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Exchange rates during financial crises[1]

Exchange rate movements during the global financial crisis of 2007–09 were unusual. Unlike in two previous episodes – the Asian crisis of 1997–98 and the crisis following the Russian debt default in 1998 – in 2008 many countries that were not at the centre of the crisis saw their currencies depreciate sharply. Such crisis-related movements reversed strongly for a number of countries. Two factors are likely to have contributed to these developments. First, during the latest crisis, safe haven effects went against the typical pattern of crisis-related flows. Second, interest rate differentials explain more of the crisis-related exchange rate movements in 2008–09 than in the past. This probably reflects structural changes in the determinants of exchange rate dynamics such as the increased role of carry trade activity.

JEL classification: F3, G01.

Financial crises are often associated with significant movements in exchange rates, which reflect both increasing risk aversion and changes in the perceived risk of investing in certain currencies. The global financial crisis of 2007–09 was no exception.

Previous work on exchange rate movements during the crisis has concentrated on the unusual (and unexpected) appreciation of the US dollar (McCauley and McGuire (2009), McGuire and von Peter (2009)). This feature investigates the flip side of this development and focuses on movements in the exchange rates of a number of emerging markets and small advanced economies against three major currencies: the Japanese yen, the Swiss franc and the US dollar.

During the crisis, a large number of currencies that were not at the centre of the turmoil depreciated. These movements reversed within a year or so. Both these experiences stand out when compared with those seen during the Asian financial crisis of 1997–98 or the crisis that followed the Russian debt default in mid-1998. We concentrate on two factors that can explain part of these unusual developments. First, during the most recent episode safe haven flows went against the typical crisis-related pattern: instead of fleeing the

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country at the epicentre of the crisis, they moved into it. Second, interest rate differentials played a bigger role than in the past in explaining some of the crisis-related exchange rate movements. The increase in carry trade activity over the past 15 years could be one explanation for this finding. If so, the dynamics of exchange rate movements around crises may have changed more fundamentally.

In the next section, we briefly review exchange rate movements during late 2008 and 2009 and compare them with those in the Asian financial crisis and the crisis following the Russian debt default. We then analyse measures from currency options, implied volatility and risk reversals, to gauge risk aversion and market perceptions of uncertainty and "safe haven" currencies during these episodes. Extending previous BIS work, we then investigate the role of interest rates for exchange rate movements during both the crisis and its immediate aftermath. The last section concludes.

Comparison of three episodes

Three recent financial crises were accompanied by substantial movements in exchange rates: the Asian financial crisis of 1997–98, the crisis that followed the Russian debt default in August 1998 and the global financial crisis of 2007–09.

The global financial crisis was different …

Of course, the first two crises differed from the most recent one in a number of ways, including their place of origin, whether they were accompanied by currency crises and the scale of contagion. The earlier two episodes centred on emerging market economies, while in the most recent crisis the epicentre of the turmoil was the US banking system. Both the Asian crisis and the crisis after the Russian default involved speculative attacks that forced a number of countries to abandon fixed exchange rate regimes.[2] By 2008, however, many more countries had floating or managed exchange rates, limiting the pent-up need for abrupt and sizeable adjustments due to misaligned currencies in the most recent episode. And, while contagion was important in all three episodes, in the Asian crisis it was largely confined to the region and after the Russian default it concentrated on emerging market economies seen to be in a similar situation, such as Brazil. The latest crisis, by contrast, was truly global.

… including with regard to exchange rate movements

Graph 1 shows the exchange rate movements of a range of countries against three major "safe haven" currencies: the US dollar, the Japanese yen and the Swiss franc. We classify the currencies of our analysis into three groups: (i) currencies of small open advanced economies, (ii) those at the centre of the Asian crisis and (iii) currencies heavily affected by the Russian debt default.[3]

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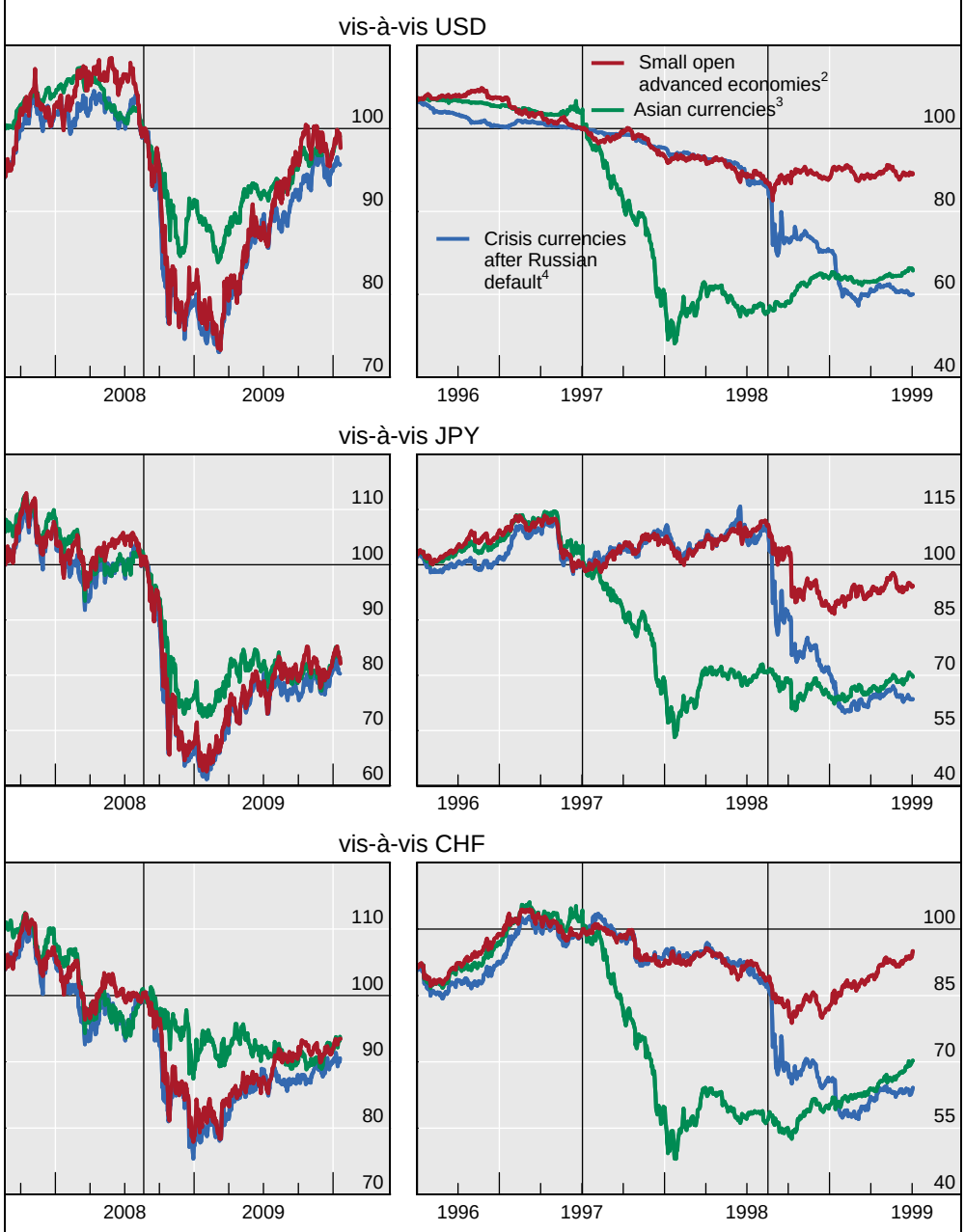
[2] For more detail on the Asian crisis, see eg Radelet et al (1998); on the Russian crisis and contagion to other countries, see eg Baig and Goldfajn (2000).

[3] The first group comprises Australia, Canada, New Zealand, Norway and Sweden, the second group Indonesia, Korea, Malaysia, Thailand and the Philippines, and the third group Brazil, Chile, Russia and South Africa.

Exchange rate movements during three financial crises[1]



[1] Rebased to crisis date = 100 in 2008 and 1997, respectively. Crisis dates are 2 July 1997, 17 August 1998 and 21 August 2008 (vertical lines). A positive number indicates an appreciation against the vis-à-vis currency. [2] Simple average of AUD, CAD, NZD, NOK and SEK. [3] Simple average of IDR, KRW, MYR, PHP and THB. [4] Simple average of BRL, CLP, RUB and ZAR.

Sources: Datastream; national data. Graph 1

Many currencies not at the centre of the crisis depreciated …

Two features of the latest crisis stand out in Graph 1. First, perhaps not surprisingly given the global nature of the turmoil, during 2008 all the selected currencies depreciated sharply against the US dollar, the yen and the Swiss franc, although the magnitudes of the declines differed. This contrasts with the previous two episodes: sharp depreciations during the Asian crisis in 1997 were largely confined to currencies in the region (green line), and mainly currencies of the third group (blue line) declined strongly after the Russian debt

default. The currencies of small advanced countries not at the centre of the crises (red line) saw little change, except for the Australian and New Zealand dollars after the Asian crisis.

… and reversed within a year

A second, more surprising, aspect of the most recent crisis is the relatively quick and strong reversal of the depreciations. While there was some reversal also during the earlier two crises, it was much less pronounced. In the case of the currencies affected during the Asian crisis, there was more of a rebound, but it was spread over several years, rather than six months, as in the most recent episode.

The role played by pre-crisis exchange rate regimes undoubtedly helps explain the limited reversal in the earlier episodes. If exchange rate levels had been out of line with fundamentals during fixed exchange rate regimes, we would not expect exchange rates to return to pre-crisis levels once the pegs were abandoned.

A factor that was particularly influential for exchange rate pressures in the most recent crisis episode was the effect of US dollar funding shortages in the non-US banking sector, which has been extensively discussed elsewhere (see, for instance, McCauley and McGuire (2009)). However, this mainly affects the US dollar exchange rate (and to a lesser extent the Swiss franc exchange rate) and is thus less likely to explain the patterns vis-à-vis the yen.

Safe haven flows and interest rate differentials could explain some of the exchange rate movements

In explaining exchange rate developments, we focus here on two factors that are common across the crises. First, the movement of exchange rates can be related to the rise and fall in uncertainty and risk aversion; flows to (and from) safe haven currencies may therefore explain some of the movements. Second, exchange rate changes can be related to interest rate differentials. One prominent channel is the impact of carry trade strategies on exchange rates both during the downturn, as carry trades unwind, and when investors seek higher-return assets once conditions normalise. We next consider each in turn.

Uncertainty, risk aversion and safe haven currencies

Uncertainty and risk aversion …

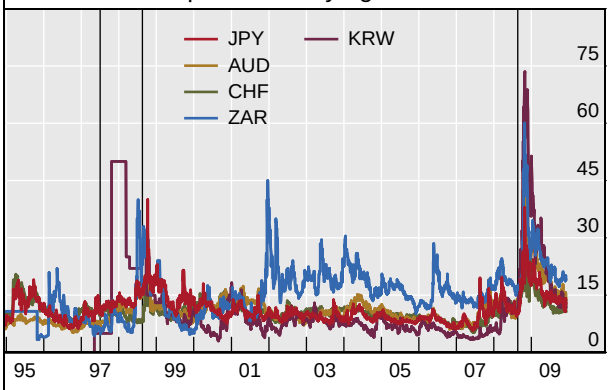
Financial crises are often associated with unusual exchange rate uncertainty and a sharp rise in risk aversion, which itself drives up the price of risk. Both factors are reflected in volatilities implied from the prices of currency options.[4] This measure increased sharply as the global financial crisis intensified in the third quarter of 2008 (Graph 2, left-hand panel). A smaller rise took place around the Russian debt default in 1998 for most currency pairs. Implied volatilities for a number of Asian currencies, such as the Korean won, increased in 1997, although there are questions about the reliability of this measure, since option markets for some of the most affected currencies were either not active or not very liquid at the time.

[4] For a discussion, see eg Neely (2005) and Bliss (2000). While the level and price of risk are difficult to disentangle in practice (see, for instance, Tarashev et al (2003) or Bliss and Panigirtzoglou (2004)), this is not an obstacle for our purposes: a rise in both factors can trigger safe haven flows.

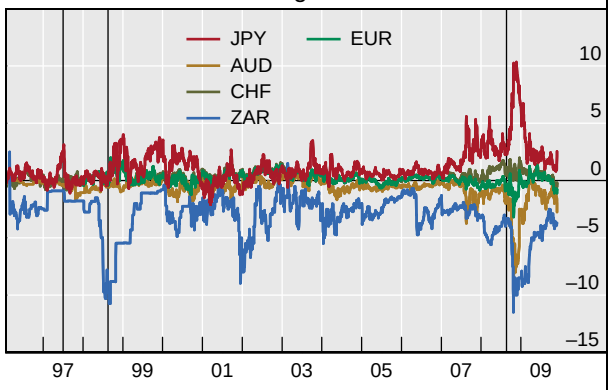
Risk aversion, exchange rate uncertainty and risk reversal

In per cent

One-month implied volatility against US dollar



One-month risk reversal against US dollar



The vertical lines mark 2 July 1997, 17 August 1998 and 21 August 2008.

Source: Bloomberg.

Graph 2

... can lead to safe haven flows

At times of high uncertainty and risk aversion, some currencies – often dubbed "safe haven currencies" – appear more attractive than others. There is no universally accepted definition of a safe haven asset – it could mean an asset with low risk or high liquidity, a hedge asset or a rainy day asset (McCauley and McGuire (2009)). All these definitions, however, have in common that one would expect the relative price of such an asset to increase during crises.

The existing literature on safe haven currencies often concentrates on *relative* effects among the five major currencies. For instance, Ranaldo and Söderlind (2007) find that periods of low risk aversion are usually associated with an appreciation of the US dollar, and periods of high risk aversion with a depreciation of the dollar against the yen and the Swiss franc. They attribute this finding to the status of the latter two currencies as safe havens. Similarly, Cairns et al (2007) find that the franc, the euro and, to some degree, the yen tend to strengthen against the dollar when volatility rises. However, they also find that the US dollar tends to appreciate during these periods against a number of *other* currencies, especially those from emerging markets, making it a safe haven relative to them. These studies rely on movements of FX spot prices to identify safe haven currencies.

Option prices suggest ...

An alternative approach is to use currency options, which embed market participants' expectations. The prices of currency options at different strikes are especially helpful. Risk reversals measure the price difference between two equivalently out-of-the-money put and call options. For freely traded currencies, an asymmetry in these prices implies that market participants pay more to insure against a sharp movement of exchange rates in one direction than an equally sized movement in the other. Since safe haven flows imply pressure on exchange rates in one direction, an asymmetry in the option prices could partly be explained by the expectation of safe haven flows.[5] Looked at in

[5] While Gagnon and Chaboud (2007) argue that movements in risk reversals tend to post-date large exchange rate movements during periods of high volatility, this is less clear for the three

reverse, such an asymmetry may therefore help *identify* safe haven currencies.[6]

The right-hand panel of Graph 2 shows risk reversals for some major currency crosses. We concentrate on crosses with the US dollar, the more liquid market segment. The results for less liquid option markets, such as those related to the South African rand, should be treated with caution. The risk reversal measures confirm the previous findings in the literature on safe haven currencies. First, during all three crisis episodes market participants disproportionately sought to hedge against an appreciation of the yen and the Swiss franc vis-à-vis the US dollar.[7]

… that the yen, the Swiss franc and, to a lesser extent, the US dollar are safe havens

Second, during the crises market participants disproportionately tried to hedge against a large depreciation of less actively traded currencies vis-à-vis the US dollar, as shown by the risk reversal measures for the Australian dollar (orange line) and the South African rand (blue line) in Graph 2. This is especially pronounced in the most recent episode, but is also evident in 1998 for the rand, and – to a lesser extent – for the Australian dollar during 1997–98.

Non-safe haven currencies depreciate during crises …

As a consequence, safe haven effects – whereby the Japanese yen, the Swiss franc and, to a lesser extent, the US dollar are more attractive than other currencies during financial crises – can partly explain why these three currencies appreciated in all three episodes.

By the same token, as uncertainty and risk aversion subside, one could expect these developments to reverse. Indeed, these factors – as measured by currency option prices – abated relatively quickly in all three crises. However, only after the latest episode, between April and September 2009, did a number of currencies appreciate sharply against the "safe haven three", reversing the crisis-related depreciations. The two earlier crises did not see such a reversal of exchange rate movements.

… and are likely to appreciate when risk aversion abates …

One factor may be that, although general risk aversion receded, during the earlier crises the perceived riskiness of the countries that depreciated initially did not reverse as quickly. After all, the countries that saw depreciations were also at the centre of these crises, and it typically took years for them to rebuild their financial systems and recover from the economic fallout. Indeed, as Graph 3 shows, sovereign bond spreads for Asian crisis economies increased

… unless country-specific risk remains

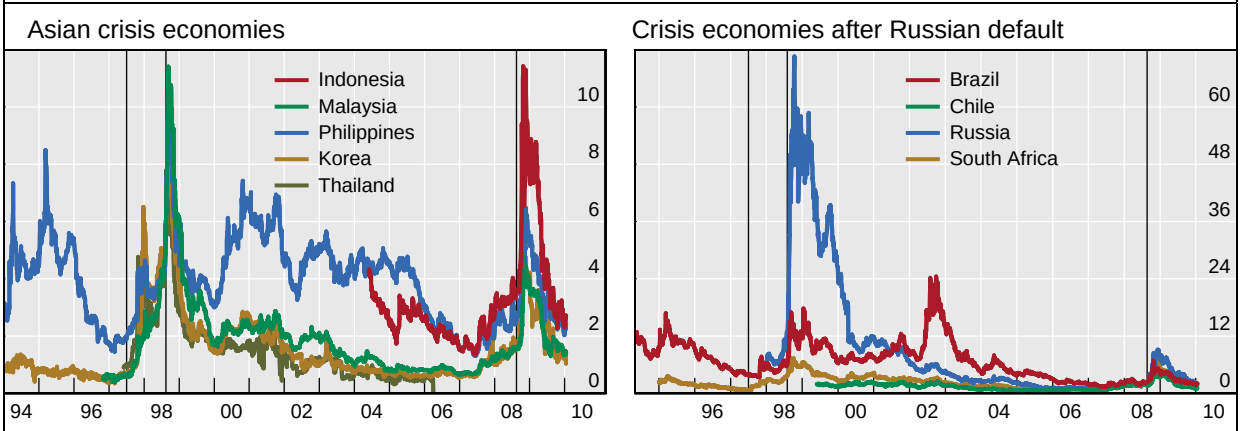
crisis episodes discussed here. Even though the risk reversals peaked after the crisis date in both 1998 and 2008, they began increasing in the run-up to those crises. Where risk reversals post-date the currency movements, one explanation could be that perceived risk associated with cumulated carry trade positions increased, as suggested by Galati et al (2007).

[6] This identification assumes that the asymmetry occurs in part because market participants think that a large appreciation of certain currencies is more likely than a depreciation of the same size. However, even when asymmetry occurs because market participants are more concerned with the effects of an appreciation than those of a depreciation, risk reversals would identify sentiment that is likely to be correlated with safe haven flows.

[7] The position of the euro is less clear. While in previous episodes the risk reversal of the franc and the euro co-moved against the US dollar, in late 2008 markets were disproportionately hedging against a depreciation of the euro against the dollar. This could, however, be due to factors specific to the 2007–09 crisis, such as the exposure of European banks to the US subprime market or the dollar shortage of European banks.

US dollar-denominated sovereign bond strip spreads

In per cent



The vertical lines mark 2 July 1997, 17 August 1998 and 21 August 2008.

Source: JPMorgan Chase.

Graph 3

even further during the Russian crisis before falling again, while those for the third group remained elevated for well over a year after the crisis date.

By contrast, after the latest crisis, as risk aversion subsided in the first half of 2009, it may have appeared attractive to invest in countries that were not at the centre of the turmoil, even if they had been negatively affected by the initial crisis sentiment. As we will argue in the next section, reduced risk aversion may have made carry trades look attractive again.

Interest rate differentials and exchange rate changes

Interest rate differentials may also contribute to exchange rate patterns around crises. A prominent channel is the effect of carry trades.

A carry trade refers to a long position in a higher-yielding instrument funded by a short position in a lower-yielding one, often denominated in a different currency. Such a trade is profitable if the interest differential is not completely offset by an appreciation of the low-yielding currency. An increase in carry trade positions tends to put downward pressure on the funding currency and upward pressure on the target currency. If exchange rates are flexible, target currencies would (other things equal) appreciate and funding currencies depreciate, making profitability self-fulfilling (for a while) and attracting further carry trades. As a result of this feedback loop, carry trades tend to be associated with a gradual appreciation of the target currency and a depreciation of the funding currency. However, this dynamic can rapidly turn if the target currency suddenly depreciates for some reason. As investors try to limit their losses and close out their carry trade positions, the downward pressure on the target currency is amplified, while the funding currency appreciates.

Carry trades, of course, are not the only reason we would expect to see a link between interest rate differentials and exchange rate movements. Any increase in (net) capital flows to economies with better growth prospects that also have higher short-term interest rates would exert upward pressure on the

higher-interest currency, similar to a build-up of carry trades. Unleveraged investments, however, are less likely to unravel rapidly in the event of market turbulence.

In the remainder of this section, we analyse the role interest rate differentials played during the initial phase of the crises and in their aftermath, with a view to explaining the unusual reversal of exchange rate movements after the latest crisis.

Exchange rates and interest rate differentials during the crises

Interest rate differentials played a much larger role in determining exchange rates in the recent financial crisis than in the previous episodes. Graph 4 shows the relationship between exchange rate changes and the level of short-term interest rates for the three crises, using a large panel of 33 economies.[8] The top panels plot crisis-related depreciations (and appreciations) vis-à-vis the yen over the two months following the crisis date against the average short-term interest rates in the *previous* six months.

In 2008, high-interest currencies depreciated by more

Two findings stand out: the slope is positive, and it increases over time. A steep upward slope is consistent with rapidly unwinding carry trades: the countries with the highest short-term interest rates in the period *prior* to the crisis date depreciate the most. Unwinding of other investments that exploit short-term interest rate differentials across countries is also consistent with an upward slope (ie capital outflow and therefore depreciation of the high-interest currency), but – to the extent that those investments are unleveraged – the unwinding could be expected to be less sudden, with a flatter slope.

This link has increased over time …

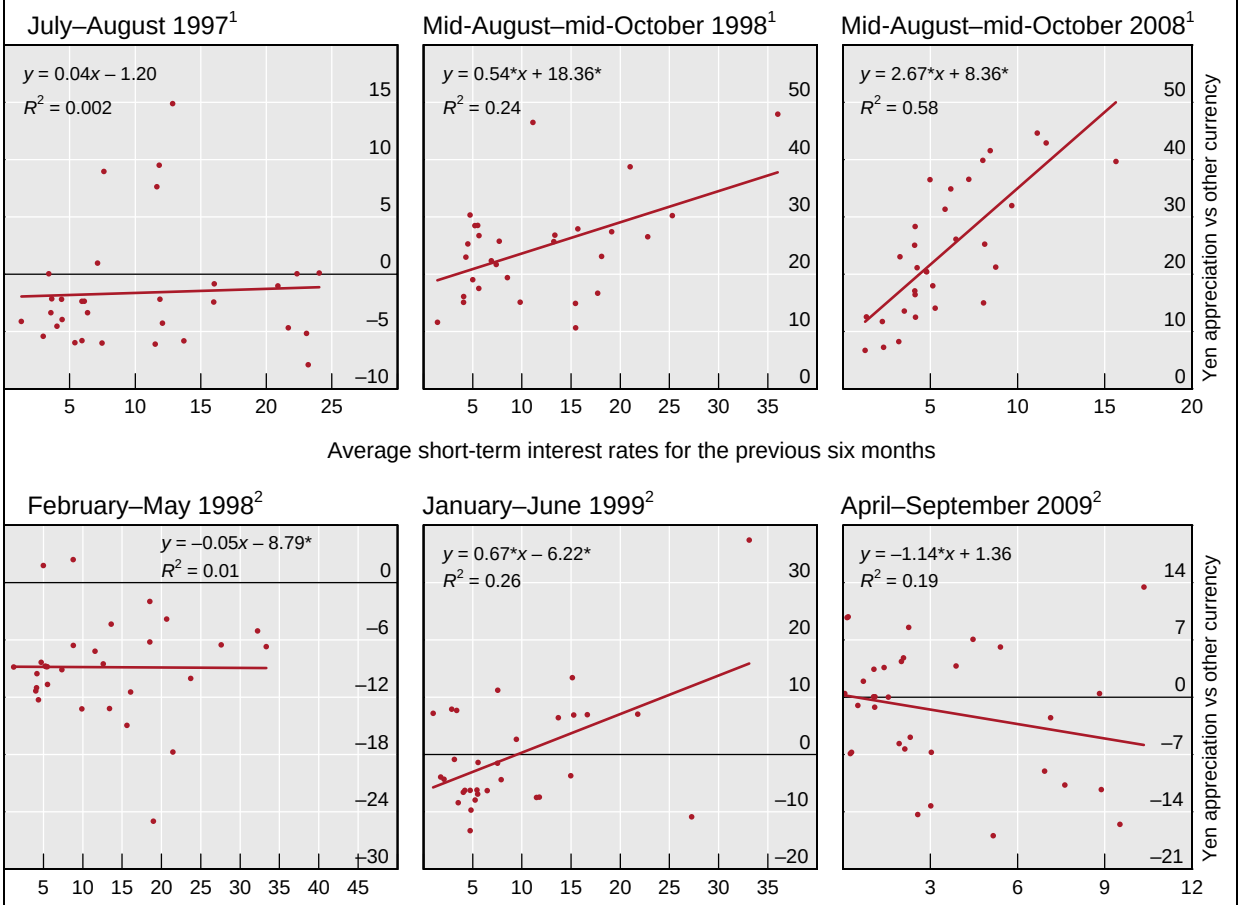
The graphs show that the link between exchange rate depreciations and higher interest rates during the crisis phase intensifies over time, consistent with an increasing role of investments related to short-term interest rate differentials. One possible explanation is the increasing role of carry trades since 1997. While the size of carry trade activity is difficult to measure, carry-to-risk ratios – measured as the short-term interest differential divided by the implied volatility from currency options – are often used as an ex ante measure of the attractiveness of carry trade. Graph 5 shows the carry-to-risk ratios for a number of countries since 1996. These ratios have been steadily rising over the past 14 years, consistent with an increasing attractiveness of yen-funded carry trades for Australia and New Zealand. The picture is, however, less clear for other popular target currencies, such as the Brazilian real, or for other funding currencies such as the US dollar.

… possibly due to carry trades

Anecdotal evidence supports the picture revealed by carry-to-risk ratios. Prior to the 1997 and 1998 crises, there were references to yen-funded carry trades, with unwinding thought to have given momentum to the appreciation of the yen in mid-1998 (Béranger et al (1999), BIS (1999)). Similarly, during 2005–07 the build-up of carry trade positions featured prominently in the

[8] Australia, Brazil, Canada, Chile, China, Chinese Taipei, Colombia, the Czech Republic, Denmark, the euro area, Hong Kong SAR, Hungary, India, Indonesia, Israel, Japan, Korea, Malaysia, Mexico, New Zealand, Norway, the Philippines, Poland, Russia, Singapore, Slovakia, South Africa, Sweden, Switzerland, Thailand, Turkey, the United Kingdom and the United States.

Exchange rate movements and interest rates around crisis periods



Excludes currencies with interest rates above 40% and those fixed to the US dollar. The HKD 12-month forward and CNY 12-month NDF are used to represent HKD and CNY respectively. For mid-August to mid-October 1998, the exclusion of Colombia (35% interest rate) yields a slope coefficient of 0.33 and an R^2 of 0.08. Regression coefficients with an asterisk denote significance at the 90% level. Interest rates are either money market rates (60b) or treasury bill rates (60c) from the IMF *International Financial Statistics*; where needed, deposit rates (60l) were used.

[1] The time periods for the crisis-related depreciations are the two months following the crisis dates, which are tied to a specific event (2 July 1997, 17 August 1998) or to a sudden increase in uncertainty and risk aversion as indicated by the VIX (21 August 2008). [2] The time periods for reversals in the aftermath of the crisis are six months long. The starting date of the six-month window is the month when exchange rates appeared to begin to reverse some of the crisis-related depreciations. For the Asian crisis, the window is only four months long, in order to avoid capturing any effects from the 1998 Russian crisis.

Sources: IMF; Bloomberg; BIS calculations. Graph 4

literature (see, for instance, Galati et al (2007)). Not surprisingly, in August and September 2008, these positions were unwound rapidly, exacerbating any crisis-related depreciations of the affected currencies (McCauley and McGuire (2009), Melvin and Taylor (2009)). Unwinding larger carry trade positions may thus partly explain why typical target currencies such as the Australian and New Zealand dollars depreciated more in late 2008 than during the previous crisis episodes.

Exchange rates and interest differentials after the crises

Interest differentials played a less consistent role in the appreciation of exchange rates after the crises than in their depreciation during these episodes. That said, during the latest crisis, their impact was more pronounced

and consistent with a larger role played by investments exploiting short-term interest differentials.

Unlike in previous crises, in 2009 high-interest currencies rebounded more strongly

The bottom panels of Graph 4 plot the changes in exchange rates vis-à-vis the yen over roughly a six-month period in the aftermath of the crises, against the average short-term interest rates over that time. There are no signs consistent with a build-up of carry trades immediately after the earlier two crisis episodes. Exchange rate movements after the Asian crisis were uncorrelated with interest rates. After the Russian turmoil waned, currencies moved into the direction predicted by the uncovered interest parity condition, ie that currencies with higher short-term interest rates should be expected to depreciate by more than those with lower rates. In contrast, from April to September 2009, exchange rate movements had a sizeable, statistically significant negative relationship with short-term interest rates: the currencies of countries with higher interest rates appreciated by more. A number of factors may have contributed to this renewed appreciation of higher-yielding currencies in 2009: a return of carry trade activity as risk aversion abated; better growth prospects in a number of higher-interest economies, especially commodity exporters; and comparatively healthy banking systems in these economies. We will discuss each in turn.

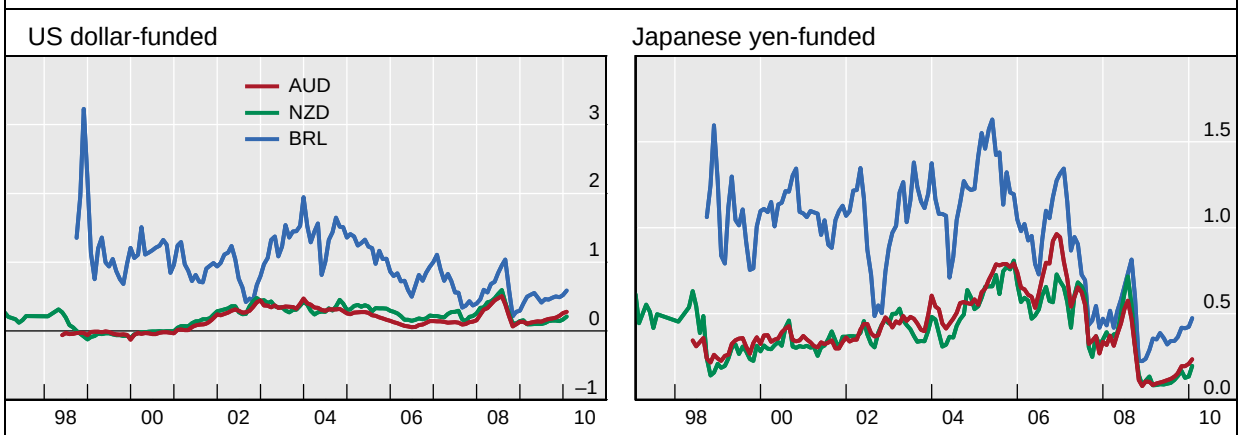
This could be due to a return of carry trade activity …

First, with extreme risk aversion abating, carry trade activity – a relatively risky strategy – may have returned in the second half of 2009. Indeed, carry trades in a number of high-yielding currencies, especially those of commodity exporters, provided extraordinarily high ex post returns over this period. Moreover, near zero interest rates prevailed in many major currencies, increasing ex ante profitability not only for traditional funding currencies such as the yen. Carry-to-risk ratios support this conclusion (Graph 5).

… better growth prospects …

Second, higher interest rates in a number of countries reflected better growth prospects, attracting foreign investment. In particular, commodity exporters, such as Australia, Brazil and Norway, recovered earlier than most other economies, profiting from the renewed strength of commodity prices and raising interest rates (or holding them at a comparatively high level) as a result.

Carry-to-risk ratios[1]



[1] Defined as the one-month interest rate differential divided by the implied volatility derived from one-month at-the-money exchange rate options.

Sources: Bloomberg; JPMorgan Chase. Graph 5

Not all investment flows seeking to achieve higher returns in these countries were necessarily leveraged carry trades.

... and comparatively healthy banking systems in these economies

Third, banking systems in these countries weathered the crisis relatively well. For instance, although a number had introduced bank debt guarantees during the crisis, none had to use large-scale bank rescue packages. A stable financial system could in turn increase expectations for output growth for these economies, thus attracting capital inflows.

Conclusion

During the global financial crisis of 2007–09, a large number of countries that were not at the centre of the crisis depreciated against three major currencies: the US dollar, the Japanese yen and the Swiss franc. Moreover, for a number of currencies, these depreciations reversed within a year or so after the crisis. Two factors can explain some of this pattern: safe haven flows and the role played by interest rate differentials.

During financial crises, capital typically flees the crisis country and moves into safe haven currencies, namely the yen, the Swiss franc and the US dollar. During the most recent crisis, however, safe haven effects led to capital flows into some of the countries most affected by the crisis. Therefore, it may not be surprising that these flows reversed as soon as risk aversion abated, with a corresponding reversal of exchange rate movements.

Comparing the latest crisis with two earlier crisis episodes, we find that the role of short-term interest rate differentials in both the depreciations and their reversal has grown over time, perhaps reflecting the increasing role carry trades play in exchange rate movements. This factor may have changed the dynamics of exchange rates around crises more generally, affecting a broader set of currencies and leading to more pronounced swings in exchange rates during and after crisis episodes.

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