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# Unconventional Monetary Policy Normalization in High-Income Countries

## Implications for Emerging Market Capital Flows and Crisis Risks

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## Abstract

As the recovery in high-income countries firms amid a gradual withdrawal of extraordinary monetary stimulus, developing countries can expect stronger demand for their exports as global trade regains momentum, but also rising interest rates and potentially weaker capital inflows. This paper assesses the implications of a normalization of policy and activity in high-income countries for financial flows and crisis risks in developing countries. In the most likely scenario, a relatively orderly process of normalization would imply a slowdown in capital inflows amounting to 0.6 percent of developing-country GDP between 2013 and 2016, driven in particular by weaker portfolio investments. However, the risk of more abrupt adjustments remains significant, especially if increased market volatility accompanies the unwinding of unprecedented central bank interventions. According to simulations, abrupt changes in market expectations, resulting in global bond yields increasing by 100 to 200 basis points within a couple of quarters, could lead to a sharp reduction in capital inflows to developing countries by between 50 and 80 percent for several months. Evidence from past banking crises suggests that countries having seen a substantial expansion of domestic credit over the past five years, deteriorating current account balances, high levels of foreign and short-term debt, and over-valued exchange rates could be more at risk in current circumstances. Countries with adequate policy buffers and investor confidence may be able to rely on market mechanisms and countercyclical macroeconomic and prudential policies to deal with a retrenchment of foreign capital. In other cases, where the scope for maneuver is more limited, countries may be forced to tighten fiscal and monetary policy to reduce financing needs and attract additional inflows.


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# Unconventional Monetary Policy Normalization in High-Income Countries: Implications for Emerging Market Capital Flows and Crisis Risks

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# 1. Introduction

The past two decades have seen dramatic changes in private capital inflows to developing countries. These flows have increased substantially both in absolute terms and as a share of developing-country GDP, and have been characterized by large fluctuations in response to changing global financial and economic conditions.

In the post-crisis period, financial inflows have averaged around 6 percent of GDP in developing countries, supported by historically low interest rates in high-income countries and stronger growth prospects across emerging and developing regions.

As the recovery in high-income countries firms amid a gradual withdrawal of extraordinary monetary stimulus, the global conditions prevailing in previous years will evolve in significant ways. Developing countries can expect in this context stronger demand for their exports as global trade regains momentum, but also rising interest rates and potentially weaker capital inflows.

In the most likely scenario, this process of normalization of activity and policy in high-income countries should follow a relatively orderly trajectory, with global interest rates rising only slowly to reach 3.6 percent by mid-2016. The analysis presented in this paper show that such gradual tightening would imply limited disruption to developing countries, with a slowdown in capital inflows amounting to 0.6 percent of developing-country GDP between 2013 and 2016, driven in particular by weaker portfolio investments.

However, the risk of more abrupt adjustments remains significant, especially if increased market volatility accompanies the actual unwinding of unprecedented central bank interventions. According to simulations, abrupt changes in market expectations, resulting in global bond yields increasing by 100 to 200 basis points within a couple of quarters, could lead to a sharp reduction in capital inflows to developing countries by between 50 and 80 percent for several months.

Some developing countries could face crisis risks should such scenario unfold. Focusing on an assessment of prevalent factors in past banking crises, evidence suggests that countries having seen a substantial expansion of domestic credit over the last five years, deteriorating current account balances, high levels of foreign and short-term debt and over-valued exchange rates could be more at risk in current circumstances.

In any event, policy makers need to consider how they would respond to a tightening of global financing conditions, and assess their specific vulnerabilities. Countries with adequate policy buffers and investor confidence may be able to rely on market mechanisms, countercyclical macroeconomic and prudential policies to deal with a retrenchment of foreign capital. In other cases, where the scope for maneuver is more limited, countries may be forced to tighten fiscal and monetary policy to reduce financing needs and attract additional inflows. Where adequate foreign reserves exist, these can be used to moderate the pace of exchange rate depreciation, while a loosening of capital inflow regulation and incentives for foreign direct investment might help smooth adjustments. Eventually, reforming domestic economies by improving the efficiency of labor markets, fiscal management, the breadth and depth of institutions, governance and infrastructure will be the most effective way to restore confidence and spur stability.

This paper examines the pattern of private capital inflows to developing countries with a view to better understanding their main determinants and outlook in current circumstances. It is organized into three sections.

The first section describes the evolution of inflows in recent years and presents econometric evidence out-lining the relative importance of changing global and country-specific conditions in that evolution. It finds that global factors accounted for about 60 percent of the increase in overall capital inflows to developing countries between 2009 and 2013, with the remainder explained by country-specific developments. Envisaging different scenarios, simulations of the likely path of capital inflows to developing countries in coming years are presented.

A second section concentrates on crisis risks and domestic vulnerabilities in the event of a disorderly adjustment, focusing on an evaluation of banking crisis probabilities at the individual country level.

A final section discusses policy options in the face of capital retrenchment risks, including macroeconomic and prudential policies as well as structural reform priorities.

## 2. Capital inflows: Past and expected trends

Since the 1990s, when they represented an average of 4 percent of developing-country GDP, private capital inflows to developing countries increased markedly during the 2000s (see box 1 for a definition of capital inflows and their link with broader balance of payment developments). During the pre-crisis boom years 2003-07, inflows surged, peaking at more than 12 percent of developing-country GDP in 2007Q3, before crashing to negative territory in 2008 with the global financial crisis. They partly recovered in the post-crisis period - averaging 6 percent between 2010 and 2013 (Figure 1).[1]

For the most part, strong capital inflows to developing countries contributed to higher investment rates and facilitated capital deepening and technological transfer, which had positive effects on growth potential and levels of development (World Bank, 2010). In most cases, the rise in private capital inflows during the pre-crisis years did not cause excessively large current account imbalances in developing countries.

Developments in central Europe were a notable exception. Massive cross-border bank lending flows (representing alone 6 percent of regional GDP in the 2003-07 period; see Figure 2), fueled credit and asset price bubbles in the pre-crisis period, contributing to a boom in private consumption, mounting current account deficits and indebtedness problems similar to those observed in high-income countries during the same period. As a result, unlike other regions developing Europe has gone through an extended period of restructuring and deleveraging similar to that of high-income countries.

While the remarkable increase in financial inflows to developing countries implied investment and growth opportunities in "normal" times, it also amplified the transmission of global financial shocks,

[1] Here and in the remainder of this paper, the post-crisis period is referred to as the period after 2009 and the boom period as 2003-07.

as starkly illustrated during the 2008-09 financial crisis, when financial inflows to developing countries fell abruptly to about -1 percent.

Most developing regions exited from the crisis relatively quickly, thanks to counter-cyclical stimulus policies, better growth prospects (reflected in their relative credit ratings; see Figure 3, and a gradual thawing of global financial conditions. As demonstrated throughout this paper, exceptionally loose monetary policy in high-income countries contributed significantly to the vigorous resurgence of financial inflows to developing countries in the post crisis period (peaking at 8.5 percent of their combined GDP by mid-2011).

This post-crisis upsurge was initially driven by a recovery in cross-border lending and later by a persistent rebalancing of portfolio investments, both largely influenced by exceptionally low interest rates and risk aversion. As a result, before the summer 2013, the weight of developing country bonds in global fixed income portfolios increased to levels last seen in the late-1990s (World Bank, 2014).

Portfolio investments (bond and equity inflows) have been robust in most regions since 2009 (Figure 2). In contrast, bank lending has moderated particularly in emerging Europe because of continued deleveraging and balance sheet adjustments by banks in high-income countries.

Foreign direct investment (FDI) has been most stable component of capital inflows, although the picture is more mixed at the regional level. In Sub-Saharan Africa, FDI inflows have increased steadily in the post-crisis period, reaching 6.5 percent of the region's GDP most recently. That contrasts with South Asia and the Middle-East and North Africa where FDI flows have been declining (to 1.3 and 0.8 percent of regional GDP respectively) during the 2011-13 period.

Over the past two years, capital inflows have stabilized at around 4.5 percent of developing-country GDP. The slowdown was also associated with stagnant international reserves, rising capital outflows, and a deterioration of current account balances in a number of countries and regions, hence increasing their exposure to changes in external conditions.

As discussed in World Bank (2014), since May 2013, expectations of a gradual unwinding of quantitative easing (QE) by the U.S. Federal Reserve led to a significant portfolio adjustment on the part of global investors away from developing countries. Issuances of developing-country bond, equity, and syndicated bank loans dropped initially by around 50 percent, imposing significant adjustment pressures on currencies, asset prices, and foreign exchange reserves of several middle-income countries.

**Box 1 Private capital inflows: definition, link with balance of payment and financial exposure**

The analysis presented in this paper is specifically focused on the behavior of net private capital inflows by foreign investors into developing countries. This box clarifies the concept, its link to current account imbalances and external vulnerabilities.

Capital flows are recorded when there is transfer of ownership of financial assets from one country to another. When non-residents are purchasing assets in a country, the transaction is designated as a capital inflow for that country, and recorded as a change in foreign liabilities on its financial account balance. When domestic investors are purchasing assets abroad, the transaction is recorded as a capital outflow.

Private capital inflows are of particular interest, being most responsive to changes in global market conditions. They are labelled as "net inflows" in the balance of payment statistics as they include repayment of debt and equity disinvestment by non-residents, in contrast to gross inflow data, which refer only to the acquisition value of the assets.

Official inflows provided by international financial institutions and bilateral creditors are excluded from this analysis, as they follow entirely different patterns and determinants.

Data used in this paper is mostly coming from the IMF balance of payment statistics (IFS database), complemented by the BIS Locational Banking data for cross-border lending, and national balance of payment data where appropriate.

**Capital inflows, current account imbalances and vulnerability to external conditions**

Capital inflows are tightly connected to broader balance of payment developments, as the financial account of a country matches by definition the sum of its current account position, changes in foreign currency reserves and statistical errors and omissions (Figure 1. 1).

Thus large capital inflows, if leading to an improved financial account balance, can potentially be associated with a deterioration of the current account of the recipient country and a growing disconnection between domestic investment and saving. This could happen for instance if inflows put significant upward pressure on the real effective exchange rate or imply excessively loose domestic financing conditions. But these relationships are far from linear.

# 3. Modeling capital flows to developing countries

This section evaluates the main determinants of capital inflows to developing countries. It explores the likely impact of the recovery in growth and normalization of policies in high-income countries, examining a scenario where financial markets react in an orderly fashion as well as two scenarios where the adjustment is less orderly.

This analysis followed a two pronged approach. In a first step, a panel regression was used to assess the relative importance of global and domestic factors in determining the equilibrium level of capital inflows.

This is useful for understanding the long-term reaction (after all adjustment has occurred) to a change in global (or domestic) conditions. However, this approach is less suited for evaluating the short-term interaction and interplay between global factors and capital inflows.

To capture such short-term dynamics and assess over-shooting risks in relation to changes in external financing conditions, a vector autoregression model was estimated in a second step, and used for further simulations.

*Accounting for global "push" and domestic "pull" factors*

The economic literature suggests that capital inflows to individual developing countries are determined by both global external conditions ("push" factors) and domestic factors ("pull" factors).[2]

The model outlined in box 2 was designed to control for the impacts on capital inflows of changes in observable global conditions, including real incentives (growth and growth expectations), financial incentives (interest rates and interest rate differentials), access to liquidity (global money supply), and global risk aversion. It also accounts for domestic pull factors (credit ratings, local interest rates, GDP levels) that can influence the volumes of capital inflows to developing economies.

Importantly, the model does not attempt to tease out the full influence that extraordinary monetary policy measures undertaken in high-income countries had on capital inflows. To do so would require determining the extent to which quantitative easing itself influenced the various drivers of capital inflows (interest rates, liquidity, risk, and growth) - a question that is under active discussion in the literature, but over which there is little consensus as yet.[3] Instead, the model simply uses a series of dummy variables to test whether extraordinary monetary measures may have had an effect on capital flows over and above those coming through the modeled channels.

The results obtained from the model are broadly consistent with the existing literature on observable factors associated with financial inflows (Alfaro, Kalemli-Oz-can and Volosovych 2008; Bruno and Shin 2013; Gelos, Sahay and Sandleris 2011; Forbes and Warnock 2012; Fratzscher, 2012).

Capital inflows to individual developing countries correlate in particular with country ratings and a number of global financial conditions, captured in the model by short-term U.S. interest rates, the yield curve, and the VIX index of implied stock market volatility (a measure of market uncertainty and risk aversion). The evidence for the effect of several other country-specific and global factors—such as growth differentials relative to the US, and aggregate developing-world growth—is somewhat weaker, and a number of factors, such as real interest rate differentials, are statistically indistinguishable from zero.

The various effects are summarized in Figure 4, which shows the response of capital inflows to a change of one standard deviation in each of the explanatory variables. The response to market uncertainty/risk aversion appears to be relatively small over the full sample. However, because of its very large changes during the crisis and post-crisis periods, its variation between the first half of

[2] Recent work includes Fratzscher (2012), which finds that push factors were dominant during the crisis but pull factors were more important in the immediate recovery phase after the global crisis, while Forbes and Warnock (2012) identify global factors, especially global risk (VIX index) as a determinant of surges. Bruno and Shin (2013) identify global factors are dominant determinants of cross-border bank flows, particularly bank leverage and VIX. This last result may be explained by the close relationship between banks' value-at-risk and the VIX (Adrian and Shin, 2010).

[3] Most of the research that has been conducted on the impact of quantitative easing has looked at its impact on economic activity in the United States, and there is very little consensus on those impacts. IMF (2013a) provides a useful review of this literature, which suggests that impacts on GDP could range between 0.13 percent growth to 8 percentage points and long-term interest rate effects that range from 75 to 200 basis points in the USA, and less than 50 to 160 basis points in the United Kingdom.

2009 and the first half of 2013 is estimated to have had the largest impact on capital inflows during this period (Figure 5).[4]

Both domestic and global factors appear to be important determinants of capital inflows to developing countries, with global factors (U.S. interest rates, risk and the additional unmodeled influence of quantitative easing) together accounting for about 60 percent of the increase in capital inflows between 2009 and 2013, with the remaining 40 percent explained by domestic factors such as countries' institutional investor rating, and developing-country growth and growth differentials.

About 13 percent of the total variation in capital flows during this period is picked up by the quantitative easing dummy, suggesting that capital flows were larger in the post-crisis period than would have been expected given the levels of other variables. These effects appear concentrated on earlier rounds of quantitative easing. When the quantitative easing indicator is split into separate episodes corresponding to QE1, 2, and 3, the impact on inflows diminishes between successive episodes. Indeed, when broken out, the QE3 variable is statistically insignificant— implying that by then all of the impact of quantitative easing on capital flows has been accounted for through its effect (if any) on the traditional drivers of capital flows.

*Implications for capital flows as global conditions normalize*

The preceding analysis confirms previous research suggesting that global economic conditions play a major role in determining capital flows to developing countries.

As conditions in high-income countries improve (that is, as output gaps are closed and growth realigns with underlying potential output), monetary policy can be expected to normalize, and the extraordinary monetary policy measures that have been undertaken will be withdrawn. In this context, capital flows to developing countries should adjust to a new equilibrium. Simulations based on the panel regression results are shown in Table 1.

These simulations are conditioned on the following underlying assumptions:

- Developing and high-income country GDP growth gradually strengthens in line with the projections presented in World Bank (2014).
- QE tapering by the U.S. Federal Reserve spans from January to December 2014, and has a very gradual effect on market conditions. It adds 50 basis points (bp) to U.S. long-term interest rates by the end of 2015 and a cumulative 100bp by the end of 2016. Policy rates in the United States start to increase in 2015Q3, from 0.25 to 2 percent by the end 2016.
- The European Central Bank (ECB), Bank of Japan and Bank of England, start to unwind their own quantitative/qualitative policies in the course of 2015-16, adding 50bp to their long term yields by the end of the forecast horizon, and tighten policy rates later than the U.S. Fed does.

[4] Estimates of the relative contribution of different factors in Figure 5 were calculated by multiplying the observed changes in short-term policy rates, yield curve, the QE episode dummy, and the risk index between the first half of 2009 and the first half of 2013 by the coefficient estimates obtained from the benchmark model.

**Box 2 Modeling the influence of high-income policy (including quantitative easing) and domestic factors on capital inflows to developing countries**

The results reported in the main text of World Bank (2014) are based on a panel econometric analysis designed to illuminate how global and domestic economic conditions influence the volume of capital inflows to individual developing countries. The study uses an unbalanced panel of available quarterly private capital inflows data for 60 developing countries for the 2000Q1- 2013Q2 period, thus spanning eight years of non-crisis year capital flows, and five years of post-crisis flows. These financial inflows comprise bond and equity portfolio flows, foreign direct investment, and cross-border bank lending, and were derived from the IMF Balance of Payments statistics and the Bank for International Settlements' Locational Banking Statistics, supplemented by national sources drawn from the Datastream and Haver Analytics databases.

The model allows for the influence on individual-country capital inflows of global economic variables ("push factors") that have been identified in the literature as affecting the propensity to invest, as well as country-specific "pull factors" that capture time-varying characteristics of individual countries that may affect the allocation of funds across countries. The observable pull and push factors include measures used to capture:

- Global financial conditions, such as the US Federal Funds rate, the US money supply (M2), and the yield curve (the difference between the US long-term interest rate and short-term policy rates). The role of global uncertainty and risk aversion was proxied by the VIX index.
- Real-side global conditions, such as high-income and developing world GDP growth, and the global composite purchasing managers index (PMI), which proxies for growth expectations.
- Domestic pull factors, including country GDP levels and institutional investor ratings, a country-specific (lagged) GDP growth differential (relative to the United States), and the interest rate differential between the developing country vis-à-vis the United States.

The extraordinary measures taken by central banks, in the United States, Europe, and Japan are likely to have influenced several of the global variables: short-term interest rates would have been affected by conventional monetary policy; the structure of the yield curve would have been affected by the Federal Reserve's purchase of mortgage-backed securities and long-term debt on secondary markets; and market uncertainty along with U.S. and global growth may have benefited from stimulatory monetary and fiscal policies. To the extent that such measures may have influenced these drivers, their influence on capital flows will have been captured in the regression.

To account for the possibility that extraordinary monetary measures have operated through other unobservable channels (or through conventional channels over and above these observable measures), a series of dummy variables covering the different episodes of quantitative easing were also included. Several alternative specifications were experimented with, including: a single QE dummy variable for all episodes of quantitative easing; separate indicator variables for each of the three episodes; and a continuous measure of QE interventions based on QE-related assets on central bank balance sheets. A non-zero coefficient on these dummies can be interpreted as indicating that there were additional influences on capital flows to developing economies from quantitative easing that are not directly attributable to observable measures.

The baseline estimation employs econometric techniques that address the influence of time-invariant unobserved country effects, a time trend, and the possibility of bias due to the inclusion of a lagged dependent variable. In addition to the baseline, several additional variations were explored.

To ascertain whether quantitative easing may have altered the magnitude of the influence of the conventional transmission channels (say by making flows more sensitive to interest rate developments), a specification that allowed for interactions between the indicator and the observable global variables was considered. However, this specification was not retained as there was little evidence in favor such interaction effects. Furthermore, specifications that included market expectations of future interest rate changes were considered, but not retained because these expectations variables were not statistically significant.

The model is robust to several different specifications of the explanatory variables, as well as the inclusion of other variables that may plausibly explain capital flows. Lagged ratios of private credit as a share of GDP (financial depth), trade/GDP (trade openness), external debt/GDP, and real exchange rate appreciation were included in alternative specifications but did not prove to be statistically significant.

More details including benchmark regression results and the regression results for the constituent components of capital inflows, are provided in annex 2 (see also Lim, Mohapatra and Stocker 2014).

The VAR model described in box 3, which maps out the inter-temporal relationships between GDP growth in high-income and developing regions, global interest rates, and uncertainty/risk taking, suggests that the VIX index will gradually rise back toward its long-term average of close to 20 by 2016, some 25 percent above current low levels.

Feeding these global "push factors" into the earlier panel regression results points to a baseline decline of capital inflows (relative to a "no change" scenario) of about 10 percent by 2016, or 0.6 percent of developing-country GDP by 2016 (see Table 1).

These results confirm that a gradual normalization of global conditions would be accompanied by a modest retrenchment of capital inflows as a percentage of developing-country GDP, although remaining broadly in line with average levels between 1990 and 2003.

*Looking a bit deeper*

The above results refer to the sum of all capital inflows (portfolio flows, international bank lending, and foreign direct investment). When inflows are decomposed into their constituent components, portfolio flows are both the most volatile and the most sensitive to the external drivers associated

**Box 3 Modeling the inter-temporal adjustment of capital inflows**

Dynamic interactions between global "push" factors, capital inflows and GDP growth in developing countries are captured using a six-dimensional vector autoregression model (VAR), estimated over the period 2000Q1 to 2013Q2 (see annex 3 for a detailed description). The VAR jointly models aggregate private capital inflows to developing countries as a share of their combined GDP; real GDP growth in both developing and G-4 countries (the United States, Euro Area, Japan and the United Kingdom); G-4 short-term interest rates; the G-4 yield curve (ten-year government bond yields minus 3-month interest rates), and the VIX index of implied stock market volatility, a popular measure of the pricing of financial market risks.

The impulse response of aggregate capital inflows in developing countries to a one standard deviation shock in the other five variables is presented in Figure 3. 1. At first sight, changes in growth patterns between developing and G4 countries seem to be dominant drivers, with the effect of shocks persisting for about a year and a half. Rising risk aversion (increase in the VIX) and a steepening of the G-4 yield curve are both associated with lower capital inflows (as a share of GDP), with peak effects after about four quarters. The direct impact of changes in short-term interest rates in the G-4 region is small.

Further investigation shows more complex interactions between global factors and highlights the central role of market uncertainty and changes in risk assessments in the transmission of monetary shocks. In particular, an increase in the VIX index leads within four quarters to lower short-term interest rates, a steepening of the yield curve, and weaker growth in the G4 and developing countries. In other words, the impact of market distress on global growth and the slope of the yield curve serve to amplify the initial effect of increased uncertainty on capital inflows.

For the sample period, the model suggests that changes in risk aversion explain around 10 percent of the variance of GDP growth in both G-4 and developing regions, 20 percent of changes in the yield curve and 25 percent of changes in short term rates (Figure 3. 2).

In addition, the VIX index is itself the variable in the model most sensitive to changes in monetary conditions, with lower interest rates reflected within two to three quarters in lower risk aversion. About 8 percent of the variance of VIX is explained in the model by such change in monetary conditions.

These results are consistent with recent studies, which tend to assign a similar or even bigger role of interest shocks in determining the price of risk, and in explaining the international transmission of monetary policy through financial flows and asset prices (Bruno and Shin 2013; Bekaert, Hoerova and Lo Luca 2012; Rey 2013).

with global financial conditions.

Estimates of the capital flow model performed on each individual component suggest that equilibrium portfolio flows are sensitive to changes in short-term interest rates, the yield curve, and global risk aversion, as well as to the QE indicator. Equilibrium foreign direct investment, in contrast, tends to be relatively insensitive to the effects of global push factors, although such flows are much more responsive to country-specific credit ratings, a result consistent with the literature (Alfaro, Kalemli-Ozcan and Volosovych 2008; Dailami, Kurlat, and Lim 2012).

Cross-border bank lending falls into an intermediate category. In particular, the coefficient on the QE dummies was the largest for bank lending—suggesting that more so than for the other flows QE operated through channels other than those modeled to boost bank lending. At the same time, bank lending was also much less sensitive to the observable fundamental factors. This suggests that the response of overall inflows to global risk conditions and QE-specific effects are driven to a 3.6). When flows into developing-country bond and equity mutual funds (a subset of portfolio flows) are considered, the sensitivity of these flows to changes in both the short-term interest rate and yield curve is much higher than for overall portfolio flows, and for other types of capital flows.

To the extent that this historical pattern persists over future tapering scenarios, portfolio flows are estimated to decline in the first year by 33 percent, while bank lending falls to a much smaller extent, and FDI hardly move at all (under the gradual tightening scenario). Partly as a result, the impact on regional capital flows may turn out to be very different.

For regions such as East Asia and the Pacific (excluding China) and Europe and Central Asia—where portfolio flows represent 53 and 45 percent of total flows respectively—enduring declines in inflows may be significantly larger than the declines in regions like Latin America, the Middle-East and North Africa, or South Asia where portfolio flows are a much smaller proportion of total flows (Figure 7).

Sub-Saharan Africa sustains the third largest impact among the six regions, as capital flows are a particularly large share of Sub-Saharan Africa's GDP (see Figure 2), even though portfolio flows are a relatively small share of overall flows (outside of South Africa, FDI is the dominant type of capital inflows—72 percent of the total).

*Tracking the dynamic behavior of capital inflows and overshooting risks*

The foregoing results assume that monetary authorities in high-income countries are able to engineer a gradual increase in long-term interest rates as quantitative easing is withdrawn in line with improved growth conditions.

However, the experience of the summer of 2013—when the yield on 10-year U.S. Treasury bills jumped by some 100 basis points in a just a few months—suggests that a smooth market reaction to the actual tapering of quantitative easing is not assured. The next set of results considers the impacts on capital inflows of two alternative scenarios:

- "Fast normalization": long-term interest rates snap up by 100 basis points in the first half of 2014, before gradually converging back to baseline levels over the subsequent two years;

- "Overshooting": market reactions are assumed to be more abrupt, resulting in a sharp (200 bp) increase in long-term interest rates in first half of 2014, followed by a more protracted adjustment back to the baseline;

**Box 4 A live experiment: tapering expectations and capital inflows during the summer of 2013**

The simulations derived from the vector autoregression (VAR) model can be compared with actual developments following the Fed tapering announcement in May 2013. After the conditions for the unwinding of quantitative easing were outlined by the Fed chairman in a congressional testimony on May 22 2013, the U.S. long term interest rates suddenly shot up by 100bp and the VIX index initially rose from 15 to 20. Emerging market bond spreads increased significantly, and issuances of developing-country bond, equity, and syndicated bank loans dropped by around 50 percent during the summer (Figure 4. 1).

Although bond, equity issuances and syndicated bank flows are conceptually different from the private capital inflow data reported in the balance of payment statistics and used in our modeling strategy, the observed deceleration of flows during the summer of 2013 appear largely consistent with the elasticities estimated in the VAR model. Counterfactual simulations show that the decline predicted by the VAR model would have been of similar magnitude albeit more gradual than actually observed (Figure 4. 1). As presented in the "fast adjustment" scenario , a 100bp shock to the yield curve generally translates within two quarters into a drop in inflows of around 50 percent, with the VIX index predicted to increase by six points.

The observed impact of financial market tensions during the summer was also reflected in a deteriorated outlook for many developing economies, particular among those considered most vulnerable (Figure 4. 2).

The vector autoregression (VAR) model described in Box 3 was used to explore inter-temporal adjustments between capital inflows, growth and global financing conditions, in order to assess the risk of a disorderly transition and sudden stops in financial inflows.

Figure 8 illustrates the adjustment path for three of the co-determined variables (capital inflows to developing economies; long-term interest rates and the VIX index of stock market volatility) under different scenarios.

In the baseline, the capital flow projections resulting from the VAR simulations are very similar to those drawn from the panel regression, with the share of capital inflows to GDP in developing countries declining by 0.5 percent over the projection horizon.

In the two more extreme scenarios, deviations from the baseline are pronounced.

In the "fast normalization" scenario, the resulting increase in market volatility and rising risk aversion leads to a sharper but partially temporary correction in flows. In this context, private capital inflows drop by an average 30 percent in 2014, with a peak impact of 50 percent toward the end of the year.

As discussed in Box 4, the magnitude of these simulated effects is broadly consistent with the adjustments observed during May-September 2013, a period that lies mainly outside of the estimation period of the model.

In the "overshooting" scenario, where long-term interest rates spike initially by 200 bp, flows would then drop by 45 percent in 2014 as whole and up to 80 percent at the peak impact.

Such a correction, albeit temporary, would have an important bearing on the probability of isolated or more diffused crises under different macroeconomic scenarios. This issue is addressed in the last section of this paper.

**Box 5 Surges, stops and aggregate capital inflows**

As discussed, in the main text, capital inflow surges tend to precede financial crises, and crises tend to occur at the same time as sudden stops. The surge in capital inflows in the pre-crisis period was typical (Figure 5. 1), as some 80 percent of developing countries in the sample suffered a sudden stop in its aftermath. The post-crisis rebound, which also classifies as a surge, was again followed by an increased incidence in stops, with 15 percent enduring such episode during 2012-13. The methodology used here to identify surge and stop episodes at the individual country level is based on Forbes and Warnock (2012), with the threshold being defined as changes in flows larger than one standard deviation around a five-year rolling mean.

The link between aggregate capital inflows to developing countries and the proportion of these countries going through either surge or stop episodes can be approximated empirically using a simple vector autoregression model approach. Over the period 2000Q1 to 2013Q2, the relationship can be summarized with the accumulated impulse response presented in Figure 5. 2.

Overall, a decline of one standard deviation in the ratio of aggregate capital inflows to GDP (corresponding to a decline of about 2.7 percent of GDP), tends to increase the proportion of countries experiencing sudden stops to 22 percent after four quarters. In the "overshooting" scenario presented in the text, capital inflows are predicted to decline by 3.5 percent of GDP, implying that more than a quarter of developing countries could experience sudden stops in such scenario.

# 4. Disequilibrium risks

The preceding analysis suggests that in the long run, the withdrawal of quantitative easing and a return to a tighter monetary policy in high-income countries will have a relatively small impact on capital inflows, reducing them from 4.6 percent of developing-country GDP in 2013Q3 to 4.0 by the end of 2016. However, the path to this new normal level of flows will matter.

If market reactions to tapering decisions are precipitous, developing countries could see flows decline by as much as 80 percent for several months. That would raise the likelihood of abrupt stops at the country level, with more than 25 percent of individual economies experiencing such an episode in these circumstances (box 5).

While this adjustment period might be short-lived, it is likely to inflict serious stresses on the financial and economic conditions in certain countries–potentially heightening crisis risks.

## A brief history of crises in developing countries

According to data compiled by the International Monetary Fund (Laeven and Valencia 2012), there were some 147 financial crises globally between 1970 and 2011 (Figure 9). Of these, 123 occurred in what are now classified as developing countries, and 95 developing countries had at least one crisis.

These crises have tended to occur in clusters, with currency crises and banking crises much more common occurrences than sovereign debt crises. The clustering suggests that crises are either being caused by common factors or that there are important contagion effects.

Crises in developing countries generally follow a period of surging capital inflows, and occur on the same year as a sudden retrenchment (Figure 10). This is particularly clear for banking crises, as 34 percent of them occurred within two years after a period of strong capital inflows to the country, versus only 20 percent for currency crises and 17 percent for sovereign debt crises. Banking crises also tend to be more strongly correlated with sudden stops in capital inflows on the year of the crisis, although the direction of causality is unclear. Moreover, the evidence suggests that having had a banking crisis in the preceding two years increases the likelihood of a sovereign debt or currency crises, whiles these other kinds of crises do not increase the likelihood of later banking crises to the same extent.[5]

## A more formal look at banking crises

An econometric analysis of the factors associated with an increased probability of crises in developing countries tends to confirm the links between the incidence of these crises, global factors, and individual country characteristics and vulnerabilities (box 6).

The empirical literature on banking crises is quite large.[6] While early work typically focused on domestic causes of banking crises, especially in a developing-country context, more recent work has focused on the effects of outside 3.9 forces, such as global monetary and financial developments and contagion, on the likelihood of a crisis in a given country.[7]

*Relative importance of global, contagion, and domestic factors*

The regression results generally confirm the influence of both global and domestic factors in determining the onset of banking crisis (annex 4 table A4.3). The modeling strongly suggests that the risk of a banking crisis rises with an increase in global risk aversion, rising global interest rates and tightening of global liquidity—especially after a period of loose global monetary conditions.

Among the contagion variables examined, only the trade linkages variable (the share of trade with other countries in crisis) was consistently statistically significant.

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[5] In the two years following a banking crisis, a country has a 28 percent chance of having a currency or sovereign debt crisis. In contrast, the likelihood of a banking or sovereign debt crisis following a currency crisis is broadly the same (c. 20 percent) as is the likelihood of one occurring before the crisis or after the currency crisis. Taken together, this data suggests that banking crises tend to cause currency and sovereign debt crises in a way that those kinds of crises do not cause bank crises – an intuition that formal tests of granger causality confirm.

[6] Eichengreen and Rose (1998) and Eichengreen and Arteta (2000) provide extensive review of the cross-country empirical literature on banking crises with a focus on developing countries. See also Reinhart and Rogoff (2009) for more recent discussion of the developments in the literature.

[7] Earlier literature that emphasized the importance of global factors in explaining financial crises are, among others, Frankel and Rose (1996), Eichengreen, Rose, and Wyplosz (1996), Eichengreen and Rose (1998), Frankel and Roubini (2001), and Reinhart and Rogoff (2009). Forbes and Warnock (2012) examines the importance of global, contagion, as well as domestic factors in explaining extreme episodes of capital flows, although it tends to focus on high income and emerging economies. For a recent treatment of global and contagion factors in the literature of financial stress transmission, see for example IMF (2013b).

As expected, domestic factors play a critical role in determining whether an individual country enters into crisis. High levels of foreign and short-term debt, an earlier period of rapid domestic credit growth (measured as the change in domestic credit to GDP ratios over the previous five years), low levels of international reserves, and an overvaluation of the real exchange rate all increase the of risk of banking crises.

Figure 11 reports the estimated sensitivity of banking crises to the different variables identified in the econometric work. It shows the absolute value of the relative importance of each identified factor in contributing to an increase or decrease in the likelihood of a crisis.[8]

**Box 6 The banking-crisis regression model**

The probability that a country will suffer a banking crisis is modeled as a function of global factors, contagion factors, and domestic factors. To assess the role of all three sets of factors on the likelihood of a crisis in a given developing country, a pooled probit model is estimated (see annex 4 for a detailed description).

The modeling work focuses on banking crises in developing countries using crisis data developed by Laeven and Valencia (2012) because the determinants of banking causes in developing countries may be distinct from those of high-income countries (Eichengreen, Rose, and Wyplosz 1996, Eichengreen and Rose 1998, Eichengreen and Arteta 2000). To avoid sample selection problems, explanatory data for the 67 developing countries that did not have a banking crisis are added to the 95 developing countries in the Laeven and Valencia data set, all of which had a banking crisis during the sample period. Observations for the three years following a crisis are dropped from the panel, so that the explanatory power of domestic factors that may have triggered a crisis are not diminished by inclusion of their post-crisis period when the binary crisis variable would be zero. All explanatory variables except global factors are entered with a one period lag in order to minimize endogeneity problems.

**Global factors**

Seven measures of global effects were tested for the model: global risk appetite, global interest rates, global growth, global liquidity, global bank leverage, and global commodity prices. Global risk appetite was measured by the Chicago Board of Trade Volatility Index (VXO), a measure commonly used to capture risk appetite in the global financial markets. Global growth is measured by the first principal component of real GDP growth in the Euro Area, Japan, United Kingdom, and the United States. Global liquidity is proxied by M2 as a share of GDP in the United States. Global interest rates are measured by the first principal components of rates on long-term government bonds in Germany, Japan, United Kingdom, and the United States. Global commodity prices are measured by the agricultural commodity index and energy commodity index.

**Contagion factors**

Following Forbes and Warnock (2012) and IMF (2013a), but giving precedence to variables that allowed for a wider country coverage, four variables were included to capture contagion effects: trade openness, trade linkage, financial linkage, and regional contagion. Trade openness is measured by a country's trade with the rest of the world scaled by its GDP. Trade linkage is defined as the bilateral trade volume between two countries (scaled by each country's total trade with the rest of the world) and multiplied by an indicator variable defined as equal to 1 if the trading partner is experiencing a banking crisis, and to 0 otherwise. Financial linkage is defined as the total bank claims between a country and BIS reporting banks scaled by GDP to capture the country's degree of integration with the global financial markets and hence exposure to financial contagion. Regional contagion is defined as the number of countries in the same region experiencing a banking crisis.

**Domestic factors**

Ten separate variables were considered to capture country-specific factors: current account and fiscal balance, total external debt and a share of short term debt, domestic credit growth, inflation, per capita GDP growth, ratio of M2 to reserves, ratio of reserves to imports, and a measure of real exchange rate overvaluation. The definition of each variable is shown in Table A4.2 in the annex 4.

of similar approaches.

Empirically, between 1970 and 2011 the global variables have played the largest role, explaining about 58 percent of the changes in the risk of banking crisis at the country level. Domestic factors—particularly credit growth over the previous five years, short-term debt, and the level of international reserves—are also important contributors to risk. Changes in domestic variables explain 29 percent of all the variation in risk over the sample period.

**Box 7 Monetary policy, domestic credit growth and country-specific vulnerabilities**

The "imported" easing of monetary conditions through large capital inflows in recent years has contributed to rapid credit expansion, widening current account deficits, and increasing banking sector vulnerabilities in some cases.

The surge of capital flows in the post-crisis period has contributed to lenient domestic credit conditions, directly through cross-border intermediation channels and indirectly through exchange rate and monetary policy spillovers. Regarding the latter, a simple Taylor Rule predicting the monetary policy stance of central banks in developing countries on the basis of domestic conditions (deviation of consumer price inflation from the policy target and the level of slack in the economy) suggests that policy rates were kept lower than normally suggested during periods of large capital inflows (Figure 7. 1 and He & McCauley (2013)).

In this context, domestic credit has grown very rapidly in several developing countries in recent years, increasing the vulnerability of some economies to a rapid tightening of financing conditions. Outstanding credit exceeds 100 percent of GDP in 15 developing economies, and rose as a share of GDP by 15 or more percentage points in about 40 developing economies between 2007 and 2012. The sharpest upsurges were recorded in Thailand, Armenia, China, Malaysia, Morocco and Turkey (Figure 7. 2). Robust real credit growth continued during 2012 and 2013 in Cambodia, Argentina, Armenia, Indonesia, and Paraguay. Monetary, fiscal, and regulatory tightening in several countries, including China, Brazil, India, and Indonesia, has helped contain a further buildup of credit risks, but banks' exposure to rising interest rates has become an increasing source of concern since the start of QE tapering expectations.

That said, it should be recognized that domestic variables are not entirely independent of external variables. In particular, as discussed in box 7, loose financial market conditions at the global level can feed through to rapid credit growth, exchange rate changes, and fluctuations in reserves at the domestic level.

The main difference between countries is that, while developing economies do not have the policy levers with which to affect global financial conditions, they can influence the extent and manner in which these bleed through into the domestic economy (see following discussion on policy).

*Model prediction*

Probability models like the one used here to estimate the sensitivity of banking crises to external, domestic, and contagion factors tend to have low predictive power because the events they model are low-probability events.

One measure of the adequacy of predictive power of the model is the proportion of threshold events it correctly predicts (and the proportion of non-events that it correctly predicts). By these measures, the model outlined in column 5 of annex table A4.3 does a reasonable job in predicting banking crises in developing countries—a conclusion supported by the AUROC statistic of more than 80 percent in the preferred model specification (see annex 4 for a discussion of alternative measures of predictive accuracy of the model).

Another measure is to compare the prediction of the model with actual events (within-sample prediction). Figure 12 plots the estimated probability of a crisis for six of the eight countries that had banking crises in 2008–09 compared with the average predicted risk for all countries during the same period.[9] In all cases, the model suggests an above-average risk of crisis for those countries that did have a crisis. Moreover, for all countries, the predicted risk of crisis increased rapidly before and including the year of crisis. However, in the cases of Mongolia and Nigeria, the predicted likelihood of banking crisis was only marginally higher than the average for all countries.

*Assessing current risks*

Given current conditions, empirical analysis of banking crisis risks suggests that several countries might be subject to heightened vulnerabilities.

Figure 13 presents key domestic risk factors in these countries. The shaded area in the center indicates average values of risk indicators in each region. The thick line represents the average values of risk indicators for countries whose predicted crisis risk are particularly elevated (one standard deviation above the average predicted risk of the entire sample).

Although conditions on the ground will vary and these kinds of gross indicators need to be interpreted with a great deal of caution, the results are instructive and point to areas of vulnerability that individual countries may need to address if they are to reduce risks of a crisis as external conditions tighten.

- In the East Asia and Pacific region, rapid credit expansions over the past five years and a rising ratio of short-term debt in total debt are common areas of concern.
- A high external debt to GDP ratio, which exposes countries to exchange rate and rollover risk, is an issue in several Central and Eastern European economies, with a heightened share of short-term debt in that total being a further concern in several others. A high short-term debt ratio makes a given level of debt much more sensitive to the short-term swings in investor sentiment or capital flows that might occur in the fast tightening and overshooting scenarios discussed earlier. Rapid credit growth is a further issue of common concern in the region, with credit to GDP ratios have risen sharply over the past five years in several economies—increasing the sensitivity of loan quality (and bank solvency) to the kind of sharp rise in interest rates discussed above.
- In Latin America and the Caribbean, fewer countries appear to be at immediate risk, with rapid credit growth combining with significant short-term debt ratios as the main sources of risk.
- In the Middle East and North Africa, political turmoil has cut deeply into economic growth in recent years (World Bank, 2014). Banking-sector risks stem mainly from its exposure to domestic credit quality and government financing needs, against the background of a deterioration in current account positions.

[9] In the Laeven and Valencia (2012) data, eight developing countries had banking crisis in 2008–09 (compared with 15 in high-income countries): Hungary, Kazakhstan, Latvia, Mongolia, Nigeria, Russian Federation, Slovenia, and Ukraine. Hungary and Slovenia were not included in the prediction sample because of missing data in external debt (Slovenia) and short-term debt (Hungary and Slovenia).

- Based on existing data, risks in South Asia appear low, but there are concerns that non-performing loans in India have increased. India has also seen a significant deterioration in its current account balance in recent years.
- Only few of the reported countries in Sub-Saharan Africa appear to have elevated risk, with deteriorating reserve positions a common thread, along with high exposure to short-term external debt in a few cases.

# 5. Policy response to weaker capital inflows

The preceding analysis suggests that in a benign scenario combining a gradual recovery in advanced economies and an orderly normalization of global financial conditions consistent with the baseline forecast of World Bank (2014), the risk of a sharp decline in global capital flows is modest.

However, events around the summer of 2013 illustrate the difficulties in managing market expectations as major central banks plan their exit from unprecedented market interventions. As discussed, an abrupt adjustment in global interest rates and increased financial market volatility could have significant impacts for capital flows, growth prospects, and financial stability in developing countries, with effects likely being concentrated among those more financially integrated and with the largest vulnerabilities.

If a disorderly adjustment occurs, authorities have a range of polices at their disposal to deal with financial market pressures, bearing in mind that the appropriate mix will vary depending on the individual country situation and policy regime. Steps that were taken developing countries during the recent May-September period included:

- Use of international reserves to support domestic currencies and smooth the adjustment process
- Implementation or exploitation of temporary swap arrangements with other central banks to increase access to liquidity and foreign currencies
- Use of monetary policy to raise benchmark interest rates and increase the attractiveness of assets denominated in national currencies
- Imposition of prudential measures such as limiting the foreign exchange positions that investors can take
- Implementing temporary capital controls on outward financial flows, while removing impediments to capital inflows for foreign direct investments and institutional investors
- Use of trade measures designed to conserve foreign currency, such as temporary import restrictions in the form of quantitative limits for commodity importers, tariffs, taxes and export support measures;
- Budgetary consolidation policies, cutting subsidies, and raising taxation
- Reforms aimed at bolstering the investment climate, in particular for foreign investors

Some of these measures worked by helping to restore market confidence and smooth adjustments. Others such as trade restrictions may have helped reduce pressures in the short-run but could have important distortionary effects and fail to address underlying sources of vulnerability.

Figure 14 attempts to summarize the range of policy options available to countries for dealing with a sudden deceleration in capital inflows. Which policy response is right for which country will depend on country-specific factors, including the exchange rate regime, the degree of capital openness, the structure of external and banking sector liabilities, and the existing state of fiscal and other macroeconomic imbalances.

In general, countries with fully floating exchange rates should be able to rely more on market absorption mechanisms (like exchange rate depreciation) and counter-cyclical macroeconomic stabilization policies when sufficient buffers are available. Countries with less flexible exchange-rate regimes, large external liabilities and foreign denominated credit may have to focus more on prudential policies and financial inflow regulation. Although limited capital account openness may shelter an economy from capital flight, these economies could still be vulnerable through the exposure of financial sector balance sheets, requiring particular attention to specific contagion channels. Finally, the size of the country will matter, with small open economies having less room for autonomous macro and prudential policies.

From an operational perspective, the design of the most appropriate response will essentially be country specific, should involve all relevant stakeholders, and be transparent.

No single solution will fit all. The rest of this section explores in greater detail the issues associated with individual policy options.

## *Allowing currency depreciation*

Relying on exchange rate depreciation to absorb adverse external shocks is appropriate if the depreciation does not itself exacerbate existing vulnerabilities (say, from currency mismatch in the loan books of firms, banks, or the sovereign) and is warranted by the fundamentals of the economy. Particularly in cases where currencies are already overvalued, currency depreciations could stimulate external competitiveness, reduce current account pressures, and eventually lead to stronger domestic activity. Such orderly adjustment would operate only in the presence of a flexible exchange rate regime and a credible macroeconomic policy framework. The shift of many developing countries toward inflation-targeting central bank objectives, fully floating currencies, and the "de-dollarization" of their economies has arguably moved a number of countries into this camp over the years.

## *Pursuing more active exchange rate and monetary policies*

A sudden decline in capital inflows could, however, generate a disruptively rapid depreciation.

In such cases, temporary interventions in currency markets (leaning against the wind) by spending international reserves or invoking currency swaps or other arrangements to reduce liquidity risks and slow the pace of adjustment toward a new equilibrium may be warranted. Swap facilities have gained particular prominence recently, with a growing number of bilateral agreements between central banks to improve liquidity conditions and limit strains on foreign exchange markets in times of financial stress.

Exchange rate interventions tend to be effective only in the short-term, however, and a country's ability to deploy them will depend on the size of reserves that it has accumulated in the past.

Central banks may also be pressured into defending their currencies by tightening monetary policy and increasing the rate of return on domestic assets. Such a policy is likely to be most effective in countries facing domestic inflationary pressures and excessive credit growth, but it could be counterproductive in countries facing severe economic headwinds if the induced slower growth exacerbates the retrenchment of capital inflows.

## *Using capital controls as part of a crisis mitigation strategy*

Maintaining an independent monetary policy and stable exchange rate in the face of fully liberalized capital accounts might become irresolvable, as large fluctuations in capital inflows will be met either by large exchange rate movements or undesirable cycles in domestic credit and money supply.

The "impossible trinity" of achieving monetary policy autonomy, stable exchange rates and full capital account openness is often cited as a reason for relying more on counter-cyclical prudential and fiscal policies, and where appropriate impose some form of controls on capital flows.

As repeatedly emphasized by the IMF and the World Bank, capital flow management instruments could be among the relevant short-term stabilization instruments to be used in a crisis situation. However, they should be used with caution, given their potential adverse effects on the level and cost of future financing and their mixed record in regulating large capital flow movements in the past (their effects seem to be most visible in changing the structure of foreign assets and liabilities rather than affecting overall fluctuations).

Although discussions on capital controls as part of crisis mitigation strategies often focus on managing capital outflows, counter-cyclical controls on inflows, where controls are loosened during sudden stop episodes and tightened during strong inflow cycles appear to be a more promising policy avenue.

Capital controls also seem most effective when they are implemented as part of a broad policy package that includes sound macroeconomic policies as well as robust financial regulation. They should be lifted once crisis conditions abate, and they may need to be adjusted continually to remain effective.

## *Implementing targeted prudential measures*

Stricter prudential rules on lending and new regulatory initiatives to rein in excessive credit growth are still a priority in some countries to limit the further accumulation of credit risks and prevent a damaging credit crunch should global financing conditions suddenly tighten.

In those countries facing more immediate external financing pressures, the focus should be on containment strategies. Targeted prudential measures aimed in particular at reducing foreign exchange exposure in the financial sector and foreign currency lending could be effective in certain circumstances, but by definition they affect only those flows intermediated through the domestic

financial sector and could have negative consequences for access to finance, in particular for small and medium companies.

Because bond and equity flows, in particular from foreign institutional investors, will arguably be most affected by rising global interest rates and the unwinding of quantitative easing policies, measures aimed at lifting barriers to such investments should be considered, along with targeted policies intended to open up new opportunities for foreign direct investments.

## *Restoring confidence through domestic reforms*

Eventually, reforming domestic economies by improving the efficiency of labor markets, fiscal management, the breadth and depth of institutions, governance and infrastructure will be the most effective way to restore confidence and spur stability (Figure 15). As emphasized by the dynamic recovery in most developing regions in the immediate aftermath of the global financial crisis in 2008-09, their resilience was significantly underpinned by a combination of a strong growth potential and an accumulation of substantial policy buffers.

Tighter liquidity standards, counter-cyclical fiscal and prudential rules are essential to build-up sufficient policy buffers and "lean against the wind" of disruptive cycles in capital flows. Such a stance requires a credible rule-based approach to macroeconomic and macro-prudential policies.

Developing countries should further enhance policies supporting private saving and domestic financial markets to intermediate it, hence reducing exposures to volatile external capital flows. These include long-term measures focusing on education, pension and health care reforms and the development of better regulated domestic bond and equity markets. In this process, authorities should closely monitor the composition of both domestic and foreign liabilities, adjusting regulation to the ever-changing nature of financial stability risks.

Reforms aimed at promoting growth and financial stability should not lose sight of the need to protect the most vulnerable and to develop social protection mechanisms to better cope with global shocks.

## *Reinforcing global coordination*

Finally, the framework for global policy coordination should be further strengthened in the context of the Group of 20 (G-20), better recognizing large cross-border spillovers from high-income country policies and the mutual benefits of greater financial and economic stability in the developing world.

Over the past five years, G-20 members have made significant progress, but a certain reform fatigue is apparent. Important gaps in building a more resilient global financial system, improving international oversight, and limiting the propagation of systemic risks still need to be filled.

In addition, more tangible progress in the G-20 development agenda in areas such as economic growth, trade, financial inclusion, infrastructure, and climate change financing could make a significant contribution to promoting development and reducing poverty.

Erecting trade barriers to solve financial and economic headwinds would be counterproductive and should be resisted in both high-income and developing countries. The momentum created by the World Trade Organization agreement in December 2013 on trade facilitation, food security, development, and access of least developed countries, could lead to new opportunities for growth and development and should be followed up with further multilateral efforts to open up trade in goods and services and strengthen disciplines for investment.

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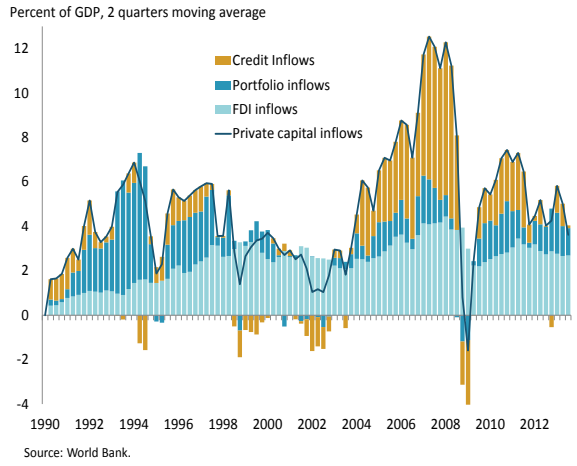
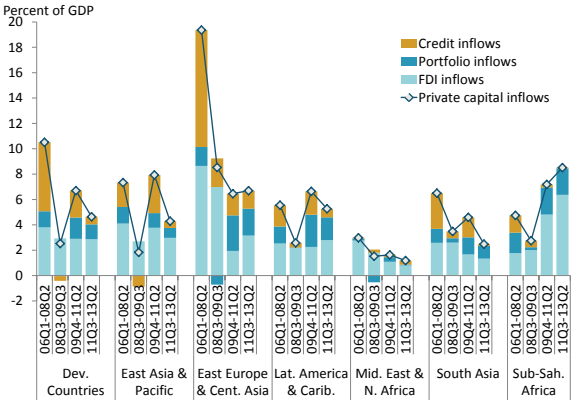
# Annex 1

**Figure 1 Private capital inflows to developing countries**



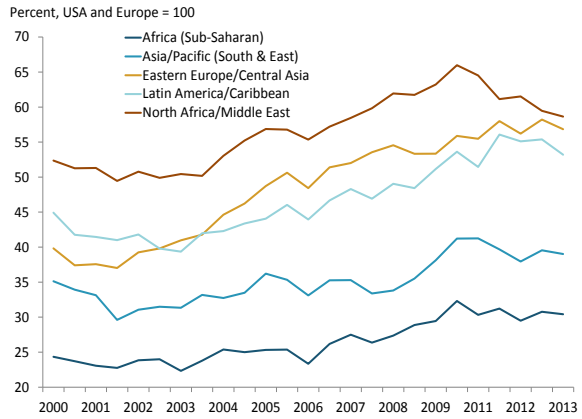

Source: World Bank.

**Figure 2 Private capital inflows to developing countries by region and type**



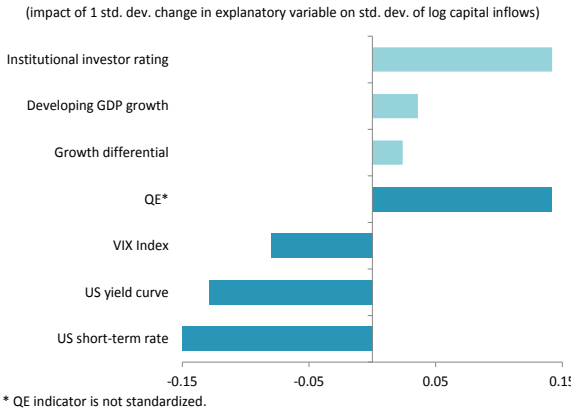

Source: World Bank.

**Figure 3 Institutional investor rating for developing countries (relative to US and EU)**




Source: World Bank.

**Figure 4 Impact of global and country-specific variables on capital inflows**




* QE indicator is not standardized.

Source: World Bank.

**Figure 1. 1 Net private capital inflows in the broader balance of payment framework**

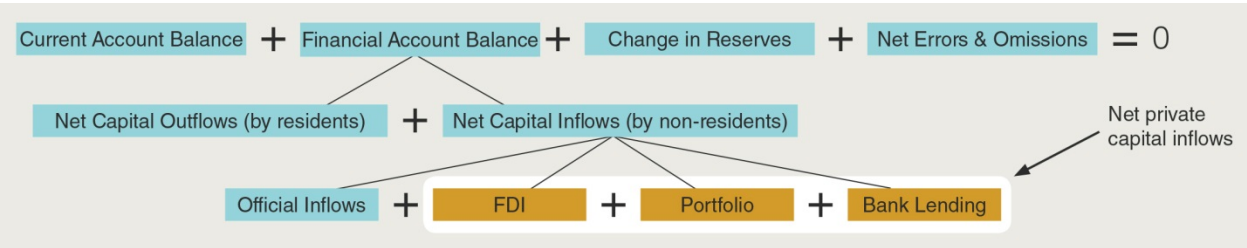
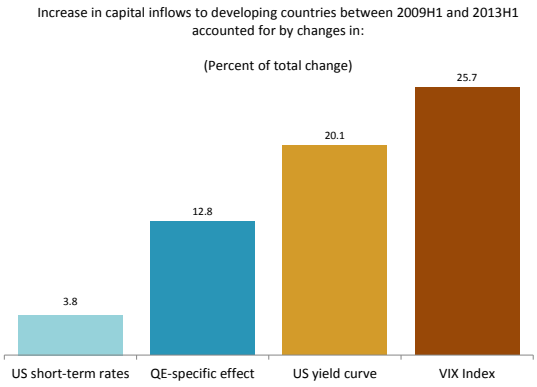
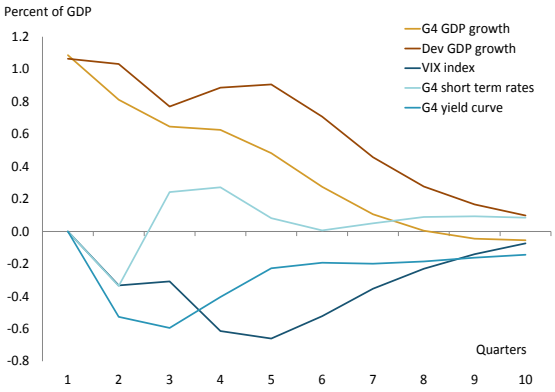


**Figure 5 Estimated contribution to increase in capital inflows in the post-crisis period**



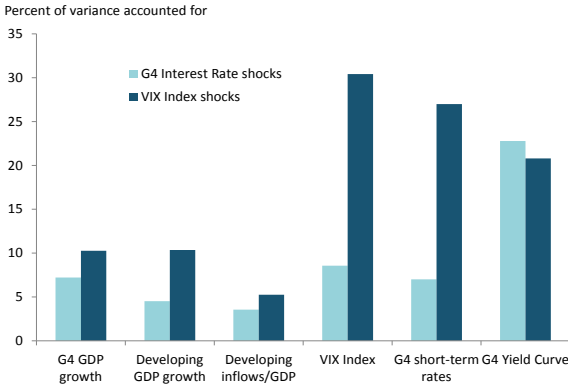

Source: World Bank.

**Figure 3. 1 Response of developing-country capital inflows (% of GDP) to one S.D. shock in:**




Source: World Bank.

**Figure 3. 2 Variance of dependent variables explained by G-4 interest rates and VIX**



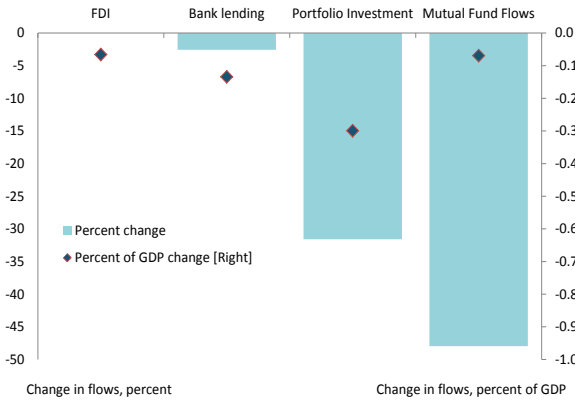

Source: World Bank.

**Table 1 Baseline results: a modest decline in capital inflows as global conditions normalize**

| | History | | Baseline | | |
|---|---|---|---|---|---|
| | 2012 | 2013 | 2014 | 2015 | 2016 |
| **Developing GDP growth** | 5.0 | 5.4 | 5.5 | 5.8 | 5.9 |
| **G4 GDP growth** | 1.4 | 1.1 | 2.2 | 2.4 | 2.4 |
| **G4 Yield curve** | 1.7 | 2.1 | 2.5 | 2.6 | 2.3 |
| **G4 10 Y Bond Yields** | 2.2 | 2.4 | 2.9 | 3.2 | 3.5 |
| **G4 3 m interest rates** | 0.4 | 0.2 | 0.3 | 0.6 | 1.2 |
| **VIX Index** | 18 | 15 | 16.9 | 18.2 | 18.9 |
| **Deviation of capital inflows from a "no change" scenario** | | | | | |
| **% of flows** | | | -3.7 | -7.4 | -10.0 |
| **% of developing country GDP** | | | -0.2 | -0.4 | -0.6 |

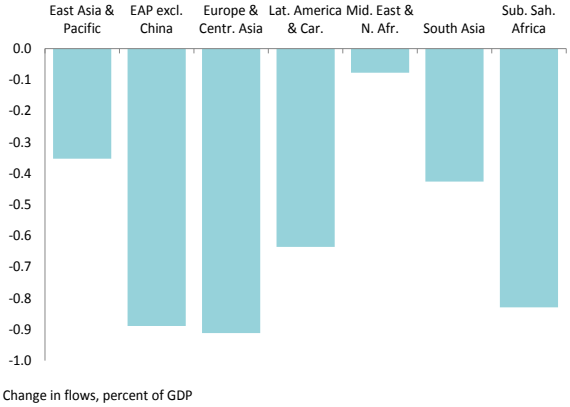
Source: World Bank.
Note: White background implies an exogenously given variable
Blue background shows VIX simulations derived from the VAR model
Gold background denotes results from the panel regression

**Figure 6 Estimated decline in capital inflows relative to no policy change baseline by type**



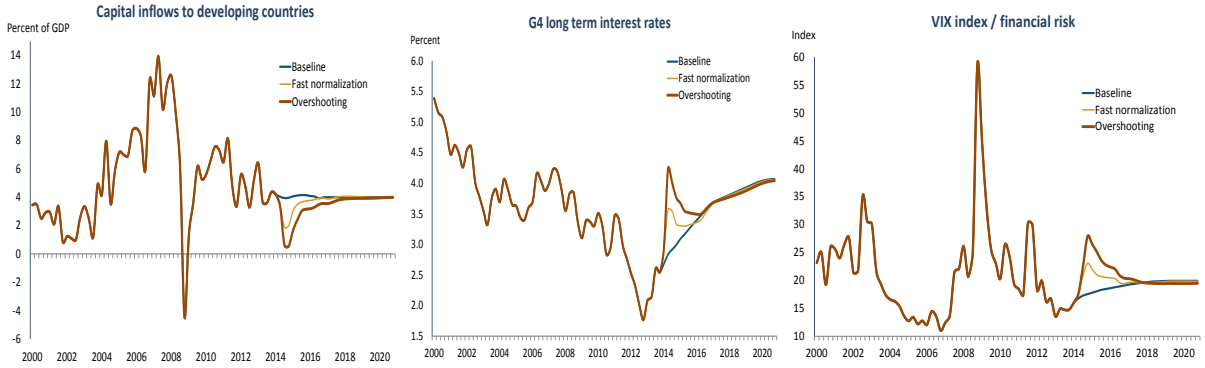

Source: World Bank.

**Figure 7 Estimated decline in regional capital inflows relative to no policy change baseline**



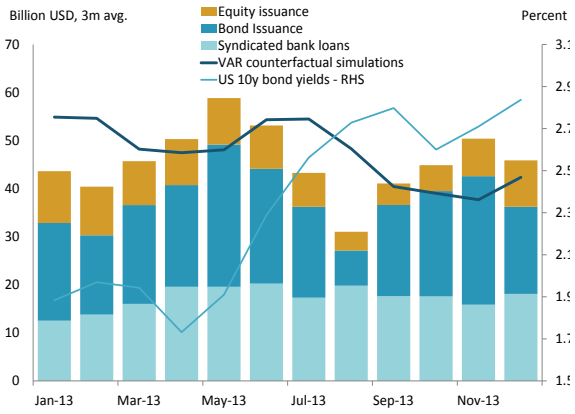

Source: World Bank.

**Figure 8 Normalization scenarios, overshooting risks and capital inflow projections**



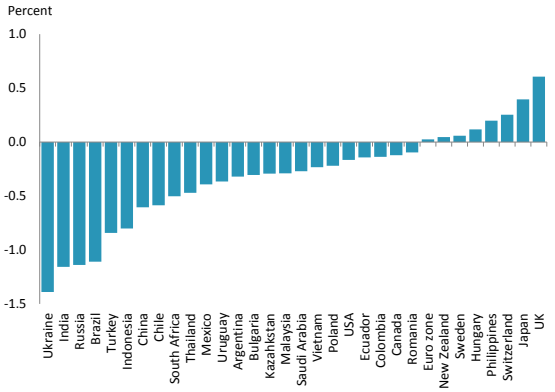

Source: World Bank

**Figure 4. 1 Gross capital inflows to developing countries in the course of 2013**



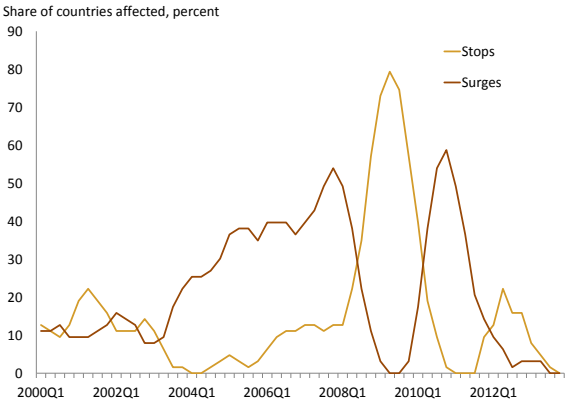

Source: World Bank.

**Figure 4. 2 2014 real GDP growth consensus forecast revisions from May to Sept 2013**



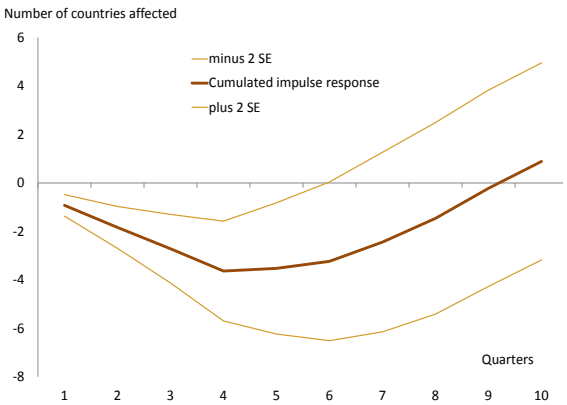

Source: World Bank.

**Figure 5. 1 Capital inflow episodes in developing countries**



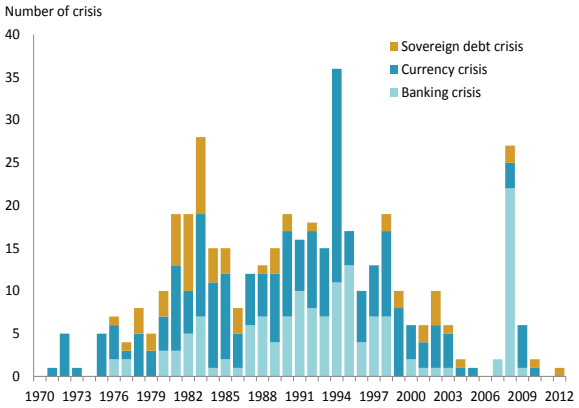

Source: World Bank.

**Figure 5. 2 Frequency of stop episodes: impulse response to changes in aggregate flows**



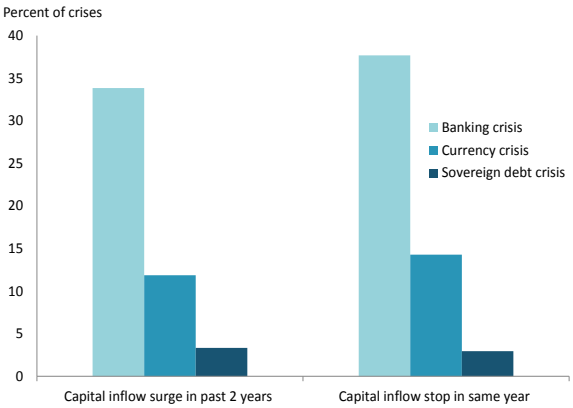

Source: World Bank.

**Figure 9 Frequency of sovereign, currency and banking crisis**



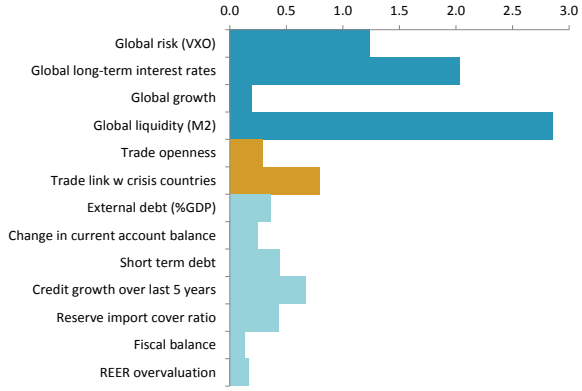

Source: World Bank.

**Figure 10 Capital inflow surges, stops and frequency of financial crises in developing countries**



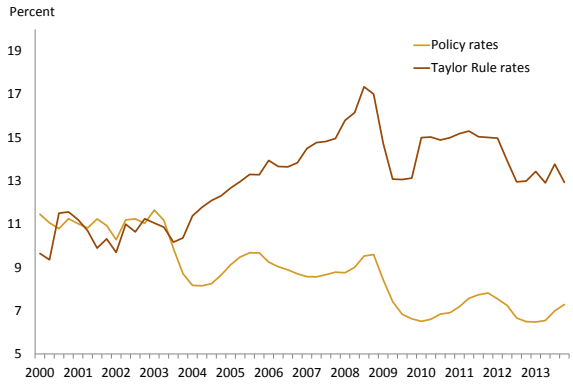

Source: World Bank.

**Figure 11 Estimated contribution to changes in banking-crisis risk**



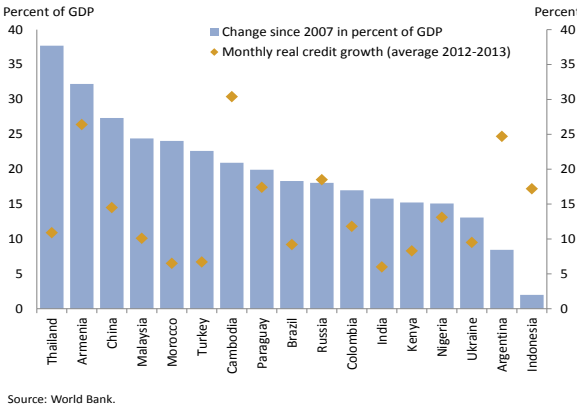

Source: World Bank.

**Figure 7. 1 Policy interest rates and "Taylor rule" rates in emerging and developing countries**



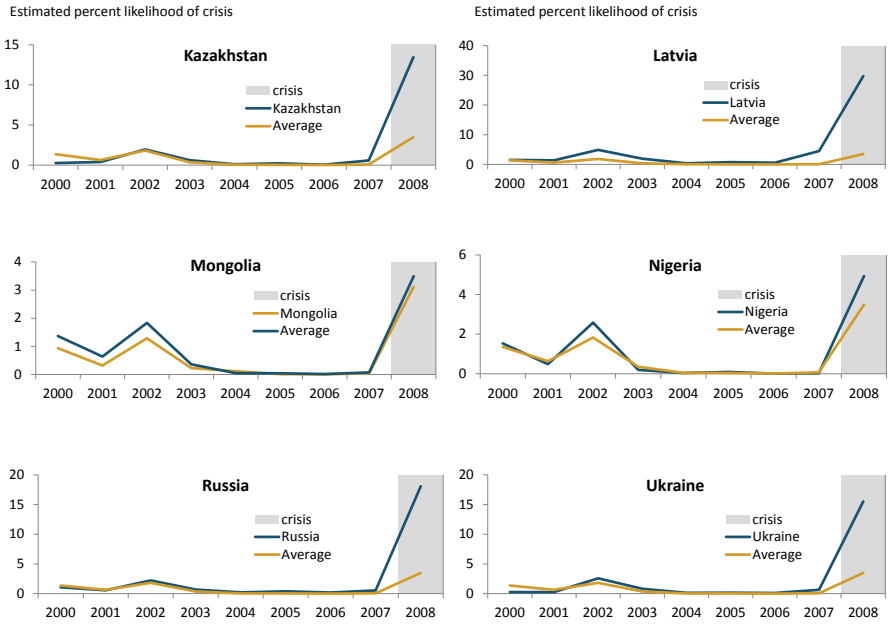

Source: World Bank.

**Figure 7. 2 Domestic credit growth in selected developing countries**



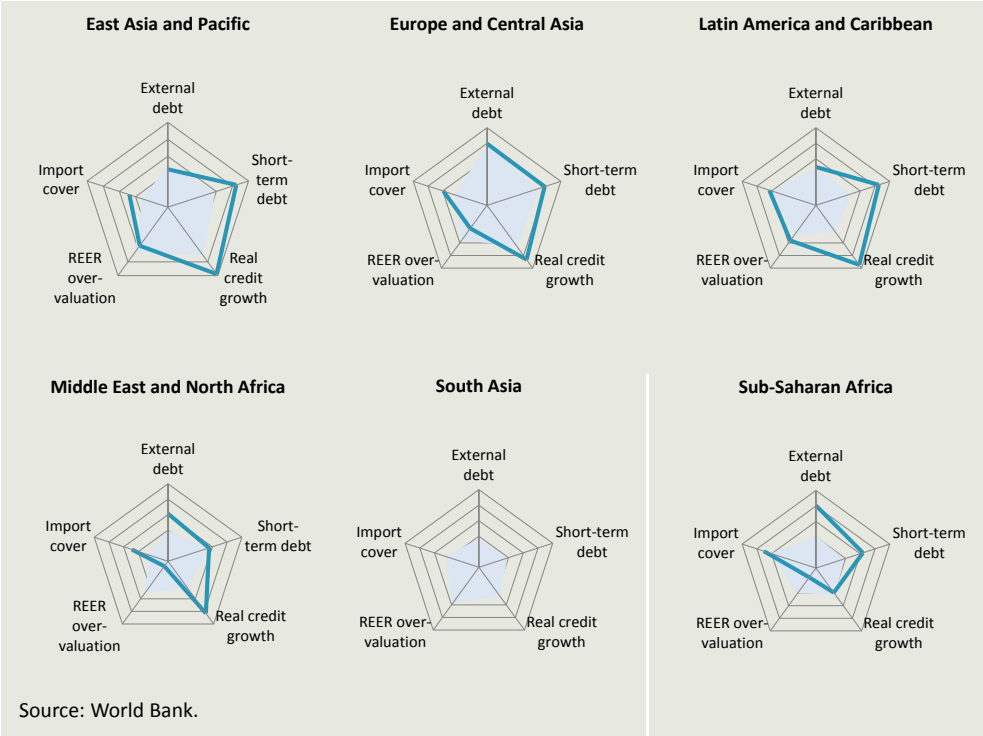

Source: World Bank.

**Figure 12 Model predictions for 2008/9 banking crisis**




Source: World Bank.

**Figure 13 Domestic sources of risk by region**




Source: World Bank.

**Figure 14 Policy options to cope with a sudden deceleration in capital inflows**

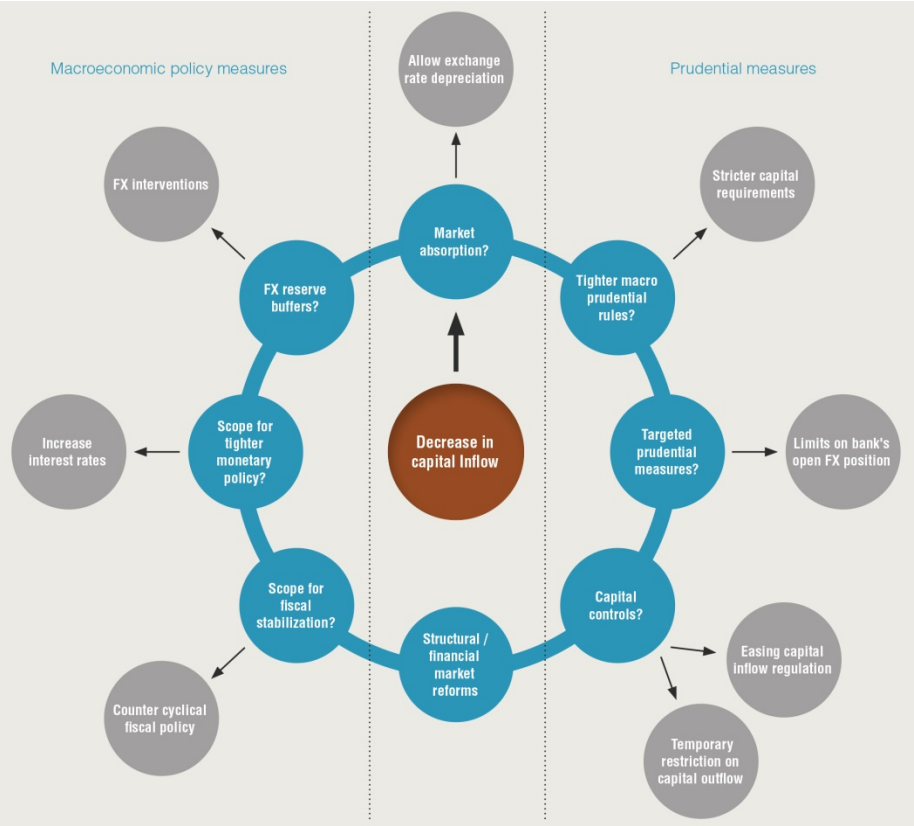



**Figure 15 Main policy pillars to restore confidence**

# Annex 2

## Technical Note: Panel data model of global and domestic factors influencing capital inflows to developing countries

*Data Sources*

The analysis of capital flows relies on an unbalanced panel of available data on quarterly capital flows for up to 60 developing countries for the 2000Q1–2013Q2 period, a span of eight years of non-crisis year capital flows, and five years of post-crisis flows (see country list in Table A2. 1). Aggregate financial inflows (GFI) are defined as the sum of changes in foreign holdings of three categories of assets (portfolio, FDI, and loans) in the developing economy, net of their own disinvestment in each of these three flows. Portfolio and FDI inflows were drawn primarily on balance of payments data from the International Monetary Fund's International Financial Statistics (IFS). These were supplemented by data from national sources drawn from Haver Analytics and Datastream (where gaps exist), and with bank lending data from the Bank of International Settlements' Locational Banking Statistics (LBS). The IFS data include a residual category, "other investments," that includes loans as a subcomponent. However, this category also includes other forms of cross-border finance (such as trade credit and cash) that are of a fundamentally different nature from bank loans, which make it harder to draw inferences when we disaggregate by flow type. We therefore use the more clearly-delineated LBS data instead.

**Table A2. 1 Country list for panel data model of capital flows**

| | | |
|---|---|---|
| Albania | Honduras | Nicaragua |
| Argentina | India | Nigeria |
| Armenia | Indonesia | Pakistan |
| Azerbaijan | Jordan | Panama |
| Bangladesh | Kazakhstan | Paraguay |
| Belarus | Kyrgyz Republic | Peru |
| Belize | Lao PDR | Philippines |
| Brazil | Latvia | Romania |
| Bulgaria | Lebanon | Russian Federation |
| Cape Verde | Lesotho | Seychelles |
| Chile | Lithuania | South Africa |
| China | Macedonia, FYR | Sri Lanka |
| Colombia | Malaysia | Suriname |
| Costa Rica | Mauritius | Thailand |
| Dominican Republic | Mexico | Turkey |
| Ecuador | Moldova | Uganda |
| Egypt, Arab Rep. | Mongolia | Ukraine |
| El Salvador | Morocco | Uruguay |
| Georgia | Mozambique | Venezuela, RB |
| Guatemala | Namibia | Vietnam |

Note: The baseline sample is the largest available sample for the parsimonious and extended benchmark specifications

We also draw on EPFR Global's Global Fund Flows and Allocations Data—which compiles secondary market transactions of bond and equity purchases in emerging market mutual funds—to

**Table A2. 2 Variable list for panel data model of capital flows**

| Variable | Source |
|---|---|
| Private financial inflow | IMF International Financial Statistics, Datastream, Haver, Bank for International Settlements |
| Portfolio investment | IMF International Financial Statistics, Datastream, Haver |
| Foreign direct investment | IMF International Financial Statistics, Datastream, Haver |
| Bank lending | Bank for International Settlements' Locational Banking Statistics |
| Mutual fund flows (equity and bonds) | EPFR Global |
| US 3-month T-bill rate | US Federal Reserve; Datastream |
| US 10-year government bond yield | US Federal Reserve; Datastream |
| US money supply (M2) | US Federal Reserve; Federal Reserve Bank of St. Louis |
| VIX | Chicago Board Options Exchange, Datastream |
| GDP & GDP growth | Datastream, Haver, World Development Indicators |
| Global Purchasing Managers' Index (PMI) | JP Morgan; Markit |
| Central bank balance sheet expansion | US Federal Reserve; European Central Bank, Bank of Japan, Bank of England; Federal Reserve Bank of St. Louis. |
| Developing-country interest rates | IMF International Financial Statistics, Datastream |
| Country rating | Institutional Investor Ratings |
| Global savings | World Development Indicators |
| Trade/GDP | Haver, Datastream, IMF International Financial Statistics, World Development Indicators |
| External debt/GDP | World Development Indicators, Datastream, BIS |
| Private sector credit/GDP | IMF International Financial Statistics |

Note: All variables are at quarterly frequency, unless indicated otherwise

obtain a complementary fund inflow measure. The main explanatory and control variables were obtained from IFS, World Development Indicators (WDI), and central banks, supplemented with Datastream and Haver where gaps exist (see specific sources in Table A2. 2). Both capital flows and explanatory variables in the model are measured in real terms, in constant 2010 exchange rates and prices.

*Model*

The main dependent variable of interest, financial inflows (GFIit), and its component parts (portfolio investment flows, foreign direct investment, and cross-border bank lending) are each modeled as a function of variables meant to proxy for various factors associated with the movement of cross-border flows. The model with both global and local determinants of capital flows is consistent with the recent policy and academic literature (see, for instance, Ahmed and Zlate 2013; Fratscher 2011; Bruno and Shin 2013; Forbes and Warnock 2012). This approach is also consistent with an earlier literature on capital flows (Chuhan, Claessens and Mamingi 1998; Sarno and Taylor 1997; Calvo Leiderman and Reinhart 1996; Montiel and Reinhart 1999).

$$GFI_{it} = GFI_{it-1} + \pi GRC_t + \lambda GFC_t + \chi QE_t + \beta' X_{it} + CRISIS_t + POSTCRISIS_t + a_i + \tau_t + \varepsilon_{it}$$

Measures used to capture relevant global financial conditions ($GFC_t$) include the US Federal Funds rate; the U.S. money supply (M2); the yield curve (the difference between the US long-term interest rate and short-term policy rates); and the VIX index. Increased short-term treasury yields raise the opportunity cost of alternative investments—including that of developing world assets—such that, all else being equal, capital inflows can be expected to fall, suggesting a negative coefficient a priori. The U.S. M2 serves as a quantity-based measure of available liquidity: an increase in M2 indicates an

increase in available financing, which reduces the liquidity premium (raises yields on liquid assets) and substitutes away from financial investments in developing countries, thus also suggesting a negative coefficient. Note, as well, that our use of M2 as the measure of the money supply ensures that it overlaps only minimally with changes in the monetary base that result from QE operations. Pairwise correlations between the two are relatively low.

The yield curve captures the effect that quantitative easing can have on long-term yields, and hence of temporal rebalancing toward higher-risk asset classes, of which developing-country investments are one (Powell 2013); this relationship between a flatter yield curve and greater investment in riskier asset thus implies an a priori negative coefficient. The role of global uncertainty and risk aversion was proxied for by the VIX index (Rey 2013): greater uncertainty is likely to be associated with weaker flows (again, a negative coefficient).

The measures used to capture global real side conditions ($GRC_t$) include high-income country GDP growth (proxied by weighted-average growth rates of the G4 economies – the United States, Euro Area, the United Kingdom, and Japan) and the global composite Purchasing Managers Index (PMI) which proxies for growth expectations. Overall developing country growth was included to account for a combined pull factor for developing countries. Stronger real-side activity is likely to translate into greater investment opportunities overall and increased flows to developing countries; in general one would expect these coefficients to be positive. The coefficient on high-income growth can be ambiguous, because faster growth in advanced economies can render financial assets there more attractive, and hence reduce inflows to the developing world. Taken together, these global factors can be regarded as "push" factors.

The extraordinary measures taken by central banks, in the United States, Europe and Japan are likely to have influenced several of the global financial and real-side variables: by affecting short-term interest rates through conventional monetary policy; by affecting the term-structure of interest rates resulting from the Federal Reserve's purchase of mortgage-backed securities and long-term debt on secondary markets (Christensen and Rudebusch 2012; Gagnon et al. 2011; Krishnamurthy and Vissing-Jorgensen 2011); by reducing uncertainty over the future stance of central bank policy by serving as a credible commitment to low future rates (Bauer and Rudebusch 2013); and by the influence of these factors on US and global growth (Chen, Curdia and Ferrero 2012). To the extent that these policies have influenced these drivers, their influence on capital flows will have been captured in the regression.

To account for the possibility that extraordinary monetary measures have operated through other channels—or if QE may have any additional, unobservable effect over and above these standard, observable variables—a series of dummy variables covering the different episodes of quantitative easing ($QE_t$) were also included. A non-zero coefficient on these dummies can be interpreted as indicating that over and above the (unidentified) influence of quantitative easing on the fundamental drivers included in the model, quantitative easing had an additional impact on capital flows to developing countries that are not captured by observables variables.

We consider three alternative measures for the additional effects of QE programs: a single QE variable that corresponds to all episodes of U.S quantitative easing; separate indicator variables for each of the three distinct episodes; and a continuous measure of QE interventions based on

expansions in the size of the central bank's balance sheet. For the indicator variables, our coding scheme for the start/end quarters defines a quarter as belonging to the implementation window if the total number of implementation days exceeded half the days in any given quarter (for example, QE1, which began on December 16, 2008, is coded as starting 2009Q1, while QE2, which came into effect on November 3, 2010, is coded as beginning 2010Q4). The baseline specification includes QE operations by the U.S. Federal Reserve, while robustness tests took into account QE operations in other major advanced-economy central banks.

**Table A2. 3 Benchmark regressions for gross financial inflows (GFI)**

| | B1 | B2 | B3 | B4 | B5 | B6 |
|---|---|---|---|---|---|---|
| Lagged inflows | 0.473 | 0.477 | 0.481 | 0.466 | 0.473 | 0.473 |
| | (0.02)*** | (0.02)*** | (0.02)*** | (0.02)*** | (0.02)*** | (0.02)*** |
| All QE | 0.031 | | | 0.026 | | |
| episodes | (0.01)*** | | | (0.01)*** | | |
| QE1 episode | | 0.041 | | | 0.049 | |
| | | (0.01)*** | | | (0.01)*** | |
| QE2 episode | | 0.031 | | | 0.035 | |
| | | (0.01)*** | | | (0.01)*** | |
| QE3 episode | | 0.025 | | | 0.006 | |
| | | (0.01)*** | | | (0.00) | |
| QE-related | | | 0.003 | | | 0.002 |
| expansion | | | (0.00)*** | | | (0.00)*** |
| | | | ***Global financial-side conditions*** | | | |
| 3M T-bill | -0.010 | -0.012 | 0.001 | -0.016 | -0.017 | -0.006 |
| rate | (0.00)*** | (0.00)*** | (0.00) | (0.01)* | (0.01)** | -0.01 |
| Yield curve | -0.014 | -0.017 | -0.001 | -0.018 | -0.025 | -0.007 |
| | (0.00)*** | (0.01)*** | (0.00) | (0.01)** | (0.01)*** | -0.01 |
| VIX | | | | -0.002 | -0.002 | -0.002 |
| | | | | (0.00)*** | (0.00)*** | (0.00)*** |
| Money supply | | | | -0.105 | 0.144 | -0.097 |
| (M2) | | | | (0.22) | (0.26) | (0.22) |
| | | | ***Global real-side conditions*** | | | |
| Global PMI | | | | -0.001 | -0.001 | -0.002 |
| | | | | (0.00) | (0.00) | (0.00) |
| Developing | 0.003 | 0.002 | 0.002 | 0.004 | 0.000 | 0.004 |
| GDP growth | (0.00)** | (0.00) | (0.00) | (0.00)** | (0.00) | (0.00)** |
| High-income | 0.001 | 0.001 | 0.001 | 0.000 | 0.001 | 0.000 |
| GDP growth | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) |
| | | | ***Country-specific controls*** | | | |
| Interest rate | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| differential | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) |
| Growth | | | | 0.001 | 0.001 | 0.001 |
| differential | | | | (0.00)* | (0.00)* | (0.00) |
| GDP | 0.132 | 0.130 | 0.130 | 0.129 | 0.125 | 0.128 |
| | (0.03)*** | (0.03)*** | (0.03)*** | (0.03)*** | (0.03)*** | (0.03)*** |
| Country insitutional | 0.002 | 0.001 | 0.001 | 0.002 | 0.002 | 0.002 |
| rating | (0.00)*** | (0.00)*** | (0.00)*** | (0.00)*** | (0.00)*** | (0.00)*** |
| | | | ***Other controls*** | | | |
| Crisis period | -0.046 | -0.052 | -0.050 | -0.022 | -0.026 | -0.026 |
| | (0.01)*** | (0.01)*** | (0.01)*** | -0.01 | (0.01)* | (0.01)* |
| Post-crisis | -0.016 | -0.025 | -0.052 | 0.002 | -0.010 | -0.027 |
| period | (0.00) | (0.01)* | (0.02)*** | (0.01) | (0.01) | (0.02) |
| Adj. $R^2$ | 0.360 | 0.360 | 0.358 | 0.368 | 0.371 | 0.367 |
| $R^2$ (within) | 0.364 | 0.365 | 0.362 | 0.374 | 0.377 | 0.372 |
| $R^2$ (between) | 0.525 | 0.527 | 0.528 | 0.526 | 0.529 | 0.528 |
| N (countries) | 1,938 (60) | 1,938 (60) | 1,938 (60) | 1,925 (60) | 1,925 (60) | 1,925 (60) |



Notes: All level variables are in logarithmic form, but rates, indices, and indicator variables are untransformed. Bootstrapped standard errors (with 100 replications) are reported in parentheses. A time trend, country fixed effects, and constant term were included in the regressions, but not reported. * indicates significance at 10 percent level, **indicates significance at 5 percent level, and

The vector $X_{it}$ captures the influence of domestic "pull" factors and includes the log of country GDP volumes, country institutional investor ratings, country-specific lagged GDP growth differential (relative to the United States), the interest rate differential between the developing country and the United States, and the aggregate developing-country GDP growth. The interest rate differential relative to the United States captures spatial rebalancing that arbitrages cross-country differences in yields. The lagged growth differential captures the relative attractiveness of investing in a particular developing country. Lagged ratios of private credit as a share of GDP (financial depth), trade/GDP (trade openness), external debt/GDP, and real exchange rate appreciation were included in alternative specifications, but were not retained in the benchmark because they were not statistically significant across most specifications and are instead presented in robustness specifications.

Country fixed effects $\alpha_i$ and a time trend $\tau_t$ were included in all specifications. An indicator for crisis and post-crisis were included to account for the large decline in capital flows during 2008-09, and the possibility of a "new normal" in financial flows thereafter. Given that the equation is a dynamic panel model with fixed effects and subject to bias, the coefficients were estimated using a bias-corrected Least Squares Dummy Variables estimator (Bruno 2005) under the strictest condition for bias approximation up to $O(1/NT^2)$, with bootstrapped standard errors.

*Results for benchmark specification*

The results for the benchmark regression for financial inflows ($GFI_{it}$) are presented in Table A2. 3. Columns B1–B3 present a parsimonious specification, while columns B4–B6 present an extended specification with a larger number of independent variables. The results suggest that global financial conditions (short-term interest rates, the yield curve, and the VIX index) play an important role in determining the level of capital flows, are signed according to a priori expectations, and are consistent with the findings of Chuhan, Claessens, and Mamingi (1996), Reinhart and Reinhart (2008), Forbes and Warnock (2012), and Bruno and Shin (2013), among others. Among global real side indicators, some factors may have had a modest impact on flows (developing-country growth rates are marginally significant (at 10 percent) in some specifications, but global PMI and high-income country growth did not prove to be significantly associated with country-level capital flows).

The indicator for quantitative easing episodes has positive and statistically significant relationship, which suggests that over and above the other modeled channels, quantitative easing induced additional capital inflows. Consistent with the literature on the impact of quantitative easing on the US economy (Curdia and Ferrero 2013; Krishnamurthy and Vissing-Jorgensen 2013), these effects are diminishing with each new QE intervention: when the QE indicator is split into separate indicators for QE1, QE2 and QE3, the magnitude and significance diminishes between successive episodes (and for QE3 the coefficient is statistically insignificant).

Consistent with the existing literature (Alfaro, Kalemli-Ozcan and Volosovych 2008; Fratzscher, 2011; Gelos, Sahay and Sandleris 2011), the results suggest that capital flows to individual countries are strongly influenced by a number of country-specific pull factors, including changes in investor country ratings, which represent the perceived quality of policies and institutions. Changes in country-specific growth differentials relative to the United States are also a statistically significant pull factor (at the 10 percent level), which is consistent with growth performance being a proxy for

the relative attractiveness of a country for international investors. Real interest rate differentials are not statistically significant, although that is consistent with the existing literature (Bruno and Shin 2013, for example).

*Interactions of QE episode dummy with global financial and real-side conditions and additional robustness tests*

To ascertain whether quantitative easing may have altered the influence of the conventional transmission channels of capital flows (say by making flows more sensitive to interest rate developments), a specification that allowed for interactions between the QE indicator and the observable global financial and real-side variables was also explored. The results show little support for the argument that the sensitivity of transmission channels for unconventional monetary policy changed as a result of QE (see Lim, Mohapatra, and Stocker, 2014, for details).

Several alternative specifications were also examined, including a host of additional controls and alternative measures. These additional controls include the global level of saving (to account for the quantity of investable funds), the (lagged) ratio of trade to output, the (lagged) ratio of private credit to output, the (lagged) ratio of debt to GDP, the inflation differential, and the (lagged) real exchange rate. Note that including these additional variables does not alter the qualitative message from our baseline results nor do the coefficients for these controls generally enter with significant coefficients.

A measure of the third QE episode that includes an additional indicator for 2013Q2 when QE tapering was anticipated was associated with a significant reduction in inflows: the coefficient on the variable is almost twice as large as average effects over all previous QE episodes. Additionally, substituting the baseline interest rate differential for the interest rate spread computed from a richer array of fixed income instruments does not change the main qualitative conclusions.

An alternative set of measures allows for the fact that unconventional monetary policies were more or less simultaneously pursued by the Bank of England (via the Asset Purchase Facility), the Bank of Japan (via its Asset Purchase Program), and the European Central Bank (through its Securities Market Program (SMP) and Outright Monetary Transactions (OMT)). For the episode indicator, we drew on qualitative information in Neeley (2013) concerning G4 central bank unconventional monetary policy actions, and coded additional quarters as QE periods if at least two additional central banks engaged in QE. We stay with the convention and exclude the ECB's Long-Term Refinancing Operations as a form of QE. Note as well that while the SMP has resulted in a substantial expansion of the ECB balance sheet, the OMT has in fact never been used, despite widespread acknowledgment that the program engendered confidence effects.

This expanded QE indicator has a similar sign and significance as the benchmark specification. Given that the VIX, interest rates and GDP growth tend to be codetermined (Albuquerque, Loayza and Serven 2005; Kose, Otrok and Whiteman 2003) a common factor (the principal component of the three variables) was derived to proxy for global conditions. We construct this factor from the varimax orthogonal rotation of the first principal component of the vector of global variables. We also considered an alternative, the proportion-weighted sum of the first three principal components (all possessed eigenvalues greater than unity). Using this single factor did not affect other coefficients significantly, although it did reduce the overall power of the regression. Moreover, the Kaiser-Meyer-Olkin test of sampling adequacy indicates that the underlying variables are sufficiently

distinct that partial correlations between them are low, and hence are not particularly well-suited for factor analysis.

*Decompositions*

To obtain greater insight into whether specific channels may be more operative then others, depending on the financial flow, we break down our dependent variable—aggregate inflows—into portfolio, loans, and FDI. Estimates of the capital flow model performed on each of these flows individually suggests presented in columns (D1)-(D3) of Table A2. 4 suggest that portfolio flows are the most sensitive to the external drivers associated with monetary conditions in high-income countries. The sensitivity of portfolio flows to changes in the yield curve is almost double that of overall capital flows, as is the response to the QE indicator. Foreign direct investment tends to be relatively insensitive to the effects of global push factors, and is much more responsive to country specific characteristics, consistent with the literature (Alfaro, Kalemli-Ozcan and Volosovych 2008, Benassy-Quere, Coupet and Mayer 2007; Dailami, Kurlat and Lim 2012). This result also corroborates with evidence from gravity-type models of FDI (which finds larger FDI flows between bilateral pairs with larger pairwise GDP), and the more general stylized fact that gross FDI inflows tend to be countercyclical and the least volatile among different financial flows (Contessi, DePace, and Francis 2013). Cross-border bank lending appears to fall into an intermediate category. In particular, the coefficient on the QE dummies is much larger for bank lending, suggesting that more so than for the other flows, QE operated through channels other than those modeled to boost bank lending. On the other hand, bank lending was much less sensitive to liquidity or portfolio rebalancing factors.

Columns D4-D6 of Table A2. 4 present measures of flows into emerging market mutual funds, a subset of portfolio inflows. The statistically significant coefficients in columns D4 are broadly comparable to overall portfolio inflows (D1). It is notable that while bond flows appear to react to more transmission channels than equity flows—debt is associated with changes in the VIX as well as in the global PMI, while equity is not—the magnitude (and standard errors) of the coefficients on equity are generally larger than those for debt. The coefficient of global PMI is negative, which indicates that inflows into debt decrease when global growth prospects improve—an outcome consistent with substitution into riskier assets when growth outlooks turn upward.

**Table A2. 4 Decomposition of financial inflows**

| | D1 | D2 | D3 | D4 | D5 | D6 |
|---|---|---|---|---|---|---|
| | *Portfolio* | *Loans* | *FDI* | *Gross fund* | *Bonds* | *Equity* |
| Lagged inflows | 0.261 | 0.307 | 0.597 | -0.088 | 0.294 | -0.011 |
| | (0.02)*** | (0.02)*** | (0.02)*** | (0.04)** | (0.03)*** | -0.03 |
| All QE | 0.018 | 0.021 | -0.003 | 0.061 | 0.015 | 0.044 |
| episodes | (0.01)*** | (0.01)*** | -0.01 | (0.02)*** | -0.02 | (0.03)* |
| | | | *Global financial-side conditions* | | | |
| 3M T-bill | -0.015 | -0.004 | 0.004 | -0.080 | -0.089 | -0.053 |
| rate | (0.01)** | (0.01) | (0.01) | (0.02)*** | (0.02)*** | (0.03)** |
| Yield curve | -0.020 | -0.002 | 0.005 | -0.090 | -0.065 | -0.064 |
| | (0.01)*** | (0.01) | (0.01) | (0.03)*** | (0.02)*** | (0.03)** |
| VIX | -0.002 | 0.000 | 0.000 | -0.002 | -0.006 | 0.000 |
| | (0.00)*** | (0.00) | (0.00) | (0.00) | (0.00)*** | (0.00) |
| Money supply | 0.015 | -0.071 | 0.056 | -1.110 | -2.120 | -0.589 |
| (M2) | (0.19) | (0.16) | (0.26) | (0.65)* | (0.45)*** | (0.66) |
| | | | *Global real-side conditions* | | | |
| Global PMI | -0.001 | -0.001 | -0.001 | 0.008 | 0.003 | 0.004 |
| | (0.00) | (0.00) | (0.00) | (0.01) | (0.00) | (0.01) |
| Developing | 0.004 | 0.000 | -0.001 | 0.014 | 0.023 | 0.007 |
| GDP growth | (0.00)*** | (0.00) | (0.00) | (0.01)*** | (0.00)*** | (0.01) |
| High-income | -0.001 | 0.002 | 0.004 | -0.011 | -0.017 | -0.007 |
| GDP growth | (0.00) | (0.00) | (0.00) | (0.01) | (0.01)*** | (0.01) |
| | | | *Country-specific controls* | | | |
| Interest rate | 0.000 | 0.000 | 0.000 | -0.001 | -0.002 | 0.000 |
| differential | (0.00) | (0.00) | (0.00) | (0.00) | (0.00)* | (0.00) |
| Growth | 0.001 | 0.001 | 0.000 | 0.001 | 0.000 | -0.001 |
| differential | (0.00)* | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) |
| GDP | 0.009 | 0.110 | 0.070 | -0.060 | 0.020 | 0.039 |
| | (0.03) | (0.02)*** | (0.04)* | (0.09) | (0.07) | (0.08) |
| Country insitutional | 0.001 | 0.001 | 0.002 | 0.002 | 0.001 | 0.000 |
| rating | (0.00)*** | (0.00)*** | (0.00)** | (0.00) | (0.00) | (0.00) |
| | | | *Other controls* | | | |
| Crisis period | -0.002 | -0.043 | -0.005 | 0.024 | -0.043 | 0.032 |
| | (0.01) | (0.01)*** | (0.02) | (0.04) | (0.03) | (0.05) |
| Post-crisis | 0.024 | -0.025 | -0.010 | 0.038 | -0.061 | 0.050 |
| period | (0.01)* | (0.01)** | (0.02) | (0.05) | (0.04) | (0.05) |
| Adj. $R^2$ | 0.157 | 0.032 | 0.399 | 0.054 | 0.193 | 0.005 |
| $R^2$ (within) | 0.164 | 0.037 | 0.403 | 0.07 | 0.203 | 0.018 |
| $R^2$ (between) | 0.572 | 0.209 | 0.854 | 0.45 | 0.562 | 0.042 |
| N (countries) | 1,925 (60) | 3,460 (85) | 2,419 (63) | 974 (31) | 1,220 (39) | 1,185 (37) |

Source: World Bank.

# Annex 3

## Technical Note: Vector autoregression analysis of capital inflows to developing countries

*Model specification*

Inter-temporal interactions between global "push" factors, capital inflows and GDP growth in developing countries are modeled using a six-dimensional vector autoregression (VAR) system, estimated over the period 2000Q1 to 2013Q2. The vector of endogenous variables consists of:

- aggregate capital inflows to developing countries as a share of their combined GDP - source: IFS / Balance of Payment data;
- Quarterly real GDP growth in both developing and G-4 countries—United States, Euro Area, Japan and the United Kingdom (sources: Haver, Datastream, National Statistical Offices)
- G-4 short term interest rates—three month money market rates (source: Datastream)
- G-4 yield curve–10 year government bond yields minus three-month interest rates (source: Datastream)
- The VIX index measuring the implied volatility of S&P 500 options (sources: Datastream, Chicago Board Options Exchange Market)

Descriptive statistics of the six dependent variables are presented in Table A3. 1.

Regarding the lag selection procedures for the VAR, the Hannan and Quinn information criterion (HIC) and Schwartz Bayesian Information Criterion (BIC) suggested one lag, but the Final Prediction Error (FPE) and Likelihood Ratio test statistics (LR) recommended two, while the Akaike Information Criterion (AIC) recommended four (Table A3. 2). A two-period lag structure was decided upon, with all eigenvalues being significant less than one. A formal Johansen Test rejects the presence of co-integration, so the system was estimated the model was estimated as an unrestricted VAR.

To compute impulse responses (Figure A3. 1) and variance decompositions (Table A3. 3), a structural identification was derived by imposing a Cholesky decomposition on the covariance matrix. The Cholesky restrictions were imposed by ordering the variables so that the first variable cannot respond to contemporaneous shocks (in the same quarter) of any other variables, the second one responds to contemporaneous shocks affecting only the first variable, and so on. The following order was suggested by expected time lags in the reaction of "real" variables to financial shocks: G-4 GDP growth, developing countries' GDP growth, developing countries capital inflows (in percent of GDP), the VIX index, G-4 short-term interest rates and the yield curve (potentially responding to all other variables in real time).

**Table A3. 1 Descriptive statistics**

| | G4 GDP Growth | DEV GDP Growth | DEV Capital Inflows / GDP | VIX Index | G4 3m interest rate | G4 yield curve |
|---|---|---|---|---|---|---|
| **Mean** | 1.3 | 6.1 | 5.5 | 21 | 2.0 | 1.5 |
| **Median** | 1.8 | 6.4 | 5.4 | 20 | 1.8 | 1.8 |
| **Std. Dev.** | 1.9 | 2.1 | 3.5 | 9 | 1.4 | 1.0 |

Source: World Bank.

**Table A3. 2 VAR lag order selection criteria**

**Sample: 2000Q1 2013Q2**
**Included observations: 46**

| Lag | LogL | LR | FPE | AIC | SC | HQ |
|---|---|---|---|---|---|---|
| 0 | -521 | NA | 359 | 23 | 23 | 23 |
| 1 | -280 | 408 | 0 | 14 | 16* | 15* |
| 2 | -245 | 51* | 0 | 14 | 17 | 15 |
| 3 | -203 | 48 | 0 | 14 | 18 | 15 |
| 4 | -151 | 48 | 0.04* | 13* | 19 | 15 |

Source: World Bank.

## Interest rate assumptions and alternative scenarios

*Baseline scenario:*

QE tapering by the U.S. Fed starts in January 2014 and ends in December 2014. Its effect is very gradual, adding 50bp to U.S. long-term interest rates by the end of 2015 and a cumulative 100bp by the end of 2016 (assuming that anticipation has already taken out half of the overall QE effect from May to November 2013).

The ECB, Bank of Japan, and Bank of England, start to unwind their own quantitative/qualitative policies in the course of 2015/16, adding 50bp to their long-term yields by the end of the forecast horizon. Only the U.S. Fed starts to increase policy rates by 2015Q3, from 0.25 to 2 percent by the end of 2016. The ECB, Bank of Japan and Bank of England follow broadly the same tightening path but a full year later. As a result, G4 long-term interest rates are expected in the baseline to increase from 2.5 percent in 2013Q4 to 3.7 percent by end 2016. The corresponding "add factor" in the VAR equation under this baseline scenario is presented in Figure A3. 2, showing slightly positive residuals from the purely model-based prediction over the projection horizon (10 to 15bp).

*Fast normalization and overshooting scenarios:*

"Fast normalization" is a scenario in which the unwinding of QE specific effects on the yield curve (100bp) is front loaded and happens within the first two quarters of 2014. The add factor to the yield curve equation is adjusted upwards in 2014Q1 and 2014Q2 by a cumulative 100bp but is lowered back to zero afterwards. In other words, only the timing of the adjustment is affected; the cumulative impact is unchanged. The model is run on the alternative add factor series and simulations for all six endogenous variables reported as the fast normalization scenario.

"Overshooting" is a scenario in which the yield curve steepens by 200bp in the first half of 2014. In this context, the add factor to the yield curve is initially shifted upward as presented in Figure A3. 2. The model is run on the alternative add factor series and simulations for all six endogenous variables reported as the "overshooting" scenario.

**Figure A3. 1 Impulse response**

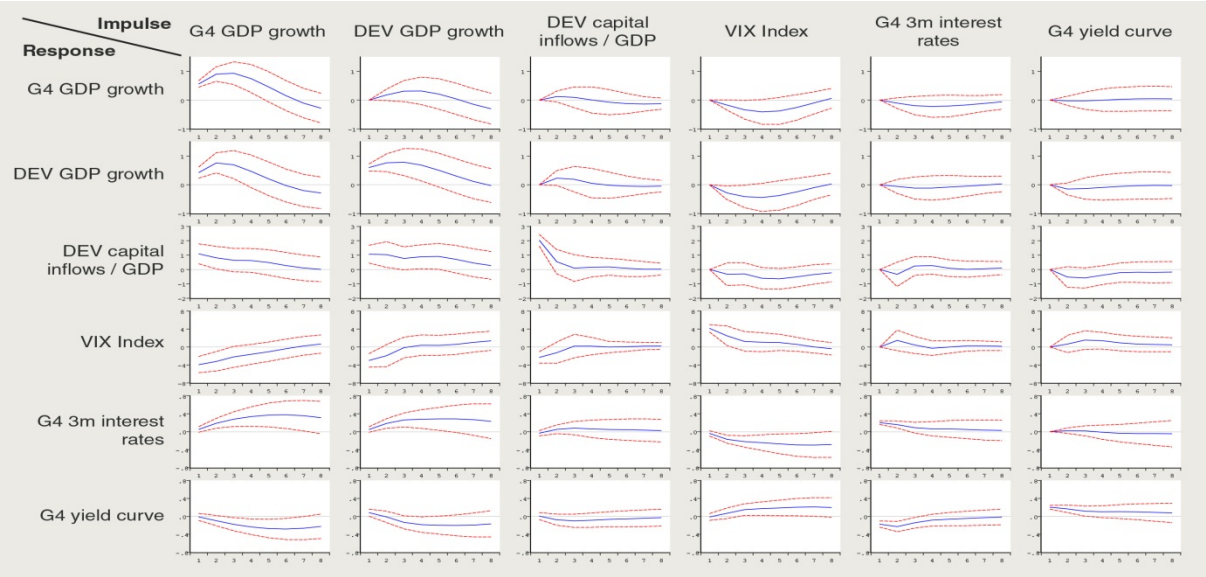
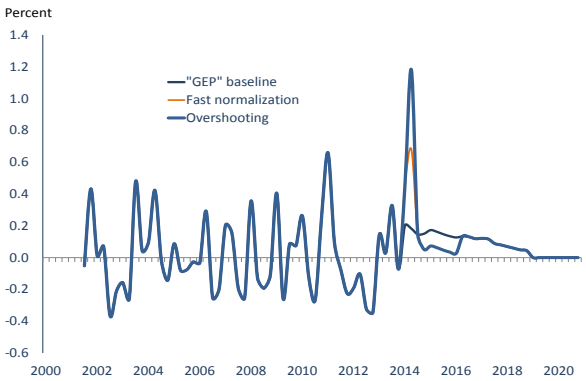



**Table A3. 3 Variance decomposition**

| | G4 GDP Growth | DEV GDP Growth | DEV Capital Inflows / GDP | VIX Index | G4 3m interest rate | G4 yield curve |
|---|---|---|---|---|---|---|
| **Variance decomposition of:** | | | | | | |
| **G4 GDP Growth** | | | | | | |
| 4 quarters | 79 | 7 | 1 | 10 | 3 | 0 |
| 8 quarters | 71 | 9 | 2 | 13 | 5 | 0 |
| **DEV GDP Growth** | | | | | | |
| 4 quarters | 36 | 49 | 2 | 11 | 1 | 1 |
| 8 quarters | 33 | 49 | 2 | 14 | 1 | 1 |
| **DEV Capital Inflows / GDP** | | | | | | |
| 4 quarters | 22 | 29 | 36 | 5 | 2 | 6 |
| 8 quarters | 19 | 34 | 29 | 10 | 2 | 6 |
| **VIX Index** | | | | | | |
| 4 quarters | 39 | 15 | 8 | 30 | 3 | 6 |
| 8 quarters | 37 | 17 | 8 | 29 | 3 | 7 |
| **G4 3m interest rate** | | | | | | |
| 4 quarters | 35 | 28 | 2 | 22 | 12 | 0 |
| 8 quarters | 41 | 26 | 1 | 26 | 5 | 0 |
| **G4 yield curve** | | | | | | |
| 4 quarters | 22 | 13 | 5 | 13 | 25 | 21 |
| 8 quarters | 34 | 19 | 3 | 20 | 11 | 12 |

Source: World Bank.

**Figure A3. 2 G4 yield curve equation: residual / add factor under different normalization scenarios**




Source: World Bank.

# Annex 4

## Technical Note: Modeling banking crisis risks in developing countries

*Data sources and coverage*

The analysis is based on the banking crisis data compiled by Laeven and Valencia (2012), which identifies 147 banking crisis in 162 countries for the period 1970–2011. The analysis focuses on the banking crisis in developing countries by excluding OECD country observations. Table A4. 1 reports country and time coverage statistics. The primary data source for the explanatory variables are the World Bank's World Development Indicators (WDI) and Global Economic Prospects (GEP), the IMF's World Economic Outlook (WEO), International Finance Statistics (IFS), and Direction of Trade Statistics (DOTS), and the Bank of International Settlements (BIS) datasets. Table A4. 2 reports the definition of the variables and data sources.

**Table A4. 1 Countries in estimation samples**

| | Country Name | Obs. | | Country Name | Obs. | | Country Name | Obs. |
|---|---|---|---|---|---|---|---|---|
| 1. | Albania | 10 | 41. | Guinea-Bissau | 5 | 81. | Rwanda | 20 |
| 2. | Algeria | 4 | 42. | Guyana | 17 | 82. | Senegal | 20 |
| 3. | Angola | 9 | 43. | Haiti | 10 | 83. | Seychelles | 23 |
| 4. | Argentina | 11 | 44. | Honduras | 23 | 84. | Sierra Leone | 20 |
| 5. | Armenia | 10 | 45. | India | 20 | 85. | Solomon Islands | 22 |
| 6. | Azerbaijan | 10 | 46. | Indonesia | 20 | 86. | South Africa | 14 |
| 7. | Bangladesh | 20 | 47. | Jamaica | 17 | 87. | Sri Lanka | 20 |
| 8. | Belarus | 10 | 48. | Jordan | 20 | 88. | St. Lucia | 23 |
| 9. | Belize | 21 | 49. | Kazakhstan | 9 | 89. | St. Vincent and the Grenadine | 23 |
| 10. | Benin | 20 | 50. | Kenya | 18 | 90. | Sudan | 23 |
| 11. | Bolivia | 14 | 51. | Kyrgyz Republic | 8 | 91. | Syrian Arab Republic | 23 |
| 12. | Botswana | 23 | 52. | Lao PDR | 12 | 92. | Tanzania | 16 |
| 13. | Brazil | 13 | 53. | Latvia | 10 | 93. | Thailand | 20 |
| 14. | Bulgaria | 10 | 54. | Lebanon | 3 | 94. | Togo | 20 |
| 15. | Burkina Faso | 11 | 55. | Lesotho | 20 | 95. | Tunisia | 20 |
| 16. | Burundi | 17 | 56. | Lithuania | 11 | 96. | Turkey | 14 |
| 17. | Cambodia | 11 | 57. | Macedonia, FYR | 9 | 97. | Uganda | 13 |
| 18. | Cameroon | 17 | 58. | Madagascar | 17 | 98. | Ukraine | 7 |
| 19. | Cape Verde | 20 | 59. | Malawi | 23 | 99. | Uruguay | 14 |
| 20. | Central African Republi | 6 | 60. | Malaysia | 20 | 100. | Vanuatu | 23 |
| 21. | Chile | 23 | 61. | Mali | 20 | 101. | Venezuela, RB | 20 |
| 22. | China | 20 | 62. | Mauritania | 2 | 102. | Vietnam | 9 |
| 23. | Colombia | 16 | 63. | Mauritius | 9 | 103. | Yemen, Rep. | 10 |
| 24. | Comoros | 9 | 64. | Mexico | 20 | 104. | Zambia | 14 |
| 25. | Congo, Dem. Rep. | 4 | 65. | Moldova | 10 | | | |
| 26. | Congo, Rep. | 19 | 66. | Mongolia | 9 | | | |
| 27. | Costa Rica | 17 | 67. | Morocco | 15 | | | |
| 28. | Cote d'Ivoire | 20 | 68. | Mozambique | 15 | | | |
| 29. | Dominica | 22 | 69. | Nepal | 20 | | | |
| 30. | Dominican Republic | 20 | 70. | Nicaragua | 13 | | | |
| 31. | Ecuador | 20 | 71. | Niger | 23 | | | |
| 32. | Egypt, Arab Rep. | 23 | 72. | Nigeria | 20 | | | |
| 33. | El Salvador | 14 | 73. | Pakistan | 23 | | | |
| 34. | Ethiopia | 23 | 74. | Panama | 13 | | | |
| 35. | Gabon | 20 | 75. | Papua New Guine | 19 | | | |
| 36. | Gambia, The | 14 | 76. | Paraguay | 15 | | | |
| 37. | Georgia | 8 | 77. | Peru | 17 | | | |
| 38. | Ghana | 17 | 78. | Philippines | 20 | | | |
| 39. | Guatemala | 23 | 79. | Romania | 8 | | | |
| 40. | Guinea | 11 | 80. | Russian Federatio | 7 | | | |

Source: World Bank, IMF, Laeven and Valencia (2012).

**Table A4. 2 List of Variables Used in the Regression Analysis**

| Variable | Definition | Source |
|---|---|---|
| **Dependent Variable** | | |
| Banking crisis | Indicator variable that equals 1 if the country experiences a systemic banking crisis for the first year | Laeven and Valencia (2012) |
| **Explanatory Variables** | | |
| *Global Variables* | | |
| Global risk | Volatility Index (VXO) calculated by the Chicago Board Options Exchange, in annual inter-quartile range | CBOE |
| Global interest rate | Change in global interest rate give by the first principal component of the G4 (US, UK, Japan, and EU) long-term interest rates | WEO |
| Global liquidity | M2 as a share of GDP in US | WEO |
| Global growth | First principal component of G4 real GDP growth | WEO |
| Agricultural Commodity Price index | Global commodity price index | GEP |
| Energy commodity price index | Global commodity price index | GEP |
| *Contagion Variables* | | |
| Openness | Exports plus imports as a share of GDP | WDI |
| Trade linkage | Bilateral trade (export plus import) as a share of total exports, mulitplied by a dummy variable that equals =1 if the trade partner experiences a banking crisis | DOT |
| Financial linkage | External position vis-à-vis BIS Reporting Banks as a share of GDP | BIS |
| Regional contagion | Dummy variable that equals 1 if the country in the same region experiences a banking crisis | WDI |
| *Domestic Variables* | | |
| External debt | Total external debt as a share of GDP | WDI |
| Current account balance | Change in current account balance as a share of GDP over last 5 years | WDI, WEO |
| Short term debt | Short term external debt plus amortization due within a year as a share of total external debt | WDI, WEO, IFS |
| Domestic credit growth | Change in domestic credit as share of GDP over last 5 years | WDI |
| Inflation | Change in the consumer price index | WDI, WEO |
| Per capita GDP growth | Growth rate of real per capita GDP | WDI |
| Import cover | Reserves as a multiple of monthly imports | WDI, WEO, IFS, GEP |
| Ratio of M2 to reserves | M2 as a share of total reserves | WDI, IFS |
| Fiscal blance | Net borrowing/ lending by the government as a share of GDP | WDI, WEO |
| REER overvaluation | Real effective exchange rate minus long term trend (estimated by 10 year moving average) | WDI, GEP |

*Empirical methodology*

In line with the literature, we estimate the relationship between the onset of banking crisis and the global, contagion, and domestic factors using a pooled probit model:

$$P(Crisis_{it} \mid W_{t,t-1}, X_{it-1}, Z_{it-1}) = F(\beta' W_{t,t-1} + \lambda' X_{it-1} + \theta' Z_{it-1})$$

where P(.) is the probability that a country i will be in banking crisis in time t, conditional on global factors W, contagion factors X, and domestic factors Z. F (.) is the standard normal distribution function that transforms a linear combination of the explanatory variables into the 0,1 interval.

A pooled regression involves pooling observations across country- and time-dimensions so that a unit of observation becomes a country-year, not a country. To allow for the fact that same countries are repeatedly observed in the sample, such that errors in the model are not independently and identically distributed, we use robust standard errors with clusters, where the cluster is defined as a country, to allow errors of a given country to be correlated over time.

We exclude observations three years following each crisis observation for a given country to avoid double counting and endogeneity. Similar approach has been used by Eichengreen, Rose and Wyplosz (1996), Eichengreen and Rose (1998), Eichengreen and Arteta (2000), and Forbes and Warnock (2012). Except for global factors, we also use lagged explanatory variables to reduce endogeneity concern. The general to specific approach is applied to arrive at the final probit specifications.

Results are reported in Table A4. 3. Column 4 in Table A4. 3 evaluates the relative importance of all three sets of factors. The results generally confirm the strong influence of both global and domestic factors in the onset of banking crises found in the separate models (columns 1–3), although not all factors remain significant in the combined model. A consolidated model, applying the general-to-specific method to eliminate the insignificant variable for later analyses, is reported in column 5. The general-to-specific modeling refers to the process of simplifying an initially general (over-parameterized) model that adequately characterizes the empirical evidence within a theoretical framework and reducing the number of variables and parameters to be estimated to achieve greater statistical efficiency without causing significant problems of model misspecifications and omitted variable bias. Central aspects of this approach include the model selection procedures based on across-model comparison and parameter constancy, as well as evaluation of selection criteria such as adjusted pseudo-R squares, Akaike Information Criterion (AIC), and Bayesian Information Criterion (BIC), all of which are reported in the bottom of Table A4. 3. Given two models, a higher adjusted pseudo-R2, or a smaller AIC or BIC indicates a better-fitting model.

In the final version of the model (column 5), all the significant impact of global and domestic variables remains. Among the global factors, we continue to find the strong influence of global risk aversion, high global liquidity, and rising global interest rates. The positive coefficient on the lagged global liquidity and the negative coefficient on the lagged global risk variable are all consistent with a view that crises in individual developing countries tend to be preceded by periods of ample liquidity and suppressed risk. Most contagion variables are not statistically significant, although the trade links variable (the share of trade with other countries that are in crisis) remains significant. Among the domestic factors, a high external and short-term debt, rapid growth in domestic credit, low levels of international reserves, and overvaluation in real exchange rates are all significantly associated with heightened risk of banking crisis, with expected signs.

The bottom of Table A4. 3 reports alternative measures of the predictive accuracy of the models:

**Percent of Correct Positive**—Let pj be the predicted probability of a positive outcome and yj be the actual outcome (0 or 1). Let c be the cutoff value which we specify as equal to the observed risk of positive outcome in the estimation sample. A prediction is classified as "positive" if pj >= c, and classified as "negative" otherwise. Percent of Correct Positive is the fraction of yj=1 observations that are correctly classified as "positive" (pj>=c). This is also known as "sensitivity" of the model.

**Percent of Correct Negative**—This is the fraction of yj=0 observations that are correctly classified as "negative" (pj<c). This measure is also known as "specificity" of the model.

**Area Under the Receiver Operating Characteristic Curve (AUROC)**—The ROC curve is a graph of specificity against (1-sensitivity) as the cutoff c is varied from 0 to 1. The curve starts at (0,

0), corresponding to c = 1, and continues to (1, 1), corresponding to c = 0. The A model with no predictive power would have a ROC curve of a 45 degree line. The greater the predictive power, the more bowed the curve would be, and hence greater the area beneath the curve. A model with no predictive power has area 0.5; a perfect model has area 1.

**Table A4. 3 Alternative specifications of banking crisis probit model**

| | (1) Global | (2) Contagion | (3) Domestic | (4) All | (5) Consolidated |
|---|---|---|---|---|---|
| Global risk (t) | 0.414 *** | | | 0.295 *** | 0.306 *** |
| | (3.80) | | | (2.60) | (2.77) |
| Global interest (t) | 0.478 | | | 0.135 | 0.189 |
| | (1.02) | | | (0.23) | (0.35) |
| Global growth (t) | -0.901 *** | | | -0.035 | -0.010 |
| | (-3.25) | | | (-0.10) | (-0.03) |
| Global liquidity (t) | -1.140 *** | | | -0.630 | -0.687 * |
| | (-2.71) | | | (-1.53) | (-1.69) |
| Agri. commdity price (t) | -0.008 | | | -0.034 | -0.035 |
| | (-0.14) | | | (-0.54) | (-0.58) |
| Energy commodity price (t) | -0.017 | | | -0.018 | -0.021 |
| | (-0.77) | | | (-0.77) | (-0.90) |
| Global risk | -0.023 | | | -0.056 | -0.038 |
| | (-0.25) | | | (-0.46) | (-0.33) |
| Global interest | 1.010 ** | | | 1.280 * | 1.300 ** |
| | (2.03) | | | (1.92) | (2.02) |
| Global growth | 0.254 | | | -0.099 | -0.099 |
| | (0.64) | | | (-0.23) | (-0.24) |
| Global liquidity | 0.935 *** | | | 0.566 * | 0.596 * |
| | (2.92) | | | (1.78) | (1.90) |
| Agri. commdity price | 0.045 | | | 0.037 | 0.036 |
| | (1.09) | | | (0.84) | (0.83) |
| Energy commodity price | -0.011 | | | 0.032 | 0.039 |
| | (-0.32) | | | (0.75) | (0.92) |
| Openness | | -1.67 *** | | -0.460 | -0.565 |
| | | (-2.62) | | (-1.13) | (-1.42) |
| Tradelinkage | | 0.239 * | | 0.161 ** | 0.163 ** |
| | | (1.69) | | (2.02) | (2.03) |
| Financial linkage | | 0.063 | | -0.073 | |
| | | (0.26) | | (-0.58) | |
| Regional contagion | | 0.208 *** | | 0.032 | |
| | | (2.67) | | (0.40) | |
| External debt | | | 0.856 ** | 0.456 | 0.559 ** |
| | | | (2.04) | (1.52) | (2.02) |
| Current account balance | | | -0.0371 | -0.031 | -0.030 |
| | | | (-0.81) | (-0.98) | (-1.00) |
| Short term debt | | | 0.798 ** | 0.403 ** | 0.360 * |
| | | | (2.47) | (2.04) | (1.84) |
| Credit growth | | | 0.0851 *** | 0.059 *** | 0.057 *** |
| | | | (2.66) | (3.49) | (3.44) |
| Inflation | | | 0.0301 ** | 0.005 | |
| | | | (2.07) | (0.51) | |
| Per capita GDP growth | | | -0.106 | -0.018 | |
| | | | (-1.62) | (-0.50) | |
| Import cover | | | -0.169 * | -0.123 * | -0.116 * |
| | | | (-1.69) | (-1.96) | (-1.76) |
| Ratio of M2 to reserves | | | 0.0122 | 0.002 | |
| | | | (0.92) | (0.32) | |
| Fiscal balance | | | -0.0416 | -0.02 | -0.022 |
| | | | (-0.93) | (-0.65) | (-0.69) |
| REER overvaluation | | | 0.000318 | 4.26E-04 * | 0.001 ** |
| | | | (0.73) | (1.83) | (2.14) |
| Observations | 3,438 | 2,567 | 1,855 | 1,584 | 1,631 |
| Observed risk | 2.9% | 3.3% | 3.2% | 3.3% | 3.3% |
| Predicted Risk (at x-bar) | | | | | |
| Percent of Correcrt Positive† | 93.9% | 61.2% | 64.4% | 82.7% | 79.3% |
| Percent of Correct Negative† | 46.6% | 57.4% | 65.1% | 68.5% | 69.0% |
| AUROC†† | 0.741 | 0.667 | 0.666 | 0.831 | 0.832 |
| Pseudo R-squared | 0.096 | 0.020 | 0.051 | 0.174 | 0.174 |
| AIC | 831.4 | 741.4 | 518.2 | 431.9 | 430.3 |
| BIC | 911.2 | 770.7 | 579.0 | 576.8 | 549.0 |

Note: Dependent varaibe is a binary indicator for a banking crisis. Explanatoyr variables are in one-period lag (t-1) unless otherwise indicated.
Reported coefficients are marginal effects of a varaibel on the probability of a baning crisis in percentage points. Robust clustered standard errors are used. T statistics in parentheses.

* significant at 10%. ** significant at 5 percent. *** significant at 1%.

†Cut-off =observed risk in the data.

†† Area Under the Receiver Operating Characteristic Curve from the probit analysis. See annex 3 for further details.