

Risk-on/risk-off, capital flows, leverage and safe assets

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Abstract

This paper describes the international flow of funds associated with calm and volatile global equity markets. During calm periods, portfolio investment by real money and leveraged investors in advanced countries flows into emerging markets. When central banks in the receiving countries resist exchange rate appreciation and buy dollars against domestic currency, they end up investing in medium-term bonds in reserve currencies. In the process they fund themselves (or “sterilise” the expansion of local bank reserves) by issuing safe assets in domestic currency to domestic investors. Thus, calm periods, marked by leveraged investing in emerging markets, lead to an asymmetric asset swap (risky emerging market assets against safe reserve currency assets) and leveraging up by emerging market central banks. In declining and volatile global equity markets, these flows reverse, and, contrary to some claims, emerging market central banks draw down reserves substantially. In effect, emerging market central banks then release safe assets from their reserves, supplying safe havens to global investors.

JEL classification: E58, F3, G15

Keywords: Capital flows, safe assets, international flow of funds, VIX, global liquidity

I. Introduction

This paper traces the international flows of funds and leverage that accompany risk-on and risk-off markets. When global equity markets are calm, leveraged portfolios expand and capital flows from advanced economies (Bruno and Shin (2011)). What has not been sufficiently recognised is that capital inflows into emerging markets systematically lead to leveraging by central banks there, and that capital outflows lead to deleveraging. Given the investment and

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financing habits of emerging market central banks, their leveraging tends to remove duration from global bond markets. As a result, their response to risk-on markets tends to put downward pressure on global bond yields, reinforcing the risk-on mode. When they deleverage, however, they accommodate a flight to quality by global investors by selling safe assets.

The international flow of funds during risk-on markets has to be understood as involving gross flows.² It involves not only current account deficit countries like Brazil and India, but also countries running current account surpluses, apart from China, which has to date used capital controls to remain mostly outside of this circuit. In the terms of Obstfeld and Taylor (2004), the alternation of risk-on and risk-off markets is not development finance—a one-way flow of capital that finances a current account deficit. Rather, it is a kind of international asset swap, in which gross flows allow investors in different countries to alter their risk profile.

Yet the gross flows are asymmetric in their risk character. The usual asset swap can be modelled as two islands at different latitudes and therefore with different weather that exchange claims on each other's harvest, allowing smoother consumption over time. In this textbook example, the claims swapped are similar in their risk character. By contrast, when risk is on, global investors acquire risky emerging market assets that respond disproportionately to global growth, and emerging market central banks invest in safe obligations of governments in the reserve currency countries.

Moreover, the asymmetric asset swap is not a stable, buy-and-hold position. When risk is off, global investors sell risky emerging market assets, and repurchase the low-risk reserve assets from emerging market central banks. In effect, global investors purchase a call option on emerging market growth, holding equities for the upside and selling them for the downside. And emerging market central banks provide safe assets – reserve currency government bonds – to global investors when risk is off.

The rest of this paper is organised as follows. Section 2 describes the risk-on flow of funds as an asymmetric asset swap involving global investors' purchase of risky assets and emerging market investors' acquisition of safe assets. Section 3 describes the risk-off flow of funds in which global investors reverse their investment in risky emerging market assets, and how emerging market investors and central banks accommodate this reversal. Section 4 explains why the drawdown of reserves during the risk-off phase is often understated. Section 5 concludes.

² See Shin (2011) and Borio and Disyatat (2011).

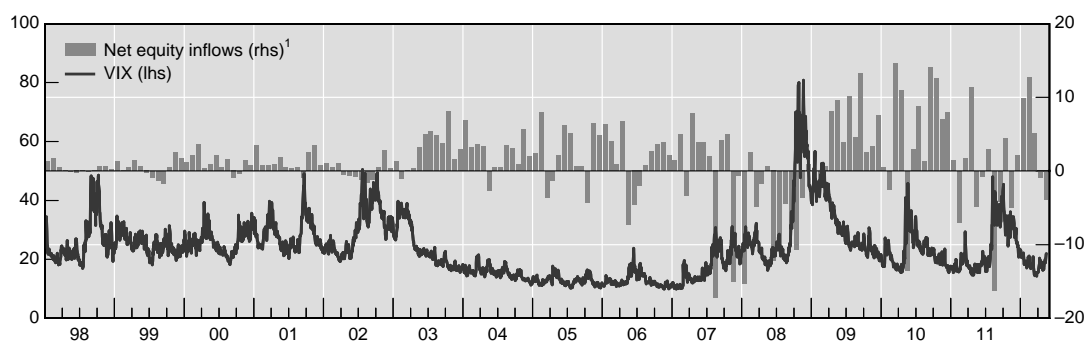
2. Risk-on

In what follows, we trace the risk-on international flow of funds through three steps: capital flow by the global investor; domestic swap from risky to safe asset by the emerging market investor; and exchange rate intervention and leveraged investment into reserve currency bonds by the emerging market central bank.

2.1 *Capital flows by global investors*

When global equity markets are calm and the VIX is low, investors in mature economies, both real money and leveraged, purchase risky equities and bonds in emerging markets (Graph 1, updating McCauley (2010, p 132)). If the investor is a real money investor, the investment is financed by sale of low-risk domestic asset. If the investor is leveraged, one can think of the investment as being financed in short-term markets like that for repo. In the latter case, the transaction represents a net increase in demand for duration.

Graph 1 Global volatility and Asian net portfolio equity inflows

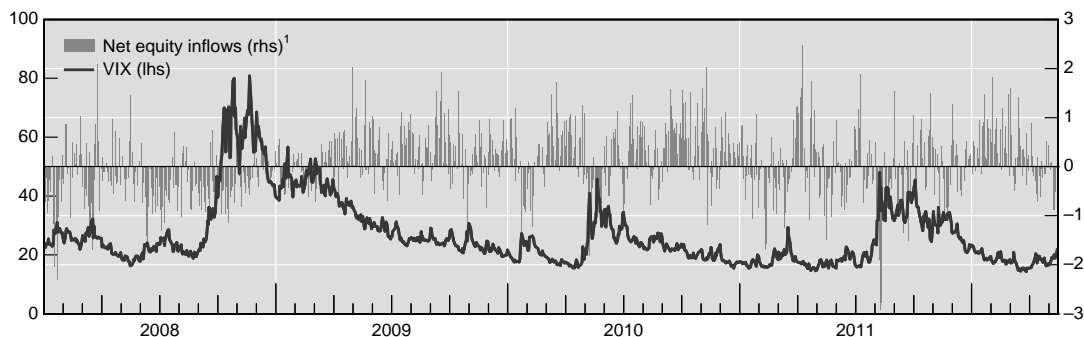


¹ Net foreign purchases of equities in India (data start in 1999); Indonesia; Korea (KOSPI and KOSDAQ); Philippines; Chinese Taipei and Thailand, in billions of US dollars.

Sources: CEIC; Bloomberg.

At higher frequency, it is evident how global investors buy and sell on a hair trigger (Graph 2). Periods of calm in global equity markets tend to lead to inflows. The CGFS (2011) cautions against interpreting the VIX as a measure of global risk aversion, but for leveraged portfolios with risk management keyed off of value-at-risk (VaR) measures, higher volatility can be associated with lower leveraging (Bruno and Shin (2011)).

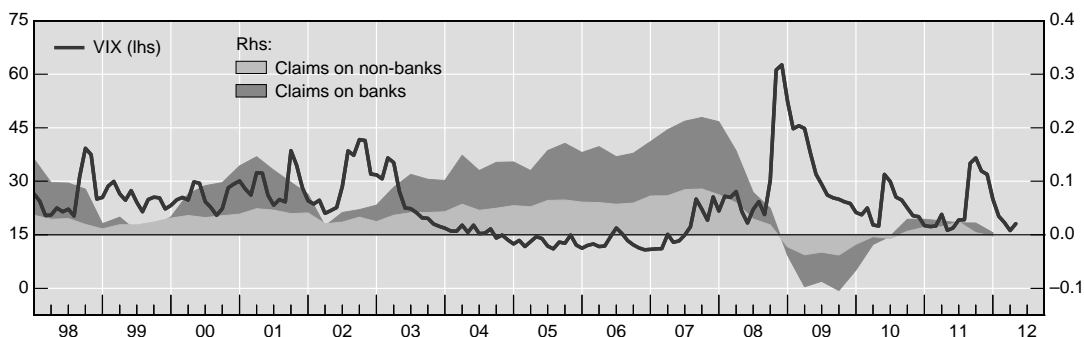
Graph 2 Global volatility and Asian net portfolio equity inflows



¹ Net foreign purchases of equities in India; Indonesia; Korea (KOSPI and KOSDAQ); Philippines; Chinese Taipei and Thailand, in billions of US dollars.

Sources: CEIC; Bloomberg.

While these daily data provide useful perspective, other capital flows measured at lower frequency also tend to track aggregate equity market volatility. CGFS (2011), drawing on McGuire and von Kleist (2008) and McGuire and von Peter (2008), shows how international bank flows co-vary with the VIX (Graph 3).³

Graph 3 Contributions to growth in international bank claims by sector and the VIX¹

¹ The stacked areas indicate the contributions to the total year-on-year rate of growth in international claims, which include all BIS reporting banks' cross-border credit and local credit in foreign currency.

Sources: Bloomberg; BIS locational banking statistics by residence.

The capital outflow tends to raise equity and bond prices and to lead to currency appreciation. This is the finding of Richards (2005) and Chai-Anant and Ho (2008) using daily data from stock exchanges in East Asia. Using data that allow them to distinguish equity purchases that are accompanied by currency hedges from those that are not, Gyntelberg et al (2009) find that generally unhedged foreign purchases of Thai stocks put upward pressure on

³ See also Borio et al (2011) and Avdjiev et al (2012).

the exchange rate.

The upshot is clear. When global investors feel confident, capital flows towards emerging financial markets. This flow tends to put upward pressure on exchange rates. Before we turn to the official reaction to such pressure, let us consider the matter from the perspective of the emerging market investor.

2.2 *The emerging market investor*

The emerging market investor who sells the equity to the foreign investors receives in the first instance a bank deposit in return. To the extent that the inflow into the local equity market is pushing up prices, the bank deposit can help maintain the balance of the local investor's portfolio between risky and safe assets. However, the local investor may bid up the price of local assets that are not in demand by global investors, both secondary equities and local real estate (Aliber (2011)). Thus, through the portfolio rebalancing of domestic investors, asset price rises diffuse from the often-narrow focus on the most liquid large-capitalisation emerging market stocks (or benchmark domestic-currency bonds) by global investors.

2.3 *Sterilised currency intervention by the emerging market central bank*

Eventually, the emerging market central bank resists the appreciation by purchasing dollars, leveraging its balance sheet. If the central bank were simply to purchase dollars, local bank reserves would become excessive and short-term interest rates would tend to fall to zero. To keep this from happening, the central bank will offset the addition to local bank reserves, often by selling its own interest-bearing liability (Ho and McCauley (2009)). If the central bank is operating monetary policy by setting a short-term rate, the effect of the intervention on bank reserves is simply folded into all the other ("autonomous") factors influencing bank reserves, including importantly fiscal flows like tax receipts, interest payments and so on. In this context, it is highly stylised, and not necessarily useful, to see the central bank as offsetting ("sterilising") the foreign exchange purchase in particular.

A key observation is that the central bank's financing ("sterilisation") of its larger holding of foreign exchange assets produces a safe asset in domestic currency. The investor who sold domestic equity to the foreign investor is unlikely to hold the central bank bill on his own account, but his bank can hold it as the asset corresponding to his deposit. From the standpoint of the domestic bank and its depositors, the central bank bill is a safe asset. Contrary to those who posit some shortage of safe assets in emerging markets, central banks can and do provide copious safe assets as a by-product of their foreign exchange policy. The Bank of Korea, for

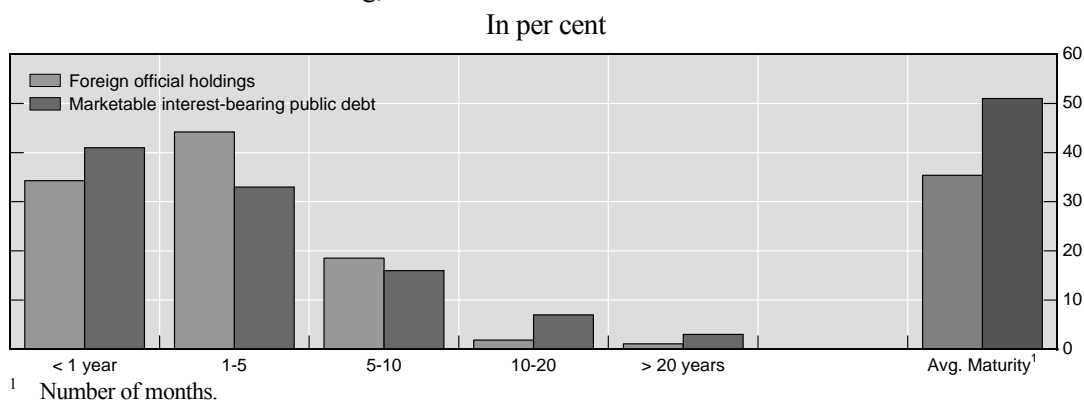
instance, has issued a larger stock of monetary stabilisation bonds (of up to two years' maturity) than the Korean government has in outstanding bonds. Truly, one observes an elastic supply of low-risk governmental obligations in many emerging markets.

2.4 Emerging market central bank investment in reserve currency bonds

The emerging market central bank not only leverages up in the process of resisting currency appreciation, it also systematically takes duration out of the portfolios of global bond investors. Thirty years ago, central banks invested mostly at the short end of the yield curve in bank deposits linked to Libor and in Treasury bills. The long bull market in bonds, however, taught central banks in Pavlovian fashion to invest farther out the yield curve. Indeed, not only did higher returns reinforce the extension of maturities, but also the trend dollar depreciation punished central banks that did not extend the maturity of their foreign exchange reserve portfolios. For instance, dollars invested in Treasury bills and compounded over 1980-2010 did not keep up with a compounded SDR liability, with its inclusion of euro, yen and sterling (McCauley and Schenk (2012)). By running a mismatch between their short-term liabilities in domestic currency and a medium-term portfolio of foreign exchange reserves, central banks could harvest a term premium to offset dollar depreciation.

Some of the most comprehensive data on the maturity of official portfolio is produced by the US Treasury and Federal Reserve survey of holdings of Treasury securities. This shows (Graph 4) that relative to overall supply, foreign officials are underinvested in Treasury bills and very long-term bonds. They are overinvested in the so-called belly of the curve, that is, in bonds of one to five year maturity (McCauley and Rigaudy (2011)).

Graph 4 Maturity of foreign official holdings of Treasury securities and total outstanding, June 2009



Sources: Department of the Treasury, Federal Reserve Bank of New York, Board of Governors of the Federal Reserve System, *Survey of foreign portfolio holdings as of June 30, 2009*, April, 2010; US Treasury.

This reserve management behaviour helps provide perspective on findings that official purchases of US bonds put downward pressure on their yields. Bernanke et al (2004) found that intervention by the Japanese Ministry of Finance in 2003-2004, for which daily data are eventually released, was associated over a short window with something like 1 basis point lower ten-year bond yields per \$1 billion in intervention (and eventual investment). Using monthly Treasury International Capital data, Warnock and Warnock (2009) find a similar response to all official investment in US bonds. Gerlach et al (2011) find that the Japanese intervention of 2003-04 tended to push down global bond yields broadly in industrialised economies and in emerging markets with more globally integrated bond markets.

2.5 Summary: the risk-on circuit as a positive feedback loop

Thus, at the end of the circuit of international fund flows is a demand by foreign exchange reserve managers for safe assets, that is, the obligations of governments deemed to be of low risk of default. But they do not demand assets that are utterly safe in relation to interest rate risk, such as Treasury bills. Since the investments of emerging market central banks in major bond markets are of longer duration than the domestic currency liabilities that they issue to finance them, the net effect is to remove duration from global bond markets. To the extent that bills and bonds in global bond markets are imperfect substitutes, the net effect of the leveraging of emerging market central bank balance sheets is to lower the yield on safe assets of medium maturity in major bond markets.

If the discount rate applied to future cash flows associated with equities is thereby reduced, the response of emerging market central banks to capital inflows feeds back in a positive fashion to global equity prices, further encouraging the “risk-on”.

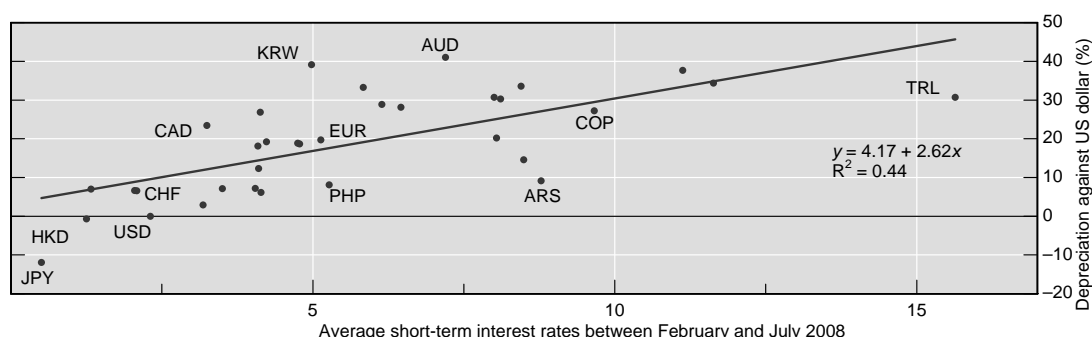
3. The risk-off circuit

When, for some reason, global equity markets turn down and the VIX rises, this process works in reverse. Seeking to limit losses, leveraged global investors liquidate risky positions, including those in emerging market equities and bonds. Local investors buy back the equities and bonds from global investors. Eventually, emerging market central banks step in to sell dollars. In the process they eventually shrink their balance sheets, selling the safe assets bought in major bond markets and reducing their liabilities in domestic currency.

When equity market volatility rises, there is a marked tendency for higher yielding currencies to depreciate. The spike in the VIX in 2008, the largest to date, was accompanied by

a sell-off in higher-yielding currencies (Graph 5).⁴ The cross-sectional relationship is very strong, with short-term interest rates in the six months February to July 2008 accounting for 44% of the variation in dollar exchange rate changes. High-yielding currencies like the Brazilian real, Indonesian rupee or Turkish lira reliably decline during risk-off periods against the dollar, while the yen tends to rise.

Graph 5 Unwinding of carry trades with rising volatility
21 August–28 October 2008



Sources: IMF, *International Financial Statistics*; Bloomberg; BIS calculations.

This can be interpreted as reflecting in part leveraged carry trades in which low-yielding currencies are used to fund investment in high-yielding currencies. When risk is on, such positions produce a run of smallish gains; when risk is off they can produce sudden large losses. The slope of the regression line in Graph 5 is about three, indicating that three years of yield differential was lost to depreciation in nine weeks. For example, the Colombian peso (COP) was yielding almost 10% between February and July 2008, but it fell almost 30% against the dollar in the nine weeks. Such periods are the nightmares of “carry-traders”.

Even those central banks that well recognise the presence of carry-traders in their foreign exchange markets tend at some point to use their reserves in an attempt to limit depreciation of the domestic currency. And when they do, they deleverage, selling their safe assets in reserve currencies and reducing their own borrowing in domestic currency. Oddly, though, there is not agreement on the question of whether central banks sell reserves extensively during persistent risk-off periods, or whether they are afraid to do so, preferring to allow currency depreciation to bear the weight of changes in global market sentiment.

⁴ See McCauley and McGuire (2009). Clarida et al (2009) and Gyntelberg and Schrimpt (2011) discuss this in terms of exchange rate volatility. In addition to the pervasive VaR-based risk management emphasised by Bruno and Shin, variations in unhedged cross-border investment in equities links equity and currency volatility.

4. Do emerging central banks really sell reserves?

The risk-on, risk-off flow of funds involves not only purchase of foreign exchange reserves by emerging market central banks in the face of capital inflows but also their sale of foreign exchange reserves in the face of capital outflows. However, it is a widely held view that emerging market central banks sell remarkably little of their foreign exchange reserves in the face of capital outflows. Aizenman and Sun (2009) termed this “fear of losing international reserves”, while Aizenman and Hutchison (2010) went for pith with “fear of reserve loss”. At a conference on global liquidity at the ECB, Pierre-Olivier Gourinchas took issue with the assertion that emerging market central banks actually sell down their foreign exchange reserves during risk-off periods. Thus, this section lays out the facts of effective reserve use in 2008-09 by Asian central banks.

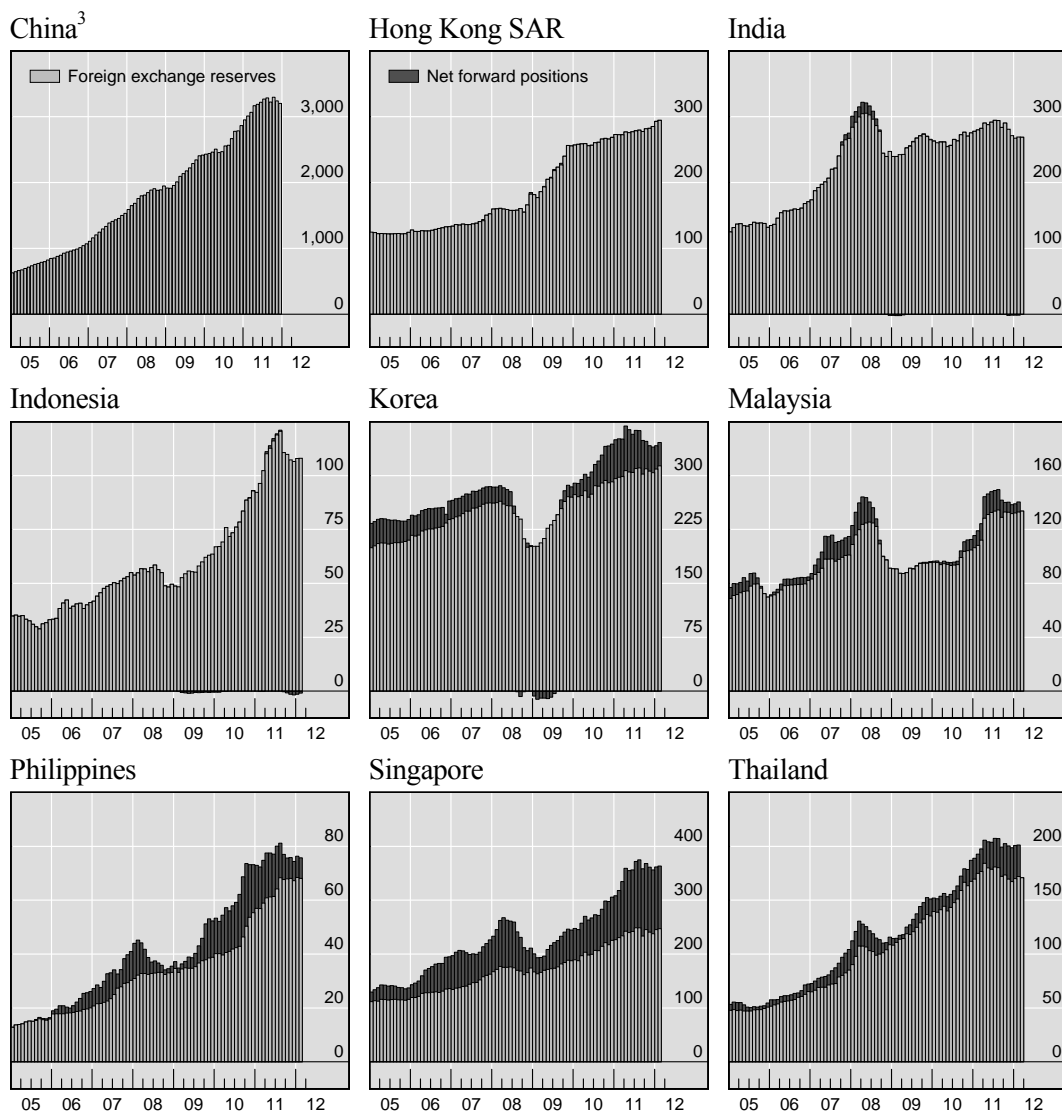
An oft-cited case in point that seems to support this “fear of reserve loss” view was the market speculation that the Korean authorities regarded \$200 billion in reserves as a minimum. At first blush, the data are not inconsistent with this view, with headline Korean reserves⁵ peaking at \$264 billion in March 2008 and bottoming in December 2008 at \$201 billion, but only if one ignores the forward book.⁶ In fact, the Korean authorities started with net forward dollar purchases of \$22 billion in March 2008 and ended up in February 2009 with a net \$11 billion in dollars sold forward, taking their net reserves to \$190 billion at the minimum in February 2009. Thus, net Korean reserves peaked at \$286 billion (\$264 billion cash and \$22 billion forward) and fell not only by the \$63 billion drop in cash reserves but also the \$33 billion swing in the forward position. Properly understood, Korean reserves dropped not by 24% (\$63 billion/\$264 billion), but rather by 33% (\$96 billion/\$286 billion). This difference between Korea’s net and cash reserves in 2008 can be seen in the centre panel of Graph 6. Table 1 shows that peak-to-trough reserve drawdowns elsewhere in East Asia were generally substantial, too.

⁵ Here we use reserves as reported in the IMF, *International Financial Statistics*, including foreign exchange, SDR and reserve position in the IMF, but excluding gold.

⁶ On the SDDS template, foreign exchange reserves are listed as number 1 under “I.A. Official reserve assets”, while the forward book is listed under “II. Predetermined short-term net drains on foreign currency assets (nominal value)”, under “2. Aggregate short and long positions in forwards and futures in foreign currencies vis-à-vis the domestic currency (including the forward leg of currency swaps)”. In effect, the SDDS treats a long forward (ie buy dollars) position as a short-term dollar loan out of reserves that does not count as reserves. In contrast, the view taken here is that, after a central bank has intervened in the foreign exchange market to buy US dollars, it is of second-order importance whether it sterilises the increase in domestic bank reserves using its own bills, a repo in domestic currency, or a foreign-exchange swap. According to the SDDS, the first two sterilisation approaches would leave official reserve assets higher as a result of the dollar purchase, while the foreign exchange swap would leave official reserve unchanged.

Graph 6 Foreign exchange reserves¹ and net forward positions²

In billions of US dollars



¹ Official reserves excluding gold, in billions of US dollars. Includes SDRs and reserve positions in the IMF.

² Long positions in forwards and futures in foreign currencies vis-à-vis the domestic currency, minus short positions.

³ Data on net forward positions are not available for China.

Sources: IMF *International Financial Statistics*; IMF, *International Reserves and Foreign Currency Liquidity*; national data.

One could interpret this to support the “fear of [headline] reserve loss”: when intervening to slow depreciation, the authorities run down the stock of their forward dollar purchases instead

of cash reserve holdings in order to “window-dress” the headline reserve figure. They might do this on the assumption that market participants do not bother to consult the disclosures of the forward position. Such neglect would be ironic, since the IMF’s special data dissemination standard (under which forward positions are reported) in part responded to the discovery in 1997-98 that the Korean authorities had placed much of their reserves with Korean banks and that the Thai authorities had run up a big forward sale of dollars. If this window-dressing interpretation is accepted,⁷ analysts should all the more use the more comprehensive measure of net reserve holdings, lest their measure of reserve loss be subject to systematic errors, rather than subject merely to noise.

Table 1 Foreign exchange reserve and forward book drawdown in Asia in 2008-09

	Peak month	Peak amount	Trough month	Trough amount	Net reserve drawdown
China	Sep-08	\$1,908	Nov-08	\$1,888	1.0%
Hong Kong	Sep-08	\$160	Oct-08	\$155	3.5%
India	Apr-08	\$322	Feb-09	\$238	26.2%
Indonesia	Jun-08	\$57	Feb-09	\$48	15.9%
Korea	Mar-08	\$286	Feb-09	\$190	33.5%
Malaysia	Apr-08	\$144	Apr-09	\$87	39.5%
Philippines	Feb-08	\$45	Oct-08	\$34	24.4%
Singapore	Apr-08	\$267	Feb-09	\$193	27.6%
Thailand	Apr-08	\$128	Nov-08	\$111	13.4%
Total ex CN, HK		\$1,250		\$901	27.9%

Sources: IMF, *IFS*; SDDS, as reported by Filardo and Yetman (2012) in Graph 6.

Whatever the reason for the behaviour of the forward book, overlooking it can lead to an understatement of the extent of emerging market central banks’ use of their reserves. As reserves are accumulated, central banks may find themselves for one reason or another depending more on swaps to sterilise dollar purchases. In particular, after a central bank has bought dollars in the spot market, it can then sterilise the increase in bank reserves by swapping dollars against domestic currency. When the swap counterparty delivers domestic currency to the central bank, the expansive effect of the original dollar purchase on local bank reserves is extinguished. The combination of the spot purchase of dollars and then the swap of dollars against domestic currency leaves nothing left but a forward purchase of dollars. It is evident in

⁷ Other interpretations are possible. Central banks could view forward dollar purchases as low quality foreign exchange reserves, since they entail the risk that the counterparty does not deliver dollars at the maturity of the contract. This might be a particular concern if the counterparties are domestic banks. Or central banks may view swaps as an inferior sterilisation instrument to central bank liabilities.

Graph 6 that most Asian central banks entered the global financial crisis with a stock of forward dollar purchases. When the pressure in the exchange market reversed, they tended to draw first on the reserves that they had financed not on balance sheet (eg, with central bank bills) but rather on the reserves that they had in effect financed off their balance sheet, that is, their forward book of dollar purchases. To resist depreciation of the domestic currency, the central bank sold dollars spot, and two days later a maturing forward dollar purchase provided the dollars. Heavy use of swaps during the latter stages of risk-on periods, followed by an unwinding of the forward book in the early stages of risk-off periods, means that not taking into account forward transactions leads to an understatement of the scale of effective reserve use in an episode of downward pressure on emerging market currencies.

In particular, the neglect of forward positions, in combination with central banks' last-hired-first-fired use of swaps as a sterilisation instrument, results in very significant understatement of the use of reserves in Asia. Among major Asian central banks for which we have information, only Bank Indonesia does not use swaps much, and the Reserve Bank of India uses them only to a limited extent. Other central banks show huge differences between reserve drawdowns including or excluding forwards (first and second columns of Table 2).

Table 2 Foreign exchange reserve drawdown: contrasting estimates I

	Author's		Aizenman & Hutchison		Author including forwards less Aizenman & Hutchison (Wide, Narrow)
	Including forwards	Excluding forwards	Wide : July 2008 – February 2009	Narrow : September 2008 – December 2008	
China	na	1.0%	-3.6%	-2.1%	4.6%, 3.1%
Hong Kong	3.5%	3.5%			
India	26.2%	21.4%	19.3%	11.1%	6.9%, 15.1%
Indonesia	15.9%	15.6%	17.3%	9.9%	-1.4%, 6.0%
Korea	33.5%	23.7%	18.7%	16.2%	14.8%, 17.3%
Malaysia	39.5%	29.4%	27.5%	16.9%	12.0%, 22.6%
Philippines	24.4%	-0.6%	-0.6%	-0.1%	25.0%, 24.5%
Singapore	27.6%	7.0%			
Thailand	13.4%	3.1%	-8.1%	-8.4%	21.5%, 21.8%
Total ex CN & HK	27.9%				

Sources: Aizenman and Hutchison (2010), and IMF, *IFS*; SDDS, as reported by Filardo and Yetman (2012) in Graph 6.

Both by imposing a common window for reserve losses and by not taking forwards into account, Aizenman and Hutchison (2010) seriously understate the reserve drawdowns in the region, overstating the evidence for their “fear of reserve loss”. The last column in Table 2 shows their understatement of reserve use, of 7-15% of peak reserves for India, 15-17% for Korea, 12-22% for Malaysia, 25% for the Philippines and 22% for Thailand.

Dominguez (2012) and Dominguez et al (2012) reject the claim that emerging market authorities did not use reserves during the global financial crisis. Their approach is very thorough in recognising that, without intervention, reserves should grow owing to investment returns and, when the dollar weakens against other reserve currencies, valuation gains. In these respects, their analysis goes well beyond that in Table 1. In addition, they implicitly criticise Aizenman and Sun (2009) for imposing a common window for reserve drawdowns and opt for a window defined by peak-to-trough real GDP. Certainly, their general point, that the reserve drawdown associated with the global financial crisis is systematically understated by Aizenman and Sun (2009), is well taken.

Still, it appears that Dominguez et al (2012) also understate the extent of the reserve drawdown both because their macroeconomically defined windows do not coincide with peak-to-trough movements in reserves and because of their non-inclusion of forward positions. Table 3 again shows in the first two columns the reserve drawdown as calculated by the author. The next column shows the macroeconomically defined window used by Dominguez et al (2012), and the next column shows the drawdown in cash reserves for that window.⁸ Judging from the Asian sample at least, Dominguez et al seem to understate the reserve drawdown during the global financial crisis.

⁸ It should be underscored that this fourth column would be the main input into Dominguez et al’s reserve drawdown, but it lacks their netting out of imputed investment earnings (always positive) and currency valuation gains (positive when the dollar is weak against other reserve currencies). But the first column does not net out imputed investment earnings or valuation gains either, so the differences should be regarded as arising from differences in the window used and from the inclusion or exclusion of forward transactions.

Table 3 Foreign exchange reserve drawdown: contrasting estimates II

	Author's		Foreign exchange drawdown over Dominguez et al (2012) window		Author including forwards less reserve decline over Dominguez et al (2012) window
	Including forwards	Excluding forwards	Window	Reserve decline excluding forwards	
China	na	1.0%	08:4-09:1	-0.4%	1.4%
Hong Kong	3.5%	3.5%	07:4-09:1	-22.0%	25.5%
India	26.2%	21.4%	08:4-09:1	2.1%	24.1%
Indonesia	15.9%	15.6%	08:3-08:4	9.9%	6.0%
Korea	33.5%	23.7%	08:4-09:1	21.3%	12.2%
Malaysia	39.5%	29.4%	08:3-09:1	22.1%	17.4%
Philippines	24.4%	-0.6%	08:4-09:1	-3.9%	28.3%
Singapore	27.6%	7.0%	07:4-09:1	-2.0%	29.6%
Thailand	13.4%	3.1%	08:4-09:1	-4.7%	18.1%
Total ex CN & HK	27.9%				

Sources: Dominguez et al (2012), Table 2, and author's calculations.

The risk of understating reserve loss during the big risk-off period of 2008-09 by not taking forward positions into account is not limited to Asia. According to Stone et al (2009), the Central Bank of Brazil had built up a \$22 billion long dollar stock position in the domestic currency futures market by early 2008 as it resisted *real* appreciation. Its subsequent intervention in this market took this net long dollar position to a net short dollar position of \$12 billion, for a net swing of \$34 billion. Stone et al (2009) report that it also sold \$14.5 billion in the spot foreign exchange market between late September 2008 and early May 2009. These spot sales represented 7% of the original holdings of \$208 billion, while the combined spot and futures sales represented almost a fifth.

The upshot is that it is easy to understate the extent to which central banks use their reserves during an extended risk-off period. As a result, it is also easy to understate the extent to which the combined official and private sector in emerging markets sell dollar assets during such a period.⁹

⁹ When a central bank buys dollars forward against domestic currency, the private sector in effect acquires a synthetic domestic currency asset. A bank, for instance, can buy a US dollar asset that, combined with a forward sale of dollars to the central bank, amounts to a domestic currency asset. In this manner, the central bank delegates to the private sector the choice of dollar asset, rather than making that

An important observation is the exceptional behaviour of the reserves of China, the largest reserve holder. In 2008, its reserve use, if any, was very limited. This is owing to the capital controls of China, which, for instance, have split the Hong Kong and New York markets for Chinese equities from those in Shanghai and Shenzhen. When risk is off, Chinese share prices in Hong Kong fall relative to those onshore (McCauley (2011)), but non-resident selling of shares in Shanghai and Shenzhen is limited. However, this might be changing. If one looks carefully at Graph 6, upper left-hand panel, one can see a reserve drop in the risk-off period of late 2011. The suggestion is that, as China opens up its capital account, including allowing the use of the renminbi offshore, its reserve holdings could decline during risk-off periods and the global flow of funds described in this paper could as a result be larger.

5. Conclusion

The international flow of funds associated with risk-on and risk-off markets are gross flows with asymmetric risk characteristics. In risk-on markets leveraged and unleveraged global investors position themselves in high-beta emerging market assets. In response, emerging market central banks that manage their currencies tend to increase their reserves, investing them in safe assets in reserve currencies. To the extent that this investment pushes down global bond yields, the risk-on is reinforced. The international flow of funds produces not an exchange of risky assets but an acquisition of risky assets on one side and an acquisition of safe assets on the other.

When risk is off, the international flow of funds reverses. An implication is that global investors are behaving as if they were replicating a call option on risky emerging market assets. Another implication is that emerging market investors and central banks accommodate global investors: emerging market investors buy back the risky assets when risk is off (providing market liquidity at times of financial strain) and emerging market central banks sell back safe assets into global investors' flight to quality bid. In these senses, one could say that emerging markets provide liquidity to global investors in risk-off markets.

choice as part of its reserve management. Similarly, when the central bank runs down its forward purchases of dollars and even sells dollars forward, the private sector can square its position by selling the dollar asset and buying a domestic currency asset.

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