

Aizenman, Joshua

Working Paper

Large hoarding of international reserves and the emerging global economic architecture

Working Paper, No. 07-08

Provided in Cooperation with:

University of California Santa Cruz, Santa Cruz Institute for International Economics (SCIE)

Suggested Citation: Aizenman, Joshua (2007) : Large hoarding of international reserves and the emerging global economic architecture, Working Paper, No. 07-08, University of California, Santa Cruz Institute for International Economics (SCIE), Santa Cruz, CA

This Version is available at:

<https://hdl.handle.net/10419/64101>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

Large hoarding of international reserves and the emerging global economic architecture

Joshua Aizenman*

UCSC and the NBER

This paper analyzes competing interpretations for the large increases in the hoarding of international reserves by developing countries. While the first phase of the rapid hoarding of reserves in the aftermath of the East Asian crisis has been dominated by self insurance against exposure to foreign shocks, the self insurance motive falls short of explaining the hoarding in Asia in the 2000s. These developments may be a symptom of an emerging new global financial architecture, which is manifested in the proliferation of decentralized and less cooperative arrangements. The emerging financial configuration of developing countries in the aftermath of the 1990s crises has been growing managed exchange rate flexibility, greater monetary independence, and deeper financial integration. Hoarding international reserves is a key ingredient enhancing the stability of this emerging configuration. While not a panacea, international reserves help by providing self insurance against sudden stops; mitigating REER effects of TOT shocks; smoothing overtime the adjustment to shocks by allowing more persistent current account patterns; and possibly even export promotion, though this mercantilist use of reserves remains debatable due to possible coordination issues. Countries following an export oriented growth strategy may end up with competitive hoarding, akin to competitive devaluations. The sheer size of China, and its lower sterilization costs suggests that China may be the winner of a hoarding game. Hoarding international reserves may also be motivated by a desire to deal with vulnerability to internal and external instability, which is magnified by exposure of the banking system to non performing loans. Testing the self insurance and precautionary motives in the context of China may be challenged by a version of the ‘peso problem.’ Hoarding international reserves and sterilization have been complementing each other during the last ten years, as developing countries have increased the intensity of both margins.

Joshua Aizenman

Economics E2 , UCSC and the NBER

1156 High St.

Santa Cruz

CA 95060

jaizen@ucsc.edu

JEL Classification: F15, F32, F42, F53

Keywords: International reserves, self insurance, competitive hoarding, export promotion

* Prepared for *Growth and Business Cycles In Theory And Practice* Conference, 12th -13th July 2007, organized by Pierre-Richard Agenor and Keith Blackburn, the Center for Growth and Business Cycle Research (CGBCR) at the University of Manchester. This paper extends comments presented at the Brookings Panel on Economic Activity, 2007. Jesus Sandoval-Hernandez provided excellent research assistance.

1. Introduction

Since the 1980s, we have witnessed intriguing developments; despite the proliferation of greater exchange rate flexibility, international reserves-GDP ratios increased substantially. Practically all the increase in reserves-GDP holding has taken place in developing countries, mostly concentrating in East Asia. The magnitude of the changes during the last twenty years is mind-boggling: global reserves increased from about 1 trillion US dollar in 1990, to more than 5 trillion US dollar in 2006. The dramatic hoarding of international reserves was lopsided: while the International reserves/GDP ratio of industrial countries was overall stable, hovering around 4%, the reserves/GDP of developing countries increased dramatically, from about 5% to about 27% (See Figure 1). Today, about two thirds of the global international reserves are held by developing countries. Most of that increase has been in Asia, where the reserves/GDP increased from about 5% in 1980 to about 37% in 2006 (32% in Asia excluding China). The most dramatic changes occurred in China, increasing its reserve/GDP from about 1% in 1980, to about 41% in 2006. Econometric evaluations suggest several structural changes in the patterns of reserves hoarded by developing countries. A notable change occurred in the 1990s, a decade when the international reserves/GDP ratios shifted upwards; a trend that intensified shortly after the East Asian crisis of 1997-8, but subsided by 2000. Another structural change have taken place in early 2000s, mostly driven by an unprecedented increase in the hoarding of international reserves in China, from close to zero during 1998-2000 to more than \$ 300 billion in 2006.¹ This dramatic change in Chinese hoarding is underscored by Figure 1b, showing that its reserve/GDP ratio almost tripled within six years, from about 14% during 1997-2000, to 41% in 2006!

A useful perspective towards the recent hoarding of international reserves by developing countries is provided by applying the Trilemma framework. To recall, the Trilemma states that countries can choose not more than two of the following three attributes: exchange rate stability, monetary independence, and financial integration [see Frankel (1999) and Obstfeld et al. (2005)]. Developing countries that opted during the late 1980s for exchange rate stability, monetary independence and financial repression, embraced during the early 1990s growing financial liberalization. Mexico, Korea and other countries found that the Trilemma is alive and kicking;

¹ See Aizenman and Marion (2003), Bird and Rajan (2003), Aizenman and Lee (2007), Jeanne (2007), and Cheung and Ito (2007) for econometric evaluation dealing with the emerging patterns of hoarding reserves.

greater financial integration made the quest for exchange rate stability and monetary independence unattainable, frequently resulting with deep financial crises, including the 1994-5 Mexican and the 1997-8 East Asian crises. Argentina chose during the early 1990s another Trilemma combination: exchange rate stability supported by a version of currency-board, and financial integration. As has been vividly illustrated by the crisis in the early 2000s, this configuration did not pass the test of time.

These crises illustrated the downside risk of financial integration and the temporariness and risks of fixed exchange rates. These developments also validate Diaz-Alejandro's 1985 conjecture: Good-bye financial repression, hello investment boom, to be followed by a costly financial crash. It also demonstrated the Mirage of Fixed Exchange Rates [dubbed by Obstfeld & Rogoff (1995)], and the possibility that a pegged exchange rate is a trap in the era of greater financial integration [see Eichengreen and Masson (1998), Eichengreen (1999), Frankel (1999); Edwards & Levy Yeyati (2005); Aizenman & Glick (2005)].

The emerging configuration of developing countries in the aftermath of the 1990s crises has been growing managed exchange rate flexibility, greater monetary independence, and deeper financial integration. This raises two important questions: why should the countries affected adversely by exposure to hot money opt for greater financial integration, and how stable is this emerging configuration? I discuss both issues in Section 2, pointing out that globalization of trade set in motion forces that induce endogenous financial globalization, and that hoarding international reserves is a key ingredient enhancing the stability of the emerging configuration in an era of greater financial integration. While not a panacea, international reserves helps by providing several services which include: self insurance against sudden stops and capital flights; mitigating REER effects of TOT shocks; smoothing overtime the adjustment to shocks by allowing more persistent current account patterns; and possibly even export promotion, though the last service remains debatable due to possible coordination issues akin to competitive devaluations.

Section 3 discusses the possibility that the large increase in hoarding international reserves is a symptom of the emergence of a new global financial architecture, which is manifested in the proliferation of decentralized and less cooperative arrangements. The hoarding takeoff during the 2000s illustrates also the downside risk of the new global financial

architecture: competitive hoarding akin to competitive devaluations. Section 4 closes with a discussion of challenges of evaluating and testing the patterns of hoarding international reserves.

2. Hoarding international reserves and the embrace of financial integration

A remarkable trend of the new configurations is that with few exceptions, countries stunned by the financial crisis during the 1990s opted to buffer their growing exposure to financial instability by hoarding international reserves, instead of reducing their financial integration. While the reserves/GDP of developed countries has remain trendless, that of developing countries increased substantially from the early 1990s, coinciding with the rapid financial integration of developing countries [see Aizenman and Lee (2007) for further Econometric assessment]. The rapid pace of financial globalization remains contentious, as leading economists question the gain from financial integration [see Rodrik (1998), Stiglitz (2002)]. Several recent papers have illustrated that the gains from financial integration are overrated [Gourinchas & Jeanne (2004), Aizenman (2005), Prasad et al. (2006)]. Rodrik (2006) articulates the benefits associated with increasing the international reserves/external exposure ratio, asking why most countries have invested more in increasing the numerator of this ratio [hoarding international reserves], and not in reducing the denominator [lessening external exposure].

A possible interpretation of these trends is that like it or not, deeper financial integration is the unavoidable outcome of rapid trade integration. Trade integration facilitates capital flights via trade misinvoicing, thus increasing the costs of enforcing financial repression, and forcing countries to tolerate greater financial integration. Hence, countries that opted for financial repression as a constrained optimal solution to the public finance problem facing low income countries [i.e., raising taxes at low costs], may find that deeper trade integration increases the costs of monitoring and enforcing financial integration to levels that justify financial opening [Aizenman (2004)]. As the Trilemma and the 1990s have illustrated, the byproduct of this trend is growing exposure to financial instability. Hoarding international reserves in the aftermath of financial crises may be viewed as self insurance against sudden stops. It allows fast adjustment to the growing downside risks of greater financial integration.² Hoarding international reserves

² See Flood and Marion (2002) for an overview of the literature explaining international reserves applying the buffer stock approach. See Ben-Bassat and Gottlieb (1992) ; Aizenman and

may also provide a solution to the constrained optimal public finance problem of a country facing the combination of costly tax collection, sovereign risk, and the need to finance critical public expenditure [Aizenman and Marion (2004)].

While providing useful services, international reserves management is subject to serious limitations. These include Moral hazard associated with insurance. First, there is the macro moral hazard: international reserves may be the target of opportunistic spending in regimes characterized by political instability and limited monitoring.³ Next, there is the micro moral hazard, where international reserves subsidize risk taking.⁴ In addition, there are fiscal costs, including the direct opportunity cost in the form of the marginal product of public capital and/or the cost of external borrowing, and the quasi costs of sterilization [Calvo (1991)].

However, the costs of sterilization have been seen so far as well below the perceived benefits of monetary stability and the wish to hoard international reserves. Notwithstanding concerns about sterilization costs, Aizenman and Glick (2007) find that hoarding international reserves and sterilization have been complementing each other during the last ten years, as developing countries have increased the intensity of both margins. Indeed, there is a significant increase in the coefficient of sterilization following the 1997-8 crisis, a trend that continues today, and applies well beyond Asia. These results are illustrated in Figure 2, which shows the coefficient of marginal sterilization in Korea [and the s.d. bounds around it] which is estimated using a quarterly rolling regression, controlling for the growth rate of the nominal GDP. Full sterilization corresponds to the value of negative 1, as depicted by the bold curve. Note the significant increase in the sterilization in Korea in the aftermath of the 1997-8 crisis. There is evidence of large sterilization after the Asian crisis for both China and Korea, and to a lesser degree for Thailand, India and Malaysia. The evidence is consistent with a regime change in China, which intensified hoarding and sterilization in the early 2000s. There is some evidence for greater sterilization in Brazil and Mexico in the aftermath of the Mexican crisis. Sterilization of FDI inflows is less than that of non-FDI inflows. Apparently, sterilizing the hoarding of

Marion (2003, 4); Lee (2004); Aizenman and Lee (2007), Garcia and Soto (2005), Jeanne and Ranciere (2005) and Rodrik (2006) for precautionary and self insurance models of hoarding international reserves.

³ See Aizenman and Marion (2004), showing that countries characterized by greater political instability and polarization opt to hold less international reserves

⁴ see Levy Yeyati (2005) which calls for liquid reserve requirements on banks, and an ex-ante suspension-of-convertibility clause.

international reserves is easier to implement in countries with a higher saving rate and greater financial repression.

Another service provided by hoarding international reserves is the mitigation of real exchange rate [REER] effects of terms of trade [TOT] shocks. TOT volatility leads to REER volatility, magnifying business cycle volatility. Countries may hoard reserves in order to stabilize the real exchange rate in the presence of volatile terms of trade shocks and volatile short term capital flows. The beneficial effect of hoarding reserves to deal with exposure to volatile TOT is reinforced by the evidence in Aghion et al. (2006), who found that real exchange rate volatility reduces growth for countries with relatively low levels of financial development. Hence, factors mitigating real exchange rate volatility may be associated with superior economic performance. Developing countries are characterized by their limited ability to mitigate TOT shocks by internal adjustments, or by external hedging. This is the outcome of the amalgamation of shallow financial systems, lack of sectoral diversification, and sovereign risk and the absence of proper financial instruments. Aizenman and Riera-Crichton (2006) found that hoarding international reserves mitigates the REER effects of TOT shocks, and that this alleviation effect is important especially for exporters of natural resources. Natural resources dependence, on average, double both the impact of TOT shocks on the REER, and the mitigation associated with hoarding international reserves. Higher international reserves/GDP may also enhance the capacity to overtime smooth the adjustment to shocks, allowing more persistent current account patterns. Such patterns are consistent with the optimal adjustment in the open economy to shocks, as predicted by the permanent income hypothesis. In contrast, a low level of reserves may require fast and rigid adjustments of the current account to shocks, where deviations from a balanced current account position are hard to sustain [see Aizenman (2006)].

The views linking the large increase in hoarding reserves to the self insurance dealing with the growing exposure to currency crisis and sudden stops face a well-known contender in a modern incarnation of mercantilism: the accumulation of international reserves triggered by concerns about export competitiveness. This explanation has been advanced by Dooley, Folkerts-Landau and Garber (2004), especially in the context of China. They interpret the accumulation of reserves as a by-product of promoting exports, which are needed to create better jobs, thereby absorbing abundant labor in traditional sectors, located mostly in agriculture. While intellectually intriguing, this interpretation remains debatable. After all, the high export growth is

not new – it is the story of East Asia since the 1950s. Yet the large increase in hoarding reserves happened mostly after 1997. Aizenman and Lee (2007) tested the importance of precautionary and mercantilist motives in accounting for the hoarding of international reserves by developing countries during 1980-2000. While variables associated with the mercantilist motive (like lagged export growth and deviation from Purchasing Power Parity) are statistically significant, their economic importance in accounting for the cross country variations in reserve hoarding is small, and is dwarfed by variables associated with precautionary demand and self insurance.

The inability of empirical research to validate a robust economic role for mercantilist hoarding through its impact on the real exchange rate, and the acceleration of large hoardings in East Asia during 2001-2007 remains a puzzle. Indeed, Bird and Rajan (2003) showed the limited ability of the self insurance model to account for the recent trends in Asia. This argument was further reinforced by Jeanne (2007), who applied an elegant utility based welfare analysis of optimal hoarding of international reserves, and a calibration that allows one to evaluate the degree to which recent hoarding trends are consistent with the model's predictions. Taking the model to the data, the results are intriguing: the levels of reserves observed in many countries in the recent period (in particular in Latin America), are within the range of the model predictions. However, the insurance model fails to account for the recent reserves buildup in emerging market countries -- most of the reserves accumulation took place in Asian emerging market countries, where the risk of a capital account crisis seemed much too small to justify such levels of self-insurance.

In the next section we will place the large hoarding of international reserves in the context of the possible emergence of a new financial architecture, a process that may also provide a possible explanation for recent trends in East Asia.

3. Hoarding international reserves and the emerging financial architecture

The big story of the global economy during the last sixty years has been changes in the global distribution of economic might, from a *unipolar* architecture dominated by the US during the mid part of the 20th century to a *multipolar* world, with a shifting distribution of economic growth. The unipolar architecture was dominated by the US centric economic organization: leading currencies were pegged to the dollar, and the US dictated the global monetary policy under the Bretton Woods system, 1944-1970. These trends are illustrated in Figure 3 by using

Maddison's data, which shows that the global GDP share of the West [West Europe, US, Canada, Australia and New Zealand] have declined from about 57% in the early 1950s to about 43% in the early 2000s, whereas the share of Asia climbed from 15% to about 40%. Consequently, emerging Asia is rapidly approaching the size of the West.

Arguably, the emerging decentralization is manifested in the proliferation of decentralized and less cooperative arrangements. Large hoarding of international reserves by developing countries may be viewed as one dimension of such arrangements – the decentralization of the hard currency lender-of-last-resort, from implicit insurance via the International Financial Institutions [IMF, World Bank, etc...], to self insurance by emerging markets. The desire to self insure may reflect evolving experience with the downside of deeper financial integration, manifested by the greater exposure to sudden stops of capital flows [see Calvo (1998), Kaminsky and Reinhart (1999) and Hutchison and Noy (2005)], and by the growing reluctance to rely on centralized solutions provided by IFIs. Yet, by definition self insurance also implies no central role for the International Financial Institutions. Other dimensions of the emerging decentralized global architecture are that more countries have shifted towards managed flexibility of the exchange rate, where there is no central role of the dollar or any other 'hard currency,' as well the proliferation of decentralized inflation targeting [Rose (2006)].

An unintended consequence of a decentralized global architecture is frequently the greater exposure to coordination failure. Countries following export oriented growth strategies [described by Dooley *et al.* (2004)] may end up with competitive hoarding to improve their competitiveness in the OECD countries [Aizenman and Lee (2006)]. Arguably, one may reconcile both the mercantilist approach [Dooley *et al.* (2004)] with the limited support of mercantilism in cross country regressions by taking the perspective of a hoarding game, where countries following an export oriented growth strategy, competing in the same third market (the US), may end up with competitive hoarding.⁵ An example of such a game, akin to Johnson's classical (1953) tariff war model, is summarized in Figure 4. In a world with symmetric EMs competing in similar industries, competitive hoarding tends to dissipate most competitive gains, leading to a '*Beggar-yourself*' and excessive hoarding. In an asymmetric world, an emerging

⁵ The hoarding may be triggered by more vigorous competition in industries approaching excess capacity.

market with low enough cost of sterilization may win the hoarding war -- its non cooperative outcome is superior to the cooperative one, akin to the '*Beggar-thy-neighbor*' outcome of asymmetric Tariff Wars [see Aizenman and Lee (2006)].

Specifically, we consider two Emerging Markets (EMs) H and F, exporting similar products to a third market, say the US. Hoarding more reserves by each EM would depreciate its real exchange rate, thereby improving its competitiveness vis-à-vis the other emerging market in third markets [i.e., the US]. H's net export is an imperfect substitute of F's export, and depends positively on its international reserve hoardings relative to F's international reserves position. We assume that H and F would prefer higher exports, thus balancing the gain from export promotion against the costs of hoarding reserves. The optimal international reserves level in the absence of competitive hoarding is normalized to 1, and point O in Figure 4 corresponds to the optimal international reserves hoarding in the absence of mercantilist hoarding. From the point of view of H, export growth propagated by hoarding international reserves is desirable [apparently due to externalities like learning by doing, etc...], but it comes at a quadratic cost, including costly sterilization and other indirect costs. Similar preferences characterize F. Curves HH and FF are the reaction functions of H and F in the competitive hoarding game. Curve Wo, Figure 4 is H's indifference curve -- configurations of (R, R^*) where H's utility equals to the benchmark of no competitive hoarding, point O. H is worse off relative to the no hoarding equilibrium at points above curve Wo. The Nash equilibrium of the competitive hoarding game is depicted by the intersection of curves HH and FF, at point S. The left panel corresponds to the symmetric case, where both H and F share the same preferences and the same cost functions. Note that H is worse-off in the symmetric competitive Nash hoarding equilibrium -- its welfare at point S is lower than at point O (the no competitive hoarding equilibrium). By symmetry, the same applies to F. Competitive hoarding *dissipates* any competitive gains in the symmetric case, reducing welfare due to the higher cost of carrying extra international reserves, implying a '*Beggar-yourself*' outcome. It can be shown that greater substitutability between the exports of two countries magnifies the negative externality associated with hoarding international reserves, and that lower sterilization costs increase the 'excess reserves' associated with competitive hoarding.

In the asymmetric case, if H's sterilization cost is low enough relative to F's cost, H would win the 'hoarding war' -- H's non cooperative outcome is superior to the cooperative one,

akin to the ‘*Beggar-thy-neighbor*’ results of asymmetric tariff wars. This is depicted by the right panel of Figure 4, where point S is below the indifference map W_0 . It can be shown that lowering H’s sterilization cost shifts HH (H’s reaction function) to the right, and the indifference curve W_0 upwards. Hence, lower sterilization costs of H would *increase* the equilibrium hoarding of H, *reducing* the hoarding of F. Financial repression of the type observed in China may reduce its sterilization costs, thereby increasing the intensity of its sterilization, and ultimately China’s international reserves hoardings. Consequently, competitive hoarding in circumstances where financial repression reduces the cost of sterilization is consistent with Jeanne (2007) who found a negative association between hoarding reserves and financial integration.

Figure 5 outlines ‘the sources’ of international reserves accumulation in China. It reveals a complex picture, where hoardings of international reserves accelerated to about an average of a \$ 110 Billion dollar annual increase during 2000-2005, and has been associated with sizable current account surpluses and inflows of capital of about \$ 60 (50) Billion, respectively. These averages mask the remarkable acceleration of China’s annual hoardings, from close to zero hoarding during 1998-2000, to about (\$100, \$200, \$250) billion during (2003, 2004, 2006), respectively. The competitive hoarding model’s predictions are consistent with aggressive reserves hoarding by China, where large inflows of capital and current account surpluses are associated with sterilization [see Aizenman and Glick (2007)]. If China’s sterilization costs are lower than Korea’s and other countries competing with China in the US market, China may win the hoarding war. The sheer size of China and its low sterilization costs, probably due to financial repression there, may force Korea and Japan to keep hoarding international reserves in order to prevent deeper erosion of their competitiveness.⁶ Arguably, it may also induce Korea and Japan to invest directly in China, in an attempt to minimize their losses in the hoarding game.

⁶ The hoarding model described above is a one shot game, yet its logic applies also in a multi period environment, where the success of export promotion at time t leads improvement in the current account at time $t+1$, inducing more reserves hoarding at time $t+1$, needed in order to slow down the real appreciation which tends to be the byproduct of export led growth strategy. The ultimate speed of the REER adjustment and the needed hoarding in each period is the outcome of a complex interaction between the speed of reallocation of resources from the declining sector to manufacturing, and the speed to which prices and wages adjust to market pressure [i.e., the duration of nominal and real rigidities]. All these issues deserve further investigation.

These observations may explain also the inability to find a robust economic role for the mercantilist approach in econometric specifications, as most of its effects tend to dissipate overtime. Competitive hoarding may also reflect coordination failure. If China is the winner by virtue of low sterilization costs and size, other Asian countries may be worse off.⁷ It also suggests the possibility of gains from regional coordination, possibly in the form of regional funds, etc. China however, may be less eager to participate in such a fund compared to other East Asian countries. The competitive hoarding view is also consistent with 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 explaining the hoarding of international reserves, a one dollar increase in international reserves by one country has been associated with an increase of about .6 dollars by the other nine ‘peer countries.’

4. Concluding Remarks

I close the paper with a discussion of alternate interpretations of hoarding international reserves, and the challenges facing empirical research dealing with explaining the evolving patterns of international reserves.

Exposure to latent domestic instability To put Chinese policies in the perspective of the historical development of East Asia, one note that the history of Japan and Korea suggest the near absence of mercantilist hoarding of international reserves during the phase of fast growth, and the prevalence of export promotion by subsidizing heavily the cost of capital in targeted sectors. This has been accomplished with the help of the state banking system and occasionally with the tacit involvement of the central bank. The legacy of subsidized capital has been the rapid increase in M2, and the accumulation of non performing loans. Floundering economic growth led to the onset of the large hoarding of reserves both in Japan (after 1992) and Korea (after 1997), most likely due both to mercantilist motives and to self insurance meant to deal with the growing fragility of its banking systems. These perspectives suggest that the massive hoarding of reserves by China may be a hybrid of mercantilist and self insurance motives [Aizenman and Lee (2006)].

⁷ Arguably, the welfare impact of the hoarding game on the US is ambiguous. In the short-run, it allows cheaper financing of US deficits. Yet, in the intermediate run it may reduce US competitiveness in the presence of learning by doing externalities.

A possible political economy explanation of Chinese international reserves hoarding should recognize the challenges confronting the administration there: managing a take-off with unprecedented global magnitude, facing uncertainty regarding the regime's survival, growing income disparities, the accumulation of non performing loans and growing dependency on international trade. An abundance of savings in China provides the Chinese administration with the opportunity to mitigate the risk of latent domestic instability by aggressive international reserves hoarding, reducing both the risk of real exchange rate instability and inflation triggered by domestic crisis.⁸ This view is consistent with a 2006 estimation by E&Y, reporting that Chinese non performing loans were almost at par with its international reserves [see Jim Peterson's report at the *International Herald Tribune*, 9-11-2006]. It also suggests that for countries averse to real exchange rate volatility and inflation, usable international reserves may equal international reserves minus short term external debt minus any provisions for the non performing loans of the domestic banking system.

Testing self-insurance/precautionary model in China and the 'Peso problem.' Systematic attempts to test the self-insurance/precautionary model may be challenged by a version of the 'Peso problem.' To exemplify, the probability of a deep crisis in China may be low, but the potential damage of such a crisis may be immense. China's take off remains unique due to the sheer size of the event, tripling China's global GDP share within 25 years [from about 5% in 1977 to about 15% in 2003, PPP adjusted]. This suggests that little can be inferred by applying the experience of other countries to guide China regarding its optimal reserves. The econometric challenges associated with quantifying the self insurance needs of a country are akin to the challenge of quantifying the optimal design of highways in the San Francisco Bay Area. Uninformed tourists visiting San Francisco would conclude that highways there are overbuilt, conjecturing that people there have strange preferences for fortified roads. The data of the last 15 years supports this conjecture. Yet, by looking at data including the San Francisco earthquake of 1906, tourists would understand the design of highways there, and may ask why some highways are under built until this day. While China has been reasonably tranquil during

⁸ Arguably, if China would face a banking crisis of the type experienced by Argentina, its deep pocket of international reserves would allow China to deal with a bank run avoiding an Argentinean type of crisis resolution [i.e., avoiding the collapse of financial intermediation and higher inflation]. Indeed, one may argue that the sheer size of Chinese international reserves may prevent a run on its banking system in the first place.

the last twenty years, the regional history of the 20th century is abundant with economic & political earthquakes; some produced domestically, some internationally.

International reserves and sovereign default Understanding the role of international reserves for Latin America requires modeling the implications of sovereign default on international reserves. As a matter of common practice, international reserves are beyond creditors reach. This implies that for countries contemplating sovereign default, international reserves and sovereign default may be applied as independent consumption smoothing instruments. Aizenman and Marion (2004) provided a model and evidence pointing out that in these circumstances, greater political instability and polarization tend to *reduce* the hoarding of international reserves, and *increase* sovereign borrowing. This interpretation may account for Jeanne's observation that in 2000, Latin America held significantly less reserves than the level predicted by his benchmark model.

Saving and hoarding international reserves With limited integration of national capital markets, one expects that countries with higher saving rates would opt to hoard more reserves. Hence, the large gap between the patterns of hoarding reserves observed in Latin America and East Asia may be also accounted for by the factors explaining the large disparities between their saving rates.

Diversification and agency problems The lack of deeper diversification of international reserves may be partially due to agency problems. Central banks may be 'loss averse,' as the cost of holding too few reserves may be much higher than the opportunity cost of international reserves [Aizenman and Marion (2003)]. If Central Bank's loss aversion exceeds that of the representative consumer, a good case can be made for putting some of the international reserves into a 'future generation' fund, managed by the treasury or other agencies.

To conclude, the profound increase in the hoarding of international reserves by developing countries during recent years is part of a complex puzzle of shifting global trends. The quest for a unified theory and empirical specification of international reserves, while admirable, may not be feasible due to the pace of global changes. It is constructive to view observed patterns of international reserve hoardings as the aggregation of several motives, with time dependent weights. Taking such an eclectic approach, the first phase of the rapid hoarding of reserves in the aftermath of the East Asian crisis has been dominated by self insurance against

exposure to foreign shocks. Countries stunned by the 1997 crisis hedged their growing financial integration with self insurance and aggressive hoarding of international reserves in the aftermath of the crisis. Yet, the self insurance against sudden stops and currency crises interpretation fails to account for the reserves buildup in emerging market countries after 2000. These recent hoarding terms may be better accounted by competitive hoarding, self insurance against latent domestic and external instability, and exposure to instability associated with growing weaknesses of Banks' balance sheets.

References

- Aghion, P., P. Bacchetta, R. Ranciere and K. Rogoff. (2006). 'Exchange Rate Volatility and Productivity Growth: The Role of Financial Development,' NBER WP # 12117.
- Aizenman, J., and J. Lee. (2007). 'International Reserves: Precautionary versus Mercantilist Views, Theory, and Evidence,' *Open Economy Review*, Vol. 11, pp.191-214.
- _____, (2006), 'Financial versus Monetary Mercantilism – Long-run View of Large International Reserves Hoarding,' NBER WP # 12718.
- Aizenman, J. (2006). 'International reserves management and the current account', NBER Working paper # 12734, forthcoming, *Current Account and External Financing*, Santiago, the Central Bank of Chile, Edited by K. Cowan, S. Edwards and R. Valdés.
- _____. (2005). 'Financial Liberalisations in Latin America in the 1990s: A Reassessment', *The World Economy*. Vol. 28, pp. 959-983.
- _____. (2004). 'Financial Opening and Development: Evidence and Policy Controversies', *American Economic Review*, Vol. 94, 2, pp. 65-70.
- Aizenman, J. and D. Riera- Crichton (2006) "Real exchange rate and international reserves in the era of growing financial and trade integration," forthcoming, *Review of Economics and Statistics*.
- Aizenman, J., N. Marion. (2003). 'The High Demand For International Reserves In the Far East: What is Going On?' *Journal of the Japanese and International Economies*, Vol. 17, pp. 370–400.
- _____. (2004). 'International reserves holdings with sovereign risk and costly tax collection.' *Economic Journal*. vol. 114, pp. 569-591.
- Aizenman, J. and R. Glick. (2007). 'Sterilization, Financial Liberalization, and Global Integration,' in progress.
- _____. (2005). 'Pegged Exchange Rate Regimes -- A Trap?' NBER 11652, forthcoming, *Journal of Money, Credit and Banking*.
- Ben Bassat, A. and D. Gottlieb. (1992). 'Optimal International Reserves and Sovereign Risk,' *Journal of International Economics* 33, pp. 345-362.
- Bird, G., and R. Rajan. (2003). 'Too Much of a Good Thing? The Adequacy of International Reserves in the Aftermath of Crises,' *The World Economy* 26 (6), 873-891.
- Calvo, G. (1998). 'Capital flows and capital-market crises: the simple economics of sudden stops.' *Journal of Applied Economics* 1, pp. 35-54.
- Calvo, G. (1991). 'The Perils of Sterilization.' *IMF Staff Papers*. Vol. 38 (4), pp. 921-6.
- Cheung, Y-W and X. W. Qian. (2006). 'Hoarding of International Reserves: Mrs Machlup's Wardrobe and the Joneses,' manuscript, UCSC.
- Cheung, Y-W and H. Ito. (2007). 'Cross-sectional analysis on the determinants of international reserves accumulation,' manuscript.
- Diaz-Alejandro, C. (1985). 'Goodbye Financial Repression, Hello Financial Crash.' *Journal of Development Economics*. Vol. 19, pp. 1-24.
- Dooley, M. P., Folkerts-Landau, D., and P. Garber. (2004). 'The Revived Bretton Woods System: The Effects of Periphery Intervention and Reserve Management on Interest Rates and Exchange Rates in Center Countries,' NBER Working Paper # 10332.
- Edwards, S. (2004). 'Thirty years of current account imbalances, current account reversals, and sudden stops.' *IMF Staff Papers* Vol. 51, Special Issue, pp. 1-49.
- Edwards, S. Levy Yeyati, E. (2005). 'Flexible exchange rates as shock absorbers.' *European Economic Review*, Vol. 49 (8), pp. 2079-2105.

- Eichengreen, B. (1999). 'Kicking the Habit: Moving from Pegged Rates to Greater Exchange Rate Flexibility.' *Economic Journal*, March, C1-C14.
- Eichengreen, B., and P. Masson. (1998). 'Exit Strategies: Policy Options for Countries Seeking Greater Exchange Rate Flexibility,' *IMF OWP* 98/168.
- Flood, R., and N. Marion. (2002). 'Holding International Reserves In an Era of High Capital Mobility,' in S.n M. Collins and D. Rodrik eds., *Brookings Trade Forum 2001*, 1-47 (Brookings Institution Press, Washington DC).
- Frankel, J. (1999). 'No single currency regime is right for all countries or at all times,' *Essays in International Finance* no. 215, Princeton U. Press.
- Garcia, P. S., and C. Soto. (2004). 'Large Hoarding of International Reserves: Are they worth it?' Central Bank of Chile Working Paper No. 299.
- Gourinchas, P.O. and O. Jeanne. (2006). 'Capital Flows to Developing Countries: The Allocation Puzzle,' mimeo, UC Berkeley, Department of Economics.
- Hutchison M. & I. Noy. (2005). 'How Bad Are Twins? Output Costs of Currency and Banking Crises,' *Journal of Money, Credit and Banking*, 37, 4, pp. 725-52
- Jeanne, O. and R., Ranci re, (2006). 'The Optimal Level of International Reserves for Emerging Market Countries: Formulas and Applications,' IMF Working Paper 06/229 (Washington: International Monetary Fund).
- Jeanne, O. (2007). 'International Reserves in Emerging Market Countries: Too Much of a Good Thing?' forthcoming, *Brookings Papers on Economic Activity*.
- Johnson, H. G. (1953). 'Optimal Tariffs and Retaliation,' *Review of Economic Studies* 21, pp. 142-53.
- Kaminsky, G., C. Reinhart. (1999). 'The Twin Crises: The Causes of Banking and Balance-of-Payments Problems,' *American Economic Review*, Vol. 89, 3, pp. 473-500.
- Lee, J. (2004). 'Insurance Value of International Reserves,' IMF Working Paper No. 04/175.
- Levy Yeyati, E. (2005). 'Liquidity Insurance in a Financially Dollarized Economy' NBER WP 12345.
- Obstfeld M. and K. Rogoff (1995). 'The Mirage of Fixed Exchange Rates', *Journal of Economic Perspectives*, Vol. 9, 4, pp. 73-96.
- Obstfeld, M., J. C. Shambaugh and A. M. Taylor. (2005). 'The Trilemma in History: Tradeoffs Among Exchange Rates, Monetary Policies, and Capital Mobility,' *Review of Economics and Statistics* 3, pp 423-438.
- Prasad, E., Rajan, R. and A. Subramanian, (2006). 'Foreign Capital and Economic Growth,' manuscript, IMF.
- Rodrik, D. (1998). 'Who Needs Capital-Account Convertibility?' *Essays in International Finance* no. 207, Princeton Press.
- _____ (2006). 'The social costs of foreign exchange reserves,' NBRE WP # 11952 .
- Rose, A. (2006). 'A stable international monetary system emerges: inflation targeting is Bretton Woods, reversed. NBRE WP # 12711, forthcoming, *Journal of International Money and Finance*.
- Stiglitz, J. (2002). *Globalization and Its Discontents*, W.W. Norton.

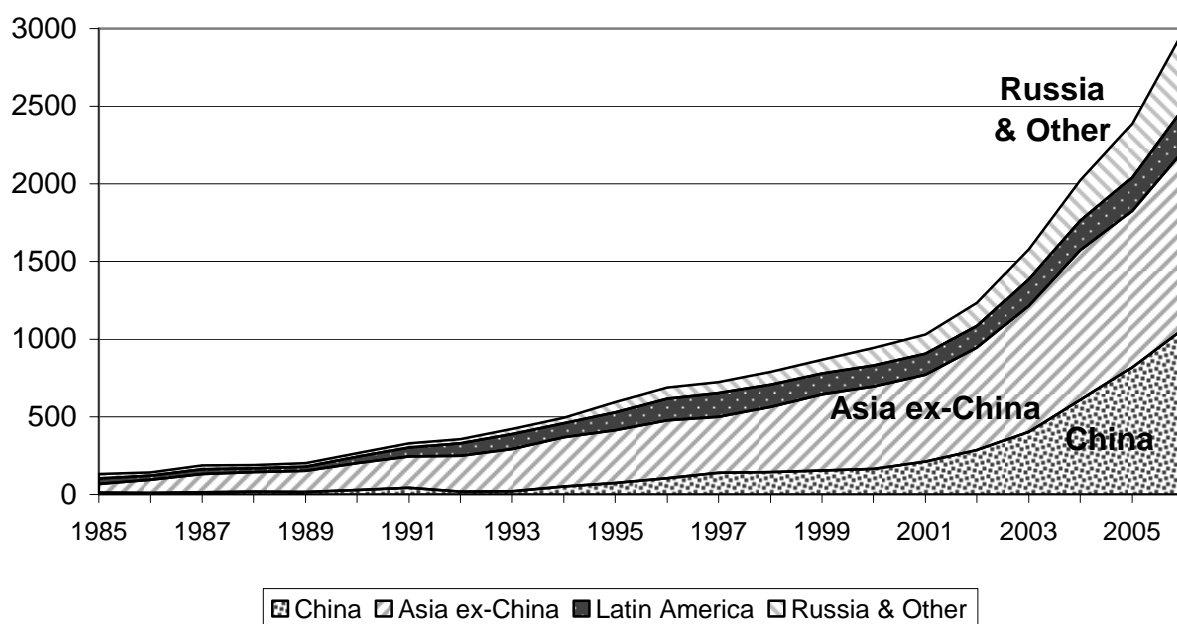


Figure 1a: Foreign Exchange Reserves in Emerging Markets, \$billions

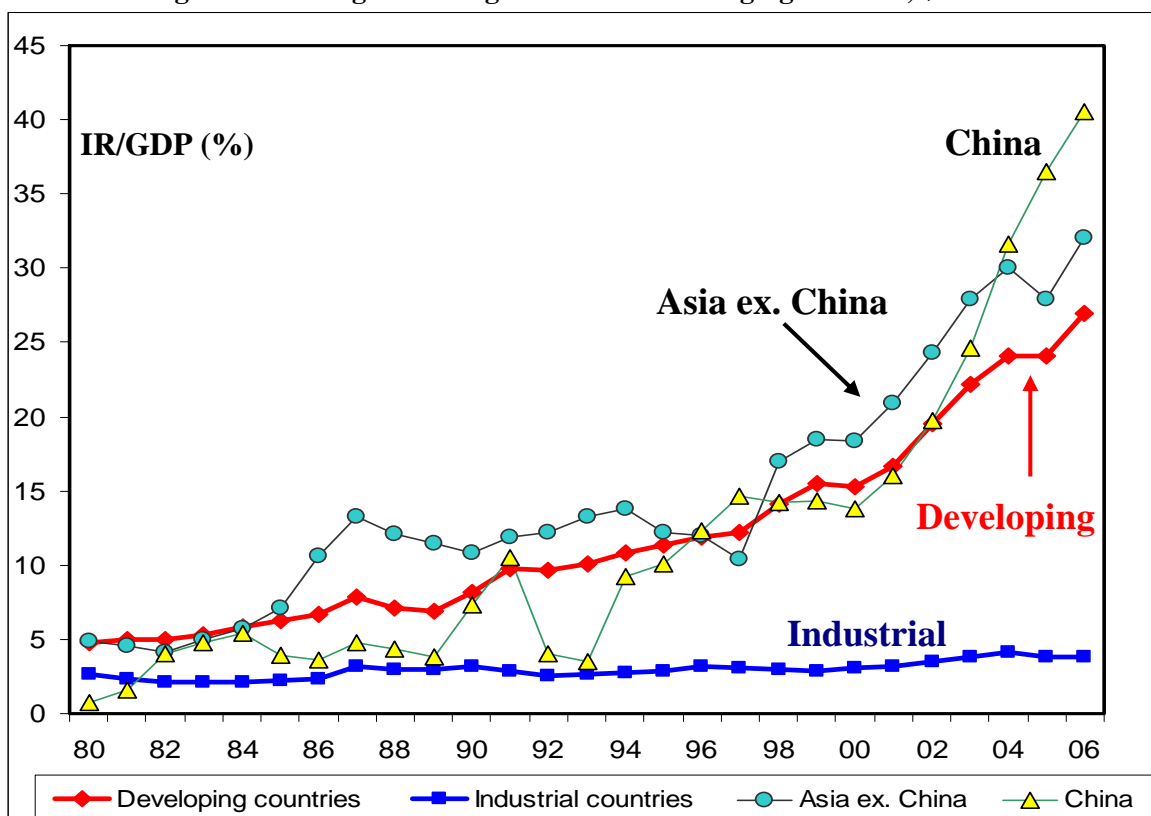


Figure 1b: aggregate IR/aggregate GDP (%), 1980-2006

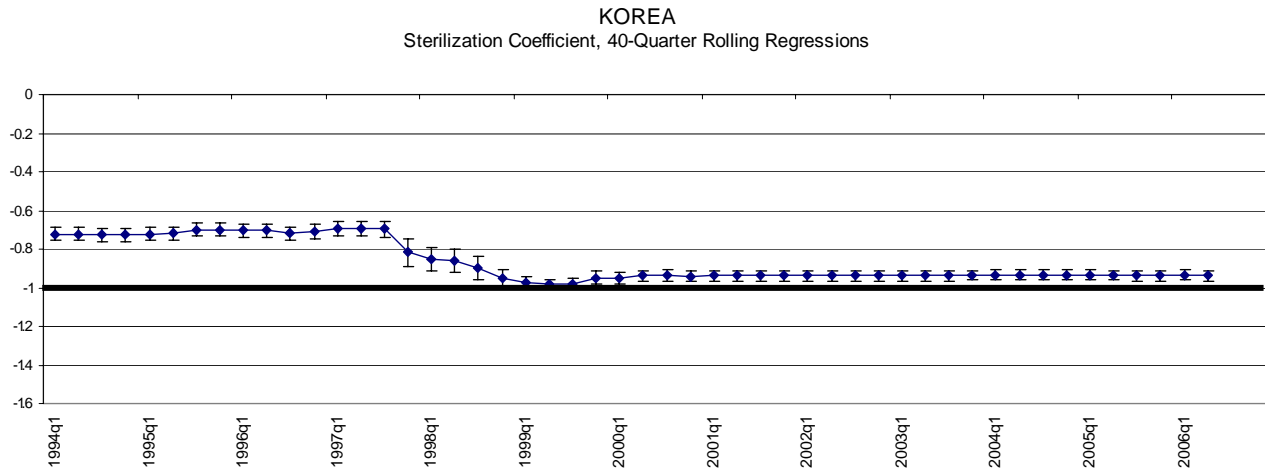


Figure 2: Sterilization coefficient, Korea, 1994-2006
Sterilization Coefficients from 40- quarter rolling regressions, controlling for nominal GDP growth. The bold curve corresponds to full sterilization.
Source: Aizenman and Glick (2007)

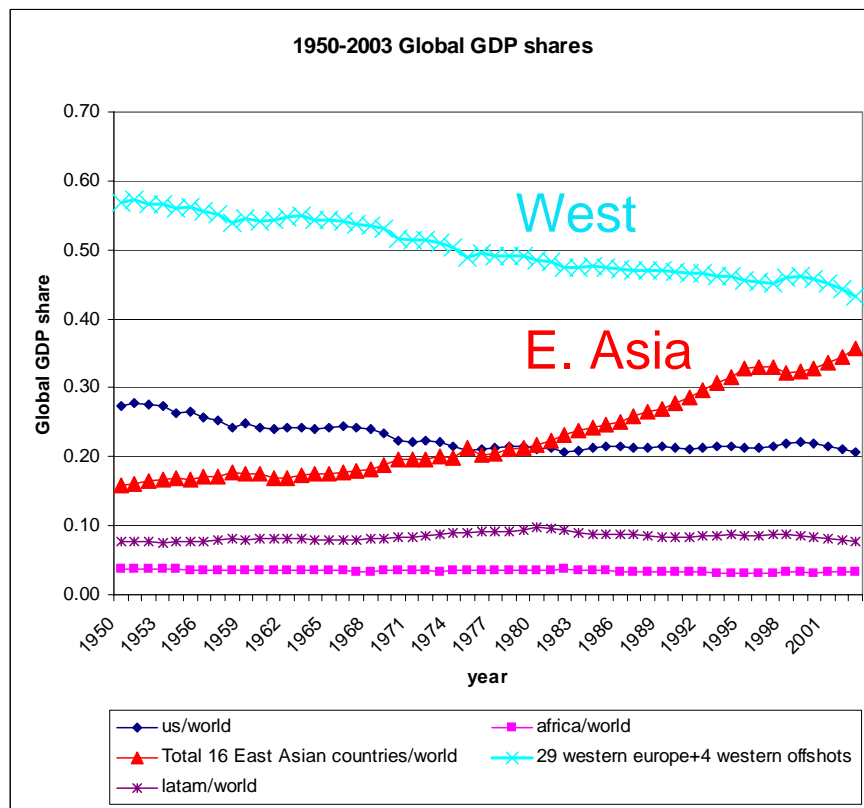
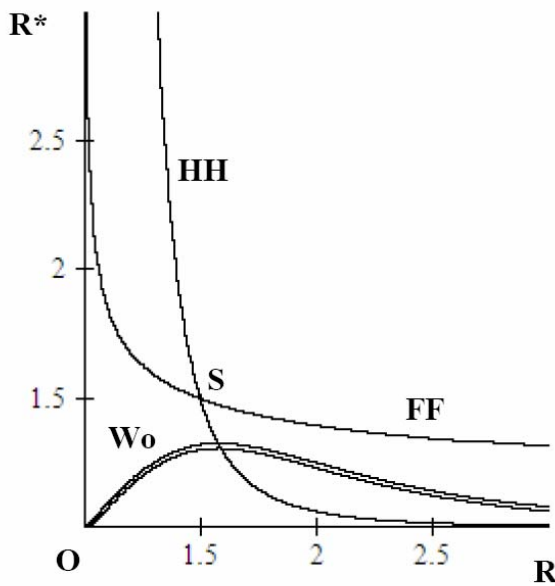
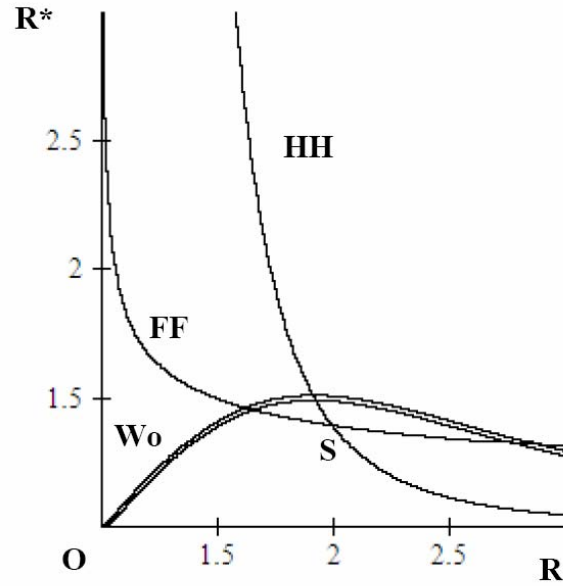


Figure 3
Global GDP shares, 1950-2004. Source: Maddison's data



I. The symmetric case:
‘Beggar yourself’



II. The asymmetric case:
‘Beggar-thy-neighbor’

Figure 4: Competitive hoarding

HH and FF are H and F reaction functions, respectively. The optimal demand for international reserves in the absence of competitive hoarding is normalized to $R = R^* = 1$. Point S is the noncooperative equilibrium. Point O corresponds to the cooperative outcome. Curve W_o , the inverted U shaped curve, is H's indifference map -- H is indifferent between the cooperative outcome and (R, R^*) forming curve W_o . Points below curve W_o are configurations of (R, R^*) where H's welfare is above H's welfare in the cooperative regime.

Panel I (the symmetric case) plots the situation when H's and F's preferences and sterilization costs are identical. For H and F, the non-cooperative outcome [point S] is inferior to the cooperative one [point O]. Panel II (the asymmetric case) plots the situation when H's sterilization costs are significantly lower than F's costs. H's non-cooperative outcome [point S] is superior to the cooperative one [point O].

See Aizenman and Lee (2006) for further analysis.

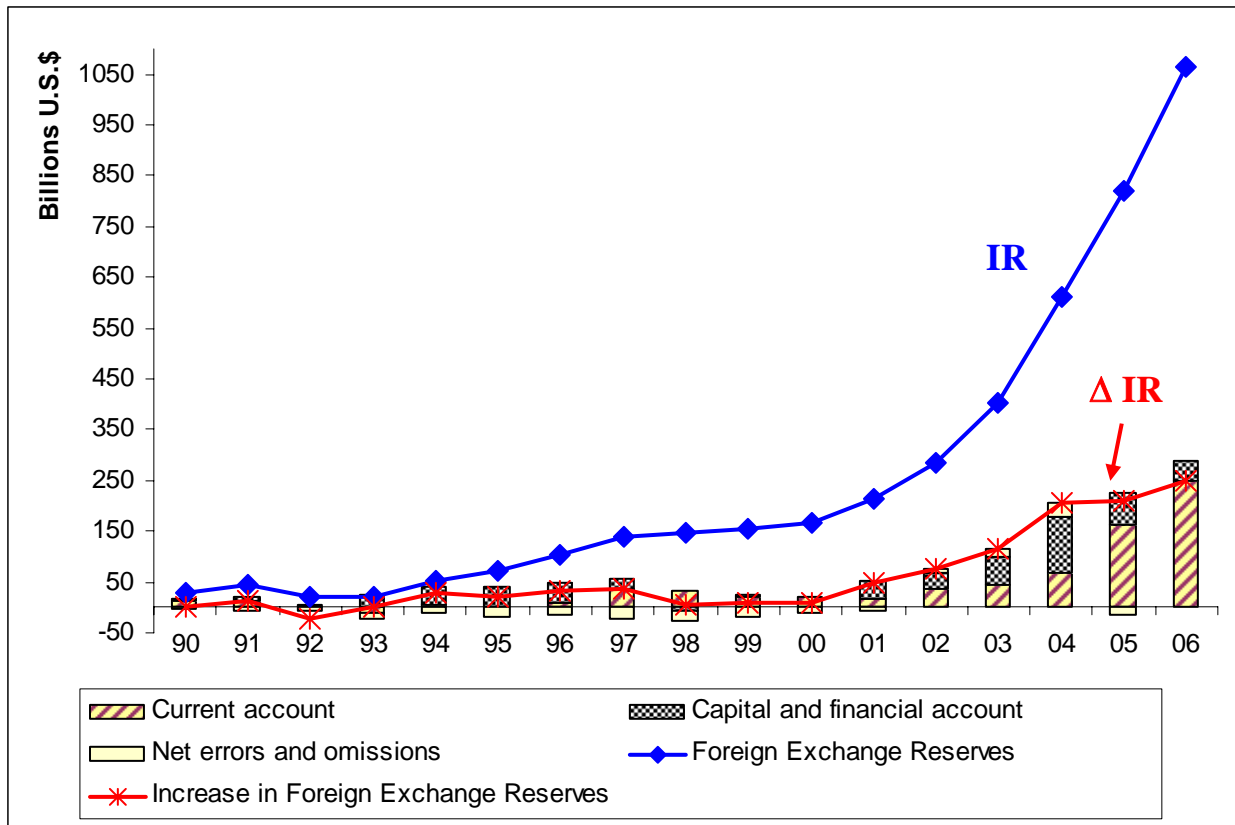


Figure 5
Chinese hoardings and sources, 1990-2006