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**Working Paper**

## Financial crisis and International reserves

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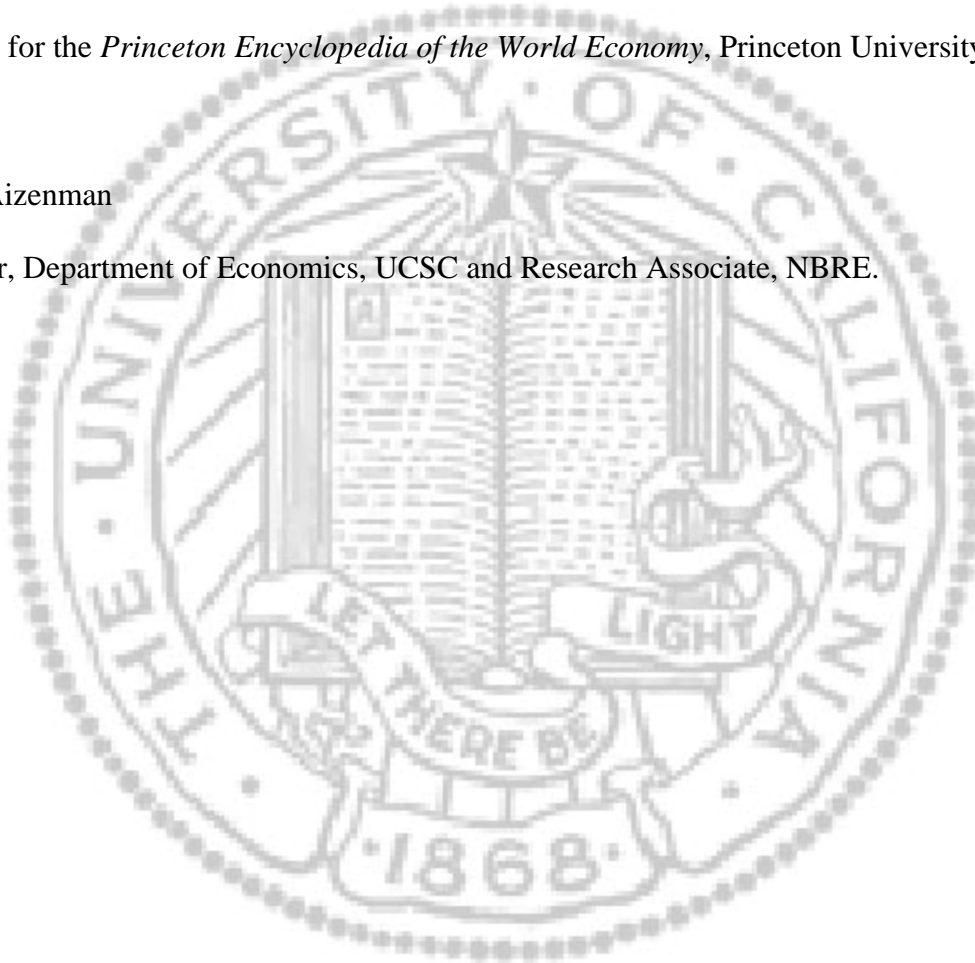
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Prepared for the *Princeton Encyclopedia of the World Economy*, Princeton University Press

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## **Financial crisis**

The financial system is a set of institutions and markets that provides financial intermediation, transferring savings into productive investment. In most developing countries the bulk of financial intermediation has been done via the banking system, with the stock market gaining importance in countries with better or improved institutions. Financial intermediation entails maturity transformation -- funding a longer-term tangible investment with shorter-term savings. As such, financial intermediation is exposed to financial fragility, in which heightened perceived risk may lead to liquidation, putting the financial system at risk.

Financial crisis refers to a rapid financial disintermediation due to financial panic. In practice, this involves a “flight to quality,” where savers attempt to liquidate assets in financial institutions due to a sudden increase in their perceived risk, moving their savings to safer assets, like foreign currency and foreign bonds in open economies, or currency, gold, and government bonds in closed economies. The ultimate manifestation of financial crises includes bank failures, stock market crashes, and currency crises, occasionally leading to deep recessions.

Hyman Minsky (1964) theorized that financial fragility – which is related to the business cycle and to leverage -- is a typical feature of any capitalist economy. These considerations are at the heart of the large literature propagated by the stock market crash of 1929 and the Great Depression (see Bernanke, 1995).

## **Financial crises and financial integration**

Financial crises during the last quarter of the 20<sup>th</sup> century focused attention on the growing role of international triggers for financial crises -- an outcome of the collapse of the Bretton Wood system, the rapid increase in the importance of emerging markets in the global

economy, and the growing financial integration of countries with the global financial system. The resumption of capital flows to developing countries in the early 1990s led to waves of “sudden stops” and reversals of capital flows, starting with the Mexican crisis of 1994-95, continuing with the Russian and the East Asian crises in the second half of the 1990s, and culminating with the Argentinean melt down in the early 2000s (see Calvo, 1998 and Edwards, 2004; also see Hot money and Sudden stops).

Most of the recent financial crises affected developing and emerging markets, leading to a heated debate regarding their causes and the needed remedies. There is solid evidence that financial opening increases the chance of financial crises. There is more tenuous evidence that financial opening contributes positively to long-run growth. Hence, there may be a complex trade-off between the adverse intermediate run and the beneficial long run effects of financial opening. These findings pose a challenge to policy makers: how to supplement financial opening with policies that would improve this intertemporal trade-off.

Placing this issue in a broader context, the debate about financial opening is a reincarnation of the earlier immiserizing growth literature in economics. In particular, while financial opening increases a country’s overall welfare when the only distortion is restricting intertemporal trade across countries, financial opening may be welfare-reducing in the presence of other distortions. An example of such a distortion is moral hazard, which frequently acts as an implicit subsidy to borrowing and investment, ultimately leading to overborrowing and crisis (McKinnon and Pill, 1999 and Dooley, 2000). Moral hazard arises when investors believe that they will be bailed out of bad investment by the taxpayer. This bailing out may be carried out by the treasury, the central bank, or by international agencies (see Asymmetric information). In these circumstances, the taxpayer subsidizes the investment. A frequent rationale for the bailing

out is the “too big to fail” doctrine – the fear that allowing large borrowers to go under will trigger a systemic crisis.

Key factors contributing to an exposure to financial crises are balance-sheet features in the form of maturity and currency mismatches between the assets and the liabilities of the banking system, leading to financial fragility (See balance sheet approach/effects). Developing countries are more susceptible to balance sheet fragilities, and are characterized by debt intolerance: the inability of emerging markets to manage levels of external debt that are manageable for advanced countries (Reinhart, Rogoff and Savastano, 2003).

This literature has led to a spirited debate concerning the wisdom of unrestricted capital mobility between the OECD and emerging markets. Advocates of financial liberalization in the early 1990s argued that external financing would alleviate the scarcity of savings in developing countries, inducing higher investment and thus higher growth rates. The 1990s experience with financial liberalization suggests that the gains from external financing are overrated – the bottleneck inhibiting economic growth is less to do with the scarcity of saving and more to do with other factors, such as the scarcity of good governance (Rodrik, 1998, Stiglitz, 2002, and Gourinchas and Olivier, 2003).

Notwithstanding the above debate, the strongest argument for financial opening is the pragmatic one. Like it or not, greater trade integration erodes the effectiveness of restrictions on capital mobility (see Aizenman, 2004). Hence, for successful emerging markets that engage in trade integration, financial opening is not a question of if, but of when and how. Instead, the hope is that proper sequencing of policies (see McKinnon, 1991) and improved coordination will reduce the severity of financial crises, thereby improving the odds of a positive long-run welfare effect of financial opening.

### **Financial opening and financial crises: the evidence**

The recent research has two common themes: it validates empirically the assertion '*Good-bye financial repression, hello financial crash.*' (Diaz-Alejandro, 1985). Yet, it also found tenuous evidence that financial liberalization tends to increase growth overtime. Both observations suggest an intertemporal trade-off. In the short-run, the fragility induced by financial opening leads frequently to crises. Yet, if these crises would force the country to deal with its structural deficiencies, financial opening may induce a higher growth rate in the long-run [see Ranciere, Tornell and Westermann, 2005).

Kaminsky and Reinhart (1999) found that problems in the banking sector typically precede a currency crisis; that a currency crisis deepens the banking crisis, activating a vicious spiral; and that financial liberalization often precedes banking crises. Glick and Hutchison (1999) investigated a sample of 90 countries during 1975-1997, covering 90 banking crises, 202 currency crises, and 37 twin crises. They found that banking and twin crises have occurred mainly in developing countries, and their number increased in the 1990s. Twin crises are mainly concentrated in financially liberalized emerging-market economies. The costs of these crises are substantial -- currency (banking) crises are very costly, reducing output by about 5%–8% (8%–10%) over a 2–4 year period (Hutchison and Noy, 2005).

A useful survey of financial liberalization is found in Williamson and Mahar (1998), who focused on 34 countries that undertook financial liberalization between 1973 and 1996. Overall, they found a mixed record of financial liberalization -- the gains are there, but the liberalization carries the risk of a financial crisis. Financial liberalization has yielded greater financial depth, and increased efficiency in the allocation of investment. Yet, it has not brought the boost in

saving. The main recommendations emerging from their study are akin to Hellman, Murdock and Stiglitz (2000) -- start with macroeconomic stabilization, improve bank supervision, while delaying capital-account convertibility to the end of the process. Maintaining high spreads may be needed in a transition until banks are able to work off the legacy of bad debt inherited from the period of financial repression, preventing moral hazard associated with 'gamble for resurrection.'

The overall effect of financial opening on growth remains debatable. Rodrik (1998) failed to depict any positive effects of financial opening on investment, growth and inflation. Bekaert, Harvey and Lundblad (2001) found that equity market liberalizations, on average, lead to a one percent increase in annual real economic growth over a five-year period. The investment/GDP ratio increases post liberalization, with the investment partially financed by foreign capital inducing worsened trade balances. The liberalization effect is enhanced by a large secondary school enrollment, a small government sector and an Anglo-Saxon legal system.

To conclude, recent financial crises affecting developing countries are the outcome of financial fragilities, reflecting the downside of growing financial integration. The challenge is mitigating the pain in ways that enhance growth and economic welfare.

*See also:* Asymmetric information, Banking crisis, Bretton Woods system, Deposit insurance, Capital flight, Currency crisis, financial liberalization, financial repression, International reserves, Lender-of-last-resort, Original sin, Sequencing of financial sector reforms.

## Further Reading

Aizenman, Joshua. 2004. "Financial Opening and Development: Evidence and Policy Controversies," *American Economic Review* 94 (2): 65-70.

Greater trade integration erodes the effectiveness of restrictions on capital flow. Thus, for a country that engages in trade integration, financial opening is not a question of if, but of when & how.

Bekaert, G, C. Harvey and R. Lundblad. 2001. "Does Financial Liberalization Spur Growth?", NBER working paper 6724.

In a large sample of countries since 1980, financial liberalization leads to a one percent increase on average in a country's annual growth rate over a five-year period.

Bernanke, Ben S. 1995. "The Macroeconomics of the Great Depression: A Comparative Approach" *Journal of Money, Credit & Banking* 27 (1): 1-28.

Monetary shocks as aggregate demand force behind the Depression; the induced financial crisis and sticky nominal wages are supply mechanisms by which nominal shocks had real effects.

Calvo, Guillermo A. 1998. "Capital flows and capital-market crises: the simple economics of sudden stop" *Journal of Applied Economics*, 1, (1): 35-54.

Articulates mechanisms through which a sudden stop in international credit flows may bring about financial and balance of payments crises, and examines factors triggering sudden stops.

Chang R. and A. Velasco. 1999. "Financial Crises in Emerging Markets," FRBA, 84 (2): 4-17.

A bank collapse multiplies the harmful effects of an initial shock. Under fixed exchange rates, a run on banks becomes a run on the currency if the Central Bank acts as a lender of last resort.

Catao, Luis and Sandeep Kapur. 2006. "Volatility and the debt-intolerance paradox," IMF Staff Papers, 53(2): 195-218.

Differences in macroeconomic volatility are accounting for debt intolerance of developing countries -- the ability to borrow is constrained by higher default risk that volatility engenders.

Demigüç-Kunt A. and E. Detragiache. 1998. "Financial Liberalization and Financial Fragility", IMF Working Paper.

Banking crises are more likely to occur in liberalized financial systems, the impact of financial liberalization on banking sector fragility is weaker where the institutional environment is strong.

Diaz-Alejandro, C. 1985. "Goodbye Financial Repression, Hello Financial Crash" *Journal of Development Economics*, 19 (1/2): 1-24.

Unintended consequences of financial liberalization: intrinsic imperfections in financial markets imply that lifting of financial repression lead frequently to financial crash.

Dooley, Michael. 2000. "A Model of Crises in Emerging Markets," *The Economic Journal*, 110(460): 256-272.

Variety of shocks generate capital inflows to emerging markets followed by successful and anticipated speculative attacks, liquidating reserve assets accumulated as self-insurance.



Edwards, Sebastian. 2004. "Financial Openness, Sudden Stops, a Current-Account Reversals," *American Economic Review* 94 (2): 59-64.

Restricting capital mobility does not reduce the probability of experiencing a reversal; flexible exchange rate regimes are able to accommodate better shocks stemming from a reversal.

Glick R. and M. Hutchison. 1999: "Banking and Currency Crises: How Common Are Twins?" In *Financial Crises in Emerging Markets*, eds. Reuven Glick, Ramon Moreno, and Mark Spiegel. New York: Cambridge University Press.

Crisis phenomenon is most common in financially liberalized emerging markets; banking crises is a leading indicator of currency crises in emerging markets. The converse does not hold.

Gourinchas, Pierre-Olivier and Olivier Jeanne. 2003. "The Elusive Gains from International Financial Integration," NBER Working paper # 9684.

Welfare gains from switching from financial autarky to perfect capital mobility in neoclassical models are negligible relative to the welfare gain of a take-off in domestic productivity.

Hellmann, F. Thomas, Kevin C. Murdock, and Joseph E. Stiglitz. 2000. "Liberalization, Moral Hazard in Banking and Prudential Regulation: Are Capital Requirements Enough?" *American Economic Review*, 90 (1): 147-165.

Competition can undermine prudent bank behavior in the presence of moral hazard. Pareto-efficient outcomes can be achieved by adding deposit-rate controls as a regulatory instrument.

Hutchison, Michael and Ilan Noy. (2005). "How Bad Are Twins? Output Costs of Currency and Banking Crises." *Journal of Money, Credit and Banking* 37(4): 725-52.

Currency (banking) crises are very costly, reducing output by about 5%–8% (8%–10%) over a 2–4 year period, no additional feedbacks associated with twin crises.

Kaminsky, Graciela L. and Carmen M. Reinhart. 1999. "The Twin Crises: The Causes of Banking and Balance-of-Payments Problems," *American Economic Review*; 89(3): 473-500.

Problems in the banking sector typically precede a currency crisis; currency crisis deepens the banking crisis, activating a vicious spiral; financial liberalization often precedes banking crises.

Minsky, M. Hyman. 1964. "Longer waves in financial relations: financial factors in the more severe depressions", *American Economic Review*, 54 (2): 324-335.

Firms need to finance investment spending and capital externally explains longer and deeper swings in economic experience.

McKinnon, Ronald. 1991. *The Order of Economic Liberalization: Financial Control in the Transition to a Market Economy*, Baltimore: Johns Hopkins University Press.

Financial control and macroeconomic stability are more critical to a successful transition than is any crash program to privatize state-owned industrial assets and the banking system.

McKinnon, Ronald and Huw Pill. 1999: "Exchange-Rate Regimes for Emerging Markets: Moral Hazard and International Overborrowing", *Oxford Review of Economic Policy*. 15 (3): 19-38.

Investigates the overborrowing syndrome. A “good” exchange rate peg better stabilize the domestic economy while limiting moral hazard in the banking system.

Ranciere Romain, Aaron Tornell and Frank Westermann. 2005. “Systemic Crises and Growth,” NBER Working paper # 11076.

Financial liberalizations facilitate risk-taking, increasing leverage and investment, leading to higher growth, but also to a greater incidence of crises.

Reinhart, C., K. Rogoff and M. Savastano. 2003. “Debt Intolerance,” *Brookings Papers on Economic Activity* 1: 1-74.

Debt intolerance is the duress many emerging markets experience at debt levels that are manageable by advanced country standards, and is linked to default and inflation history.

Rodrik, Dani. 1998. “Who Needs Capital-Account Convertibility?” in Peter Kenen (ed), *Should the IMF Pursue Capital Account Convertibility? Essays in International Finance* no. 207, Princeton: Princeton University Press (May).

The magnitude of recent crises is not justified by changes in the fundamentals of the affected economies; capital account liberalization is not as a necessary tool for growth.

Williamson, John and Molly Mahar. 1998. *A Survey of Financial Liberalization, Princeton Essays in International Finance*, 211.

Evidence that financial liberalizations lead to financial deepening and increase the efficiency of investment allocation; but frequently spawn financial crisis.

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## **International Reserves**

International reserves are the liquid external assets (foreign currency, foreign currency bonds, plus gold) under the control of the central bank. Under the Bretton Woods system, adequate reserves were measured by months of imports: the prevailing rule of thumb considered four months of imports to be reasonable coverage. This perspective fitted well a world with limited financial integration, in which trade openness reflected a country's vulnerability to external shocks (Fischer, 2001). In the absence of reserves, balance of payment deficits would have to be corrected through a reduction in aggregate expenditures, imposing macroeconomic adjustment costs, manifested in sharp contractions of investment and consumption, inducing thereby recessionary pressures. As greater trade openness increased the exposure to trade shocks, minimizing adjustment costs required higher reserve holdings. An intriguing development since the 1960s has been that, despite the proliferation of greater exchange rate flexibility, international reserves-GDP ratios increased substantially. Reserve holdings have trended upwards; at the end of 1999, reserves were about 6 per cent of global GDP, 3.5 times what they were at the end of 1960 and 50 per cent higher than in 1990. Practically all the increase in reserves-GDP holding has been by developing countries, mostly concentrated in East Asia (Flood and Marion, 2002).

### **International reserves as a buffer stock**

The earlier literature focused on using international reserves as a buffer stock, part of the management of an adjustable-peg or managed-floating exchange-rate regime. Accordingly, optimal reserves balance the macroeconomic adjustment costs incurred in the absence of reserves with the opportunity cost of holding reserves (Frenkel and Jovanovic, 1981). The buffer stock

model predicts that average reserves depend negatively on adjustment costs, the opportunity cost of reserves, and exchange rate flexibility; and positively on GDP and on reserve volatility, driven frequently by the underlying volatility of international trade. Overall, the literature of the 1980s supported these predictions (see Flood and Marion, 2002).

Recent trends in hoarding reserves, especially the large increase in hoarding international reserves in East Asia stirred lively debate among economists and financial observers. While useful, the buffer stock model has limited capacity to account for the recent development in hoarding international reserves – the greater flexibility of the exchange rates exhibited in recent decades should work in the direction of reducing reserve hoarding, in contrast to the trends reported above. As an indication of excess hoarding, some observers noted that developing countries frequently borrow at much higher interest rates than what they earn on reserves.

### **International reserves and self-insurance**

The recent literature provided several interpretations for these puzzles, focusing on the observation that the deeper financial integration of developing countries has increased exposure to volatile short-term inflows of capital (dubbed “hot money”), subject to frequent sudden stops and reversals (see Calvo, 1998 and Edwards, 2004). Looking at the 1980s and 1990s, the magnitude and speed of the reversal of capital flows throughout the 1997–8 East Asian financial crisis surprised most observers (Aizenman and Marion, 2003). Most viewed East Asian countries as less vulnerable to the perils associated with hot money than Latin American countries. After all, East Asian countries were more open to international trade, had sounder fiscal policies, and much stronger growth performance. In retrospect, the 1997–8 crisis exposed hidden

vulnerabilities of East Asian countries, forcing the market to update the probability of sudden stops affecting all countries.

The above observations suggest that hoarding international reserves can be viewed as a precautionary adjustment, reflecting the desire for self-insurance against exposure to future sudden stops. Self-insurance has several interpretations. The first focuses on precautionary hoarding of international reserves needed to stabilize fiscal expenditure in developing countries (see Aizenman and Marion, 2004). Specifically, a country characterized by volatile output, inelastic demand for fiscal outlays, high tax collection costs and sovereign risk may want to accumulate both international reserves and external debt. External debt allows the country to smooth consumption when output is volatile. International reserves that are beyond the reach of creditors would allow such a country to smooth consumption in the event that adverse shocks trigger a default on foreign debt.

Another version of self-insurance and precautionary demand for international reserves views international reserves as output stabilizers (Ben-Bassat and Gottlieb, 1992 and Aizenman and Lee, 2005). Accordingly, international reserves can reduce the probability of an output drop induced by a sudden stop and/or the depth of the output collapse when the sudden stop materializes. This argument is in line with the Guidotti-Greenspan rule of thumb of the 1990s -- countries should hold liquid reserves equal to their foreign liabilities coming due within a year. This rule reflects the shifting focus from reserve adequacy measured in terms of trade flows of goods to flows of assets.

Back of the envelope estimation suggests that the expected benefits of following a Guidotti-Greenspan rule is about 1 percentage points of the GDP. This would be the case if a country holding reserves equal to its short-term debt reduces the annual probability of

experiencing a sharp reversal in capital flows by 10 percentage points on average [in line with Rodrik and Velasco (1999), see Rodrik (2006)]; and if the output cost of a financial crisis is about 10 percentage points of GDP, as found by Hutchison and Noy (2002). Similar results have been obtained using more elaborated models [see Garcia and Soto (2004) and Jeanne and Ranciere (2005)]. These authors concluded that self insurance against sudden stops plays an important role in accounting for recent hoarding of international reserves.

While the Guidotti-Greenspan-IMF rule focused on the ratio of reserves to short term debt, Kim et al. (2005) looked at a more flexible rule, based on the behavior of different types of capital flows during currency crises. Application to selected Asian countries leads them to conclude that the countries affected by the East Asian countries held excessive reserves by 2003 – the affected countries have already built up more than adequate reserve levels to handle a repeat of the actual capital outflows that occurred during the 1997-98 crises scaled up to 2003 values. One may note, however, that the rapidly changing structure of the developing countries' financial integration implies that future possible crises would not resemble the previous ones. For example, Korea, one of the countries affected by the 1997-8 crisis, lifted restrictions on foreign equity ownership lifted in the aftermath of the crisis. In response, foreigners' shareholding as a percentage of the total market capitalization has risen from 12% at 1997, to 40% by 2003. Arguably, the sizable accumulation of reserves by Korea during that period may reflect the wish to cover short-term external debt plus some portion of foreigners' shareholdings, in the desire to reduce possible real exchange rate reciprocations of future reversals of capital flows.

**International reserves: Precaution versus Mercantilism**

The Korean policy suggests another angle associated with international reserves -- the possibility that international reserves management may lower real exchange rate volatility, which in turn may allow a smoother output and potentially higher growth rate. To put this topic in the broader context, note that the literature of the 1990s identified large adverse effects of exogenous volatility on the GDP and economic growth in developing countries. An important channel that may explain such negative levels and growth effects of volatility are capital markets imperfection and low levels of financial development (Aghion et al., 2006).

The views linking the large increase in hoarding reserves to growing exposure to sudden stops associated with financial integration face a well-known contender in a modern incarnation of mercantilism (Dooley et al., 2003). According to this interpretation, reserves accumulation is a by-product of promoting exports, which is needed to create better jobs, thereby absorbing abundant labor in traditional sectors. While intellectually intriguing, this interpretation remains debatable -- the history of Japan and Korea suggests the near absence of mercantilist hoarding of international reserves during the phase of fast growth, and the prevalence of export promotion by preferential financing in targeted sectors. Floundering economic growth led to the onset of large hoarding of reserves both in Japan and Korea, probably due to both mercantilist motives and self insurance to deal with growing fragility of the banking system. These perspectives suggest that the massive hoarding of reserves by China is a hybrid of the mercantilist and self insurance motives [see Aizenman and Lee (2006)]. Yet, mercantilist hoarding by one country may induce competitive hoarding by other countries, to preempt any competitive advantage gained by the first country, a reaction which would dissipate most competitiveness gains. This view is supported by the interdependence of the demand for international reserves among ten East Asian

countries reported by Cheung and Qian (2006). They found that, controlling for conventional variables, a one dollar increase in international reserves by one country has been associated with an increase of about .6 dollar by the other nine “peer countries.”

Overall, greater exposures of developing countries to sudden stops and reversals of hot money, growing trade openness, the desire to improve competitiveness and to reduce real exchange rate volatility go a long way towards accounting for the observed increase in the rapid and massive stockpiling of international reserves by developing markets.

*Also see:* Bretton Woods system, Currency crisis, Dollar standard, Dominant currency, Exchange rate (types), Exchange rate volatility, Financial crisis, Foreign exchange intervention, International liquidity, Global imbalances, Gold standard, Mercantilism, Real exchange rate, Reserve currency, Vehicle currency, Sterilization, Sudden stops.



**Further Readings:**

Aghion, Philippe, Philippe Bacchetta, Romain Ranciere and Kenneth Rogoff. 2006, “Exchange Rate Volatility and Productivity Growth: The Role of Financial Development,” NBER Working paper # 12117.

Evidence that real exchange rate volatility is associated with lower productivity growth.

Aizenman, Joshua and Nancy P Marion. 2003. “The high demand for international reserves in the Far East: what’s going on?” *Journal of the Japanese and International Economies* 17, 370–400.

Explains the higher demand for reserves using the precautionary demand and downside risk aversion motives.

Aizenman, Joshua and Nancy P Marion. 2004. “International reserves holdings with sovereign risk and costly tax collection.” *Economic Journal* 114, 569–91.

Models precautionary use of reserves by developing countries, and the negative impact of political instability on IR.

Aizenman, Joshua and Jaewoo Lee. 2005. “International reserves: precautionary versus mercantilist views, theory and evidence.” forthcoming, *Open Economies Review*.

Evidence and a model of the relative importance of the precautionary view of IR.

Aizenman, Joshua and Jaewoo Lee. 2006 “Financial versus Monetary Mercantilism – Long-run View of Large International Reserves Hoarding,” NBER Working paper # 12718.

A key instrument of the East Asian development strategy has been subsidizing the cost of capital; hoarding IR tend to occurred in the aftermath of floundering growth; defines and explains competitive hoarding.

Ben-Bassat Avraham and Daniel Gottlieb. 1992. “Optimal international reserves and sovereign risk.” *Journal of International Economics* 33, 345–62.

Explains and estimates the importance of sovereign risk and the cost of default as a major determinant of the demand for IR.

Calvo, Guillermo. 1998. “Capital flows and capital-market crises: the simple economics of sudden stops.” *Journal of Applied Economics* 1, 35–54.

Explains mechanisms through which a sudden stop in international credit flows may bring about financial and balance of payments crises, and examines factors triggering sudden stops.

Cheung, Yin-Wong and Xing Wang Qian. (2006), “Hoarding of International Reserves: Mrs Machlup’s Wardrobe and the Joneses,” manuscript, UCSC.

Shows the interdependence of the demand for IR among ten East Asian countries.

Dooley P. Michael, David Folkerts-Landau, and Peter Garber. 2003. “An essay on the revived Bretton Woods system.” Working Paper No. 9971. Cambridge, MA: NBER.

The use of fixed exchange rate in Asia has reestablished the US as the center country in the modified Bretton Woods system; links it to an export-led growth supported by undervalued exchange rates strategy of East Asia.

Edwards, S. 2004. “Thirty years of current account imbalances, current account reversals, and sudden stops.” *IMF Staff Papers* 51 (Special Issue), 1–49.

Major reversals in current account deficits have been associated to sudden stops of capital inflows; the probability of a reversal depends on external debt/GDP, IR/GDP and debt services. More open countries suffer less in a reversal.

Fischer, Stanley. 2001. Opening Remarks, IMF/World Bank International Reserves: Policy Issues Forum.

Overview the changing patterns of hoarding international reserves.

Flood, Robert and Nancy P. Marion. 2002. "Holding international reserves in an era of high capital mobility." In *Brookings Trade Forum 2001*, ed. S. Collins and D. Rodrik. Washington, DC: Brookings Institution Press.

Buffer-stock reserve models work about as well in the modern floating-rate period as they did during the Bretton Woods regime. During both periods models' fundamentals explain only about 15% percent of reserves volatility.

Frenkel, Jacob and Boyan Jovanovic. 1981. "Optimal international reserves: a stochastic framework." *Economic Journal* 91, 507–14.

Adjustment cost model of the demand for IR, highlighting the role of uncertainty.

Garcia, Pablo, and Claudio Soto, "Large Holdings of International Reserves: Are They Worth It?" Central Bank of Chile Working Papers N° 299, December 2004.

Estimate crisis probabilities, and apply it to evaluate the optimal stock of reserves, concluding that observed stocks of reserves for most of the cases are consistent with an optimal self insurance policy.

Hutchison, M. Michael and Ilan Noy. 2006. "Sudden Stops and the Mexican Wave: Currency Crises, Capital Flow Reversals and Output Loss in Emerging Markets," *Journal of Development Economics* 79(1), 225-248.

Sudden-stop crises have a large negative, but short-lived, impact on output growth over and above that found with currency crises. The cumulative output loss of a sudden stop is around 13–15% over a 3-year period.

Jeanne, Olivier, and Romain Ranciere, 2005 "The Optimal Level of International Reserves for Emerging Market Economies: Formulas and Applications," IMF Research Department.

An insurance model of international reserves in the presence of sudden stop can explain reserves of the order of magnitude observed in many emerging market countries, but not the recent buildup of reserves in Asia.

Kim Jung Sik, Jie Li, Ramkishan Rajan, Ozan Sula and Thomas D. Willett. 2005. "Reserve Adequacy in Asia Revisited: New Benchmarks Based on the Size and Composition of Capital Flows," forthcoming in *KIEP-Claremont conference volume*.

Presents new benchmarks for judging reserve adequacy, and conclude that the reserve levels in East Asia are more than the needed to finance capital outflows of the severity of the 1997–98 Asian crises.

Rodrik, Dani. 2006. "The Social Cost of Foreign Exchange Reserves," *International Economic Journal*, 20(3), 253 - 266

Cost-benefit analysis of hoarding international reserves using the self-insurance motive. Explaining why developing countries have not tried harder to reduce short-term foreign liabilities instead of hoarding reserves remains a puzzle.

Rodrik, Dani, and Andres Velasco, 1999, "Short-Term Capital Flows," NBER WP # 7364.

A model of self fulfilling crises; estimation shows that greater short-term debt/reserves ratio is a robust predictor of financial crises, and is associated with more severe crises when capital flows reverse.

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