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Xingwang Qian
Andreas Steiner

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Visiting address:
Nettelbosje 2
9747 AE Groningen
The Netherlands

Postal address:
P.O. Box 800
9700 AV Groningen
The Netherlands

T +31 50 363 9090/3815

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Xingwang Qian
SUNY Buffalo State, USA

Andreas Steiner
University of Groningen, Faculty of Economics and Business, Department of Global Economics and Management, The Netherlands and CESifo

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University of Groningen and CESifo

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Abstract

International reserves safeguard financial stability. This paper shows that this direct effect is reinforced by reserves' interaction with the maturity structure of external debt. The longer the average maturity of external debt, the stronger the marginal effect of international reserves.

Keywords: Reinforcement Effect, International Reserves, Financial Stability, Debt Maturity
JEL Classification Numbers: F3, F4

Corresponding Addresses:
Xingwang Qian, Economics and Finance Department, SUNY Buffalo State, Buffalo, NY 14222, USA, Email: qianx@buffalostate.edu
Andreas Steiner, University of Groningen, Faculty of Economics and Business, Groningen, Netherlands, Email: a.c.steiner@rug.nl

1. Introduction

The literature motivating central banks' holdings of international reserves has identified a number of channels through which reserves contribute to financial stability: They reduce the probability of financial crises, moderate output losses and smooth consumption amid financial crises.[1] The global financial crisis of 2008 has reaffirmed the importance of reserve holdings. By way of example, Ostry et al. (2012) document that emerging market countries with adequate reserve holdings ahead of the crisis generally suffered smaller output and consumption declines. However, reserve holdings are associated with substantial social costs because the domestic return on capital usually exceeds the yield of reserves (Rodrik, 2006).

In the recent past many emerging market and developing countries have piled up international reserves at unprecedented pace and probably to excess levels. The marginal effect of international reserves on financial stability diminishes as reserve holdings increase (IMF, 2011). At the same time, the social costs associated with reserves increase. Therefore, it may be questioned whether the accumulation of reserves to safeguard financial stability is still optimal in terms of costs and benefits.

In fact, as a substitute for reserves, better economic fundamentals contribute to financial stability. For example, low and relatively stable inflation, an exchange rate near equilibrium, a reasonable level and composition of foreign liabilities (e.g. FDI versus hot money inflows), a sound maturity structure of external debt (e.g. long-term versus short-term debt) are all economic fundamentals that help to reduce the probability of financial crises (see, among others, Frankel and Saravelos, 2012).

While it is clear that both reserves and sound economic fundamentals individually enhance financial stability, holding international reserves may enhance some fundamentals and thereby indirectly contribute to financial stability. Indeed, the literature highlights several positive effects of international reserves on economic fundamentals. For example, Cheung and Qian (2009) show that international reserves serve as an indicator for financial health, thus facilitating foreign capital inflows. Qian and Steiner (2014) go further to argue that reserves reduce the risk premium of foreign equity investment (PEI), thereby tilting the composition of foreign capital inflows towards relatively more PEI and less FDI. Finally, Qian and Steiner (2017) find that international reserves lengthen the average maturity of

[1] See for example Aizenman and Marion (2004), Aizenman and Lee (2007), and Steiner (2014).

external debt in emerging and developing countries and thereby contribute to financial stability.

Against this backdrop we postulate that the degree to which international reserves influence a country's financial stability is endogenously determined by international reserves, economic fundamentals, and their interactions. We interpret this interaction mechanism as the *reinforcement effect* of international reserves for financial stability, an effect that has not yet been identified by the literature.

Utilizing a regression specification featuring international reserves, debt maturity and their interaction, we find that, apart from the positive individual effects of reserves and long-term external debt on financial stability, they reinforce each other in enhancing financial stability of emerging markets and developing countries. The effect of international reserves on financial stability is the stronger, the longer the average maturity of external debt is.

The paper is organized as follows: The next section describes the empirical approach. Section 3 is devoted to the empirical analyses. Policy implications are discussed in the concluding section.

2. Empirical approach and data

We use macroeconomic data to empirically test the hypothesis that international reserves and the maturity structure of external debt reinforce each other in their contribution to financial stability. To do so, we set up a standard regression specification with a measure of financial stability being the dependent variable (*FinStab*) and explanatory variables including international reserves (*IR*), the external debt maturity structure measured by the ratio of long-term over short-term debt (*LT/ST*), their interaction term (*IR*LT/ST*) that proxies the reinforcement effect and other control variables. In particular, our empirical model is a fixed effects panel regression:[2]

$$(FinStab)_{i,t} = \alpha \cdot IR_{i,t-1} + \beta \cdot (LT/ST)_{i,t-1} + \gamma \cdot ((LT/ST) * IR)_{i,t-1} + \gamma \cdot X_{i,t-1} + c_i + \varepsilon_{i,t}$$

[2] The Hausman test rejects a random effects specification.

where X is a set of control variables, c_i a country fixed effect and ε the error term.[3] All variables except financial account openness are expressed in logarithms such that coefficients denote elasticities. Our data set covers 107 emerging and developing countries over the period 1984 - 2014. A list of countries may be found in Appendix I. Appendix II lists the variable definitions and their sources. Summary statistics are provided in Appendix III.

Financial stability is an enormously broad concept that is linked to many aspects of a country, e.g. the real economy, the financial system, its political and institutional quality, interactions between the real and financial economy, as well as interactions with other countries. This makes it very difficult to numerically measure financial stability with a single aggregate index. To rein this issue, many papers including financial stability reports from the IMF and numerous central bank publications either examine the stability of a country's financial institutions (e.g. deposit takers, other financial corporations, real estate market) or focus on sectors of an economy - the real sector, the corporate sector, the household sector, the external sector, the financial sector, and the financial market - to assess systemic vulnerability and financial stability.[4] Since international reserves are primarily related to external stability, we focus on assessing financial stability of the external sector. The financial risk index (FRI) extracted from the International Country Risk Guide (ICRG) is used to measure external vulnerability. FRI is compiled from the following risk components: foreign debt as a percentage of GDP, foreign debt service as a percentage of exports of goods and services (*XGS*), current account as a percentage of *XGS*, net liquidity as months of import cover, and exchange rate stability.

Although being relatively comprehensive, the FRI index is a synthetic measure compiled from potentially endogenous factors such as the level of external debt. As a robustness check, we employ an alternative measure for financial stability, the EMBI+ spread, which is calculated as the EMBI+ premium over a U.S. government bond with comparable features.[5] The EMBI+ spread gauges the risk level of a country's sovereign debt, which in turn reflects the degree of financial stability – a high EMBI+ spread indicates a lower level of financial stability. EMBI+ data are available for a shorter time period from 1993 to 2014 and a smaller number of countries (maximum of 48 countries) only.

Our explanatory variables of main interest are international reserves, the maturity structure of external debt, and their interaction term. Drawing on the literature we

[3] A time trend is also included in the regression.
[4] See IMF (2006) and a comprehensive survey provided by Gadanecz and Jayaram (2009).
[5] The Emerging Markets Bond Index Plus (EMBI+) tracks total returns for traded debt instruments in emerging markets that are denominated in foreign currency and of fixed income.

sequentially add further control variables. Financial stability might be affected by external factors – the world interest rate, trade openness and financial account openness – and domestic macroeconomic risk factors, proxied by changes of inflation, the government deficit, and political risk. Finally, we control for financial crises (Mexico 1994, East Asia 1997, and the 2008 global financial crisis) and the risk of a bank run or internal drain, measured by M2/GDP.

3. Results

There are two main findings that can be derived from the bare-bone specifications presented in Table 1 (Columns 1-3): First, as expected, both international reserves and a higher share of LT debt promote financial stability. Second, there is a strong reinforcement effect – the interaction of international reserves and the debt maturity structure increases the positive impact on financial stability by about 30%, other things equal.

Next, we sequentially add further control variables to the regression. The presence of a reinforcement effect is confirmed after adding external factors and domestic factors in Columns 4 and 5, respectively. In fact, the reinforcement effect is estimated to be stronger (the coefficient increases from 0.014 to 0.021), although international reserves become insignificant. This shows that reserves' effect on financial stability primarily works indirectly, namely through their positive impact on fundamentals, and less directly through their mere availability (signalling effect). The model that controls for financial crises (Column 6) yields similar results as those of previous regressions. When we include all groups of control variables in the regression in Column 7, the reinforcement effect of international reserves on financial stability is once again confirmed. Most of the control variables are significant and their signs as expected. For example, lower inflation and better political and institutional quality are positively associated with financial stability, whereas financial crises deteriorate financial stability. The last specification explains 49% of the variation in financial stability.

Next, we re-run the regressions of Table 1 but with the EMBI+ spread as alternative dependent variable.[6] As shown in Table 2, the results are comparable to those of Table 1.[7] For example, according to our estimate, a 1% increase in international reserves lowers the

[6] These regressions do not include the dummy variable for the Mexican crisis because of the shorter time period.

[7] Because of the definitions of the dependent variables, the signs of the coefficients change. While an increase in the financial risk index, the dependent variable in Table 1, implies lower financial instability, an increase in the EMBI+ spread (Table 2) denotes higher instabilities.

sovereign spread in developing countries by 0.39%. This suggests that a country with a higher level of reserves is financially more stable; similar results are obtained for the maturity structure of external debt. The reinforcement effect is stronger across all regressions using EMBI+ as dependent variable. Yields in financial markets seem to be more sensitive to reserve levels than the macroeconomic indicators that form the financial risk index. Nonetheless, both result tables point in the same direction: International reserves interact with the maturity structure of external debt and reinforce their effect on financial stability. Overall, the identified reinforcement effect is robust regardless of the measurement of financial stability and the specific set of control variables.

4. Concluding remarks

This paper examines how international reserves and the maturity structure of external debt interact and reinforce financial stability in emerging and developing countries. Due to this reinforcement effect reserves holdings entail a double dividend, which has been disregarded in the international finance literature so far. First, international reserves directly contribute to financial stability. Second, in the interplay with macroeconomic fundamentals they unfold an additional positive marginal effect.

It is important to note that the identified benefits of reserves do not stem from their active use, but just from holding them: While the traditional literature argues that reserves may be sold in times of crises to stabilize the domestic financial system, our effects stem from the presence of a large lifejacket of reserves.

Our findings also have significant policy implications. Due to the reinforcement effect, a given level of financial stability might be achieved with less reserves. Central banks may reconsider the adequacy of their reserve holdings. On the downside, if a low average maturity of external debt goes hand in hand with falling reserves, this increases the probability of a financial crisis.

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Appendix I: Country sample list

Country list for Table 1:
Albania, Algeria, Angola, Argentina, Armenia, Azerbaijan, Bahrain, Bahamas, Bangladesh, Belarus, Bolivia, Botswana, Brazil, Bulgaria, Burkina Faso, Cameroon, Chile, China, Colombia, Congo Dem. Rep., Congo Rep., Croatia, Costa Rica, Cyprus, Czech Republic, Dominican Republic, Ecuador, Egypt, El Salvador, Estonia, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Guatemala, Guyana, Haiti, Honduras, Hungary, India, Indonesia, Iraq, Israel, Jamaica, Jordan, Kazakhstan, Kenya, Korea Rep., Kuwait, Latvia, Lebanon, Liberia, Libya, Lithuania, Madagascar, Malawi, Malaysia, Mali, Mexico, Moldova, Mongolia, Morocco, Mozambique, Myanmar, Namibia, Nicaragua, Niger, Nigeria, Oman, Pakistan, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Poland, Qatar, Romania, Russian Federation, Saudi Arabia, Senegal, Sierra Leone, Singapore, Slovak Republic, Slovenia, South Africa, Sri Lanka Sudan, Suriname, Syrian Arab Republic, Tanzania, Thailand, Togo, Trinidad and Tobago, Tunisia, Turkey, Uganda, Ukraine, United Arab Emirates, Uruguay, Venezuela, Vietnam, Yemen, Zambia, Zimbabwe.

Country list for Table 2:
Algeria, Argentina, Belarus, Belize, Brazil, Bulgaria, Chile, China, Colombia, Cote d'Ivoire, Croatia, Dominican Republic, Ecuador, Egypt, El Salvador, Gabon, Georgia, Ghana, Hungary, Indonesia, Iraq, Jamaica, Jordan, Kazakhstan, Korea Rep., Lebanon, Lithuania, Malaysia, Mexico, Morocco, Nigeria, Pakistan, Panama, Peru, Philippines, Poland, Russian Federation, Senegal, South Africa, Sri Lanka, Thailand, Trinidad and Tobago, Tunisia, Turkey, Ukraine, Uruguay, Venezuela, Vietnam.

Appendix II: Variable definitions and sources

FRI	Financial risk index (ICRG) measures the external vulnerability of a country. The following factors are assessed: Foreign debt as a percentage of GDP, foreign debt service as a percentage of exports of goods and services (XGS), current account as a percentage of XGS, net liquidity as months of import cover, and exchange rate stability. Risk ratings range from a high of 50 (least risk) to a low of 0 (highest risk).
EMBI+ spread	Secondary market spreads are calculated as the JP Morgan EMBI+ premium over a U.S. government bond with comparable features. EMBI+ captures total returns for traded external debt instruments (US dollar-denominated Brady bonds, loans and Eurobonds) in emerging markets. Data source: World Bank Global Economic Monitor (GEM).
LT/ST debt	Ratio of long-term over short-term external debt. Short-term debt is defined as debt that has an original maturity of one year or less. Long-term debt has an original or extended maturity of more than one year. Data source: World Bank International Debt Statistics.
Int. reserves	Total reserves minus gold over GDP in current US dollar. Data source: World Bank World Development Indicators (WDI).
M2/GDP	Risk of bank run and internal drain measured by money and quasi money (M2) as % of GDP. Data source: World Bank World Development Indicators (WDI).

Real openness	Trade openness measured by imports and exports of goods and services as % of GDP. Data source: World Bank World Development Indicators (WDI).
Financial openness	Chinn-Ito index of de jure capital controls. A higher value indicates a more open financial account. Source: Chinn and Ito (2006).
Inflation	Changes in the inflation rate measured by the logarithm of current inflation over previous year's inflation. Data source: World Bank World Development Indicators (WDI).
Govern. deficit	Government deficit measured by the logarithm of government spending to government revenue. Data source: World Bank World Development Indicators (WDI).
Political risk	Overall political risk index that covers 12 risk components from ICRG. Smaller values indicate higher levels of risk.
World interest rate	Change in the 3-month US Treasury bill rate.
Mexican crisis	Mexican crisis of 1994, dummy variable, I(t>=1994 and t<1997) = 1.
Asian crisis	Asian financial crisis of 1997, dummy variable, I(t>=1997 and t<2008) = 1.
Global fin. crisis	Global financial crisis beginning in 2008, dummy variable, I(t>=2008) = 1.
Trend	Time trend

Appendix III: Summary statistics of variables

Variable	Obs	Mean	Std. Dev.	Min	Max
Fin. risk index	3390	3.465181	0.3161196	1.386294	3.912023
EMBI+ spread	708	5.843748	0.8254484	2.780026	8.661092
Int. reserves	4835	-2.351437	1.150858	-9.341909	1.105303
LT/ST debt	3948	2.449126	1.691523	-2.083873	16.37172
Govern. deficit	2378	-0.3601051	0.5730245	-2.6181	4.044331
Inflation	4191	-0.0604691	0.9334667	-7.607177	6.982428
Financial openness	4985	-0.2261708	1.433688	-1.843764	2.477618
Real openness	5168	4.281402	0.6434815	-3.863269	6.27615
World interest rate	7104	0.6893717	1.774857	-3.426515	2.640841
M2/GDP	4787	3.620062	0.7270214	-1.319245	9.817226
Political risk	3272	0.0058778	0.0850239	-0.9520088	0.9382696

Table 1: Determinants of financial stability – Financial risk index (ICRG), 1984-2014

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Int. reserves	0.064***		0.030**	0.009	0.021	0.026*	0.007
	(0.01)		(0.02)	(0.02)	(0.03)	(0.01)	(0.03)
LT/ST debt		0.011	0.034***	0.033***	0.049**	0.033***	0.038**
		(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.02)
Int. reserves* LT/ST debt			0.014***	0.016***	0.021*	0.014***	0.017**
			(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
World interest rate				0.003			0.002
				(0.01)			(0.01)
Real openness				0.115**			-0.062
				(0.05)			(0.05)
Financial openness				0.035***			0.026*
				(0.01)			(0.01)
Inflation					-0.006**		-0.009**
					(0.00)		(0.00)
Govern. deficit					-0.048		-0.086**
					(0.04)		(0.04)
Political risk					0.306***		0.285***
					(0.07)		(0.07)
M2/GDP						-0.031	-0.028
						(0.02)	(0.05)
Mexican crisis						0.057***	-0.007
						(0.02)	(0.03)
Asian crisis						-0.000	-0.146**
						(0.04)	(0.06)
Global fin. crisis						-0.083	-0.254***
						(0.06)	(0.07)
Trend	0.013***	0.020***	0.016***	0.016***	0.014***	0.020***	0.031***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Constant	-57.923***	-89.809***	-68.844***	-71.358***	-59.053***	-89.037***	-137.368***
	-4.757	-5.13	-5.029	-7.175	-8.569	-11.739	-19.143
R-squared	0.45	0.47	0.50	0.51	0.42	0.53	0.49
# of observations	3099	2521	2322	1779	1076	2294	830
# of groups	107	82	80	79	67	80	64

Notes: Fixed effect panel data regressions. All variables - except the crisis dummies and financial openness - are in logarithms and lagged by one period. Robust errors are in parentheses. The symbols *, ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

Table 2: Determinants of financial stability – EMBI+ spread, 1993-2014

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Int. reserves	-0.391***		-0.311**	-0.222*	-0.410**	-0.402***	-0.191*
	(0.11)		(0.12)	(0.12)	(0.17)	(0.12)	(0.10)
LT/ST debt		-0.043	-0.199***	-0.314***	-0.242***	-0.122	-0.245***
		(0.04)	(0.07)	(0.05)	(0.09)	(0.07)	(0.04)
Int. reserves* LT/ST debt			-0.062*	-0.145***	-0.092**	-0.026	-0.126***
			(0.03)	(0.03)	(0.04)	(0.03)	(0.03)
World interest rate				0.004			0.047
				(0.03)			(0.03)
Real openness				0.179			0.534
				(0.26)			(0.44)
Financial openness				-0.087			-0.150
				(0.06)			(0.11)
Inflation					0.000		-0.011
					(0.03)		(0.03)
Govern. deficit					0.178		0.134
					(0.28)		(0.24)
Political risk					-1.043**		-0.775*
					(0.50)		(0.41)
M2/GDP						-0.264	0.047
						(0.26)	(0.28)
Asian crisis						0.578***	0.836***
						(0.12)	(0.16)
Global fin. crisis						1.436***	2.159***
						(0.19)	(0.23)
Trend	-0.020**	-0.030***	-0.024***	-0.034**	-0.022*	-0.085***	-0.163***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
Constant	97.263**	144.057***	117.127***	165.238**	114.257*	391.555***	854.808***
	(39.31)	(41.17)	(38.20)	(63.18)	(56.27)	(59.90)	(101.22)
R-squared	0.15	0.08	0.22	0.27	0.31	0.37	0.64
# of observations	703	570	565	365	358	558	244
# of groups	48	39	39	37	33	39	30

Notes: Fixed effect panel data regressions. All variables - except the crisis dummies and financial openness - are in logarithms and lagged by one period. Robust errors are in parentheses. The symbols *, ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

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