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Abstract

A striking and unexpected feature of the financial crisis has been the sharp appreciation of the US dollar against virtually all currencies globally. The paper finds that negative US-specific macroeconomic shocks during the crisis have triggered a significant strengthening of the US dollar, rather than a weakening. Macroeconomic fundamentals and financial exposure of individual countries are found to have played a key role in the transmission process of US shocks: in particular countries with low FX reserves, weak current account positions and high direct financial exposure vis-à-vis the United States have experienced substantially larger currency depreciations during the crisis overall, and to US shocks in particular.

Keywords: Financial crisis, exchange rates, global imbalances, shocks, United States, US dollar, transmission channels.

JEL Classification: F31, F4, G1

Non-technical summary

Before the current financial crisis, there was a fairly widespread consensus that the large global imbalances in current account positions and underlying capital flows to finance these imbalances would ultimately require a large depreciation of the US dollar. The argument was that a decline in the value of the US dollar is inevitable to achieve an improvement in US competitiveness and thus a sustainable reduction in the US trade deficit, and the fear was that such an adjustment may be large and disruptive. However, as we now know, one of the striking characteristics of the crisis has been a substantial appreciation, rather than depreciation, of the US dollar against virtually all but a few currencies.

What explains these sharp and unexpected movements in global exchange rate configurations? And why has there been so much heterogeneity across countries in currency developments during the crisis? The paper attempts to shed light on these questions and peculiar global FX movements by analyzing the drivers of currency changes and the channels through which shocks have been transmitted to FX markets during the crisis. In the first step of the empirical analysis, the paper attempts to explain the large heterogeneity of bilateral exchange rate movements vis-à-vis the US dollar for 54 currencies, covering both advanced economies as well as emerging market economies (EMEs). The empirical findings suggest three factors to have played a dominant role in global FX adjustments since the summer of 2008: first, countries with large financial liabilities vis-à-vis the United States, i.e. those in which US investors held relatively large portfolio investments (both in equities and in bonds), experienced significantly larger depreciations against the US dollar.

The second factor that appears to have played a key role for global FX movements since the summer of 2008 is the size of FX reserves. To illustrate the economic significance, countries with FX reserves to GDP ratios below the cross-country average depreciated, on average, by 23%, while those with larger than average reserves weakened only by 7% against the US dollar. This is a striking result, in particular as FX reserves had risen dramatically over the past decade, especially among emerging market central banks. There appears to have been a broad consensus that only some part of this reserve accumulation can be explained by a precautionary motive to guard against capital flow reversals, in particular following the 1997-98 Asian financial crisis, while a substantial part was the result of fixed exchange rate regimes, high commodity prices or other factors. In short, the findings suggest that either some countries had lacked sufficient reserve to stem against the magnitude of their currency's decline during the financial crisis, or that in some instances what may have been considered as "excessive" FX reserves may in fact been beneficial in reducing the pressure on domestic currencies.

A third factor that comes out as a significant determinant of the exchange rate adjustment process during the crisis is the size of countries' current account positions. Those with current account positions higher than the average across the 54 economies before the crisis experienced, on average, only a 10% depreciation against the US dollar, while those with large current account deficits had, on average, a 22% depreciation between July 2008 and February 2009.

The second part of the empirical analysis investigates the daily response during the financial crisis of global FX configurations to a set of common shocks, using US macroeconomic announcement shocks as a proxy for such shocks that are common to all 54 currencies in the sample. These US "shocks" are the unexpected components of macroeconomic announcements about US real, financial and confidence variables.

Investigating the daily FX responses to such US shocks reveals a striking finding. Before the financial crisis, a negative US shock, i.e. a worse than expected performance of a US variable, led to a depreciation of the US dollar against foreign currencies. However, during the financial crisis this response pattern even switched its sign: a negative US shock during the financial crisis since July 2008 has induced, on average, an appreciation of the US dollar. This validates the often heard claim that "when the US sneezes, the world catches a cold," i.e. it suggests that bad news for the US economy may either have been perceived as even worse news for other economies, or have triggered an actual or expected repatriation of capital from foreign markets, so as to induce a US dollar strengthening. The economic magnitude of the global FX response to US shocks is substantial. Moreover, these findings are robust to alternative model specifications, such as when excluding oil exporters and peggers, and hold equally for advanced economies as for EMEs.

The final part of the paper investigated the channels for understanding this peculiar response pattern. Overall, the empirical tests here confirm the findings of the first part of the paper: currencies of countries with high financial exposure to the United States, with low FX reserves and a high current account deficit have experienced stronger responses to US shocks during the financial crisis. Moreover, given that the majority of US shocks have been negative since July 2008, the findings suggest that such a stronger response of these countries to common US shocks can explain a significant part of the cross-country heterogeneity in FX movements during the crisis.

With the crisis still in full swing, many open questions remain. It is of course hard to make predictions whether the sharp currency movements witnessed during 2008 and early 2009 are a temporary phenomenon and will be reversed once the crisis abates. Moreover, those who have for years predicted a US dollar depreciation in the long-run may still turn out to be ultimately correct. The paper suggests that the

crisis has not been entirely indiscriminate and emphasizes the importance of strong macroeconomic fundamentals, in particular sufficient FX reserves and sound current account positions to counter capital flow reversals. Yet the benefits of financial openness, integration and exposure during good times, may also entail costs in bad times as it makes it hard for countries to de-couple from adverse shocks occurring elsewhere in the world.

1 Introduction

The current financial crisis has caused sharp movements in global exchange rate configurations. Before the crisis, there was a fairly widespread consensus that the large global imbalances in current account positions and underlying capital flows to finance these imbalances would ultimately require a large depreciation of the US dollar. The argument was that a decline in the value of the US dollar is inevitable to achieve an improvement in US competitiveness and thus a sustainable reduction in the US trade deficit (e.g. Obstfeld and Rogoff 2005; Blanchard, Giavazzi and Sa 2005). A widespread fear was that such an adjustment may occur suddenly and be rather disruptive (Krugman 2007).[1]

In short, there was a fairly widespread expectation that a US dollar depreciation would play an important if not central role in the global adjustment process. However, as we now know, the adjustment process has taken a very different path with a collapse in asset prices and a massive deleveraging process among financial institutions being at the core of the crisis. Moreover, one of the striking characteristics of the crisis, in particular since its intensification in the summer of 2008, has been a very substantial appreciation, rather than depreciation, of the US dollar against virtually all but a few currencies. This is even more striking given that the United States was the origin of the financial crisis, and that at least many emerging markets had initially little direct financial exposure by holding relatively few US toxic assets.

Figures 1 – 2

Figure 1 illustrates this pattern in global FX configurations, showing that while the US dollar depreciated somewhat in 2007 and the first half of 2008 (an upward movement in the figure), it appreciated sharply from July 2008 onwards (a downward movement), and in particular in the weeks following the collapse of Lehman Brothers in September 2008. While Figure 1 indicates that this appreciation trend of the US dollar has been present equally against exchange rates of advanced economies and emerging markets, Figure 2 shows that nevertheless the heterogeneity in bilateral exchange rate movements against the US dollar has increased significantly after July 2008, implying that countries have fared very differently with regard to exchange rate movements.[2]

[1] Of course there are also dissenting voices, arguing that the large US current account deficit is the result of a natural outcome of financial globalization in general and a preference for US financial assets in particular (e.g. Cabellero et al. 2008, Cooper 2008).

[2] The figures exclude de facto fixed exchange rate regimes; a more detailed discussion follows below in sections 2 and 3.

What explains these sharp and unexpected movements in global exchange rate configurations? And why has there been so much heterogeneity across countries in currency developments during the crisis? There are at least three factors that are being stressed as having played a seminal role for global FX movements in 2008 and 2009. The first one relates to a sharp reversal in the pattern of global capital flows, in particular since the summer of 2008 as US investors started withdrawing capital from abroad to raise cash for redemptions, or a more general flight-to-safety phenomenon in which both US and foreign investors have shifted out of equities and into fixed income instruments, particularly into (presumably) safe US government bonds and bills. A second prominent factor is the need for US dollar liquidity of non-US firms, which helps explain the loss in FX reserves among several, in particular emerging market central banks, and the establishment of a significant number of swap arrangements of the Federal Reserve with central banks in both advanced and emerging economies. And third, the unwinding of carry trade positions appears to have been a prominent factor for some currencies, in particular such as the sharp rise of the Japanese yen since the summer of 2008.

The paper attempts to shed light on these peculiar global FX movements by analyzing the drivers of currency changes and the channels through which shocks have been transmitted to FX markets during the crisis. In the first step of the empirical analysis, the paper attempts to explain the large heterogeneity of bilateral exchange rate movements vis-à-vis the US dollar for 54 currencies, covering both advanced economies as well as emerging market economies (EMEs). Following the rationale for the two above-mentioned channels, the paper tests for the role of capital flight by analyzing whether differences in the external exposure of countries to capital flow reversals are relevant in explaining the cross-country heterogeneity in currency movements. Moreover, the simple, stylized model controls for various macroeconomic fundamentals that proxy how good governments and central banks are equipped to counter large capital outflows.

The empirical findings suggest three factors to have played a dominant role in global FX adjustments since the summer of 2008: first, countries with large financial liabilities vis-à-vis the United States, i.e. those in which US investors held relatively large portfolio investments (both in equities and in bonds), experienced significantly larger depreciations against the US dollar. Moreover, these differences are substantial: countries with a financial exposure larger than the average, across all 54 countries in the sample, depreciated by 25% in the period July 2008-February 2009, whereas those with a lower than average financial exposure fell only by 14%.

The second factor that appears to have played a key role for global FX movements since the summer of 2008 is the size of FX reserves. To illustrate the economic

significance, countries with FX reserves to GDP ratios below the cross-country average depreciated, on average, by 23%, while those with larger than average reserves weakened only by 7% against the US dollar. This is a striking result, in particular as FX reserves had risen dramatically over the past decade, especially among emerging market central banks. There appears to have been a broad consensus that only some part of this reserve accumulation can be explained by a precautionary motive to guard against capital flow reversals, in particular following the 1997-98 Asian financial crisis, while a substantial part was the result of fixed exchange rate regimes, high commodity prices or other factors.[3] In short, the findings suggest that either some countries had lacked sufficient reserve to stem against the magnitude of their currency's decline during the financial crisis, or that in some instances what may have been considered as "excessive" FX reserves may in fact been beneficial in reducing the pressure on domestic currencies.

A third factor that comes out as a significant determinant of the exchange rate adjustment process during the crisis is the size of countries' current account positions.[4] Those with current account positions higher than the average across the 54 economies before the crisis experienced, on average, only a 10% depreciation against the US dollar, while those with large current account deficits had, on average, a 22% depreciation between July 2008 and February 2009. Moreover, two further variables which are statistically significant in some, though not all model specifications are the size of firms' external indebtedness and a country's sovereign rating, lending further support to the finding that it is the financial exposure of a country that has played a central role as a driver of global FX configurations.

Finally, the paper controls and test for the role of broad set of other macroeconomic determinants usually included in models of exchange rate determination, such as differentials with the United States in interest rates, economic growth, inflation, government debt and productivity, but none of these seem to be able to explain the cross-country heterogeneity in currency movements during the crisis. In addition, the empirical results of the paper indicate that neither trade openness nor the trade

[3] Aizenman and Marion (2003) stress that the accumulation of reserves in Emerging Asia can be rationalised by the desire for precautionary savings, while also Aizenman and Lee (2007) go in a similar direction and make the case that precautionary and not mercantilist reasons can account for the reserves build-up. Similarly, Obstfeld, Shambaugh and Taylor (2009) show that the size of countries' FX reserves is indeed a decent predictor of FX movements in 2008. Other studies stressing the role of a precautionary motive behind reserve accumulation are Chinn and Ito (2007) and Gruber and Kamin (2007).

[4] More broadly, this factor fits into the literature emphasizing the role of the net foreign asset position of countries as a predictor for future net exports (trade channel) and future exchange rate movements (valuation channel) - see in particular Gourinchas and Rey (2007).

exposure of countries globally or bilaterally vis-à-vis the United States appear to be a relevant determinant for the transmission of the crisis to global FX markets, again underlining the primacy of the financial exposure channel.

There are several caveats to this analysis which warrants being cautious in interpreting the empirical results. One important point is that all determinants in the empirical model are measured prior to August 2007 so as to take into account that FX reserves, financial exposure, current account positions and other included controls have been adjusting, often significantly subsequently and partly as a result of FX movements.

Moreover, the role of FX reserves may be closely related to exchange rate policies, as e.g. countries with a de facto fixed exchange rate regime, such as China, may have accumulated substantial FX reserves prior to the crisis, yet also did not adjust their currencies much during the crisis as they managed to stick to their regime without having to devalue. Another caveat may be the role of commodity prices, which reached a peak in the summer of 2008 and declined sharply thereafter. Hence currencies of oil exporters, such as Russia, are likely to have declined more substantially – despite large FX reserve prior to and heavy FX interventions during the crisis – because of the enormous drop in commodity prices. However, the above-mentioned findings are robust to excluding exchange rate peggers and oil exporters from the country sample.

Another potentially serious caveat is that much of the cross-country heterogeneity in FX movements during the financial crisis may not be explained by differences in financial exposure, FX reserves and current account positions, but rather by differences in countries' policy responses or country-specific shocks. In other words, the cross-country differences in FX adjustments may not necessarily solely reflect differences in exposure to a set of common shocks, but may in part be due to differences in exposure to idiosyncratic, country-specific shocks.

The second part of the empirical analysis therefore investigates the daily response during the financial crisis of global FX configurations to a set of common shocks, using US macroeconomic announcement shocks as a proxy for such shocks that are common to all 54 currencies in the sample. These US "shocks" are the unexpected components of macroeconomic announcements about US real, financial and confidence variables. While one can clearly think of other, possibly more important US specific events during the crisis (e.g. the collapse of Lehman Brothers, the initial rejection of the TARP program by US Congress, etc.), the advantage of using US macroeconomic news is that they are not only US specific but also that the unexpected component of an announcement can be cleanly identified through the availability of prior market

expectations.[5]

Investigating the daily FX responses to such US shocks reveals a striking finding. Before the financial crisis, a negative US shock, i.e. a worse than expected performance of a US variable, led to a depreciation of the US dollar against foreign currencies. However, during the financial crisis this response pattern even switched its sign: a negative US shock during the financial crisis since July 2008 has induced, on average, an appreciation of the US dollar. This suggests that bad news for the US economy may either have been perceived as even worse news for other economies, or have triggered an actual or expected repatriation of capital from foreign markets, so as to induce a US dollar strengthening. The economic magnitude of the global FX response to US shocks is substantial. Moreover, these findings are robust to alternative model specifications, such as when excluding oil exporters and peggers, and hold equally for advanced economies as for EMEs.

The final part of the paper investigated the channels for understanding this peculiar response pattern. Overall, the empirical tests here confirm the findings of the first part of the paper: currencies of countries with high financial exposure to the United States, with low FX reserves and a high current account deficit have experienced stronger responses to US shocks during the financial crisis. Moreover, given that the majority of US shocks have been negative since July 2008, the findings suggest that such a stronger response of these countries to common US shocks can explain a significant part of the cross-country heterogeneity in FX movements during the crisis.

The paper relates directly or indirectly to various strands of the literature on exchange rate determination, while work on the financial crisis and the transmission channels is still quite scarce. There is a growing literature on global financial linkages and the transmission channels for various types of shocks. An important early study is Forbes and Chinn (2004), who use a factor model and show that trade and financial linkages an explain part of cross-country equity returns. Hausman and Wongswan (2006), Wongswan (2006), Fratzscher (2008) and Ammer, Vega and Wongswan (2009) test for the transmission of US monetary policy shocks to equity markets, though Hausman and Wongswan (2006) and Fratzscher (2008) also analyze interest rate and exchange rate responses. Yet, the novelty of the present paper and its intended contribution to the literature is the focus on the current financial crisis, and the findings that stress the fundamental and peculiar change of the transmission channels during the crisis compared to tranquil times.

[5] There is a fairly sizeable literature on the effects of macroeconomic announcements establishing that such shocks exert a significant effect on asset prices and also on exchange rates (see e.g. Andersen et al. 2003, Ehrmann and Fratzscher 2005b).

The paper is organized as follows. Section 2 briefly summarizes the data used in the empirical analysis, while section 3 presents the benchmark empirical model and findings for the cross-sectional analysis, including several robustness tests. Section 4 then investigates the transmission of US-specific macroeconomic announcement shocks; first illustrating the time-variations in the transmission process, and then analyzing the transmission channels. Section 5 summarizes the findings and concludes.

2 Data

This section briefly outlines the data and country coverage used in the empirical analysis. First, for reasons outlined in the Introduction the focus of the study is on the response of bilateral exchange rates against the US dollar during the financial crisis. One may, of course, extend the analysis to other bilateral rates – e.g. bilateral movements vis-à-vis the euro area very important for currencies in Central and Eastern Europe – or to effective exchange rate movements, but the focus here is quite narrowly on the US dollar given its peculiar rise during the crisis across the great majority of countries.

A related issue is the definition of the crisis period itself. The period chosen here is 1 July 2008 to 31 January 2009. The starting point may be somewhat arbitrary, but is motivated by the peak in particular of EME currencies in early July 2008. The empirical analysis below tests for the sensitivity of the findings when choosing a different crisis definition, e.g. starting with the collapse of Lehman Brothers on 15 September or using a longer period with the starting date of 6 August 2007, when the first indications of financial market turbulences appeared.

Table 1 lists the country sample, which comprises 54 advanced and emerging market economies. The balance across regions and countries is fairly even, with the objective of including mostly relatively open economies only, though there are several smaller and more closed EMEs as well. The empirical analysis at various points tests for the sensitivity when splitting and narrowing the country sample, e.g. by excluding oil exporters and de facto exchange rate peggers. The de facto exchange rate regime classification used here stems from Reinhart and Rogoff (2004).

Tables 1 – 2

Table 2 provides summary statistics for the list of macroeconomic determinants for the transmission of the crisis to bilateral exchange rates. It is, of course, hard to determine which variables should be included and there is a large literature trying to

explain or predict exchange rate movements. This literature shows how difficult it is to agree on a particular structural model or even a set of determinants for exchange rates (e.g. Cheung et al. 2004). This is made even more difficult by the fact that the focus in the present paper is on the financial crisis, during which drivers of exchange rates may have been fundamentally different from more tranquil periods.

As explained in detail in the Introduction, a specific aim of the present paper is to test for the relevance of the sudden-stop hypothesis. Hence, the paper attempts to use various proxies for external exposure of countries, both bilaterally vis-à-vis the United States and globally. One such measure is the stock of financial liabilities, stemming from the Coordinated Portfolio Investment Survey (CPIS) of the IMF, and being defined as the portfolio investment (equity plus debt) liabilities vis-à-vis US investors over GDP for each country. A second measure, and one focusing on the role of domestic investors, is the size of portfolio investment assets held abroad by domestic investors, again scaled by the country's GDP. There are various drawbacks to the CPIS data, which have discussed by e.g. Lane and Milesi-Ferretti (2003), Warnock (2006) and Daude and Fratzscher (2008).

A related measure is the real exposure of countries via trade, which is proxied as the ratio of imports from the US to GDP, and alternatively as the ratio of exports to the US to GDP. Moreover, as discussed in the Introduction, a frequently mentioned channel behind exchange rate movements during the crisis is the need for US dollar liquidity of firms. We use the total external debt of firms listed making up a country's main stock index, normalized by a country's GDP.[6] This data is sourced from Bloomberg.

The analysis at various stages also includes or controls for various proxies for the strength of countries' macroeconomic fundamentals, such as GDP growth, productivity growth, interest rates, inflation, the current account-to-GDP ratio, the government balance-to-GDP ratio as well as the sovereign rating of countries. These variables (bar the last) are measured relative to the US variables, though such a relative definition is obviously not needed in the cross-sectional analysis.

Table 3

Finally, as discussed in the Introduction, the second part of the analysis conditions on the transmission of US-specific shocks to global exchange rate configurations. For US-specific shocks, the paper takes US macroeconomic announcement surprises.

[6] A related query is clearly the choice of the denominator for these various exposure proxies. The preferred strategy here is to use GDP as this variable is relatively stable over time, and thus allows us to distinguish the role of different potential determinants.

These surprises are the unexpected component of macroeconomic announcements, measured as the difference between the announced value and the value expected by market participants just prior to the announcement. Andersen et al. (2003), Ehrmann and Fratzscher (2005a), and Fratzscher (2008) provide a detailed account of the construction and validity of these data. Table 3 lists these macro news shocks, where all the data series stem from MMS and Bloomberg, with the exception of the monetary policy surprises which are the surprise components of FOMC decisions, based on the change in fed funds futures rates, and are constructed following the methodology by Gürkaynak et al. (2005).

3 Empirical model and benchmark results

The present section now proceeds to present the benchmark model specification and results for the determinants of exchange rate movements during the crisis. It also discusses several extensions and sensitivity checks.

What explains the cross-country heterogeneity in exchange rate movements during the crisis? To test for the role of the various potential determinants for each of the 54 countries i, the basic empirical model is formulated as

$$\Delta s_i = \alpha + \beta X_i + \gamma Z_i + \varepsilon_i \tag{1}$$

where Δs_i is the exchange rate change of country i over the crisis period (1 July 2008 – 31 January 2009 for the benchmark specification); X_i is a vector of country-specific macroeconomic fundamentals and Z_i is a vector of variables proxying the external exposure of countries, in particular vis-à-vis the United States.

Note that there is no time dimension in this model, which may pose a challenge given that the cross-sectional dimension includes only 54 countries; a point which will be remedied in the conditional analysis of section 4. Moreover, it is important to stress that all determinants X_i and Z_i are measured before the crisis, and more precisely as an average over the period Q1 2005 to Q2 2007. This is important so as to ensure that these determinants are truly exogenous to the crisis in the model specification.

Table 4

Table 4 presents the benchmark results for model (1), using various sub-sets of the determinants X_i and Z_i. Overall, the findings suggest that it was in particular three factors that help us explain the cross-country exchange rate movements during the financial crisis. First, it is in particular the financial exposure vis-à-vis the United

States that is statistically significant in the estimation. The negative sign indicates that a higher ratio of portfolio liabilities vis-à-vis US investors to GDP raises the decline in the bilateral US dollar exchange rate of a country.

A second driver of cross-country exchange rate movements is the size of FX reserves, measured as a share of GDP. The positive sign indicates that higher FX reserves lower the depreciation of currencies significantly. This result implies that some countries may have had insufficient reserves and suffered proportionally more from the capital flight and downward pressure on their currencies, or put differently, that in some instances what may have been perceived as "excessive" FX reserves prior to the crisis may in fact been important in reducing the pressure on domestic currencies during the crisis.

A third driving factor for currencies during the crisis appears to be the size of countries' current account positions, with those countries having stronger positions suffering significantly less from currency depreciations. A curious result is the positive significant coefficient for foreign financial assets in specification (2). The positive sign implies that countries that held a lot of financial assets, as a share of GDP, abroad found there currencies to be less affected. One possible interpretation is that such countries were able to better withstand the withdrawal of capital by US investors as they were able to partly compensate such outflows by repatriating capital from abroad and meeting US dollar liquidity demands. Nevertheless, this variable is statistically significant at the 10% level only in one of the specifications.

In addition, two further variables which are statistically significant in some, though not all model specifications are the size of firms' external indebtedness and a country's sovereign rating, stressing further the interpretation that it is the financial exposure of countries that has been instrumental in the transmission process of the crisis to global FX markets.

By contrast, other macroeconomic controls, such as GDP growth rates or the government balance, are not statistically significant. Moreover, also the proxies for trade exposure vis-à-vis the United States are always insignificant.

Figures 3 – 4

How large and economically meaningful are these differences in financial exposure, FX reserves and current account positions? As an overall proxy of the goodness of fit of the empirical model, the R-squared measure for the full model specification (4) indicates that the macroeconomic fundamentals and exposure variables explain more than 50% of the cross-sectional difference.

To shed more light on the contribution of individual determinants, Figures 3 and 4 plot the average exchange rate evolution for two contrasting groups. One group

is the one with relatively stronger fundamentals or lower exposure while the other is the one with weaker fundamentals or higher exposure, i.e. relative to the average across all countries.[7]

The figures reveal several interesting stylized facts. A first one is the magnitude of the effects: countries with a financial exposure that is higher than the average declined by 25% in the period July 2008-February 2009, while those with a lower than average financial exposure depreciated only by about 14%. Similarly, countries with FX reserves to GDP ratios below the cross-country average depreciated, on average, by 23%, while those with larger than average reserves weakened only by 7% against the US dollar. Those with current account positions higher than the average before the crisis had, on average, only a 10% decline against the US dollar, while those with large current account deficits had a 22% depreciation between July 2008 and February 2009.

Table 5

As the final step, various extensions and sensitivity tests were conducted. Specifications (1) and (2) of Table 5 shows the findings when excluding de facto exchange rate peggers as well as oil exporting countries. The findings discussed above remain robust to this change in the country sample. Specification (3) and (4) alter the definition of the crisis period and analyze the role of the various determinants when the crisis period is extended to 6 August 2007 to 31 January 2009, i.e. also including the earlier, less severe turmoil period. The significant coefficients for the financial exposure remains, but those for the current account position disappear in this specification. Moreover, it seems that sovereign ratings are more important when extending the crisis definition.

Overall, the analysis of this section suggests that the size of countries' FX reserves, the current account position and the financial exposure of countries vis-à-vis the United States have been instrumental in explaining the sharp depreciation of many currencies against the US dollar during the financial crisis. Not only does the model explain a sizeable portion of the cross-country variation in exchange rate movements, but the magnitude of the effects of these three factors seems substantial. Other macroeconomic fundamentals such as growth differentials, interest rate differentials, and inflation differentials do not seem to play a role. Moreover, it seems in particular the financial exposure of countries, and not the trade exposure, that helps explain the sharp depreciation of currencies during the crisis.

[7] A caveat to be kept in mind for the graphical analysis is that these are partial and do not control for the other determinants, as countries e.g. with low FX reserves may also be those with weak current account positions.

4 Transmission channels and US shocks

The analysis so far has shown that FX reserves, current account positions and financial exposure are important in explaining the cross-country response of exchange rates to the financial crisis. One caveat of that analysis is that it does not control for other factors that are country-specific, and may possibly correlated to these macroeconomic variables. Since the present paper is primarily interested in the transmission of the crisis from the United States, where it originated, to global FX markets, a more direct test of the transmission process and its underlying channels is to directly identify and condition on US-specific shocks. This is the purpose of this section.

4.1 The time-varying effect of US shocks on exchange rates

As discussed in sections 1 and 2, the paper takes US macroeconomic news shocks, using a standard set of announcements for US real, financial and confidence variables, to analyze through which channels these shocks are transmitted to FX markets. This set thus constitutes a set of shocks that are common to all 54 currencies in the sample. The analysis moves away from a pure cross-sectional perspective and analyses the transmission of US shocks over time during the crisis and at a daily frequency in a panel setting. More specifically, the first of two empirical models for the transmission of US macro shocks is formulated as

$$\Delta s_{i,t} = \alpha + \delta S_t + \beta X_i + \gamma Z_i + \varepsilon_{i,t} \tag{2}$$

where $\Delta s_{i,t}$ is now the exchange rate change of country i on a particular day t during the crisis period (1 July 2008 – 31 January 2009); X_i is a vector of country-specific macroeconomic fundamentals and Z_i is a vector of variables proxying the external exposure of countries, in particular vis-à-vis the United States, again as above measured before August 2007. S_t is the vector of US macroeconomic shocks, with the specification allowing for country fixed effects.

Table 6

A first test is whether US macroeconomic shocks exerted any significant effect on the 54 bilateral exchange rates, and more importantly, whether this effect was any different during the crisis than during more tranquil periods. Table 6 shows the point estimates for the 11 US macroeconomic shocks, for the period 1994-June 2008 in the first column and the crisis period 1 July 2008 – 31 January 2009 in the second

set of columns. The last column provides p values for whether the point estimates before the crisis are statistically different from those during the crisis.[8] A negative coefficient δ in the table indicates that a "positive" US macro news, i.e. a stronger than expected performance of the US economy, leads to an appreciation of the US dollar and thus a depreciation of the non-US currencies, and vice versa.[9]

Table 6 reveals a striking finding: before the crisis, negative US news indeed, as one would expect, induced an appreciation of the non-US currencies. This is the case for all of the 11 variables bar PPI.[10] However, during the crisis after 1 July 2008 the sign of the effects flips for several (though not all) of the macroeconomic shocks. This means that while before the crisis negative US news induced a depreciation of the US dollar, negative news during the crisis now led to an appreciation of the US dollar and a depreciation of the non-US currencies. The last column confirms that the change in the effect of US shocks on exchange rates is indeed also statistically significant in most of the cases.

What this suggests is that news about the weakening of the US economy during the crisis may have been perceived as even worse news for other countries. Alternatively, the reverse exchange rate reaction may have triggered an actual or expected repatriation of capital by US investors from abroad, or safe-haven flows by foreign investors, thus inducing a US dollar strengthening.

Table 7

As a next step, various robustness checks are conducted. The first model of Table 7 repeats the analysis for the crisis period but excludes oil exporters and de facto peggers. The second and third models of the table provide the estimates for advanced economies and for EMEs separately. The fourth model shows the point estimates when extending the crisis period to 6 August 2007 – 31 January 2009. With a few exceptions, the results are robust and confirmed.

[8] More precisely, this requires estimating equation (2) by introducing an additional time interaction term for the period before versus after 1 July 2008.

[9] Accordingly, the unemployment variable has been inversed in order to ensure consistency with this logic.

[10] The theoretical prior for the expected sign of inflationary shocks on the exchange rate is not entirely clear. On the one hand, higher than expected inflation may trigger expectations of an economic weakening due to capacity constraints and monetary tightening, thus inducing a depreciation of the domestic currency. On the other hand, as shown by Clarida and Waldman (2007) higher than expected inflation in the US has frequently trigger an appreciation of the US dollar, which may be due to the dominance of the effect of higher expected interest rates on the exchange rate. In the analysis below, where macro news are aggregate, both inflation variables are therefore excluded from the analysis.

Figures 5 – 6

Figure 5 illustrates the dynamics of the effect of US shocks on exchange rates, by aggregating all US macroeconomic shocks into a single aggregate shock, such that $\delta_1 = \delta_2 = ... = \delta_n.$, i.e. the coefficients for the effect of each of the macroeconomic news on exchange rates are set to be equal. In other words, each of the macroeconomic shocks is normalized such that a one standard-deviation shock has the same effect on exchange rates during tranquil times. This is followed by the estimation

$$\Delta s_{i,t} = \alpha + \delta_t S_t^N + \beta X_i + \gamma Z_i + \varepsilon_{i,t} \quad (3)$$

with S_t^N as this normalized US aggregate macro shock. The model of equation (3) is estimated using rolling windows over four quarters. Figure 5 shows that prior to 2008 this coefficient δ_t for the aggregate US macro shock is negative, indicating that worse than expected US news triggered a depreciation of the US dollar. By contrast, δ_t becomes positive in 2008 and in particular towards the end of 2008 and early 2009.

Figure 6 plots the fitted values for $(\delta_t S_t^N)$ from estimating equation (3). The figure indicates that in Q4 of 2008 about 5 percentage points of the depreciation of the 54 currencies, on average, can be accounted for by the set of US macro news included here. Comparing that to an overall average depreciation of about 20% of the 54 currencies against the US dollar suggests that this is about one quarter of this overall adjustment. Nevertheless, given that the number of US shocks included is very limited (with most days in fact having no US macroeconomic announcements), this is sizeable and is suggestive that US-specific shocks are indeed important in accounting for the global depreciation of currencies against the US dollar during the crisis.

4.2 Transmission channels of US shocks to exchange rates during the crisis

The final part of the analysis returns to the first question of the analysis, asking whether differences in countries' macroeconomic fundamentals and external exposure can explain why some currencies have depreciated so much stringer against the US dollar during the crisis than others.

The test in this sub-section conditions on US macroeconomic shocks by estimating

$$\Delta s_{i,t} = \alpha + \mu (S_t X_i) + \lambda (S_t Z_i) + \delta S_t + \beta X_i + \gamma Z_i + \varepsilon_{i,t} \quad (4)$$

where now, compared to equation (2), two interaction terms between the US macro shocks S_t, on the one hand, and the macro fundamentals X_i and external exposure Z_i for the 54 countries are added.

What is of interest in this model are in particular the parameters μ and λ, as these determine whether differences in the macroeconomic fundamentals X_i or differences in exposure Z_i across countries help explain the transmission of US shocks during the crisis. If only δ were statistically significant while μ and λ are not, then this would be indicative that there are important omitted variables (possibly country specific-shocks) in the pure cross-sectional analysis of section 3 that explain the results in that section. In short, to verify the findings of the analysis of section 3, one would expect that the same macro variables and financial exposure variables identified in section 3 also explain the differences in the cross-country exchange rate response to US specific shocks.

Table 8

Table 8 presents the results for model (4), with the columns labeled "US shock" providing the estimates for δ and the columns labeled "interaction" showing the estimates for μ and λ. The prior consistent with that of section 3 is that better fundamentals should help shield countries' currencies from the transmission of a negative US shock, hence $\mu<0$, while a higher external exposure should raise the transmission, i.e. $\lambda>0$.

The findings presented in Table 8 indeed largely confirm these hypotheses: while negative US shocks induce depreciations against the US dollar among the 54 currencies in the sample ($\delta>0$), this effect is weaker for countries with large FX reserves (first set of columns) and for those with a strong current account position (second set of columns). Similarly, for several US shocks the adverse effect is larger the higher the financial exposure vis-à-vis the United States (third set of columns).

These asymmetries are most significant for these three factors, while the interaction terms are mostly insignificant for other macroeconomic fundamentals and exposure variables. The last two sets of columns of Table 8 show the corresponding results for GDP growth and export exposure, underlining that the interaction terms are indeed mostly not significant.[11]

Overall, the empirical tests of this section have confirmed the findings of the first part of the paper: currencies of countries with high financial exposure to the United States, with low FX reserves and a high current account deficit have experienced

[11] The results for the other macro and exposure variables are not shown here for brevity reasons, but interaction terms for these are indeed mostly statistically insignificant.

stronger responses to US shocks during the financial crisis. In addition, given that the majority of US shocks have been negative during the crisis, the results indicate that such a stronger response of these countries to common US shocks can explain a significant part of the cross-country heterogeneity in FX movements during the crisis.

5 Conclusions

The financial crisis has triggered sharp and unexpected currency movements, with the US dollar appreciating significantly against virtually all currencies, especially since the intensification of the crisis in summer/fall 2008. The paper has shown that at least part of this pattern in global exchange rate configurations is explained by the peculiar effect of US-specific shocks on exchange rates. While worse than expected US macroeconomic announcements tended to cause a weakening in the US dollar during more tranquil times, such negative US shocks have actually had the opposite effect in the second half of 2008 and early 2009, triggering a strengthening of the US dollar.

A repatriation of capital to the US by US investors, a flight-to-safety phenomenon by US and non-US investors, an increased need for US dollar liquidity and an unwinding of carry trade positions may all have played a role in the sharp appreciation trend of the US dollar. The worse the crisis became, and thus the greater the need for capital and US dollar liquidity the stronger appear to have been the pressure on the US dollar to appreciate. While the paper could not test these hypothesis directly, it tried to test for these transmission channels by analyzing whether differences in countries' macroeconomic fundamentals and financial (and real) exposure to the United States can account for cross-country differences in exchange rate movements, both unconditionally and when conditioning on US-specific shocks.

The paper indeed confirmed that countries' fundamentals and financial exposure were highly relevant transmission channels: in particular countries with high direct financial exposure towards the United States, with low foreign exchange reserve coverage and with weak current account positions suffered substantially more in terms of currency depreciations. The findings of the paper also confirmed that these effects are not only statistically significant but also economically meaningful.

With the crisis still in full swing, many open questions remain. It is of course hard to make predictions whether the sharp currency movements witnessed during 2008 and early 2009 are a temporary phenomenon and will be reversed once the crisis abates. Moreover, those who have for years predicted a US dollar depreciation in the long-run may still turn out to be ultimately correct. The paper suggests that the

crisis has not been entirely indiscriminate and emphasizes the importance of strong macroeconomic fundamentals, in particular sufficient FX reserves and sound current account positions to counter capital flow reversals. Yet the benefits of financial openness, integration and exposure during good times, may also entail costs in bad times as it makes it hard for countries to de-couple from adverse shocks occurring elsewhere in the world.

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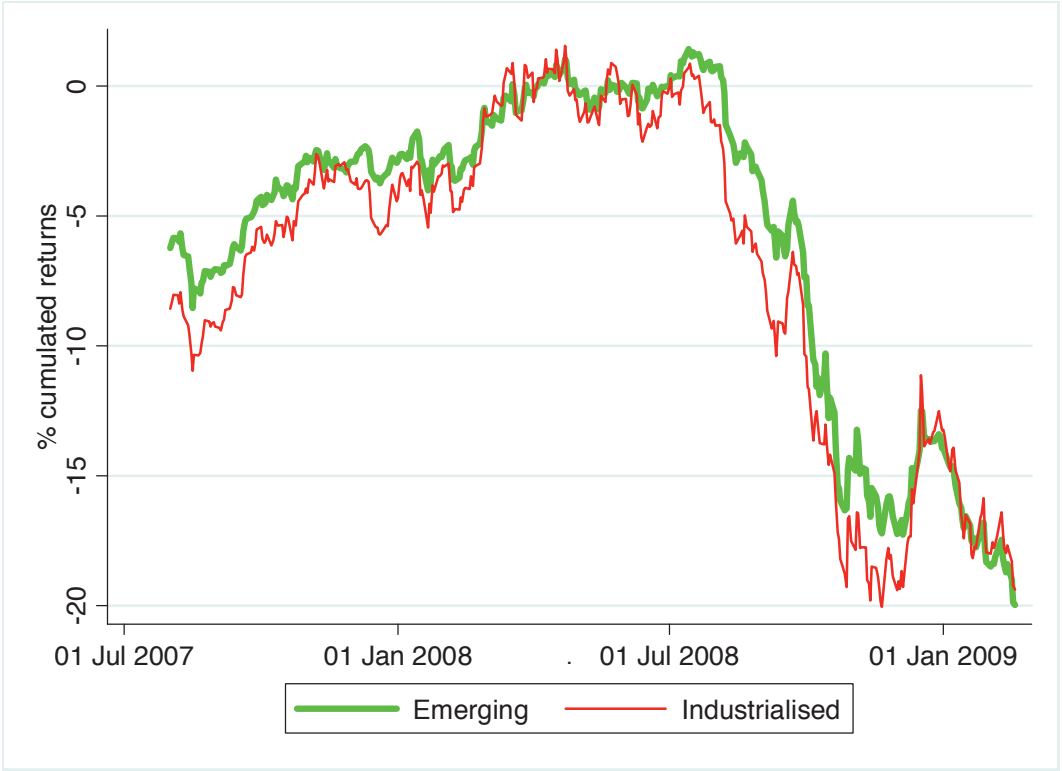
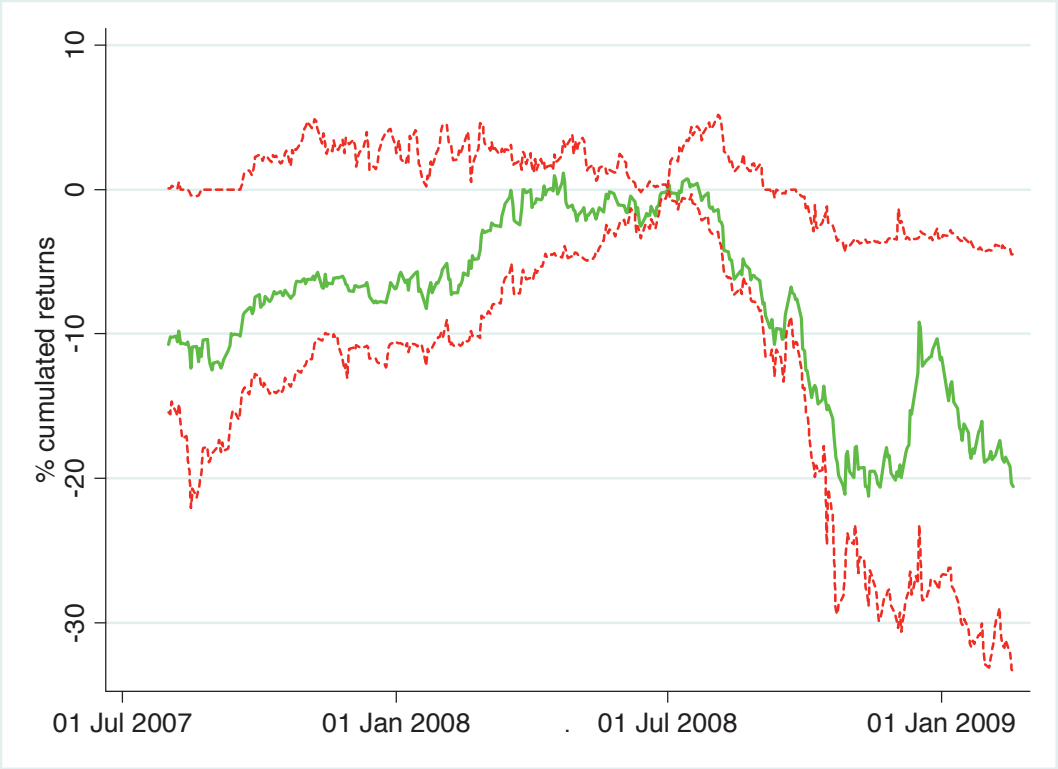
Figure 1: Bilateral USD exchange rate movements during the financial crisis – industrialized versus emerging market economies



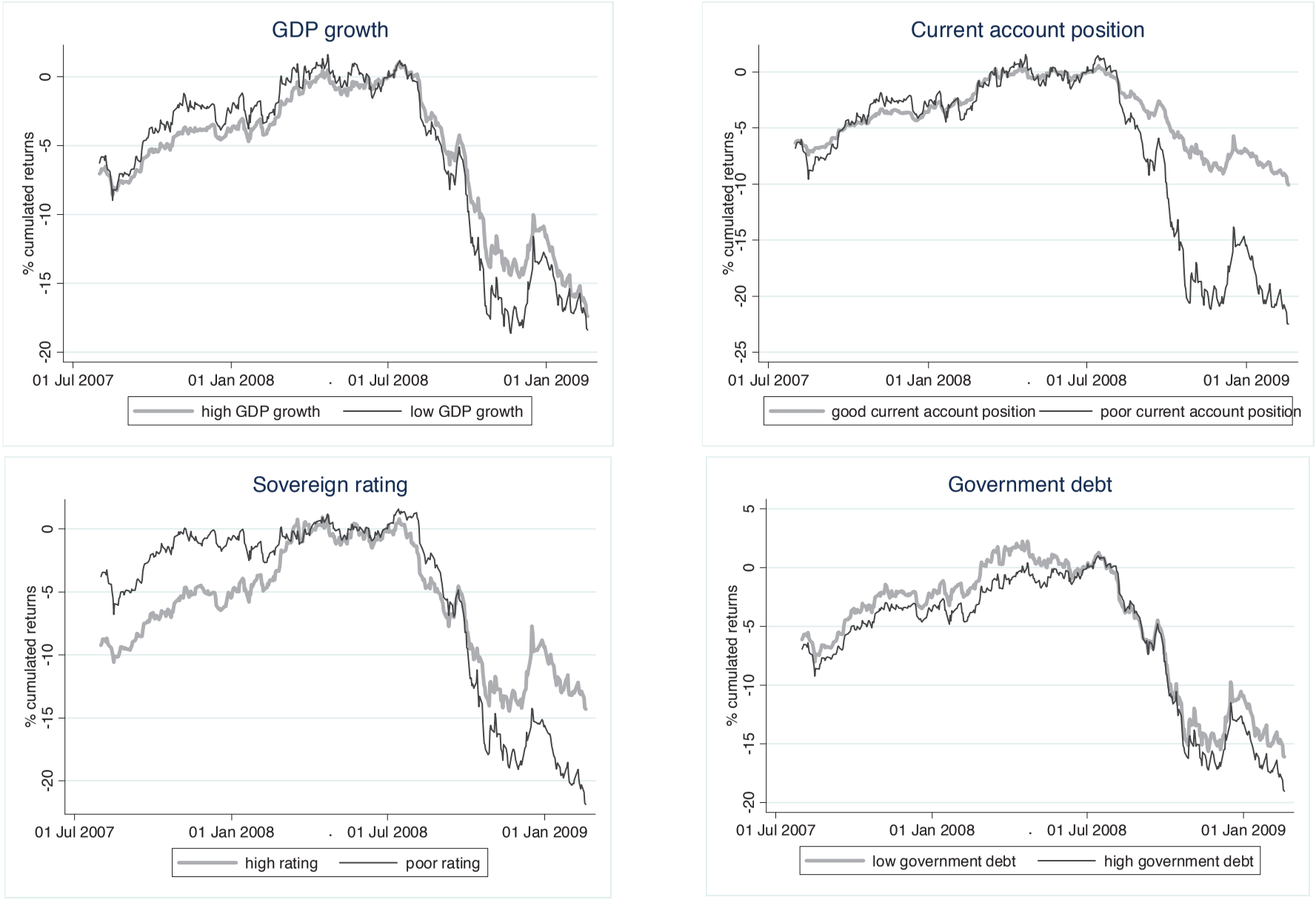
Notes: The figure shows the cumulated average (unweighted) bilateral exchange rate movements against the US dollar for 11 industrialized countries and 35 emerging market economies, excluding countries with de facto fixed exchange rate regimes vis-à-vis the US dollar. All cumulated figures are in percent relative to exchange rates on 1 July 2008.

Figure 2: Bilateral USD exchange rate movements during the financial crisis – median and heterogeneity across currencies



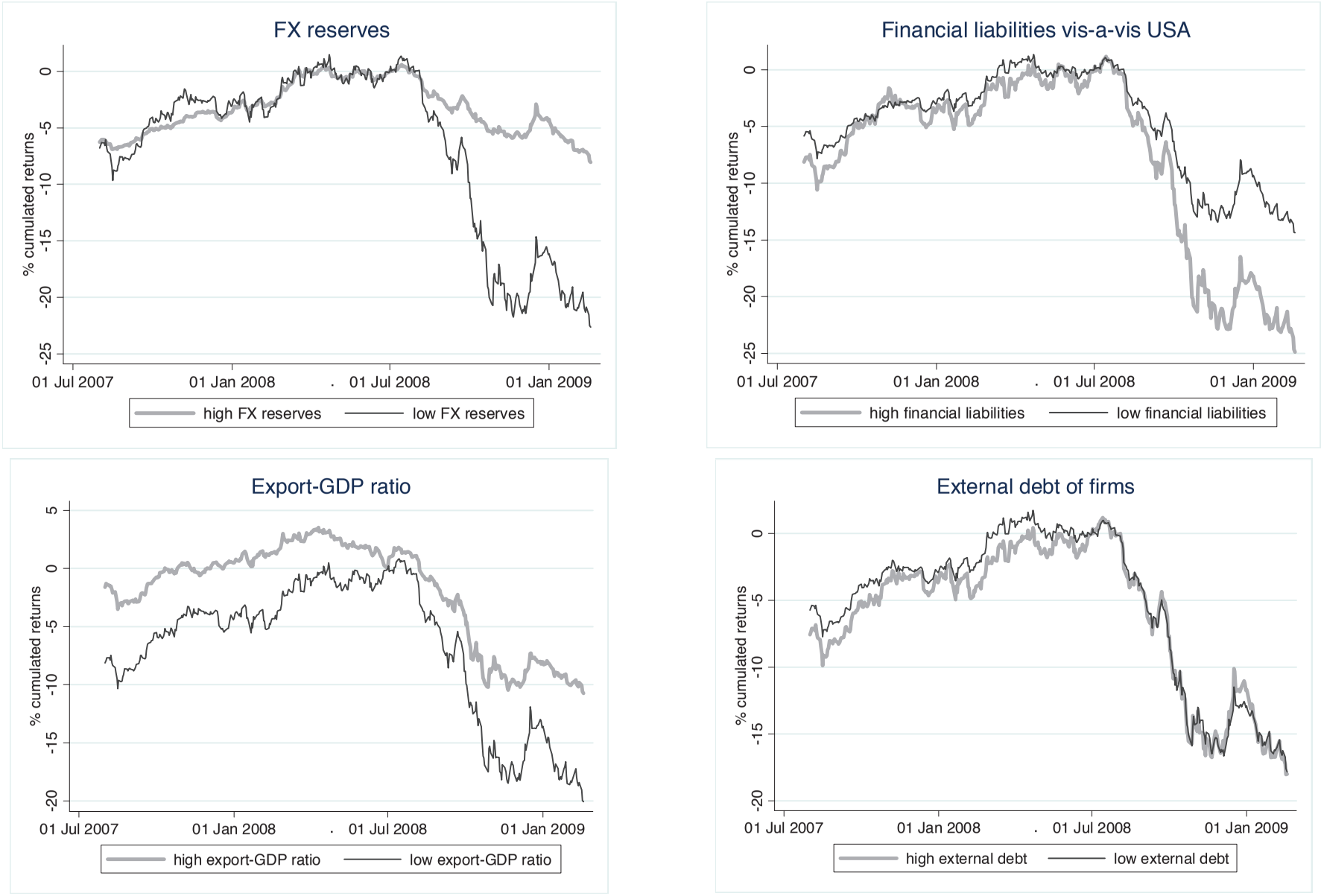
Notes: The figure shows the cumulated median bilateral exchange rate movements against the US dollar (solid line) for 11 industrialized countries and 35 emerging market economies, excluding countries with de facto fixed exchange rate regimes vis-à-vis the US dollar, together with the 10th and 90th percentiles (dashed lines). All cumulated figures are in percent relative to exchange rates on 1 July 2008.

Figure 3: Bilateral USD exchange rate movements during the financial crisis – by determinant



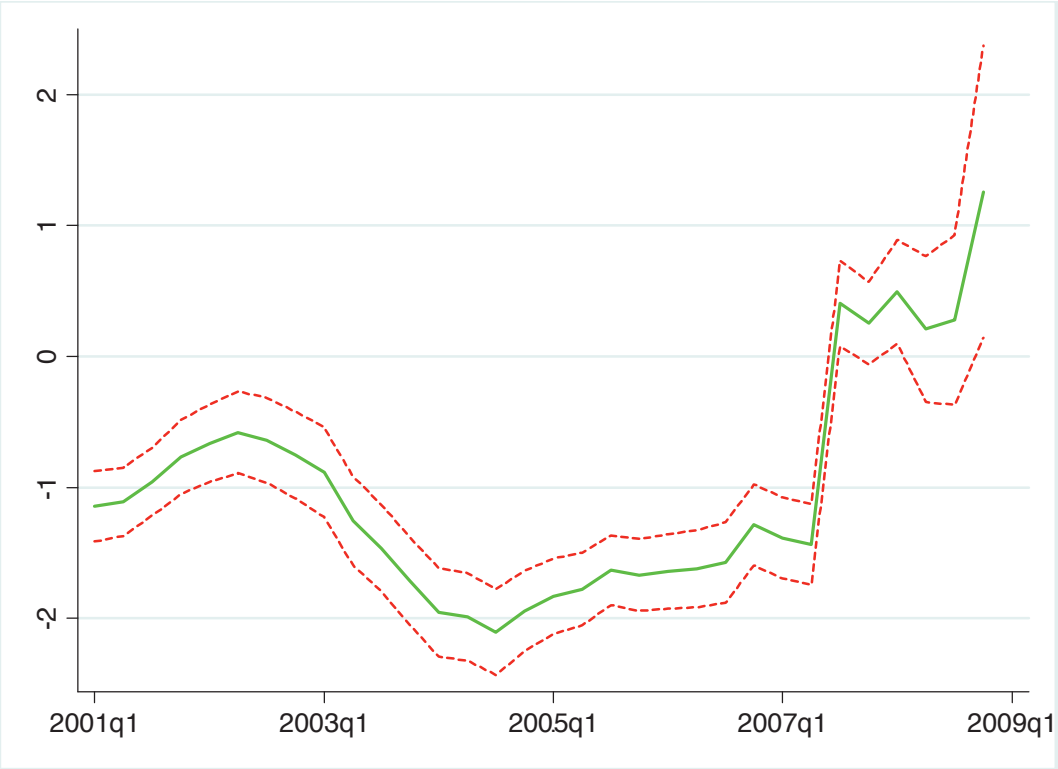
Notes: The figure shows the cumulated average (unweighted) bilateral exchange rate movements (relative to 1 July 2008) against the US dollar for 46 industrialized and emerging currencies, with each countries fundamentals grouped relative to the average for all 46 countries before the crisis.

Figure 4: Bilateral USD exchange rate movements during the financial crisis – by determinant



Notes: The figure shows the cumulated average (unweighted) bilateral exchange rate movements (relative to 1 July 2008) against the US dollar for 46 industrialized and emerging currencies, with each countries fundamentals grouped relative to the average for all 46 countries before the crisis.

Figure 5: Global FX response coefficient to US macro shocks

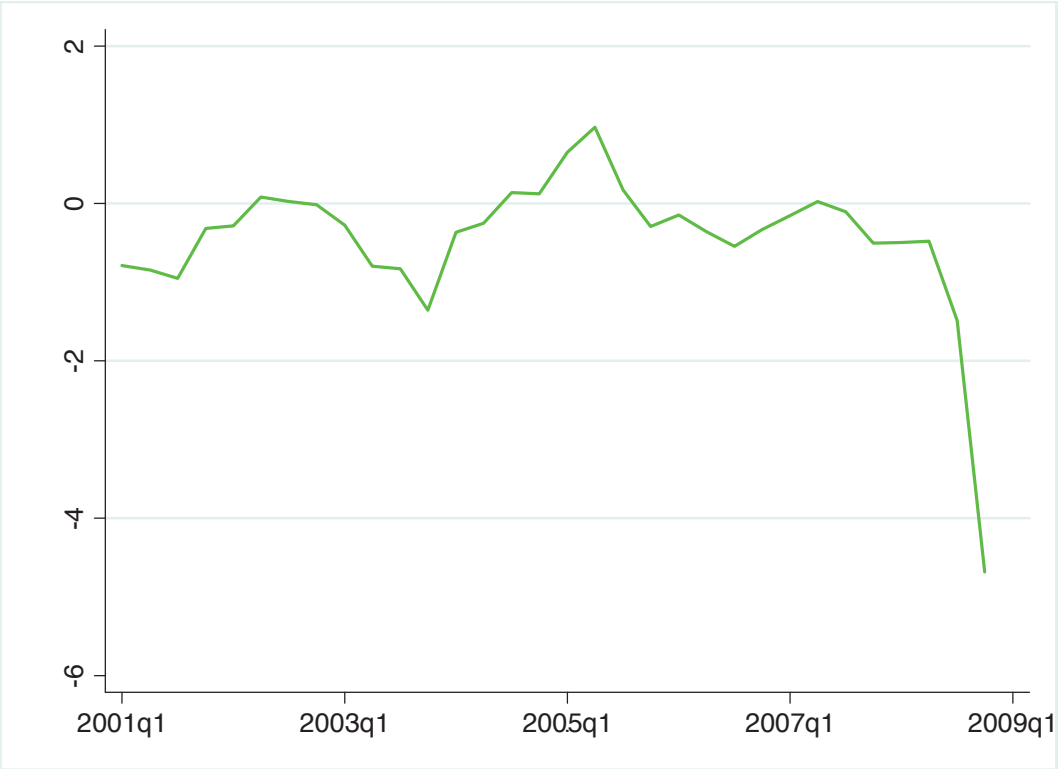


Notes: The figure shows the response coefficient δ (solid line) of exchange rates to the aggregate US macro announcement shock S^N, together with the 90 confidence band (dashed lines), based on the estimation of equation (3):

$$\Delta s_{i,t} = \alpha_i + \delta_t S_t^N + \beta X_i + \gamma Z_i + \varepsilon_{i,t} \quad (3)$$

.

Figure 6: Overall global FX reaction to US macro shocks



Notes: The figure shows the average reaction of exchange rates to US macro announcement shocks, or the fitted value ($\delta * S^N$) at any point in time based on the estimation of equation (3):

$$\Delta s_{i,t} = \alpha_i + \delta_t S_t^N + \beta X_i + \gamma Z_i + \varepsilon_{i,t} \quad (3).$$

Table 1: Country sample

Industrialised	EME Asia	EME Latin America	EME Europe	EME M. East / Africa
Australia	China	Argentina	Bulgaria	Bahrain
Canada	Hong Kong	Brazil	Croatia	Botswana
Denmark	India	Chile	Czech Republic	Egypt
Euro area	Indonesia	Colombia	Estonia	Israel
Iceland	Korea	Costa Rica	Hungary	Lebanon
Japan	Pakistan	Jamaica	Latvia	Namibia
New Zealand	Singapore	Mexico	Lithuania	Oman
Norway	Taiwan	Peru	Poland	Qatar
Sweden	Thailand	Venezuela	Romania	South Africa
Switzerland			Russia	Tunisia
UK			Serbia	Turkey
			Slovakia	UAE
			Ukraine	

Table 2: Summary statistics, macro and exposure determinants

	mean	std. dev.	min.	max.
Sovereign rating	15.8	5.0	6	22
FX reserves	16.5	18.8	0.3	83.9
GDP growth	5.3	2.5	1.6	11.8
Current account position	-1.0	7.7	-22.8	23.0
Government budget	-0.2	3.2	-7.4	8.9
Short-term interest rates	5.9	3.9	0.5	20.9
Inflation	4.5	3.3	0.2	16.2
Productivity growth	-0.2	2.9	-6.1	5.0
Trade openness	101.9	67.0	26.2	447.7
Exports to US	4.3	6.1	3.1	28.0
Imports from US	3.6	5.4	2.1	22.8
Foreign financial assets	55.8	105.7	3.9	576.9
Financial liabilities vis-à-vis USA	11.6	12.5	1.1	42.4
External debt of firms	1.6	1.0	0.3	7.2

Sources: IMF (WEO, DOTS, CPIS), Bloomberg.

Table 3: Summary statistics, US macro announcement surprises

			Surprise / shock	
Variable	Definition / Unit	Obs.	Mean	std. dev.
1. Monetary policy				
Monetary policy	in %	202	0.062	0.063
2. Real activity				
Industrial production	MoM % change	297	0.219	0.169
GDP	Quarterly YoY % change	90	0.369	0.353
NF payroll employment	MoM change (100,000)	282	0.658	0.528
Unemployment	in %	288	0.121	0.099
3. Confidence / forward-looking				
NAPM / ISM	index (around 50)	221	1.609	1.276
Consumer confidence	index (around 100)	204	3.927	3.144
Housing starts	Monthly, in 1000	297	78.94	59.99
4. Prices				
CPI	MoM % change	297	0.103	0.086
PPI	MoM % change	301	0.293	0.231
5. Net exports				
Trade balance	in USD billion	299	1.467	0.947

Sources: MMS, S&P and Bloomberg.

Table 4: Determinants of global FX movements during the financial crisis

	Benchmark			
	(1)	(2)	(3)	(4)
	coef.	coef.	coef.	coef.
	(std. err.)	(std. err.)	(std. err.)	(std. err.)
Country fundamentals:				
Sovereign rating	1.208			1.370 **
	(0.690)			*(0.634)*
FX reserves	0.281 **			0.266 **
	(0.129)			*(0.117)*
GDP growth	0.273			0.119
	(0.924)			*(0.861)*
Current account position	0.623 **			0.420 *
	(0.301)			*(0.295)*
Government budget	-0.598			-0.651
	(0.726)			*(0.653)*
Interest rate	0.177			0.350
	(0.646)			*(0.627)*
Inflation	0.890			0.532
	(0.985)			*(0.88)*
External exposure:				
Exports to US		0.007		-0.245
		(0.545)		*(0.533)*
Imports from US		0.632		0.573
		(0.611)		*(0.607)*
Foreign financial assets		0.040 **		0.025
		(0.019)		*(0.018)*
Financial liabilities vis-à-vis USA		-0.586 ***		-0.557 ***
		(0.159)		*(0.148)*
External debt of firms			-5.520 ***	-2.649
			(1.992)	*(1.993)*
Observations	54	54	54	54
R-squared	0.31	0.24	0.12	0.52

Notes: The table shows the coefficients for the relation of various country fundamentals and trade and financial linkages with the cumulated bilateral exchange rate movements against the US dollar between 1 July 2008 and 31 January 2009.

Table 5: Robustness and extensions – Determinants of global FX movements during the financial crisis

	No oil exporters, peggers				Aug. 2007 - Jan. 2009			
	(1) coef. (std. err.)		(2) coef. (std. err.)		(3) coef. (std. err.)		(4) coef. (std. err.)	
Country fundamentals:								
Sovereign rating	0.652		0.965	*	1.264	**	1.468	***
	(0.477)		*(0.481)*		*(0.577)*		*(0.540)*	
FX reserves	0.240	*	0.234	**	0.157		0.133	*
	(0.120)		*(0.109)*		*(0.107)*		*(0.074)*	
GDP growth	0.437		0.199		0.455		0.486	
	(0.83)		*(0.786)*		*(0.772)*		*(0.734)*	
Current account position	0.666	**	0.454	*	0.281	**	0.143	
	(0.289)		*(0.284)*		*-0.145*		*(0.195)*	
Government budget	-0.373		-0.452		-0.520		-0.458	
	(0.691)		*(0.618)*		*(0.607)*		*(0.556)*	
Interest rate	0.452		0.443		0.403		0.350	
	(0.618)		*(0.691)*		*(0.609)*		*(0.627)*	
Inflation	0.351		0.375		0.310		0.343	
	(0.519)		*(0.544)*		*(0.514)*		*(0.611)*	
External exposure:								
Exports to US			-0.351				-0.599	
			(0.519)				*(0.455)*	
Imports from US			0.719				0.743	
			(0.577)				*(0.517)*	
Foreign financial assets			0.024				0.008	
			(0.017)				*(0.015)*	
Financial liabilities vis-à-vis USA			-0.580	***			-0.479	***
			(0.145)				*(0.126)*	
External debt of firms			-2.140				-0.889	
			(1.851)				*(1.699)*	
Observations	46		46		54		54	
R-squared	0.29		0.51		0.25		0.46	

Notes: The table shows the coefficients for the relation of various country fundamentals and trade and financial linkages with the cumulated bilateral exchange rate movements against the US dollar, in models (1) and (2) without oil exporters between 1 July 2008 and 31 January 2009, and in models (3) and (4) between 6 August 2007 and 31 January 2009.

Table 6: The changing effect of US macro shocks during the financial crisis

	Benchmark: Before July 2008		Crisis: Since July 2008		Signif.
	coef.	*std. err.*	coef.	*std. err.*	*P value*
1. Monetary policy					
Monetary policy	-0.671 ***	*(0.158)*	3.668 ***	*(1.024)*	0.003
2. Real activity					
Industrial production	-0.040 ***	*(0.014)*	0.203 ***	*(0.054)*	0.000
GDP	-0.206 **	*(0.088)*	0.556 ***	*(0.215)*	0.089
NF payroll employment	-0.210 ***	*(0.016)*	0.363 **	*(0.145)*	0.002
Unemployment (inverse)	-0.840 ***	*(0.089)*	2.182 ***	*(0.427)*	0.000
3. Confidence / forward-looking					
NAPM / ISM	-0.203 ***	*(0.021)*	0.274 ***	*(0.093)*	0.001
Consumer confidence	-0.275 ***	*(0.036)*	0.535 **	*(0.244)*	0.000
Housing starts	-0.074 ***	*(0.026)*	-1.110 ***	*(0.270)*	0.000
4. Prices					
CPI	-0.077 ***	*(0.017)*	-0.112 ***	*(0.041)*	0.044
PPI	0.017 ***	*(0.006)*	0.018	*(0.031)*	0.597
5. Net exports					
Trade balance	-0.577 ***	*(0.069)*	2.874 ***	*(0.354)*	0.000
Observations	40,174		2,809		
Countries	54		54		

Notes: The table shows the effects of US macroeconomic news shocks on bilateral exchange rate movements against the US dollar over the indicated time periods. ***, **, and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Table 7: Robustness – the changing effect of US macro shocks during the financial crisis

	Excl. oil export. & peg Since July 2008		Advanced economies Since July 2008		Emerging economies Since July 2008		All economies Since August 2007	
	coef.	*std. err.*	coef.	*std. err.*	coef.	*std. err.*	coef.	*std. err.*
1. Monetary policy								
Monetary policy	4.106 ***	*(1.155)*	8.007 ***	*(2.930)*	2.531 **	*(1.043)*	1.611 ***	*(0.274)*
2. Real activity								
Industrial production	0.229 ***	*(0.060)*	0.21 ***	*(0.057)*	0.201 ***	*(0.066)*	0.191 ***	*(0.048)*
GDP	0.614 **	*(0.241)*	1.088 **	*(0.437)*	0.417 *	*(0.241)*	-0.188	*(0.191)*
NF payroll employment	0.406 **	*(0.163)*	0.108	*(0.584)*	0.43 ***	*(0.101)*	0.159 **	*(0.075)*
Unemployment (inverse)	2.493 ***	*(0.475)*	2.767 ***	*(0.760)*	2.029 ***	*(0.491)*	0.187	*(0.194)*
3. Confidence / forward-looking								
NAPM / ISM	0.308 ***	*(0.105)*	0.251	*(0.275)*	0.28 ***	*(0.094)*	0.117 *	*(0.066)*
Consumer confidence	0.607 **	*(0.277)*	1.820 ***	*(0.552)*	0.199	*(0.266)*	-0.021	*(0.156)*
Housing starts	-1.243 ***	*(0.306)*	-1.561 ***	*(0.603)*	-0.992 ***	*(0.302)*	-0.071	*(0.125)*
4. Prices								
CPI	-0.128 ***	*(0.046)*	-0.283 ***	*(0.092)*	-0.068	*(0.046)*	-0.214 ***	*(0.032)*
PPI	0.02	*(0.034)*	0.107	*(0.068)*	-0.005	*(0.034)*	-0.001	*(0.013)*
5. Net exports								
Trade balance	3.24 ***	*(0.395)*	4.404 ***	*(0.860)*	2.473 ***	*(0.382)*	1.562 ***	*(0.198)*
Observations	2,491		583		2,226		7,791	
Countries	46		11		43		54	

Notes: The table shows the effects of US macroeconomic news shocks on bilateral exchange rate movements against the US dollar over the indicated time periods and country groups. ***, **, and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Table 8: Determinants of US shock transmission during the financial crisis

	FX reserves		Current account		Financial liab.s vis-à-vis USA		Growth		Exports to US	
	US shock	*interaction*	US shock	*interaction*	US shock	*interaction*	US shock	*interaction*	US shock	*interaction*
1. Monetary policy										
Monetary policy	5.355 ***	-0.082 **	3.646 ***	-0.246 **	4.873 ***	0.234	7.55 **	-0.627	4.764 ***	-0.162
	(1.552)	*(0.032)*	*(1.124)*	*(0.123)*	*(1.426)*	*(0.16)*	*(3.306)*	*(0.479)*	*(1.475)*	*(0.149)*
2. Real activity										
Industrial production	0.322 ***	0.021 ***	0.205 ***	0.033	0.247 ***	0.095 ***	0.366 ***	0.19	0.254 ***	0.006
	(0.077)	*(0.008)*	*(0.058)*	*(0.029)*	*(0.075)*	*(0.045)*	*(0.141)*	*(0.118)*	*(0.077)*	*(0.04)*
GDP	0.958 ***	-0.01 ***	0.515 **	0.025	0.78 ***	0.034 **	1.236 *	-0.02	0.824 ***	0.009
	(0.328)	*(0.003)*	*(0.245)*	*(0.034)*	*(0.300)*	*(0.018)*	*(0.671)*	*(0.049)*	*(0.309)*	*(0.016)*
NF payroll employment	0.56 ***	-0.006 **	0.419 ***	-0.033 **	0.418 **	0.026 ***	0.494	0.017	0.339	-0.022 ***
	(0.189)	*(0.003)*	*(0.135)*	*(0.016)*	*(0.174)*	*(0.010)*	*(0.397)*	*(0.042)*	*(0.211)*	*(0.008)*
Unemployment (inverse	2.928 ***	-0.036 ***	2.423 ***	-0.054 ***	2.757 ***	0.123 ***	3.018 ***	-0.091	2.79 ***	-0.063
	(0.626)	*(0.014)*	*(0.470)*	*(0.022)*	*(0.571)*	*(0.048)*	*(1.109)*	*(0.18)*	*(0.596)*	*(0.063)*
3. Confidence / forward-looking										
NAPM / ISM	0.394 ***	-0.006 ***	0.304 ***	-0.014 **	0.399 ***	-0.005	0.209	-0.025	0.405 ***	-0.006
	(0.128)	*(0.002)*	*(0.101)*	*(0.006)*	*(0.118)*	*(0.009)*	*(0.268)*	*(0.017)*	*(0.130)*	*(0.008)*
Consumer confidence	0.593	-0.019 *	0.563 *	-0.053 *	0.622 *	0.051 *	0.662	-0.114	0.558	-0.05 **
	(0.363)	*(0.010)*	*(0.290)*	*(0.030)*	*(0.367)*	*(0.030)*	*(0.706)*	*(0.1)*	*(0.374)*	*(0.024)*
Housing starts	-1.551 ***	0.010	-1.252 ***	-0.02 **	-1.318 ***	0.004	-2.37 ***	-0.014	-1.329 ***	-0.001
	(0.417)	*(0.001)*	*(0.305)*	*(0.009)*	*(0.384)*	*(0.008)*	*(0.824)*	*(0.018)*	*(0.392)*	*(0.006)*
4. Prices										
CPI	-0.115 *	-0.003	-0.121 ***	-0.021	-0.107 *	-0.007	-0.045	-0.012	-0.119 **	0.008
	(0.062)	*(0.01)*	*(0.046)*	*(0.031)*	*(0.059)*	*(0.033)*	*(0.116)*	*(0.094)*	*(0.058)*	*(0.028)*
PPI	0.027	0.010	0.019	0	0.019	0	0.125	-0.019	0.014	0.001
	(0.045)	*(0.001)*	*(0.034)*	*(0.004)*	*(0.044)*	*(0.006)*	*(0.083)*	*(0.013)*	*(0.045)*	*(0.004)*
5. Net exports										
Trade balance	4.206 ***	-0.065 ***	3.043 ***	-0.122 ***	3.587 ***	-0.098	4.023 ***	-0.141	3.528 ***	-0.065
	(0.504)	*(0.012)*	*(0.389)*	*(0.044)*	*(0.507)*	*(0.06)*	*(1.121)*	*(0.176)*	*(0.508)*	*(0.052)*
Observations	2809		2809		2809		2809		2809	
Countries	54		54		54		54		54	

Notes: The table shows the effects of US macroeconomic news shocks on bilateral exchange rate movements against the US dollar during the crisis period, adding an interaction term of the respective shock with the fundamental indicated in the columns. ***, **, and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

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