

## Global liquidity, foreign exchange reserves and exchange rates of emerging market economies

*Global factors such as the provision of liquidity by central banks or the assessment of risk in the international equity markets have a significant impact on the capital flows between advanced economies and emerging market economies (EMEs). This recently became apparent in the context of the international financial crisis. An increase in global liquidity in times of low tension in the financial markets tends to exert upward pressure on the currencies of EMEs as investors from advanced economies are prepared to take greater risks in their pursuit of higher yields. However, this increases recipient countries' vulnerability to turnarounds in sentiment if there is a change in risk assessment in the international financial markets.*

*Abrupt reactions in the exchange rate can be overwhelming to the adjustment potential of smaller (emerging market) economies, in particular, and weigh on the relevant country's financial sector. As capital controls are often associated with major drawbacks and macroprudential measures may not suffice to absorb significant exogenous shocks, many EMEs try to stabilise or even completely fix the exchange rate of their currency by intervening in the foreign exchange market. This requires the accumulation of an adequate cushion of foreign exchange reserves. However, the eligible forms of investment produce comparatively low yields, which is why reserve holdings are usually associated with opportunity costs. Empirical studies conducted by the Bundesbank show that foreign exchange reserves can offer preventive protection against tensions in the foreign exchange markets. The relationship between reserve holdings and the stabilisation of the exchange rate is not linear, however; holding "excessive" foreign exchange reserves does not bring any additional benefit. Overall, a healthy mix of policy measures which takes into account the entire economic development of the relevant country seems to be the best way for EMEs to hedge against financial turmoil. Monetary policy decision-makers in the industrial countries ought to consider the impact of their monetary policy decisions on the exchange rates and capital flows of EMEs, as these have repercussions on the process of ensuring price and financial stability in the industrial countries' own currency areas.*

## Capital flows and exchange rate movements

*High capital flows into EMEs*

Over the past few years, the experiences of some EMEs in the context of the global financial crisis have highlighted the strong impact of global factors on international capital flows. After the turn of the millennium, many EMEs initially recorded a steady rise in gross capital inflows; this was followed by the outbreak of the financial crisis in autumn 2008, when international capital flows plummeted and the flow of funds into EMEs declined significantly. Within a short space of time, EMEs' currencies recorded in some cases considerable losses against the US dollar.<sup>1</sup> Yet, from 2010 onwards, the low interest rates in the industrial countries – the result of an expansionary monetary policy pursued by various central banks, not least the US Fed's securities purchase programme (quantitative easing) – increasingly steered international capital flows back towards the higher-yielding assets of EMEs in Asia, Europe and Latin America which were not directly affected by the financial crisis.

*Tapering talk provoked strong reactions in foreign exchange markets of EMEs*

The brief debate about whether the US Fed was going to taper its securities purchases in spring 2013 (tapering talk) was accompanied by noticeable exchange rate reactions in the foreign exchange markets and capital outflows from some EMEs. For instance, the Brazilian real and the Uruguayan peso depreciated by more than 11% against the US dollar within three months (from end-April to end-July 2013).<sup>2</sup> The reactions by private investors, however, were relatively short-lived and limited to a few months.

*Decline in capital inflows in subsequent years*

However, in the two subsequent years, international investment in EMEs fell significantly. The decline affected EMEs in Asia – China in particular – more strongly than those in Europe and Latin America. With regard to investment instruments, developments were mainly driven by the fact that net purchases of EMEs' debt securities came to a halt. Amongst other things, this is likely to have been caused by the actual

scale-back of the Fed's monthly purchasing volume at the time and the complete cessation of its purchase programme in October 2014.<sup>3</sup> It is also striking, however, that lending by foreign banks to borrowers in China was negative in this period; this is likely to have been linked to doubts arising about China's economic development. In summer 2015, these doubts additionally led to severe losses on Chinese equities.

## Importance of global factors

Empirical studies have unanimously demonstrated that capital flows between advanced economies and EMEs are largely influenced by factors such as the monetary policy of major economies' central banks, risk assessment in the international equity markets and economic cycles across the globe.<sup>4</sup> Although it is true that some importance can be attributed to the differences in growth between recipient and origin countries, individual countries are limited in their ability to go beyond growth-enhancing policies and influence capital inflows and outflows through targeted economic policy measures.<sup>5</sup>

*Dependence on global determinants ...*

<sup>1</sup> The 32 EME currencies examined in greater detail in this article depreciated by an average of around 13% against the US dollar between end-June 2008 and end-December 2008. However, exchange rate reactions varied considerably across countries.

<sup>2</sup> On average, the 32 EME currencies reviewed here depreciated by around 3½% against the US dollar in this period.

<sup>3</sup> Indirect effects resulting from portfolio shifts by private investors played a role in this context. At no point did the Fed purchase securities issued by EMEs.

<sup>4</sup> See, for example, K Forbes and F Warnock (2012), Capital Flow Waves: Surges, Stops, Flight and Retrenchment, *Journal of International Economics* 88(2), pp 235-251; J Aizenman, M D Chinn and H Ito (2015), Monetary Policy Spillovers and the Trilemma in the New Normal: Periphery Country Sensitivity to Core Country Conditions, NBER Working Paper 21128; P Anaya et al (2017), Spillovers of US unconventional monetary policy to emerging markets: The role of capital flows, *Journal of International Money and Finance* 73, pp 275-295; or IMF (2016), Understanding the Slowdown in Capital Flows in Emerging Markets, *World Economic Outlook*, April 2016, Chapter 2, pp 63-99.

<sup>5</sup> See, for example, H Shin (2012), Global Banking Glut and Loan Risk Premium, *IMF Economic Review*, 60, pp 155-192; or H Rey (2015), Dilemma not Trilemma: The Global Financial Cycle and Monetary Policy Independence, NBER Working Paper 21162.

... justifies  
 macroprudential  
 precautionary  
 measures

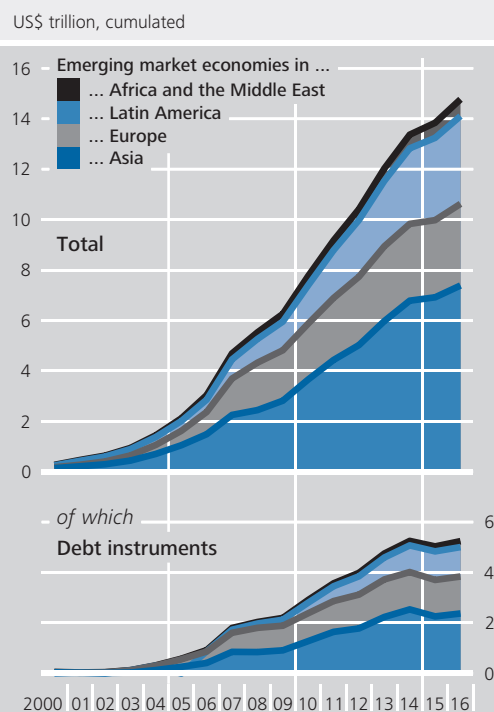
This substantial dependence of EMEs on the financing conditions in place in mature economies triggered a discussion in the academic literature and in international organisations such as the International Monetary Fund (IMF); this discussion has led to interventions in the free movement of capital being carefully reassessed. In particular, macroprudential policy measures, which are aimed at preventing systemic crises in the financial system and may range from a more in-depth communication of warnings to specific provisions for ensuring a risk buffer, are deemed to be an integral part of a successful policy mix nowadays.<sup>6</sup> However, measures that explicitly distinguish between residents and non-residents in a discriminatory manner (ie in the form of capital controls), in particular, risk not being deployed to achieve the primary objectives and, instead, being abused for protectionist purposes, thereby provoking retaliatory measures by non-residents. This would result in welfare losses.

It is for this reason that a policy aimed at preventing sudden capital reversals and the associated harmful consequences for macroeconomic stability is, generally speaking, preferable to compromising a country's capital movements altogether.

Accumulation  
 of foreign  
 exchange  
 reserves

A widely used tool in this context is the holding of foreign exchange reserves. In principle, there are a number of conceivable motives for accumulating reserves. On the one hand, EMEs could pursue "mercantilist motives", gaining a competitive advantage at the international level by accumulating reserves to weaken their own currency. On the other hand, they could prepare for a scenario where sudden capital outflows might – without any intervention in the foreign exchange market – be followed by a sharp depreciation in the domestic currency along with the resulting risks to financial stability.<sup>7</sup> If an EME has sufficient foreign exchange reserves, it may avoid an excessive depreciation of its own currency by selling off these reserves, thus breaking or at least mitigating the transmission mechanism outlined above. However,

### Gross capital flows into emerging market economies\*



Sources: Haver Analytics and Bundesbank calculations. \* Based on data from 40 emerging market economies in the specified regions.  
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reserve holdings usually entail opportunity costs (see also page 22).

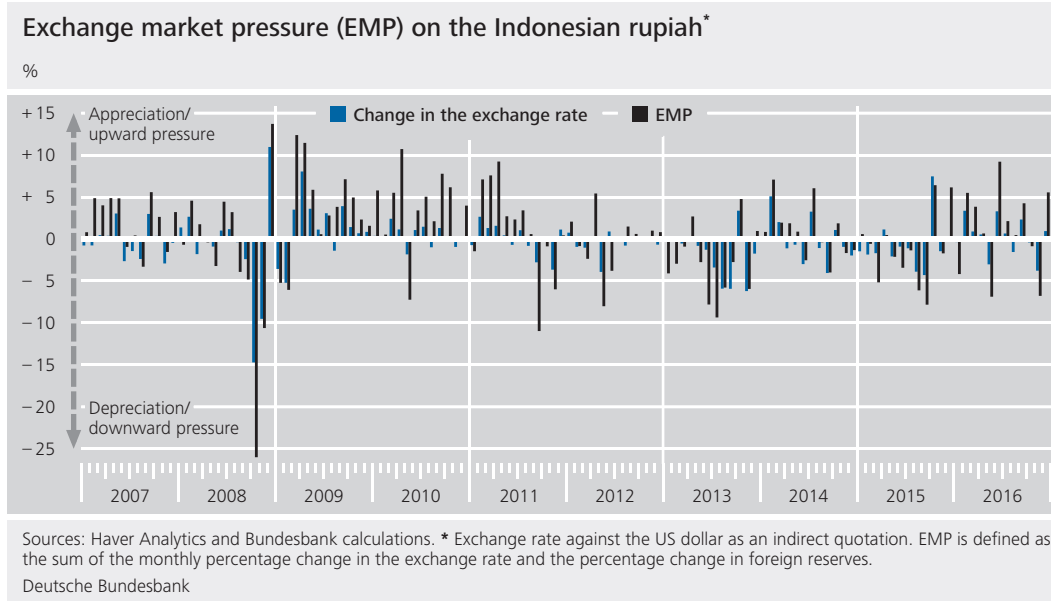
## Exchange market pressure

In order to adequately convey the interaction between exchange rate reactions and changes in the foreign exchange reserves amidst tension in the foreign exchange markets, the concept of exchange market pressure (EMP) was introduced in the literature. In its simplest form, EMP is calculated as the sum of the rates of change in the exchange rate and in foreign ex-

Exchange market pressure combines changes in exchange rate and foreign exchange reserves

<sup>6</sup> See IMF (2012), *The Liberalization and Management of Capital Flows: An Institutional View*; and G20, *Coherent Conclusions for the Management of Capital Flows Drawing on Country Experiences as endorsed by G20 Finance Ministers and Central Bank Governors*, 15 October 2011.

<sup>7</sup> If the value of the domestic currency depreciates against another currency in which loans have previously been taken out (ie foreign currency loans), this implies an increase in the real debt burden per se.



change reserves.<sup>8</sup> A positive (negative) value indicates upward (downward) pressure on the domestic currency, ie either an increase (decrease) in foreign exchange reserves and/or an appreciation (depreciation) of the domestic currency against the currency of the base country (in this case, the US dollar). The underlying assumption of this definition is the notion that a country's own currency would appreciate to a greater or depreciate to a lesser extent had it not purchased foreign currency, ie if the domestic currency were in shorter supply.

The concept of EMP can be illustrated by the example of the Indonesian rupiah and its exchange rate against the US dollar following the outbreak of the financial crisis (see the above chart). The downward pressure on the Indonesian rupiah was higher than the actual depreciation both when Lehman Brothers collapsed in autumn 2008 and in the wake of the tapering talk in spring 2013. This was attributable to a decrease in foreign exchange reserves, causing depreciation to weaken.<sup>9</sup> By contrast, in the majority of the other observations depicted here, the upward pressure was higher than the actual appreciation. This pattern is consistent with the hypothesis that reserves were accumulated for precautionary reasons in order to later mitigate exchange rate reactions.

## Global liquidity and exchange market pressure in EMEs

In the context of the debate on possible side effects of the expansionary monetary policy stance of the industrial countries, international effects are examined alongside potential domestic effects such as the distortion of asset prices. A number of studies have thus shown that capital inflows into EMEs have increased in the wake of the advanced economies' more expansionary monetary policy stance. By contrast, the impact on the foreign exchange markets of EMEs has been studied less. This is pre-

*International side effects of the expansionary monetary policy*

<sup>8</sup> The exchange rate is shown as an indirect quotation here, ie in units of foreign currency per unit of domestic currency. In the original definition in L Girton and D Roper (1977), *A Monetary Model of Exchange Market Pressure Applied to the Postwar Canadian Experience*, *American Economic Review*, 67(4), pp 537-548, instead of the rate of change in foreign exchange reserves, the absolute change in foreign exchange reserves is divided by the monetary base of the previous period. However, O Hossfeld and M Pramor in *Global Liquidity and Exchange Market Pressure in Emerging Market Economies*, Deutsche Bundesbank Discussion Paper, forthcoming, show that the two measures of EMP are very highly correlated (for more on the different definitions, see also pp 19-20).

<sup>9</sup> The gap between the EMP and the rate of change in the exchange rate does not provide straightforward insights into how strong the exchange rate reaction would have been without an intervention in the foreign exchange market; it merely indicates whether the sign is positive or negative. To make an exact statement about the scope, one would first need to estimate how strongly the exchange rate reacts to interventions in the foreign exchange market.

sumably attributable to the fact that the exchange rates in many EMEs over the last few decades were typically not freely flexible, but were to some extent at least influenced by the authorities (eg fixed exchange rates, currency board arrangements or exchange rate bands), making the results less meaningful if only the exchange rate movements are considered.<sup>10</sup>

*International  
 monetary policy  
 transmission  
 channels*

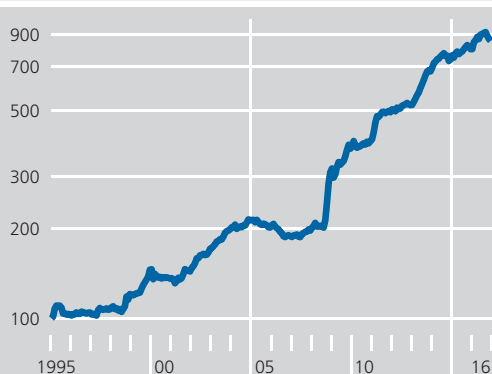
For the reasons above, the impact of global liquidity on the exchange market pressure in EMEs was examined in a recent empirical study by the Bundesbank. Before analysing the empirical evidence, the fundamental question concerns the transmission channels through which monetary policy changes in advanced economies are able to impact on capital inflows and ultimately on the exchange market pressure in EMEs. Three closely intertwined and potentially mutually reinforcing channels are identified in the literature: the classic carry trade channel, the risk-taking channel and the funding liquidity channel.

Speculative transactions within which investors seeking higher yields try to exploit international interest rate differentials without hedging the exchange rate risk are known as carry trades.<sup>11</sup> A declining interest rate level in the advanced economies amidst an unchanged interest rate level in the EMEs would accordingly result in a widened interest rate differential, thus increasing the appeal of carry trade positions in the currencies of EMEs.

Furthermore, monetary policy decisions may have an impact on market participants' willingness to take risky positions (referred to as the risk-taking channel). In this way, according to a study by Bruno and Shin (2015), a restrictive monetary policy shock results in reduced cross-border capital flows by means of an intensified deleveraging of banks.<sup>12</sup> Closely related to this, an increase in short-term funding liquidity leads to a boost in international investors' risk-taking propensity (known as the funding liquidity channel), according to Adrian (2015).<sup>13</sup>

### Monetary liquidity\*

January 1995 = 100, monthly, log scale



Sources: Board of Governors of the Federal Reserve System (United States), Bank of Japan and Bundesbank calculations.  
 \* Based on the sum of the monetary basis of Japan, the United Kingdom and the United States in US dollars.

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An analysis of the link between global liquidity and exchange market pressure in EMEs is first hampered by the fact that there is no standard definition of exchange market pressure in the literature; rather, a large number of competing definitions exist. Second, the concept of global liquidity is multifaceted, meaning that it is both more difficult to grasp and ultimately definition-dependent.<sup>14</sup> Although the various indicators do have a common core, namely the ease of funding, the Bundesbank's analysis shows that not all indicators are highly correlated with each other.

*Multifaceted  
 global liquidity*

On the basis of panel regressions with fixed country effects over the period from 1995 to

<sup>10</sup> Of the 32 EMEs in the study, only six had fully flexible exchange rates over the entire observation period from 1995 to 2015, according to the IMF's classification system.

<sup>11</sup> See Deutsche Bundesbank, Exchange rates and financial stress, Monthly Report, July 2014, pp 15-28. See also M K Brunnermeier, S Nagel and L H Pedersen (2008), Carry Trades and Currency Crashes, NBER Macroeconomics Annual, 23(1), pp 313-348, and L Menkhoff, L Sarno, M Schmeling and A Schrimpf (2012), Carry Trades and Global Foreign Exchange Volatility, Journal of Finance, 67(2), pp 681-718.

<sup>12</sup> See V Bruno and H S Shin (2015), Capital Flows and the Risk-Taking Channel of Monetary Policy, Journal of Monetary Economics, 71, pp 119-132.

<sup>13</sup> See T Adrian, E Etula and H S Shin (2015), Risk Appetite and Exchange Rates, Staff Report, Federal Reserve Bank of New York.

<sup>14</sup> See ECB, Financial Stability Review (2012), pp 140 ff and BIS (2011), Global Liquidity – Concept, Measurement and Policy Implications, CGFS Paper No 45.

## Global liquidity and exchange market pressure in emerging market economies

The aim of the econometric analysis presented here is to estimate the impact of global liquidity on exchange market pressure (EMP) in emerging market economies (EMEs).<sup>1</sup> The analysis is complicated by the fact that there is neither a clear definition of global liquidity nor an indisputable definition of EMP. In view of this, the study takes into account a variety of global liquidity indicators so as to reflect the multifaceted concept as accurately as possible. A simple correlation analysis of the indicators examined in the study also shows the need for this approach, since at least some of the indicators are only weakly contemporaneously correlated.

For the sake of simplicity and clarity, the econometric model on which the analysis is based and the estimation results are initially examined for a selected definition of EMP and three different liquidity indicators only. The econometric model, which was estimated using panel fixed effects regressions with 32 EMEs and monthly data from January 1995 to December 2015, is:

$$\begin{aligned} \text{EMP}_{it} = & \beta_0 i + \beta_1 (i_{i,t-1} - i_{i,t-1}^{\text{US}}) \\ & + \beta_2 (\pi_{i,t-1} - \pi_{i,t-1}^{\text{US}}) \\ & + \beta_3 \text{GL}_{jt} + \phi'_1 x_{i,t-1} + \phi'_2 f_t + v_{it}. \end{aligned}$$

The dependent variable  $\text{EMP}_{it}$  measures EMP in country  $i$  at time  $t$ . It is calculated as the sum of the percentage change in the exchange rate and the percentage change in foreign exchange reserves compared with the previous period.<sup>2</sup> An increase represents appreciation in the exchange rate and/or an increase in foreign exchange reserves. This definition of EMP is based on the notion that exchange rate appreciation (depreciation) would have been more pronounced if a central bank had not inter-

vened in the foreign exchange market by purchasing (selling) foreign currency and thus weakening (strengthening) its own currency.

The explanatory variable  $\text{GL}_{jt}$  denotes one of three alternative liquidity measures, which are used in turn as the regressor in the model:  $\text{GL}_{jt} \in \{\text{MB}_t, \text{TC}_t, \text{BL}_t\}$ . Here,  $\text{MB}_t$  represents the aggregate monetary base of selected advanced economies converted into US dollars,  $\text{TC}_t$  denotes total credit in advanced economies and  $\text{BL}_t$  stands for the bank leverage ratio.<sup>3</sup> Since both the monetary base and total credit are non-stationary, these two variables are incorporated into the regression as differences in the logarithms, ie as growth rates.

In addition to the respective liquidity indicator, the model contains a variety of control variables so as to reduce the risk of a biased estimator. The term  $(i_{i,t-1} - i_{i,t-1}^{\text{US}})$  denotes the interest rate differential between the respective EME and the United States in the previous period and  $(\pi_{i,t-1} - \pi_{i,t-1}^{\text{US}})$  represents the difference in inflation rates, while the vector  $x_{i,t-1}$  comprises further control variables (dummy variables for a banking crisis and sovereign debt crisis and a measure of a country's level of financial openness). The vector  $f_t$  includes other global factors that could have an impact on EMP in EMEs. These include energy prices, com-

<sup>1</sup> See O Hossfeld and M Pramor, Global Liquidity and Exchange Market Pressure in Emerging Market Economies, Deutsche Bundesbank Discussion Paper, forthcoming.

<sup>2</sup> The exchange rate is defined here as an indirect quotation against the US dollar.

<sup>3</sup> As the study's observation period begins in 1995, ie prior to the introduction of the euro, the aggregate monetary base is calculated as the sum of the monetary bases of Japan, the United Kingdom and the United States only.



modity prices (excluding energy) and global financial market uncertainty. The latter is approximated by the VIX, a measure of volatility for the US equity market, which is usually applied in the literature as a measure of global uncertainty. The adjacent table shows the estimation results for the simple measurement of EMP above and the three selected liquidity indicators.<sup>4</sup>

It is noteworthy that, for each of the three liquidity measures, irrespective of whether the monetary base, total credit or the bank leverage ratio is used as the liquidity indicator, an increase in the respective indicator is always associated with upward pressure on EME currencies.

However, as there is no consensus in the literature as to how precisely EMP should be defined – in terms of standardised weights or potentially also taking into account an interest rate component, for instance – it may be the case that the results only apply to the above definition of EMP.<sup>5</sup> To investigate this issue, the validity of the results, at least in qualitative terms, when using other conventional definitions of EMP was explored. The findings show that the core result remains virtually unchanged – in other words, it is extremely robust.

The table at the top of page 20 shows a schematic overview of the estimation results for eight different definitions of EMP and seven indicators of global liquidity, as well as for a slightly modified model specification for EMP measures that include an interest rate component in addition to the exchange rate and foreign exchange reserve components.<sup>6</sup>

Ultimately, the question arises as to whether the manner in which EMP responds to changes in global liquidity hinges on the degree of tension on the financial markets

### Comparison of estimation results for selected liquidity indicators

Determinant	EMP	EMP	EMP
$(i_{t-1} - i_{t-1}^{US})$	-0.029	-0.039*	-0.034
$(\pi_{t-1} - \pi_{t-1}^{US})$	0.018*	-0.013	0.018*
Banking crisis <sub>t-1</sub>	-5.888***	-6.335***	-6.768***
Sovereign debt crisis <sub>t-1</sub>	0.248	1.636	0.415
Level of financial openness <sub>t-1</sub>	0.521	-0.576	0.049
$\Delta \ln$ (commodity prices <sub>t</sub> )	0.370***	0.268***	0.339***
$\Delta \ln$ (energy prices <sub>t</sub> )	0.033	0.028	0.020
$\Delta \ln$ (VIX <sub>t</sub> )	-0.033***	-0.039***	-0.035***
$\Delta \ln$ (MB <sub>t</sub> )	0.145**		
$\Delta \ln$ (TC <sub>t</sub> )		0.988***	
Bank leverage <sub>t-1</sub>			0.312***

\*\*\* / \*\* / \* denote significance at the 1%/5%/10% level.

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– the anecdotal evidence seems to point in this direction, at any rate. To explore this issue, regime-specific regressions were estimated, meaning that the estimated coefficients may differ depending on the regime. Observations of points in time at which the value of the VIX is below its 90% quantile are assigned to the low tension regime, while the rest are assigned to the high tension regime. The results for the standard

<sup>4</sup> The impact of two of the global factors, namely commodity prices and energy prices, on EMP were initially estimated heterogeneously, ie by country. As the estimation results for the key variables remain virtually unaffected by dropping homogeneity restrictions, however, the table here likewise contains only the homogeneous estimation results for the purpose of providing a clear overview. In the discussion paper, estimation results based on an expanded model with additional control variables are also presented. These do not differ substantially in qualitative terms from the results presented here, though.

<sup>5</sup> The rationale behind taking into account an interest rate component when calculating EMP is that an interest rate cut makes investing in domestic currency less attractive, thus lowering EMP.

<sup>6</sup> In this case, the model's explanatory variable is no longer the differential between interest rates at home and abroad but rather US interest rate growth; this prevents regressor endogeneity.

### Robustness of estimation results in terms of how exchange market pressure (EMP) is defined and which liquidity indicator is selected<sup>o</sup>

Liquidity indicator	Baseline model								Modified model			
	EMP measure											
	1	1s	2	2s	3	3s	4	4s	3	3s	4	4s
MB	+	+	+	+	0	+	0	+	0	+	0	+
M3	+	+	+	+	+	+	0	+	+	+	0	+
TC	+	+	+	+	+	+	+	+	+	+	+	+
GAP	+	+	+	+	+	+	+	+	0	+	0	+
CP	+	+	+	+	0	+	0	+	0	+	0	+
BL	+	+	+	+	0	+	0	+	0	0	0	0
TED	0	0	0	0	0	0	0	0	0	0	0	0

<sup>o</sup> The table shows the signs of the estimated coefficients depending on the selected model specification. A plus sign (“+”) indicates a particular liquidity indicator’s positive impact on the respective EMP measure. Coefficients that do not deviate significantly from zero at a significance level of 10% are marked as “0”. MB and M3 are both monetary liquidity measures, with MB representing the aggregate monetary base and M3 the more broadly defined monetary aggregate M3. TC and GAP are liquidity measures based on credit volumes in advanced economies. TC denotes total credit, while GAP represents the credit-to-GDP gap. The other three measures approximate various aspects of short-term market liquidity. CP measures the volume of outstanding commercial paper (issued by corporations as a short-term form of financing) in the United States, BL the bank leverage ratio and TED the TED spread, which is the difference between the three-month LIBOR rate and the three-month Treasury bill interest rate. MB, M3, TC and CP are incorporated into the regression as differences in the logarithms (growth rates), while the remaining variables enter in lagged levels. In the modified model, US interest rate growth is used instead of the interest rate differential as the explanatory variable.

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definition of EMP and the monetary base as the liquidity indicator are presented in the table below.

The results show that the impact of global liquidity is positive and significant only in times of low tension on the financial mar-

kets. In times of heightened tension, by contrast, the liquidity indicator no longer has any significant impact on EMP in EMEs. This finding is consistent with a pattern of investor behaviour characterised by relatively low risk aversion during periods of low tension on the financial markets, such that investors on a search for yield turn to EMEs. However, if tension is high and risk propensity lower, this transmission mechanism appears to peter out. On the contrary, the negative sign and high statistical significance of the term  $\Delta \ln(VIX_t)$  suggest that an increase in tension in the stress regime is associated with marked downward pressure on EME currencies – probably because investors then withdraw their capital from EMEs (see the box on pages 23 to 25). This finding is also of relevance in terms of policy. It shows, on the one hand, that an increase in monetary liquidity in advanced economies during periods of calm exerts upward pressure on EME currencies, which could increase their vulnerability in the

### Regime-specific estimation results

Determinant	Tension on the financial markets	
	Low	High
$(i_{t-1} - i_t^{US})$	-0.020	-0.157*
$(\pi_{t-1} - \pi_t^{US})$	0.014	0.137**
Banking crisis <sub>t-1</sub>	-5.914***	-3.498
Sovereign debt crisis <sub>t-1</sub>	0.969	-2.897
Level of financial openness <sub>t-1</sub>	1.007	-3.404
$\Delta \ln(\text{commodity prices}_t)$	0.336***	0.213
$\Delta \ln(\text{energy prices}_t)$	0.034	0.083
$\Delta \ln(VIX_t)$	-0.015	-0.097***
$\Delta \ln(MB_t)$	0.163**	0.055

\*\*\* / \*\* / \* denote significance at the 1%/5%/10% level.

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event of a sudden reversal of capital inflows.<sup>7</sup> On the other hand, the result also shows that, in times of crisis, the provision of additional liquidity in advanced economies would not directly culminate in a decrease in downward pressure on EME currencies via this channel as a result of the failure of the transmission mechanism described above. It is conceivable, however, that the monetary policy pursued by advanced economies could lower the degree of tension on the financial markets, which would – based on the results above – cause downward pressure to weaken.

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<sup>7</sup> This applies first and foremost to a scenario in which upward pressure is caused by appreciation in EME currencies rather than by building up sufficient holdings of foreign exchange reserves.

2015 for a total of 32 EMEs, the Bundesbank study examines the extent to which global liquidity affects the exchange market pressure in EMEs. In each case, one of eight alternative measures of exchange market pressure acts as a dependent variable and one of up to 17 liquidity indicators acts as a key explanatory variable. In addition, the model takes up to 11 other potential determinants of exchange market pressure into account in order to prevent results being distorted by the omission of relevant variables. These include, for example, the interest rate differential between the respective EME and the United States, which acts as the base country for the purposes of the analysis, the difference in inflation rates, the development of commodity prices, the degree of uncertainty on the international financial markets, the degree of financial openness and the existence of a banking crisis in the EME.

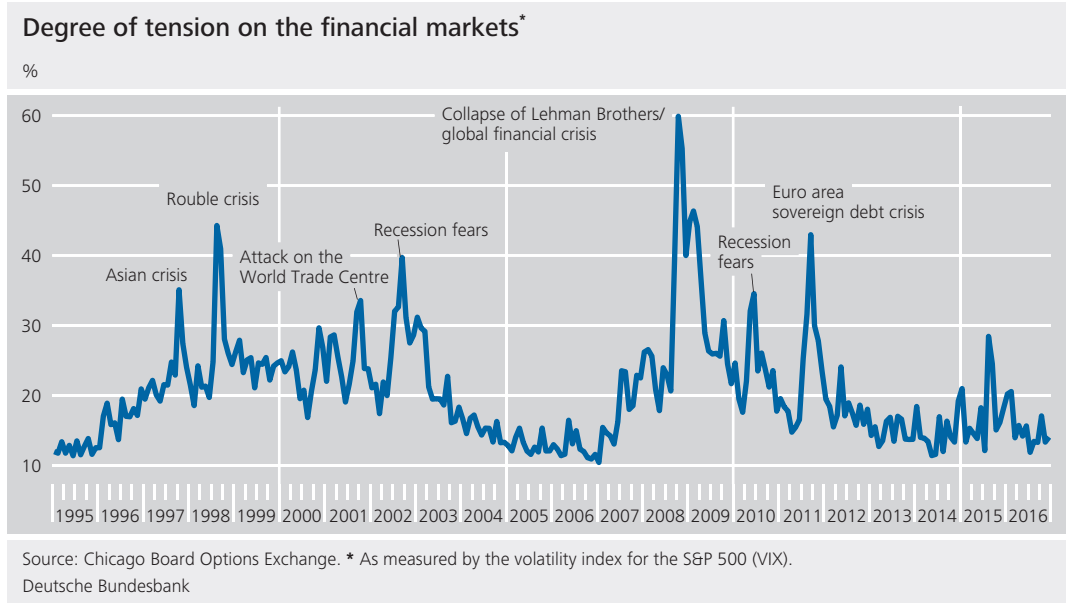
Based on a number of different indicators, the results show that increased global liquidity is

accompanied by upward pressure on the currencies of EMEs, and is largely independent of the selected definition of exchange market pressure. This applies both to simple monetary liquidity measures, such as the aggregate monetary base of advanced economies or the aggregated broad monetary aggregate M3, and the total credit volume or various measures of market liquidity (the bank leverage ratio or the outstanding amount of commercial paper in the United States). Of the other examined variables, the existence of a banking crisis in an EME has a particular impact on exchange market pressure. The results show that a banking crisis is associated with considerable downward pressure on the currency of the respective EME.

However, regime-specific regression results also show that this impact is restricted to times of relatively low tension on the financial markets. In times of heightened tension, an increase in various liquidity measures no longer results in a

*Increase in global liquidity associated with upward pressure on the currencies of EMEs*

*Transmission dependent on the degree of tension on the financial markets, however*



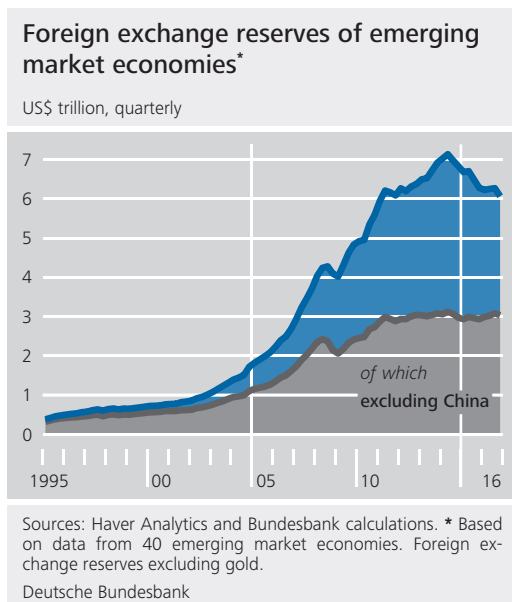
significant rise in exchange market pressure. This finding is consistent with a pattern of investor behaviour characterised by relatively low risk aversion during periods of low tension on the financial markets, such that investors in their search for yield turn to the EMEs. If tension is high, however, and risk propensity is lower (risk-off mode), this effect peters out, and the opposite occurs: in times of heightened tension on the financial markets, further increasing tension is linked to notable downward pressure on the currencies of EMEs, presumably because investors then withdraw their capital from EMEs.<sup>15</sup>

If the upward pressure on the currencies of EMEs in times of low tension is primarily attributable to appreciation of the domestic currency, and not to an increase in foreign exchange reserves, an expansionary or more expansionary monetary policy in the advanced economies may increase the vulnerability of EMEs.

## ■ Sufficient foreign reserves

It may be possible to limit this vulnerability with a sufficient stock of foreign exchange reserves. In particular, this could be expected to be the case if the reserves not only offset actual capital outflows, but from the outset also prevented the danger of the sudden divestment by non-residents by bolstering confidence in the country concerned. However, the holding of foreign exchange reserves is usually connected with opportunity costs due to the comparatively low yields on safe and liquid assets. In addition, building up such reserves makes it necessary to have surpluses in the other (private) balance of payments transactions, although this should not pose a problem in an environ-

*Opportunity costs ...*



<sup>15</sup> In times of relatively low tension, however, changes in the degree of tension have no significant impact on exchange market pressure.

## Do sufficient foreign exchange reserve holdings reduce the probability of balance of payments crises?

On the basis of experiences with balance of payments crises in recent years, the International Monetary Fund (IMF) has developed an approach for evaluating the adequacy of foreign exchange reserves (“assessment of reserve adequacy”). The first part of the two-stage procedure involves identifying critical events which resulted from sharp depreciations of the currency or from a massive loss of foreign exchange reserves (exchange market pressure, EMP). Second, the scale of the liquidity outflow such episodes threaten to trigger is calculated. External debt, the money in circulation and potential export losses have proven to be key variables in the analyses carried out by the IMF. Under this approach, foreign exchange reserves are considered to be adequate if a country is in a position to cover 90% of the potential drains on liquidity calculated using this procedure.<sup>1</sup>

The Bundesbank has replicated the IMF’s approach in its own calculations to measure exchange rate pressure. However, the Bank used the EMP index preferred by Hossfeld and Pramor,<sup>2</sup> which differs slightly from the IMF’s definition. The analysis presented here examines the extent to which a country-specific currency buffer calculated using this approach helps mitigate the risk of balance of payments crises. The estimates are carried out based on annual data from 32 emerging market economies and cover the period from 1996 to 2015.<sup>3</sup>

Two different crisis definitions are applied when examining the suitability of foreign exchange reserves as a means of preventing balance of payments crises. The above-mentioned episodes of exchange market tension – that is, years marked by a strong depreciation of the domestic currency or a

massive loss of foreign exchange reserves – are the basis for one estimate. An EMP index that is more than 1½ standard deviations below the country-specific average of the observation period serves as a threshold level. An alternative estimate explores the extent to which a sufficient cushion of foreign exchange reserves can mitigate the threat of capital being drained by non-residents (defined as negative gross capital inflows). Direct investment flows are not taken into account here, as they are more likely to be linked to strategic objectives and typically do not trigger balance of payments crises. The estimates are carried out as panel regressions with random country effects.<sup>4</sup>

$$\begin{aligned} \text{CRISIS}_{i,t} = & \beta_1 + \beta_2 \text{LIQU}_t + \beta_3 \text{VIX}_t \\ & + \beta_4 \text{GDP\_Diff}_{i,adv,t} \\ & + \beta_5 \text{ARA\_DUM}_{i,t} \end{aligned}$$

whereby CRISIS = dummy with a value of one in a crisis year and with a value of zero in all other years; LIQU = global liquidity measured as the aggregate money stock in the United States, the euro area (M2 in each case) and Japan (M4); VIX = volatility index for the S&P 500; GDP\_Diff = growth differential between the real gross domestic product and that of advanced

<sup>1</sup> IMF (2011), *Assessing Reserve Adequacy*, Policy Paper.

<sup>2</sup> See O Hossfeld and M Pramor, *Global Liquidity and Exchange Market Pressure in Emerging Market Economies*, Deutsche Bundesbank Discussion Paper, forthcoming.

<sup>3</sup> The selection of countries used for this study is in keeping with the panel of the study on the importance of global liquidity for exchange rate pressure in emerging market economies.

<sup>4</sup> A Hausman test does not reject the null hypothesis of the admissibility of an estimator with random effects compared to an estimator with fixed country effects (significance level of 5%). The estimated standard errors are robust to serial correlation.

### Factors influencing the likelihood of balance of payments crises in emerging market economies

Factor	Crisis <sub>EMP</sub>		Crisis <sub>capital outflows</sub>	
	Baseline model	Additional reserves	Baseline model	Additional reserves
LIQU	0.012	0.013	-0.025*	-0.026*
VIX	0.209***	0.209***	0.024**	0.024**
GDP_DUM	-34.8***	-34.9***	-8.11***	-8.058***
ARA_DUM	-0.788*	-0.841	0.084	0.063
EXC_RES	-	0.246	-	-0.722
Constant	-6.58***	-6.58***	-0.958***	-0.960***

\*\*\* / \*\* / \* indicate significance level of 1%/5%/10%.

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economies;<sup>5</sup> ARA\_DUM = dummy with a value of one if foreign exchange reserves are considered to be sufficiently high, and zero if they are less than sufficient;  $i$  = country indices;  $t$  = time index.<sup>6</sup>

Since the endogenous variable can only assume values of zero or one depending on whether or not the year is a crisis year, a probit estimate is applied which specifies the likelihood of a crisis occurring in a given country at a given time.

The estimation results are summarised in the table above. The factors influencing the likelihood of a crisis escalating in the foreign exchange markets are quite well captured by the model described. With the exception of global liquidity, the possible contribution of which cannot be backed by statistical evidence, all variables are significant and display the expected sign (column 1). The theory that an adequate stock of foreign exchange reserves is likely to prevent an abrupt depreciation of the domestic currency or necessary interventions by the central bank is likewise supported. However, foreign exchange reserves that exceed the level considered to be adequate do not lead to an additional stability gain (EXC\_RES in column 2).<sup>7</sup>

With regard to the likelihood of capital outflows by non-residents, a foreign reserve buffer apparently does not offer any preventive protection. The estimated coefficients are not significant either in the baseline model or in combination with additional reserve holdings. In line with other empirical studies, however, the analysis confirms that differences in economic growth between the recipient country and the euro area or the United States are of major importance for the cross-border financial flows of emerging market economies.<sup>8</sup> The importance of global factors for the capital movements of emerging market economies is also confirmed. This is true, at least for the danger examined here – one which is especially threatening for

<sup>5</sup> The euro area is used as a reference for the European economies, and the United States for all other emerging market economies.

<sup>6</sup> The VIX is calculated by the Chicago Board Options Exchange (CBOE). All other variables are taken from the IMF's International Financial Statistics.

<sup>7</sup> EXC\_RES = reserve assets in relation to gross domestic product with a value of zero where ARA\_DUM = 0. Due to the combination of this obviously redundant variable, the previously confirmed determinant ARA\_DUM also loses significance owing to multi-collinearity.

<sup>8</sup> See, for example, IMF, Understanding the Slowdown of Capital Flows to Emerging Markets, World Economic Outlook, April 2016, Chapter 2, pp 63-99; J Aizenman, MD Chinn and H Ito (2015), Monetary Policy Spillovers and the Trilemma in the New Normal: Periphery Country Sensitivity to Core Country Conditions, NBER Working Paper 21128; and H Rey (2015), Dilemma not Trilemma: The Global Financial Cycle and Monetary Policy Independence, NBER Working Paper 21162.

emerging market economies – of extensive divestments by non-residents (ie capital outflows affecting not only individual instruments or sectors) which result in negative gross capital inflows.

To conclude, it may be said that the likelihood of balance of payments crises is largely determined by economic developments in emerging market and advanced economies. Furthermore, global factors also play a role in the shape of the liquidity provided and uncertainty in the financial markets. A sufficient stock of foreign exchange reserves provides a certain degree of protection against possible distortions in the foreign exchange markets in the form of abrupt exchange rate adjustments or a loss of foreign exchange reserves. By contrast, there is no evidence that they are effective in preventing capital outflows caused by the withdrawal of international investors.

ment of increasing investment inflows. It therefore seems appropriate to build up sufficient, but not excessive reserves.

The IMF has developed a method of determining an appropriate amount of foreign exchange reserves on the basis of a country's financial and macroeconomic characteristics.<sup>16</sup> Essentially, this approach is intended to assess the extent of potential capital outflows which in times of crisis must be offset by reducing foreign exchange reserves. Times of crisis are defined on the basis of exchange market pressure caused by foreign exchange market tensions as described above. These tensions are reflected in a depreciation of the domestic currency or a loss of foreign exchange reserves.<sup>17</sup> The scale of the anticipated outflows is derived from previous crises and increases with the threat of declining export activity, the external liabilities and the amount of money in the circulation.

Empirical studies by the Bundesbank show that a sufficient stock of foreign exchange reserves calculated using this approach actually reduces the risk of tensions on the foreign exchange markets, and therefore also has a preventative effect. Holding additional or "excessive" reserves within the meaning of the model, on the other hand, has no stabilising effect beyond this, and is therefore ineffective (see the box on pages 23 to 25). In addition to a sufficient foreign exchange buffer, the economic developments in the respective EME and the advanced economies are also important here, as are global factors, particularly the risk assessment on the international financial markets.

Interestingly, however, the stock of foreign exchange reserves has no significant impact on

*Stabilising effect of foreign exchange reserves on foreign exchange markets, ...*

*... of foreign exchange reserves*

<sup>16</sup> IMF (2011), Assessing Reserve Adequacy, Policy Paper.  
<sup>17</sup> The EMP index is based on B Eichengreen et al (1997), Contagious Currency Crises, NBER Working Paper, 5681. For different EMP calculation methods, see O Hossfeld and M Pramor, op cit.

*... but no protection against extensive withdrawal of capital*

the risk of an extensive divestment by foreign investors, which includes long-term forms of investment such as bonds and stocks. In the Bundesbank's estimates, it is not possible to identify a link between the amount of official foreign exchange holdings and the probability of negative gross capital inflows in EMEs across all portfolio investment and other capital movements, which mainly comprise loans and deposits. Instead, particular importance is attributed to the growth differential between the gross domestic product of the recipient country and that of the advanced economies. Global factors also play a role. For instance, a shortage of global liquidity or increasing uncertainty on the global equity markets significantly increases the probability of foreign capital outflows from the EMEs.

## ■ Conclusion

In summary, it can be concluded that monetary policy decisions in the industrial countries can also make a considerable impact on the foreign exchange markets of EMEs. It is worth noting here that although an increase in global liquid-

ity in times of low tension on the financial markets puts the currencies of EMEs under upward pressure, this does not provide any immediate relief for the foreign exchange markets in times of crisis by bolstering the currencies of EMEs.

With this in mind, the monetary policy decision makers in the industrial countries should consider the repercussions of possible exchange rate effects or potential capital movements when ensuring price and financial stability in their own area of responsibility. At the same time, it is the responsibility of the EMEs to ensure that their economies are more resilient to global factors. Apart from macroprudential measures, which are designed to promote the stability of the financial sector, it appears sensible to also maintain an adequate stock of foreign exchange reserves as a buffer against sudden turnarounds on the foreign exchange markets in question. This instrument provides a certain degree of protection against short-term disruptions on these markets. However, it is not suited to preventing extensive private capital outflows which may arise as a result of deteriorating growth prospects in EMEs.