated with those of the U.S. is consistent with Jordà, et al. (2018) who attribute the synchronization of financial cycles to fluctuations in risk premiums. If the long-term interest rate reflects risk premiums, it can be less well-connected with the short-term interest rates.

Thus, there is a possibility that policy makers of a financially open economy may find it difficult to control the longer end of the yield curve. That is, as we observe in the last decade, even if the short-term rate is under the control of domestic monetary authorities, the longer-end of the

[4] 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 all the way essentially to the 0.00-0.25 by December 2008.

yield curve can be more exposed to global financial cycles so that policy makers may not have a good grip on the longer-end of the yield curve.

In fact, Figure 3 illustrates that the correlation between the short- and long-term yields has been in a moderately declining trend for developing economies. Interestingly, the extent of downward trend is more evident among non-EMG developing economies. This declining trend may or may not be related to financial globalization that has been proceeding in the time period.

Now, it is reasonable to investigate how greater exposure to international financial markets could affect the extent of linkage between short- and long-term interest rates, which we will investigate in the next section.

3. Estimation on the Determinants of the Yield Curve

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 $\hat{\beta}_i$ in the model can be considered as a measure of the pass-through from the short-term interest rates ($i_{STi,t}$) to the long-term interest rates ($i_{LTi,t}$).

$$\Delta i_{LTi,t} = \alpha + \beta_i \Delta i_{STi,t} + \varepsilon_{i,t} \qquad (1)$$

We estimate the β coefficient with a 36-month rolling window for each of our sample 109 countries, which means that we allow the extent of interest rate pass-through for each country to vary over time.

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

$$\hat{\beta}_{i,t} = \varphi_0 + \varphi_1 KFlow_{i,t} + X'\Phi + u_{i,t}. \qquad (2)$$

KFlow is net capital flows as a share of GDP,[5] and *X* is a vector of other determinants

[5] Positive values of net capital inflows mean capital inflows while negative values mean capital outflows.

including the variables for relative income (to the U.S.), inflation volatility, output volatility, financial development, and the dummy for financial crisis. Inflation volatility and output volatility are measured as the 5-year standard deviations of CPI-inflation and real output growth rates, respectively. Both inflation and output volatilities would contribute to higher degrees of uncertainties, either monetary or real, for monetary policy makers.

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.

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. In this analysis, we implicitly assume monetary authorities implement monetary policy on a discretionary basis; they try to manipulate the long-term interest rate as a way to influence the real economy. However, monetary authorities could take a rule-based approach, in which case the goal of their policy is to stabilize the long-term interest rates. The latter case may not be directly captured by this estimation framework. However, the inflation volatility variable indirectly controls for the possibility of a rule-based monetary policy, because inflation volatility would usually affect the decision of whether or not to implement rule-based monetary policy.

The extent of interest rate pass-through may differ depending on whether the policy rate rises or falls because the term premium often makes the yield curve upward sloping. Output gap provides information on whether the yield curve is upward or downward sloping. We measure output gap as 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.

The crisis dummy 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.

We include a country's relative income with respect to the United States in X to capture the impact of the stage of development. 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.

Lastly, we suspect that 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*). Each of *FM* and *FI* is the first principal components of three variables: "depth," "access," and "efficiency," respectively.[6]

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 panel. Our sample is composed of 132 countries in 1978 through 2016. We focus on the sample of 109 developing countries (LDC), out of which 38 countries are emerging market economies (EMG).[7]

Table 1 reports the results of the estimations conducted with the Ordinary Least Squares

[6] That is, there are FM-depth, FM-access, FM-efficiency, and FI-depth, FI-access, FI-efficiency. Each of the six sub-indexes is the first principal components of the component variables. For further details, refer to Svirydzenka (2016).

[7] See Appendix for country groups. Not all the countries used for the previous summary statistics are included in the estimations due to data limitations.

(OLS) method (with robust standard errors).[8]

In Table 1, we see that 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. For the EMGs, the coefficient on the net capital flow is found to be negative, but not statistically significant.

Inflation volatility's coefficients are found to be significantly positive for both LDC and EMG samples. This outcome indicates that 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. In other words, high inflation risk is passed through to the longer end of the yield curve. This result is consistent with the literature where either high inflation or inflation volatility is found to be associated with higher interest rate pass-through (Cottarelli and Kourelis, 1994; Mojon, 2000; and Sander and Kleimeier, 2004)

The rest of the control variables appears consistent with theoretical predictions. Output volatility has significantly negative coefficients for both LDC and EMG groups, which suggests that higher output stability impedes smooth transmission of monetary policy by increasing uncertainty of future economic conditions and policy management. Meanwhile, the significantly positive estimate on financial development indicates that improving the conditions of financial sectors could help central bank gain better control of the long end of the yield curve. However, we must take this result with a grain of salt because financial development can be correlated with capital inflows.

Not just financial development, but other right-hand side variables can affect net capital inflows, or vice versa. That is, net capital inflows may be endogenous in the last OLS estimation. Also, we may need to be concerned about the endogeneity issue arising from bilateral causality of the estimation model.

In fact, as the literature has shown, many "push" and "pull" factors may affect the direction and the volume of cross-border capital flows. These factors include global factors such as the monetary policy of the center economy (Aizenman, et al. 2016) and the level of risk appetite of international investors as well as some domestic factors of capital recipient countries such as the

[8] The variables for net capital inflow, inflation volatility, and output volatility contain outliers. We control for the outliers by including the dummies for them. Hence, part of the high adjusted R-squares, especially for the full and IDC samples, reflect the contributions of the dummies for the outliers.

level of institutional or legal development, growth prospects, the state of its own monetary policy, and the capital controls policy. These factors could first affect the volumes and the directions of capital flows, then the latter may affect the interest rate pass-through.

To both incorporate the literature on the determinants of capital inflows and mitigate the endogeneity issue, we 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 (the Chinn-Ito index); and output gap. We also include 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.[9] 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 which should also capture global common shocks in both stages.[10]

Table 2 reports the results from the 2SLS 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 of developing countries and emerging market economies. A one percentage point increase in net capital inflows, which happened between 2005-07 and 2011-13 among developing countries on average, would lead to a 1.2 percentage point decrease in the correlation between the changes in the short- and the long-term rates. 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 only econometrically significant, but also economically significant.

We have seen the negative impact of net capital inflows on the extent of interest rate pass-through. This variable is, however, specific about the direction of capital flows. One may wonder what matters is not just net capital inflows, but also outflows. In other words, a country with its financial account generally more open (either way) may have a weaker link between the short- and the long-term interest rates.

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[9] The definition of "financial centers" follows Lane and Milesi-Ferretti (2017).

[10] 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."

Columns (1) and (2) show the results for the LDC and EMG samples, respectively, from the estimations where the variable for net capital inflows is included in absolute values. The variable for the absolute values of net capital inflows is significantly negative but only for the LDC group. We have some weak evidence that the general openness of the financial account negatively affects the short- and long-term interest rate link.

From a difference point of view, 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 in terms of net financial flows. Following this argument, we include the sum of credit and debit of financial accounts (from the balance of payments) divided by GDP.

Also, instead of using such flow variables, we can measure 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 calculate the sum of external assets and liabilities divided by GDP and include it in the estimation.

Columns (3) and (4) show that the estimate of the variable for gross financial flows is negative but not statistically significant for either LDC or EMG groups. When we include the gross capital stock variable, we find its estimate to be 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.

3.2 Further Analysis

The effect of net capital inflows on the extent of 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 the level of de jure financial openness of our sample economies.

In the first four columns of Table 4, we divide the samples of LDC and EMG into two subgroups each depending on whether the economy of concern is open or closed in terms of the de jure measure of financial openness. The country-year's with the de jure measure of capital openness above the median are regarded as "open," and otherwise regarded as "closed."

In Columns (1) through (4), we see that only financially open regimes have the significantly negative estimates for net capital inflows for both LDC and EMG groups. That is, if a developing or emerging market economy is highly open (in terms of removal of capital controls) to cross-border capital flows and receives a greater amount of capital inflows, it tends to have a smaller extent of interest rate pass-through, i.e., monetary policy authorities would have a weaker grip on 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). However, we do not find any difference between countries with greater exchange rate stability and those with lower exchange rate stability (not reported). However, the impact of the exchange rate regime may differ depending on the extent of financial openness based on the idea of the monetary trilemma (see footnote 3). That is, 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 complete financial autarky and exchange rate fixity or full financial openness and floating exchange rate, the country would retain monetary independence.

Following this, we divide our sample of developing economies into four groups and run the regression for each of the groups, whose results we report in Table 5 (only with the estimated coefficient of the net capital inflow variable for each group). Based on the trilemma theorem, 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.[11]

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 significant. That 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 effect of short-term rate changes on 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 is open to international financial markets, the degree of

[11] In the case of panel (4), the trilemma will not be 'binding' since both financial openness and exchange rate stability are at low levels, though that must indicate the level of monetary independence is higher.

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.

Our regression results show that only developing economies with developed financial markets tend to have a negative correlation between net capital inflows and the degree of interest rate pass-through. As in the case of external financial openness, more developed financial markets may make it harder for policy makers to have a control on the longer-term interest rates. Both financial development and financial openness affect the degree of substitutability between domestic and foreign financial bonds. The degree of substitutability across bond markets and other financial assets plays a key role in the transition mechanism (He and McCauley, 2013).[12] Hence, where the environment of the financial markets allows the degree of substitutability to be high, the elasticity of capital flows with respect to changes in the short-term rate also tends to be high, which creates counterforce to a rate change.

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 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

[12] 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.

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 Global Financial Crisis of 2008, advanced economies implemented expansionary monetary policy, that eventually caused an enormous amount of capital to flow to developing or emerging market economies in search for higher yields, causing both economic and financial overheating in the recipient countries. Facing the influx of capital that threatened to bring out financial instability, several emerging market economies, such as Brazil, Indonesia, Korea, Russia, and Thailand implemented macroprudential policies.[13]

Here, we are interested in whether macroprudential policies can have an impact on the extent of interest rate pass-through. If these policies are effective, they should allow monetary policy makers to regain control over the yield curve.

When an economy is experiencing a financial bubble, for example, the pricing of a financial asset may not occur properly – an influx of capital can cause 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. However, if monetary authorities implement macroprudential policies, a more appropriate pricing of assets may occur, which may allow monetary authorities to have a better grip on the long-end of the yield curve. Thus, if we include a variable that reflects the implementation of macroprudential policies, it can enter the estimation with a positive coefficient. We run the following estimation model:

$$\hat{\beta}_{i,t} = \varphi_0 + \varphi_1 KFlow_{i,t} + \varphi_2 MPI_{i,t} + X'\Phi + u_{i,t}, \qquad (3)$$

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. (2015, 2017a) and we expect $\varphi_2 > 0$ if macroprudential policies are effective.

The macroprudential policy index, or 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

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

regarding the use and effectiveness of 18 macroprudential policy instruments. Cerruti, et al. (2015, 2017a) focused on 12 policy instruments and compiled 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.[14]

- 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 treat *MPI* as the measure for the *extensity* of macroprudential policy implementation. Cerruti, et al. (2015) make it clear that each of the 12 dummies does not "capture the intensity of the measures and any changes in intensity over time."[15] Although each dummy does not directly refer to the stringency of individual policy measures, MPI, as an aggregate of the 12 dummies, does reflect the *extensity* of the macroprudential measures.

Countries have adopted varying institutional arrangements to avoid the accumulation of systematic risk and the occurrence of financial crisis. Obviously, there is no "one-size-fit-all" macroprudential policy framework. Instead, a broad range and variety of macroprudential policy tools have been in use in many countries with different policy objectives. Some policy tools are

[14] For more details on the dataset, refer to Appendix 2 as well as Cerruti, et al. (2015).
[15] The authors also argue that codifying the degree of intensity of the measures would involve a certain degree of subjective judgements.

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 domestic 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 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 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 categorize 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 Settles (BIS) do.

According 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 resilience of the financial system while maintaining the supply of credit 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 equation (3) for the sample of developing economies.[16] While the estimate on net capital inflows remains significantly negative (with a bigger magnitude), the estimate on MPI is found to be positive, but only marginally significant (with the p-value of 13%).[17] 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

[16] 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.

[17] 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.

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 macroprudential measures is found to be significantly positive. Capital-tools, or broad-based tools, are intended to preemptively increase resilience of the financial system and maintain the supply of credit, while the domestic financial market is experiencing overheating, by forcing financial institutions to take countercyclical accumulation. These policies might 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 individual macroprudential policies by including each of the 12 dummy variables individually and jointly instead of MPI. The significantly positive estimate of the (broad-based) capital tools reflects the positive contributions of loan loss-provision and limits on interbank exposure. However, at the same time, 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 face the issue of 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 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. If that is the case, 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 policy makers 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 short-term and long-term interest rates. Our estimation results suggest that a country receiving more net capital inflows tends to have a weaker link between short- and long-term interest rates. When we instrumented net capital inflows with its potential determinants based on the literature to control potential endogeneity, we found that both the magnitude and the statistical significance of the estimate for net capital inflows increases. Even when we replace the variable for net capital inflows with the measures of de facto financial openness, we still obtain more or less consistent results.

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, policy makers need to be aware of the possibility that receiving more capital flows may lead to weakening the link between short-term and long-term interest rates, making it more difficult to manage macroeconomic and financial stability.

Second, Aizenman, et al. (2015) and others show that we still live in the world dictated by the trilemma. That means, instead of the dilemma world Rey (2013), economies can retain monetary autonomy while having open financial markets by having a flexible exchange rate regime. Simply examining the correlation of short-term interest rates with that of the U.S. leads to an observation that on average developing economies have retained monetary autonomy in the last decade. However, the markets for longer-term bonds and other financial assets seem to be closer to the world Rey (2013) contends; they are more vulnerable to shocks emanating from the center economy, i.e., the U.S., if they have open financial markets. That is, longer-term assets are subject to more risk and asset markets in the world can be more synchronized by risk premium.

With that being said, even if a developing economy retains monetary independence in terms

of short-term interest rate, in terms of longer-term assets, it can be more subject to Rey's type of dilemma world. In short, it can be quite difficult for developing economies to have autonomous influence on the longer-end of the yield curve.

Further, 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 helping countries retain control over longer-term interest rates. Policy makers must be aware of this challenge.

Last, macroprudential measures have received much attention since the breakout of the GFC. Several emerging market economies have implemented these measures in the immediate aftermath of the global crisis to manage potential impacts of surging capital inflows on macroeconomic and financial stability.

Our empirical tests show that imposing macroprudential policies may help the 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 to be effective

Even if foreign factors or the monetary policy of the center country is influential and affects the ebbs and flows of capital for EMEs as an aggregate, it does not mean all the EMEs would experience the surges of capital flows. To the same extent of global factors, domestic or "pull" factors also matter. That is, each country's economic and institutional characteristics do affect the allocation of global capital. Furthermore, not all the countries that experience massive capital inflows would experience a financial crisis. However, we need to be aware of all the potential channels and linkages among economic and noneconomic factors. The link between financial globalization and the extent of interest pass-through can be one of them.

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Appendix 1: Country Groups

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

Appendix 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)		
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. (2015), IMF-FSB-BIS (2016), Aizenman, et al. (2017).

Table 1: Determinants of the Short to Long-term Interest Rate Pass-through: OLS, 1980 – 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

Notes: * $p<0.1$; ** $p<0.05$; *** $p<0.01$. The constant term and yearly fixed effects are included in the estimation, though their estimates are not reported in the table.

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

Notes: * $p<0.1$; ** $p<0.05$; *** $p<0.01$. 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.

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

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

	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

Notes: * $p<0.1$; ** $p<0.05$; *** $p<0.01$. 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.

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

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

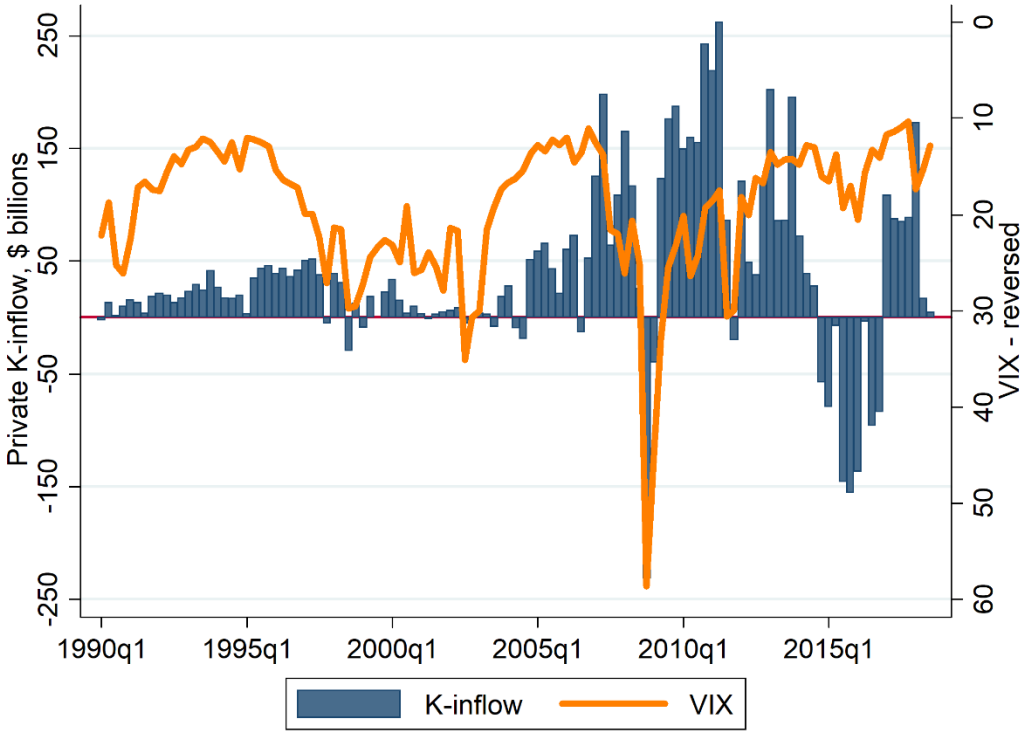
Table 6: Estimates of Net Capital Inflow and Macroprudential Policies, 1999 – 2016

Dep. Var. : Est. beta	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Net K-inflow	-1.690	-1.680	-1.922	-1.418	-1.925	-1.814	-2.226	-1.678	-1.931
	(0.601)***	(0.605)***	(0.649)***	(0.527)***	(0.580)***	(0.612)***	(0.665)***	(0.605)***	(0.688)***
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)					
Loan loss-provision					0.190				
					(0.085)**				
Countercyclical k-requirements						-0.148			
						(0.108)			
K-surcharge on SIFI							-0.408		
							(0.151)***		
Limits on interbank exposure								0.118	
								(0.053)**	
Loan-to-value ratio									-0.009
									(0.063)
Debt-to-income ratio									
Leverage ratio									
Concentration limits									
Limits on foreign currency loan									
Countercyclical reserve requirements									
Limits on domestic currency loan									
Levy on financial institution									
Adjusted R^2	0.41	0.41	0.38	0.55	0.39	0.39	0.35	0.41	0.38

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

Dep. Var. : Est. beta	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Net K-inflow	-2.014	-1.800	-1.734	-1.510	-1.891	-1.762	-1.769	-2.245
	(0.601)***	(0.611)***	(0.608)***	(0.546)***	(0.636)***	(0.594)***	(0.595)***	(0.678)***
MPI								
Capital tools								
Asset-side tools								
Liquidity-related tools								
Loan loss-provision								0.161
								(0.080)**
Countercyclical k-requirements								-0.118
								(0.144)
K-surcharge on SIFI								-0.413
								(0.202)**
Limits on interbank exposure								0.129
								(0.056)**
Loan-to-value ratio								0.017
								(0.068)
Debt-to-income ratio	-0.017							-0.098
	(0.075)							(0.068)
Leverage ratio		-0.015						0.030
		(0.080)						(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	0.37	0.39	0.40	0.43	0.38	0.40	0.39	0.40

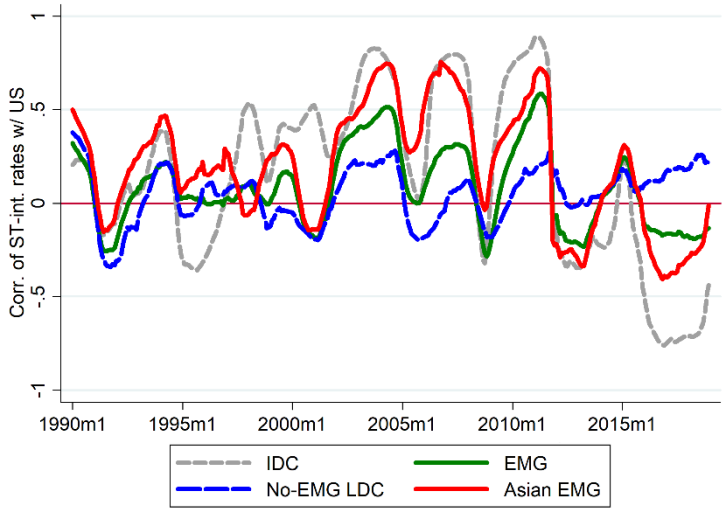
Figure 1: VIX and Net Capital Flows to EMEs



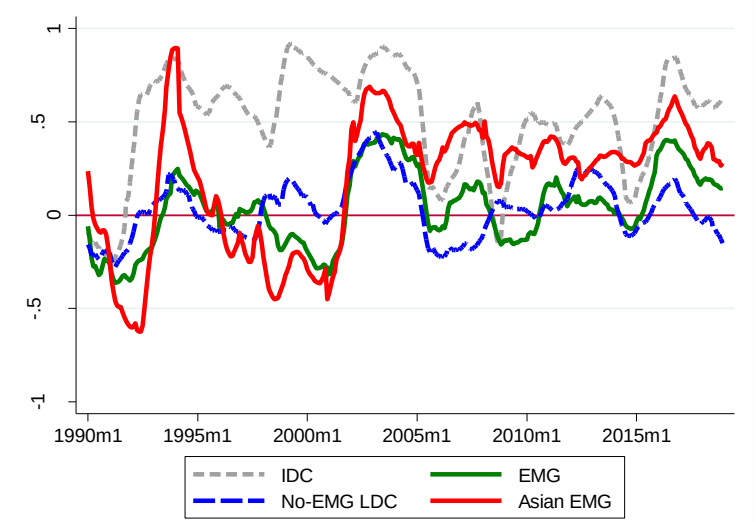
Note: VIX is a measure of the implied volatility of U.S. S&P 500 index options. Both VIX and net capital flows are shown as four-months moving averages. The VIX index is a measure of uncertainty or risk aversion of the markets. The scale for the VIX index (on the right-hand side) is reversed so that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

Figure 2: Correlations of Financial Variables With the U.S.

(a) Short-term interest rates



(b) Long-term interest rates



(c) Stock market prices

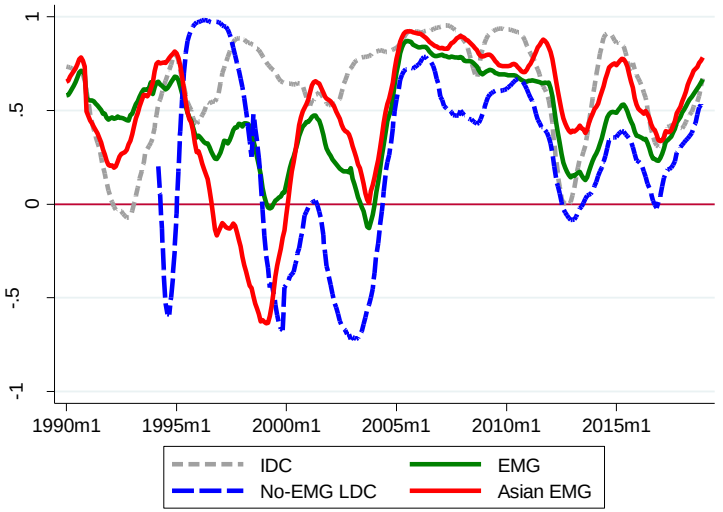


Figure 3: Correlations between Short- and Long-term Interest Rates among Developing Economies