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CHINA'S GROWTH, STABILITY, AND USE OF INTERNATIONAL RESERVES

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China's Growth, Stability, and Use of International Reserves  
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**ABSTRACT**

Since the onset of the global financial crisis, China and the U.S. have reduced their current-account imbalances as a share of GDP to less than half their pre-crisis levels. For China, the reduction in its current-account surplus post-crisis suggests a structural change. Panel regressions for a sample of almost 100 countries over 1983-2013 confirm that the relationship between current-account balances and economic variables changed in important ways after the financial crisis. China's rebalancing has been accompanied by a decline in its reserves-to-GDP ratio and greater outward FDI that, in turn, has mitigated reserve hoarding.

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## 1. INTRODUCTION

In 2007-2009 the United States faced a severe financial crisis that resulted in the worst downturn in output and employment since the Great Depression. Economists and policy makers have concentrated on understanding the fundamental causes of this crisis and how to end it. In addition, the dramatic collapse in world trade that was both triggered by the crisis and helped spread it has led to new work on the linkages between financial distress and global trade flows. A topic that has received less attention is how East-West global imbalances—particularly those of China and the United States-- have changed in the aftermath of the financial crisis. That is the focus of this paper.

In the run-up to the financial crisis, the world economy was characterized by enormous current-account imbalances (Figure 1). China's surplus alone was 0.7% of world GDP in 2008 while the United States had a deficit of more than 1% of world GDP that year. The current-account balances of the world's surplus countries (e.g., China, Germany, Japan, oil exporters) exceeded 2.5% of global GDP in 2008; the current-account balances of the world's deficit countries (e.g., the United States, non-Asian emerging markets, the Euro area excluding Germany) also were about 2.5% of global GDP.

Prior to the financial crisis, some suggested large imbalances could be sustained for the foreseeable future. Dooley, Folkerts-Landau and Garber (2003, 2005), for example, argued an Asian periphery, primarily China, could pursue a development strategy of export-led growth supported by undervalued exchange rates and capital controls for many years. Large current-account surpluses and official capital outflows in the form of accumulated reserve asset claims on the United States would characterize the Asian periphery for perhaps a decade or more. Moreover, the strategy was a "win" for the center (e.g., the United States) as well, since virtually unlimited demand for its financial assets would allow it to run large current-account deficits, living beyond its means for years.

At some point, the Asian periphery would grow sufficiently to graduate to the center. It would then undertake financial liberalization and adopt greater exchange-rate flexibility. But when that happened, another set of developing countries would step forward to become the new periphery, pursuing the same export-led growth strategy against the center as had China and the Asian periphery, and before them, post-war Europe and Japan. As a result, global imbalances, with the periphery running large current-account surpluses and the center large current-account deficits, would be a regular feature of the international monetary system for years to come.

In later work, Dooley *et al* (2004) provided an asset-market interpretation of the win-win view of global imbalances. The interpretation went as follows. U.S. deficits supplied international collateral to poorer countries on the periphery eager to undertake capital formation; the collateral freed them from a reliance on inefficient domestic financial markets. FDI flows into China provided supporting evidence for this claim.<sup>1</sup>

The modern mercantilist view, embraced by Aizenman and Lee (2007, 2008) and others, provided a less sanguine interpretation for the persistent global imbalances that emerged in the 2000s. While Aizenman and Lee confirmed the hoarding of international reserves that accompanied current-account surpluses was dominated by a precautionary motive prior to 2000, a finding consistent with Aizenman and Marion's (2003, 2004) earlier interpretations, there appeared to be a regime change afterwards.<sup>2</sup> China's international reserves that had been trendless during the second half of the 1990s, hovering around 15% of GDP, grew after 2000 at an annual rate of about 4%, reaching almost 45% of GDP by 2007 (Figure 2).

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<sup>1</sup> Caballero, Farhi and Gourinchas (2008), Ju and Wei (2010) and others explored this interpretation in models with FDI and global imbalances.

<sup>2</sup> While the mercantilist motive for hoarding international reserves played a significant statistical role in accounting for the behavior in international reserves/GDP during the period 1980-2000, the precautionary motive was more important economically.

Aizenman and Lee (2008) pointed to monetary mercantilism as the main reason for the regime change. Like earlier mercantilist efforts to expand export markets and accumulate gold described by Adam Smith (1776), after the year 2000 countries such as China started pushing exports to promote growth, racking up current-account surpluses and growing stockpiles of international reserves. The numbers were impressive. On the eve of the financial crisis, China's real GDP growth had reached 14% (Figure 3), its current-account surplus had grown to 10% of GDP (Figure 4), and its international reserves had reached almost 45% of GDP prior to the crisis, peaking at about 50% in 2010 (Figure 2). However, unlike Dooley *et al*'s (2003, 2004, 2005) win-win view of global imbalances buffered by international reserve hoarding, Aizenman and Lee (2008) warned that modern mercantilism could lead to unintended adverse consequences such as competitive hoarding.

The view that large East-West global imbalances could be sustained for a long period was not shared by everyone. Eichengreen (2007) and Feldstein (2008), for example, argued the Asian periphery was not monolithic; some member of the periphery might abandon fixed exchange rates against the dollar sooner than later, either willingly or in response to speculative pressures, thereby reducing East-West global imbalances. Obstfeld and Rogoff (2005) also saw large imbalances as unsustainable and worried whether they would unwind gradually or abruptly.

Alfaro, Kalemli-Ozcan and Volosovych (2011) observed that global imbalances where poorer countries financed richer ones were driven mainly by government decisions and official capital flows, since private funds tended to move in the opposite direction, attracted by higher growth rates in poorer countries. They raised concerns about the global efficiency and sustainability of these trends.<sup>3</sup>

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<sup>3</sup> Feenstra and Hong (2010) raised questions about the efficacy and sustainability of export-led growth in China as the way to increase future employment. They calculated that export growth over the period 2000-2005 could explain the entire increase in China's employment over that

Aizenman and Sun (2010) also raised doubts that large global imbalances could be sustainable. They argued that with China growing at twice the rate of the United States, the U.S. current-account deficits needed to absorb China's surpluses in coming years -- in the absence of other big countries willing to run large deficits -- would be unrealistically high and hence self-limiting in the not too distant future.<sup>4</sup>

Then the financial crisis hit. In the U.S., the private sector was forced to deleverage and reduced its demand for imports. Other crisis-hit developed countries also cut back on imports. As China experienced weaker export demand, it took seriously the IMF's call for more reliance on domestic spending to sustain growth. It began promoting greater domestic consumption and investment with the help of a domestic credit boom. It also pursued fiscal stimulus and allowed its real exchange rate to appreciate. It attempted to diversify its holdings of dollar-denominated reserve assets by creating a sovereign wealth fund and encouraging outward foreign direct investment.

The data are revealing. Since the onset of the financial crisis, East-West global imbalances have fallen dramatically. The current-account balances of the world's big surplus economies that totaled 2.5% of world GDP in 2008 have been below 2% since 2009; the current-account deficits of the biggest deficit countries have shown a similar decline (Figure 1).

China and the United States have also seen their imbalances shrink (Figure 6). China's current-account surplus fell from 10.1% of GDP in 2007 to 5.1% in 2009 and to 2.3% in 2012

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period, but comparable employment gains could have been achieved by growing domestic demand.

<sup>4</sup> Aizenman and Jinjark (2009) captured empirically the asymmetric effect of the U.S. as the "demander of last resort." For the period 1981-2006, a 1% increase in the lagged US current-account deficit was associated with a 0.5% increase in the current-account surpluses of surplus countries. They projected a sizable drop in China's current-account surpluses after 2006, possibly falling to 1% of China's GDP by 2013 in a "worst-case scenario" where all conditioning variables deteriorated by one standard deviation.

(Figure 4). As a share of global GDP, China's surplus fell from 0.7% in 2008 to 0.27% in 2012 (Figure 1). The drop in 2009 alone was the largest ever recorded in the last thirty years (Table 1b). According to the IMF, China's current-account surplus is expected to be 0.32% of world GDP at the end of 2013.

Before the financial crisis, the U.S. current-account deficit was about 6% of U.S. GDP in both 2005 and 2006 and 5% in 2007. After the onset of the financial crisis it fell to 2.7% in 2009 and 2.8% in 2012. As a share of global GDP, the U.S. current-account deficit also fell dramatically. The IMF expects it to be at a sixteen-year low of 0.64% by the end of 2013.

Standard macroeconomic models can easily account for the reduction in global imbalances in the immediate aftermath of a financial crisis. Financial frictions and household deleveraging reduce import demand as well as aggregate demand in crisis-hit countries, reducing their current-account deficits. The decline or reversal in international financial inflows during a financial crisis also depreciates their real exchange rates, further reducing their deficits. If weak demand impacts many countries, there are few to take up the slack. Countries with large current-account surpluses, such as China, will see demand collapse for their exports and will experience declining current-account surpluses. Policies that stimulate domestic demand to make up for the export shortfall can reduce current-account surpluses even more.

In this paper, we look at the data and move directly to an empirical investigation. We explore panel regressions as a way to highlight important correlations between current-account balances and economic variables both before and after the financial crisis. Although data are only available for six years since the onset of the financial crisis, the regression estimates provide some suggestive evidence on whether the crisis will have a long-lasting impact on moderating current-account imbalances, particularly those of China and the United States.

The rest of the paper is organized as follows. Section 2 describes the data and our estimation procedure. Section 3 presents baseline results and checks their robustness to alternative specifications. Section 4 focuses on China. It compares the actual decline in China's current-account surpluses post-2006 with predicted values based on the panel regression's pre-crisis sample coefficients and on its post-crisis sample coefficients. The results indicate a structural change post-crisis. The decline in China's reserve stockpile post-crisis is also shown to be driven somewhat by a new wave of outward foreign direct investment (FDI) into developed economies as China seeks higher-yielding real foreign assets. This new trend is supported by an easing of capital controls on outward flows.<sup>5</sup> China has joined other emerging markets in relaxing outflow controls, motivated by the desire to dampen rising stock prices, the appreciation in the exchange rate, real exchange-rate volatility, and the large accumulation of international reserves. [See Aizenman and Pasricha (2013)]. We speculate that China's smaller current-account surpluses and more moderate reserve accumulation may become a longer-term norm as lower global growth forces China to rely more on domestic demand to expand its economy and as the high cost of holding international reserves pushes China to place even more emphasis on outward FDI. Section 5 concludes.

## **2. DATA AND ESTIMATION**

We assembled panel data on current-account balances and other economic variables for a group of developed and developing countries over the period 1980-2012. Data definitions, data sources and country coverage are described in the Appendix. Most data are from the Economist Intelligence Unit (EIU). The EIU data are obtained from individual country sources, the

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<sup>5</sup> WSJ, December 19, 2013 reported, "Beijing will ease the approval process for all but the largest Chinese investments in overseas companies and projects, a major relaxation of regulatory oversight that analysts say is aimed at encouraging Chinese firms to expand abroad."

International Monetary Fund's *International Financial Statistics* and the World Bank's *World Development Indicators*. We supplement these data with data from the *External Wealth of Nations* and other sources.

We restrict the sample to countries with annual observations in each of two sub-periods, one before the financial crisis and the other after its onset. The sample is further restricted by data availability. Our final sample contains 95 countries; 30 of these countries are OECD members.

The estimation draws on the empirical framework in Chinn and Prasad (2003) and Gruber and Kamin (2007). The estimating equation is:

$$CAY_{i,t} = \alpha CAY_{i,t-1} + BX_{i,t-1} + C_i + \gamma DEMAND_{USA,t-1} + e_{it}; C_i = \{c_1, \dots, c_{94}\} \quad (1)$$

where  $CAY_{i,t}$  is the current-account balance as a percentage of GDP of country  $i$  at time  $t$ ,  $X_{i,t-1}$  is a vector of lagged economic variables,  $C_i = \{c_1, \dots, c_{94}\}$  is a vector of country fixed effects, and  $DEMAND_{USA,t-1}$  is the lagged U.S. current-account balance as a share of GDP. The economic factors included in  $X$  are economic performance, captured by the growth rate of real GDP and real GDP per capita; structure, represented by openness to trade and the share of natural resources exports in GDP; external wealth, measured by international reserves as a share of GDP; debt, measured by the stock of public debt as a share of GDP; and the real exchange rate.<sup>6</sup>

Since the current account is the result of saving and investment decisions, the empirical specification in (1) uses standard variables that are correlated with these decisions along with structural and policy measures. The specification also includes the U.S. demand variable (measured by the U.S. current-account deficit as a percent of GDP) used in Aizenman and Jinjarak (2009) to capture the notion that the U.S. acted as a “demander of last resort” for the

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<sup>6</sup> We also consider the role of liquidity, captured by bank lending to the public and private sectors as a share of GDP, in one version of our estimation. Including the liquidity variable reduces the number of countries in the sample from 95 to 83.

exports of China and other countries, enabling them to run big current-account surpluses over part of the sample period.

The Appendix provides a table of summary statistics for the variables used in the estimation.

### **3. BASELINE RESULTS AND ROBUSTNESS CHECKS**

Before proceeding with the formal estimation, we first test for possible non-stationarity. For each variable, we perform panel data unit-root tests using a Fisher-type (Choi, 2001) procedure, including one lag in the test. The test is not limited to a balanced sample and has a null hypothesis that all the panels contain a unit root. Based on the test results, non-stationary variables are then first-differenced.

Table 2a presents baseline results over the sample period 1983-2012 and two sub-periods 1983-2006 and 2007-2012. The panel regressions explain over one-half of the variation in the current account. The goodness of fit is better for the 1983-2006 sub-period ( $R^2 = 0.69$ ) than for the 2007-2012 sub-period ( $R^2 = 0.55$ ), suggesting a change after the onset of the financial crisis. The Table 2a results indicate that most of the economic variables are significantly correlated with the current account in the whole sample and across the two sub-periods. The signs on the correlations are as expected. The correlations can be characterized as follows:

- The correlation between the current-account surplus and an increase in international reserves is always positive and significant.
- The correlation between the current-account surplus and an increase in U.S. demand is positive and significant for the full sample period and pre-crisis period. The correlation is

insignificant post-crisis. The latter result suggests a possible structural change in the role of the U.S. as the demander of last resort following the financial crisis.

- The correlation between the current-account surplus and real GDP growth is always negative and significant; the same is true of the correlation between the current-account surplus and the increase in public debt.
- The correlation between the current-account surplus and trade is positive and significant for the full sample period and pre-crisis period but negative and significant post-crisis.
- The correlation between the current-account surplus and appreciation of the real exchange rate is negative and significant for the full sample period but insignificant in each of the two sub-periods.

The correlation results for trade and the real exchange rate are consistent with the complementary relationship between the surplus countries and the U.S. prior to the financial crisis and its reversal after the crisis. Prior to the crisis, the relatively high rates of employment and low rates of unemployment in the U.S. as well as the presumption that *The Great Moderation* was the new normal put to rest most concerns about increasing global imbalances. Moreover, large and growing U.S. current-account deficits translated into large and growing world demand for U.S. assets that helped keep U.S. interest rates low and allowed the U.S. to access global savings when its own saving rate was low. These trends were complemented by the growing exports and current-account surpluses of China and other emerging markets as they pursued export-led growth strategies.

The financial crisis forced countries to confront a changed global picture, with much slower growth in the OECD countries and reduced demand for the exports of emerging markets that had previously relied on export-led growth strategies. In the post-crisis environment, depreciating currencies and hoarding international reserves are not enough to sustain robust

export-led growth. The estimates in Table 2a confirm that a structural change has taken place post-crisis. An F-test rejects the null of no structural change between the pre-crisis period (1983-2006) and the post-crisis period (2007-2012).

To explore further possible differences between the pre- and post-crisis periods, we re-estimate the regression over the entire sample period, now including a dummy variable equal to one for the post-crisis years 2007-2012 plus interactive terms. The results are reported in Table 2b. The F-test confirms that the null of no structural change between the pre-crisis and post-crisis periods can be rejected with high confidence.

Several results in Table 2b are noteworthy. The positive correlation between the current-account surplus and international reserves prior to the crisis is significantly more positive in the post-crisis period. This pattern is consistent with greater competitive hoarding in times of global recessionary pressures. The negative correlations of the current-account surplus with real GDP growth and the increase in public debt are significantly more negative after the crisis. This result is consistent with greater fiscal retrenchment in the surplus countries in the aftermath of the crisis.

The correlation between the current-account surplus and U.S. demand in the pre-crisis period ( $\rho_{pre-crisis} = 0.35$ ) is positive and highly significant. The positive correlation is much weaker in the post-crisis period ( $\rho_{post-crisis} = \rho_{pre-crisis} + \rho_{interaction} = 0.35 - 0.28$ ); although an F-test reveals it is still significant ( $F=8.52$ ,  $Prob>F=0.0036$ ). After the onset of the financial crisis, the United States no longer plays such an important role as ‘demander of last resort’ for the exports of other countries. Its private and public sectors have had to undergo substantial adjustments, making them less able to absorb the world’s exports. The U.S. private sector has had to deleverage in response to the negative wealth effects of declining real estate and portfolio valuations. The more limited access of households to the credit market has raised private savings.

The U.S. public sector has contracted in response to the end of the federal fiscal stimulus, the drop of public investment and spending, and the negative stimulus stemming from declining tax revenues and mounting debts in the fifty U.S. states. These private and public sector adjustments post-crisis have required the U.S. to retreat from its role as “demander of last resort” for the world’s exports.

Table 3a reports results for the current accounts of surplus and non-surplus countries in the pre- and post-crisis periods. A surplus country is defined as one having a current-account surplus greater than 1.5 percent of GDP in a given year and having experienced an increasing surplus in the prior two years. The current accounts of surplus countries are significantly correlated with fewer economic variables than the full sample of countries, and even these significant correlations do not generally carry over to the post-crisis period. Prior to the financial crisis, the current accounts of surplus countries are positively and significantly associated with the increase in international reserves, trade, and the increase in the US current-account deficit.

After the financial crisis, the first two correlations are insignificant and the correlation with U.S. demand reverses sign; it is now negative and significant. An F- test rejects the null of no structural break for surplus countries after the onset of the financial crisis.

An F- test also rejects the null of no structural break across the two periods for non-surplus countries. A number of correlations that are highly significant prior to the crisis lose their significance in the post-crisis period. The role of the U.S. as a “demander of last resort,” for example, loses its significance after 2006.

To explore further the possible differences between the pre- and post-crisis periods for the two country groupings, we estimate separate regressions for the surplus and non-surplus countries, using the full sample period and including the time dummy and its interactions. The

results are reported in Table 3b. F-tests reject the null of no structural break post-crisis for both the surplus and non-surplus countries.

The role of the U.S. as a demander of last resort is not an important factor either before or after the crisis for non-surplus countries. For the surplus countries, it is a significant factor in each period.<sup>7</sup> Interestingly, the U.S. role as demander of last resort is significantly different after the onset of the crisis for surplus countries.

The correlation between the current-account surplus and increase in international reserves is positive and significant for both surplus and non-surplus countries prior to the crisis. After the crisis, there is no significant change in the correlation for non-surplus countries. For the countries in surplus, however, the correlation is significantly dampened after the crisis, although an F-test shows that it remains positive and significant.<sup>8</sup>

#### **4. CHINA'S CURRENT-ACCOUNT AND INTERNATIONAL RESERVES**

Figure 8 illustrates China's current-account surplus over the period 1999-2012. It also depicts two forecasts of China's current account for the post-2006 period. The pre-crisis forecast is based on the estimated regression coefficients of the pre-crisis regression in Table 2a, while the post-crisis forecast is based on coefficients from the 2007-2012 period regression in Table 2a.

The pre-crisis forecast predicts a declining current account/GDP surplus for China after 2008. This prediction is in line with the realized decrease in China's current-account surplus,

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<sup>7</sup> An F-test reveals that the correlation in the post-crisis period is significant;  $F=9.80$ ,  $\text{Prob}>F=0.0022$ .

<sup>8</sup> In one version we added the growth of domestic credit as a share of GDP as a regressor and interacted it with the time dummy. Including the domestic credit variable reduces the country sample from 95 to 83. The correlation of the current-account surplus and the growth of domestic credit is positive and significant in the pre-crisis period only for the non-surplus countries and the correlation in the post-crisis period is not significantly different from the one in the pre-crisis period.

but it under-predicts the magnitude of the decline in each of the post-crisis years. The post-crisis forecast predicts a sharp drop in China's current account as early as 2007 and over-predicts the decline in China's current-account surplus in both 2007 and 2008. That said, from 2009 onwards, the post-crisis forecast and China's actual current account match up quite nicely. The forecast predicts a 1 percent higher surplus in 2011 than was realized, possibly because it does not account for the fiscal package adopted by China's government to stimulate the economy.

Finally, we examine the changes in China's international reserves over the last thirty-three years (Figure 5 and 7). We quantify the sources of these changes. This exercise allows us to trace the changing impact of inward and outward FDI on international reserves, as well as the influence of the trade balance, domestic credit, and real exchange-rate appreciation. As there is no reason for the relationship between reserves and these factors to be stable over time, we examine separately the pre-crisis and post-crisis periods.

Table 4 reports the results of regressing the change in China's international reserves/GDP on trade/GDP, the flows of inward and outward FDI/GDP, the increase in domestic credit/GDP, and real exchange-rate appreciation. Columns I-V report estimated coefficients and their standard errors when each of the source variables enters the estimation individually. The results indicate reserve increases are positively and significantly correlated with the trade balance, inward and outward FDI flows, the increase in domestic credit and the appreciation of the real exchange rate. Estimates in Columns VI and VII show these correlations differ when the economic variables are considered jointly or when the time periods differ.

We summarize the sources of changes in China's international reserves in Figure 9. This figure plots the economic significance of a one-standard-deviation increase in the source variable on the change in China's international reserves as a percent of its GDP. The calculation is based on the regression reported in Table 4, Column VII. The figure reveals the role of China's trade

balance on its international reserves has been remarkably symmetric in the pre- and post-crisis periods, highlighting the common impact of the financial crisis on China's current account and international reserves. Domestic credit also plays much the same role as a source of change in the pre- and post-crisis periods. The same cannot be said for FDI. Outward FDI played no significant role prior to the crisis but it has become an important source of change in China's international reserves after the crisis.

To put these results in a broader perspective, it is worth noting that in 2012, domestic investment in China reached almost 50 percent of GDP and domestic credit grew to about 200 percent of GDP. In addition, China's saving rate is probably well above the 'Golden Rule' rate. These considerations suggest a need to rebalance the economy. China's remarkable fiscal and monetary stimuli in the early stages of the financial crisis prevented a hard landing during the period 2008-10. However, such policies do not substitute for a needed restructuring of the economy, a restructuring that reverses policies depressing Chinese consumption and preventing faster real appreciation. This rebalancing may entail lower current-account surpluses, faster growth of the non-traded sector, and reduced hoarding of reserves. Channeling international reserves into foreign equity and outward FDI may be part of this transformation.

## 5. CONCLUSION

Panel regressions show that standard variables adopted by the literature, measures capturing economic performance, economic structure, external wealth, debt, and the exchange rate, are helpful in “explaining” the current-account behavior of almost 100 countries over the period 1983-2012. The role of the United States in sustaining current-account surpluses elsewhere by running its own sizeable deficits has obviously diminished after the onset of the financial crisis. The role of the financial crisis in reducing global imbalances is also evident. Moreover, there is some evidence that the financial crisis -- and the impact it has had on both economic indicators and policy actions -- has brought about a structural change in the relationship between current accounts and these economic factors.

The rebalancing of current accounts in both China and the United States post-crisis will likely change the pattern of international reserve hoarding. While the precautionary motive for hoarding international reserves is consistent with China holding a sizeable international reserve stockpile, it does not support the optimality of holding reserves in the form of low-yielding U.S. government debt at levels of 40 to 50 percent of GDP (Jeanne, 2007). Arguably, Dooley et al. (2003) provided a too optimistic assessment about the sustainability and global desirability, of an export-led growth strategy propagated by large current-account surpluses and international reserves hoarding. While this strategy may work well for small emerging markets at the stage of early takeoffs, its viability is limited for large and fast-growing economies when OECD countries are experiencing modest growth.

The export-led growth strategy initially worked for China, leading to a remarkable growth spell in the 2000s. The numbers were impressive: the U.S. GDP exceeded Chinese GDP (current US\$) by a factor of 17 in 1990, by 8.5 in 2000, and by only 2 in 2012. (World Bank, *World Development Indicators*). China’s growing current-account surplus in the early 2000s, at time of full

employment in the U.S. and when the size of the U.S. economy exceeded China's by a hefty margin, encountered limited opposition and even favorable support from mainstream economists. However, the costs of this strategy, both to China and to China's competitors, have become clearer over time. Intriguingly, the success of Chinese export-led growth strategy probably propagated the headwinds leading to its possible demise, as there is limited tolerance for its continuation at a time of falling employment rates and growth rates in the OECD and at a time when China's GDP has grown to about half the size of the U.S. economy (in current US\$).

Hoarding reserves may delay the real appreciation associated with successful export-led growth, but the inevitable appreciation of China's currency will depress even further the real return on dollar-denominated assets held as international reserves. A more balanced strategy calls for diversifying out of liquid U.S. government bonds and into less liquid but (ex-ante) higher-yielding real foreign assets. That diversification can take place through greater outward FDI that, in turn, mitigates reserve hoarding. Indeed, as Figure 7 illustrates, this diversification has already begun.<sup>9</sup>

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<sup>9</sup> See Yang (2012) for further discussion of possible adjustment modes in China.

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## Appendix

### Data Description

Current Account/GDP:	Current-account balance as a percentage of GDP. Source: EIU.
International Reserves/GDP:	Total reserves (excluding gold), including foreign exchange, reserve position with the IMF and SDRs at end-period. Source: Economist Intelligent Unit (EIU).
Real GDP Growth:	Percentage change in real GDP (constant USD), over previous year (based on Gross domestic product (GDP) at constant market prices, rebased to 2005 constant prices and translated into US\$ using local currency:\$ PPP exchange rate in 2005.). Source: EIU.
World GDP:	World's Gross domestic product at purchasing power parity (PPP) in US\$. Source: EIU.
Inward FDI:	Stock of direct investment by non-residents into the country, as a percentage of GDP.
Outward FDI:	Stock of direct investment capital by domestic residents out of the country, as a percentage of GDP.
GDP per Head:	GDP at purchasing power parity (PPP), divided by population. Source: EIU.
Exports of Natural Resources:	Exports of fuel and minerals as percentage of GDP. Source: World Development Indicators (WDI).
Real Exchange Rate Appreciation:	Trade-weighted basket of currencies converted to an index (1997=100) and adjusted for relative price movements. Source: EIU.
Trade/GDP:	[Exports + Imports]/GDP ratio. Source: EIU.
Domestic Credit/GDP:	(Bank lending to public and private sectors)/GDP
Stock of Public Debt/GDP:	Total debt domestic, external owed by central government (both local and foreign currency) to domestic residents, foreign nationals and multilateral institutions such as the IMF, expressed as a percentage of GDP.
US Demand:	Current-account deficit as percentage of GDP. Source: EIU.

### List of Countries

Countries included in the estimation (95):

Argentina (AR), Austria (AT), Australia (AU), Azerbaijan (AZ), Bangladesh (BD), Belgium (BE), Bahrain (BH), Burundi (BI), Bolivia (BO), Botswana (BW), Belize (BZ), Canada (CA), Switzerland (CH), Cote D'Ivoire (CI), Chile (CL), Cameroon (CM), China (CN), Colombia (CO), Costa Rica (CR), Cuba (CU), Germany (DE), Denmark (DK), Dominican Republic (DO), Algeria (DZ), Ecuador (EC), Estonia (EE), Egypt (EG), Spain (ES), Ethiopia (ET), Finland (FI), Fiji (FJ), France (FR), Gabon (GA), United Kingdom (GB), Ghana (GH), Greece (GR), Guatemala (GT), Honduras (HN), Croatia (HR),

Hungary (*HU*), Indonesia (*ID*), Ireland (*IE*), India (*IN*), Iceland (*IS*), Italy (*IT*), Jamaica (*JM*), Jordan (*JO*), Japan (*JP*), Kenya (*KE*), Korea, Rep. Of (*KR*), Kuwait (*KW*), Kazakhstan (*KZ*), Sri Lanka (*LK*), Lithuania (*LT*), Luxembourg (*LU*), Latvia (*LV*), Morocco (*MA*), Moldova (*MD*), Macedonia (*MK*), Malawi (*MW*), Mexico (*MX*), Malaysia (*MY*), Namibia (*NA*), Nigeria (*NG*), Nicaragua (*NI*), Netherlands (*NL*), Norway (*NO*), New Zealand (*NZ*), Panama (*PA*), Peru (*PE*), Papua New Guinea (*PG*), Philippines (*PH*), Pakistan (*PK*), Portugal (*PT*), Paraguay (*PY*), Qatar (*QA*), Romania (*RO*), Russian Federation (*RU*), Saudi Arabia (*SA*), Sudan (*SD*), Sweden (*SE*), Singapore (*SG*), El Salvador (*SV*), Syrian Arab Republic (*SY*), Thailand (*TH*), Tunisia (*TN*), Turkey (*TR*), Trinidad & Tobago (*TT*), Tanzania (*TZ*), Ukraine (*UA*), United States (*US*), Venezuela (*VE*), Yemen (*YE*), South Africa (*ZA*), Zambia (*ZM*).

Countries excluded from the estimation due to data availability (76):

Afghanistan (*AF*), Anguilla (*AI*), Antigua (*AG*), Aruba (*AW*), Bahamas (*BS*), Bermuda (*BM*), Bhutan (*BT*), Brunei (*BN*), Bulgaria (*BG*), Burkina Faso (*BF*), Cambodia (*KH*), Cape Verde (*CV*), Cayman Islands (*KY*), Central African Republic (*CF*), Chad (*TD*), Comoros (*KM*), Congo, Democratic Republic Of (*CD*), Cook Islands (*CK*), Czech Republic (*CZ*), Djibouti (*DJ*), Dominica (*DM*), Eritrea (*ER*), Georgia (*GE*), Grenada (*GD*), Guinea (*GN*), Guinea-Bissau (*GW*), Guyana (*GY*), Haiti (*HT*), Iran (*IR*), Iraq (*IQ*), Kiribati (*KI*), Kyrgyz Republic (*KG*), Laos (*LA*), Lesotho (*LS*), Liberia (*LR*), Macau (*MO*), Madagascar (*MG*), Marshall Islands (*MH*), Mauritania (*MR*), Micronesia, Fed. States Of (*FM*), Mongolia (*MN*), Montserrat (*MS*), Nauru (*NR*), Nepal (*NP*), Netherlands Antilles (*AN*), New Caledonia (*NC*), Niger (*NE*), North Korea (*KP*), Palau (*PW*), Palestinian Territory (*PS*), Puerto Rico (*PR*), Rwanda (*RW*), Saint Kitts And Nevis (*KN*), Saint Lucia (*LC*), Saint Vincent And The Grenadines (*VC*), Samoa (*WS*), Seychelles (*SC*), Slovakia (*SK*), Senegal (*SN*), Solomon Islands (*SB*), Somalia (*SO*), Suriname (*SR*), Swaziland (*SZ*), Taiwan (*TW*), Tajikistan (*TJ*), The Gambia (*GM*), Timor-Leste (*TL*), Togo (*TG*), Tonga (*TO*), Turkmenistan (*TM*), Turks & Caicos Islands (*TC*), Tuvalu (*TV*), Uganda (*UG*), Uzbekistan (*UZ*), Vanuatu (*VU*), Virgin Islands, British (*VG*).

Appendix Table A.1: Summary Statistics of the Data.

Variable	Obs	Mean	Std. Dev.	Min	Max
Current-account balance%GDP	1645	-0.4	8.1	-29.8	44.6
International reserves%GDP	1645	14.3	16.3	0.0	112.1
Growth of GDP/head	1645	0.6	1.0	-6.5	13.9
Natural-resource exports%GDP	1645	26.1	29.2	0.0	99.7
Real GDP growth	1645	3.8	4.2	-18.8	44.9
Real exchange rate index (1997=100)	1645	104.7	49.7	19.7	660.4
Stock of Public Debt/GDP	1645	57.4	38.4	0.0	445.7
Trade/GDP	1645	0.6	0.4	0.0	3.5
US current-account deficit%GDP	1645	3.3	1.6	-0.2	6.0

Figure 1: Current-Account Balances as a Percentage of World's GDP.  
 Source: The Economist, September 28, 2013.

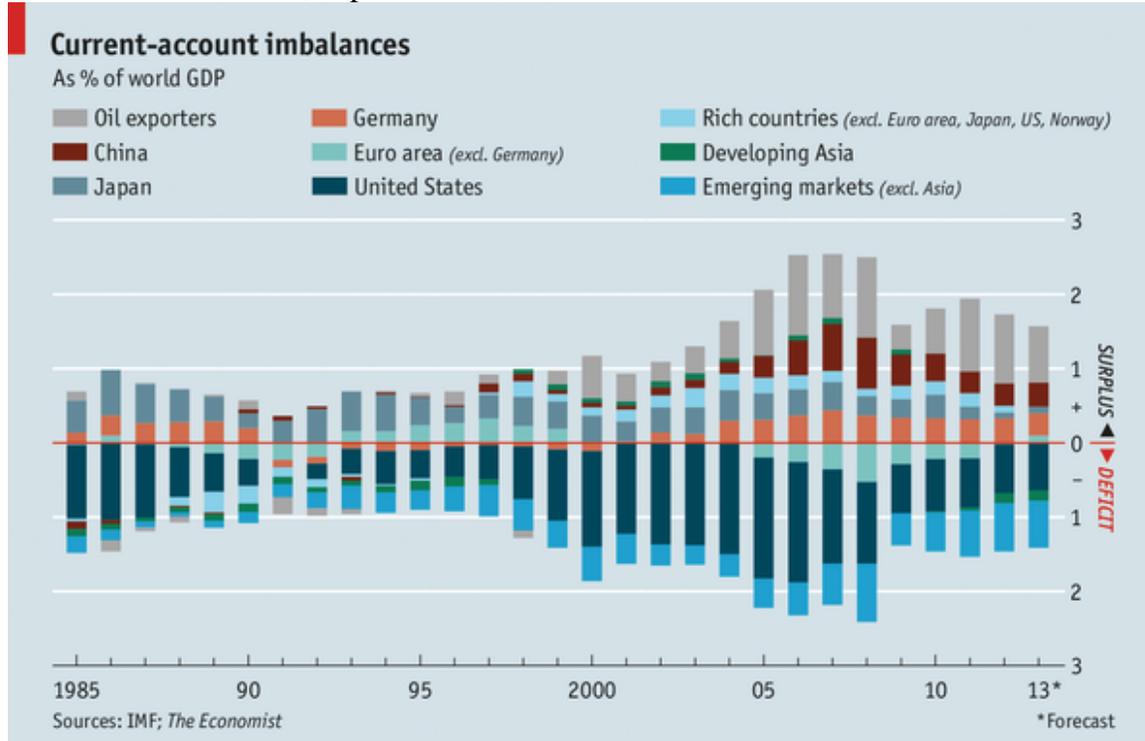


Figure 2: China's International Reserves/GDP (%), 1980-2012.

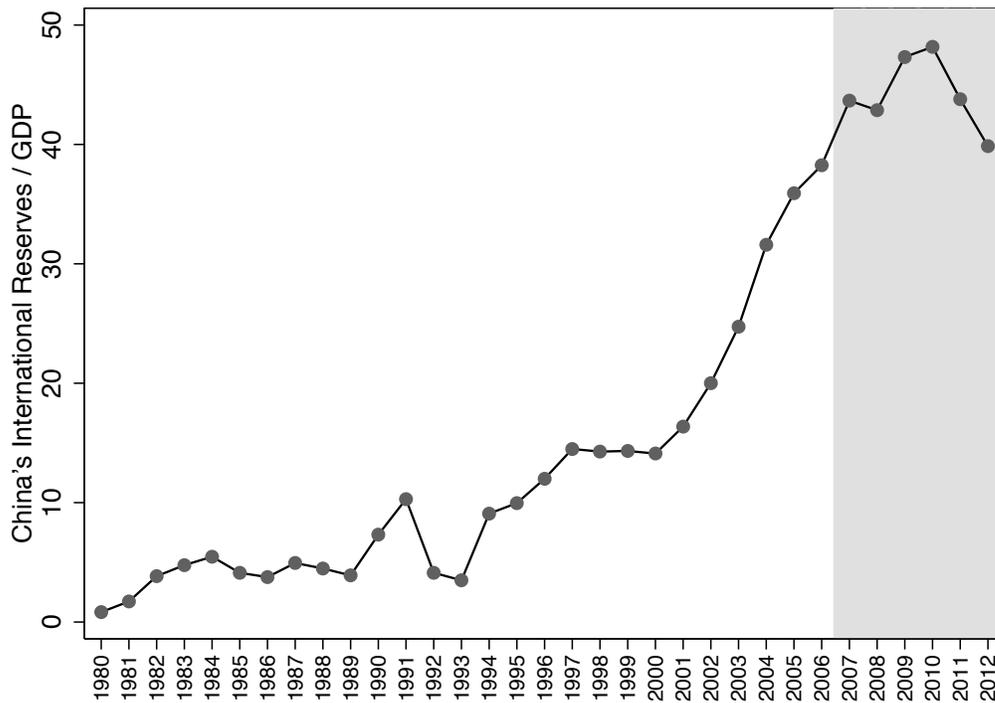


Figure 3: China's Real GDP Growth (% , annual), 1980-2012.

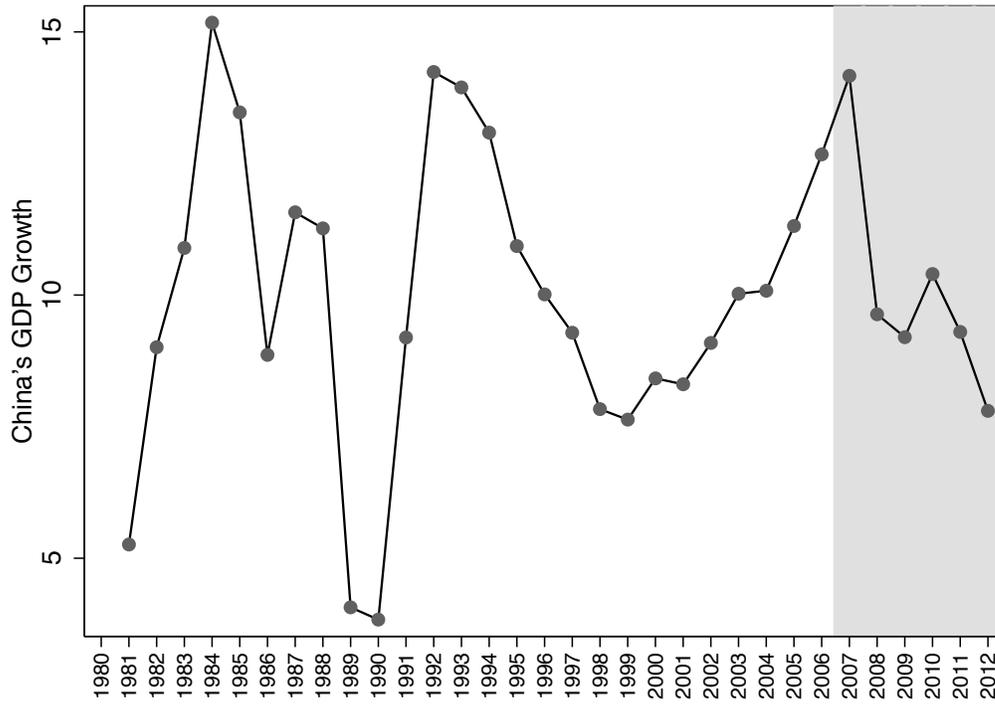


Figure 4: China's Current Account/GDP (%), 1980-2012.

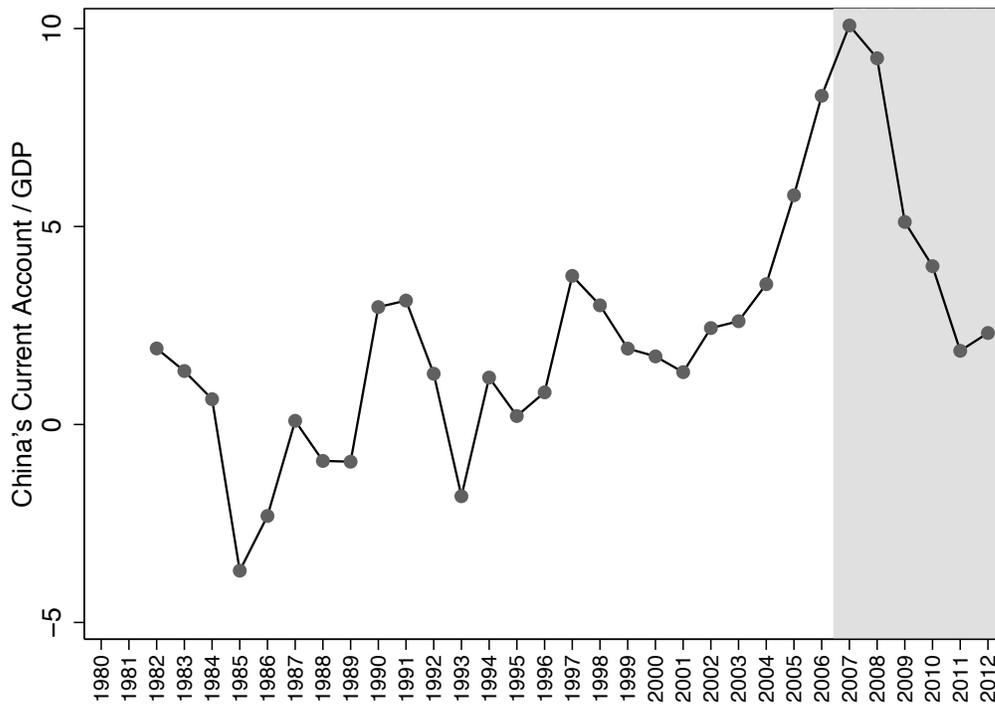


Figure 5: Adjustment of China's International Reserves.

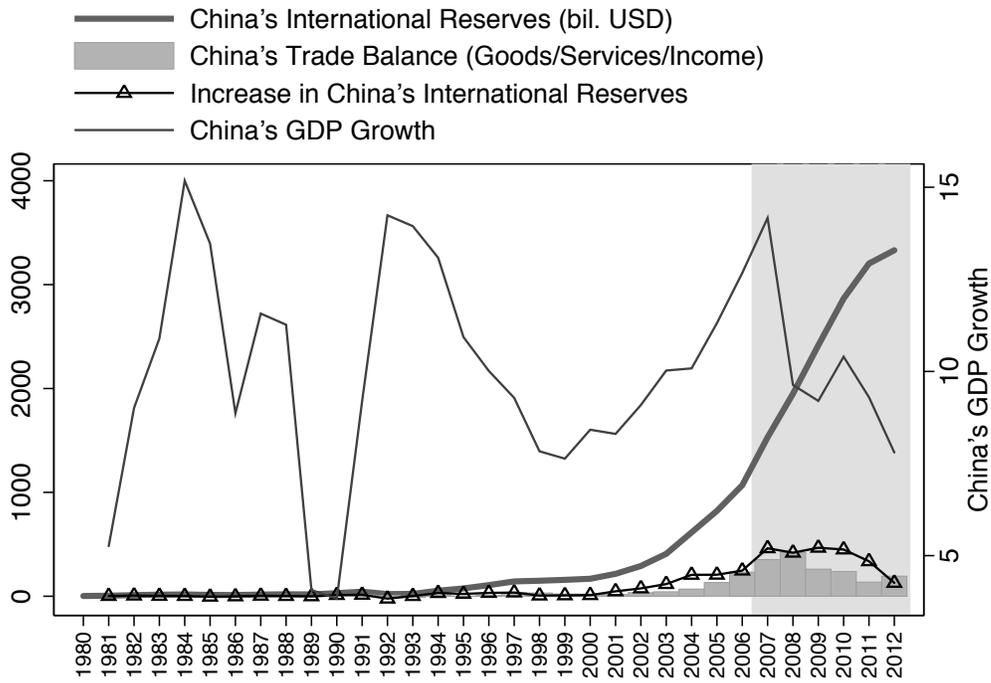


Figure 6: Current Accounts of China and USA.

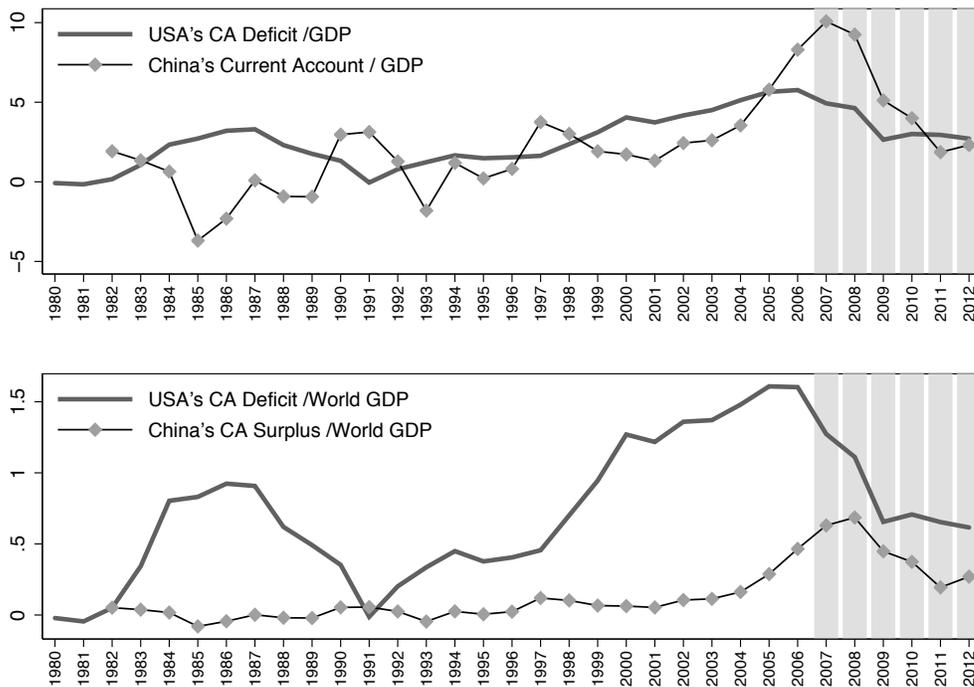


Figure 7: China's International Reserves and Outward FDI.

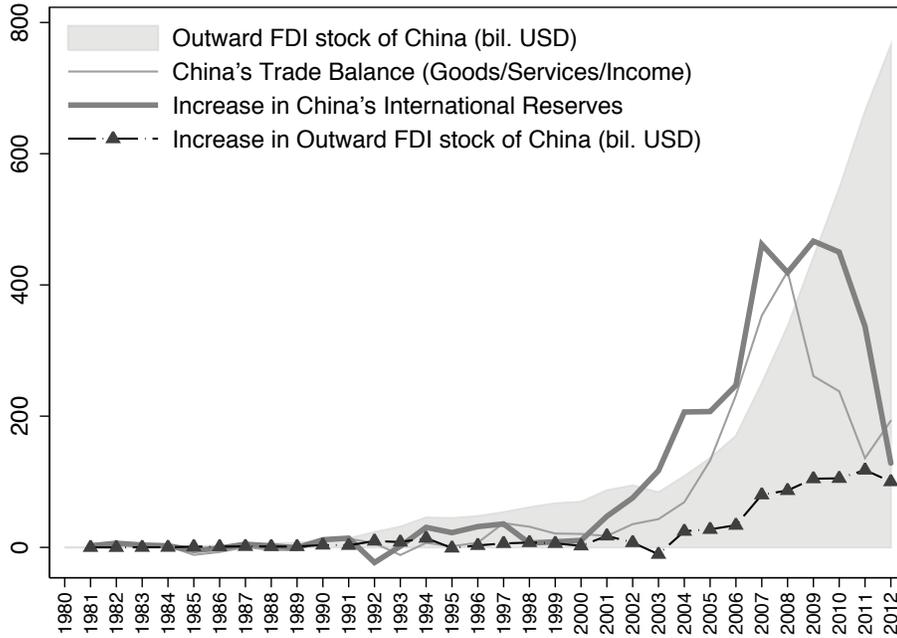


Figure 8: Forecast of China's Current Account Based on the Panel Estimation. Pre-crisis (post-crisis) forecast based on estimated regression coefficients for period 1983-2006 (2007-2012).

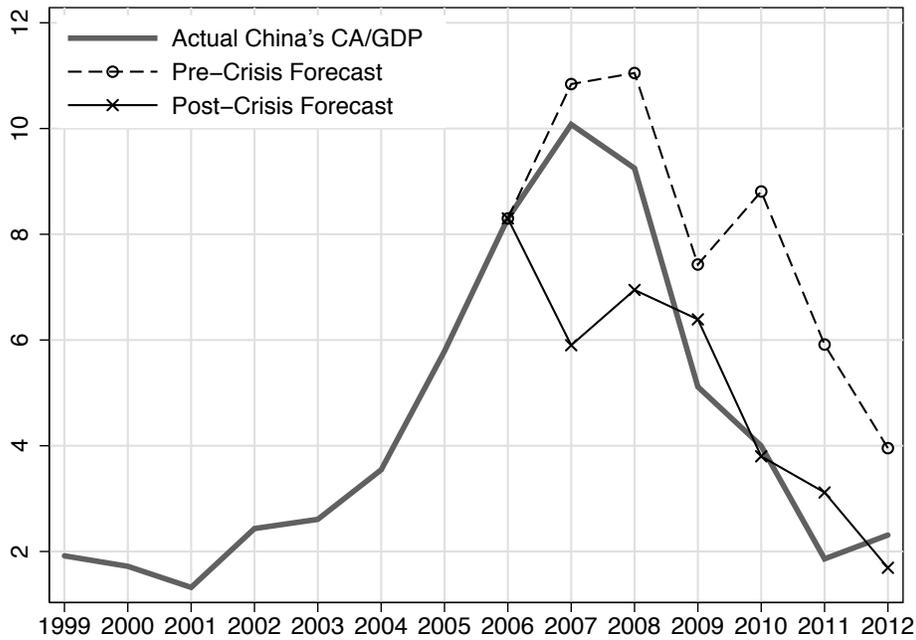


Figure 9: Sources of Changes in China's International Reserves/GDP (%).  
This figure plots economic significance of one-standard-deviation increase in the regressors for China's international reserves/GDP (%), based on regression results in Table 4, VII.

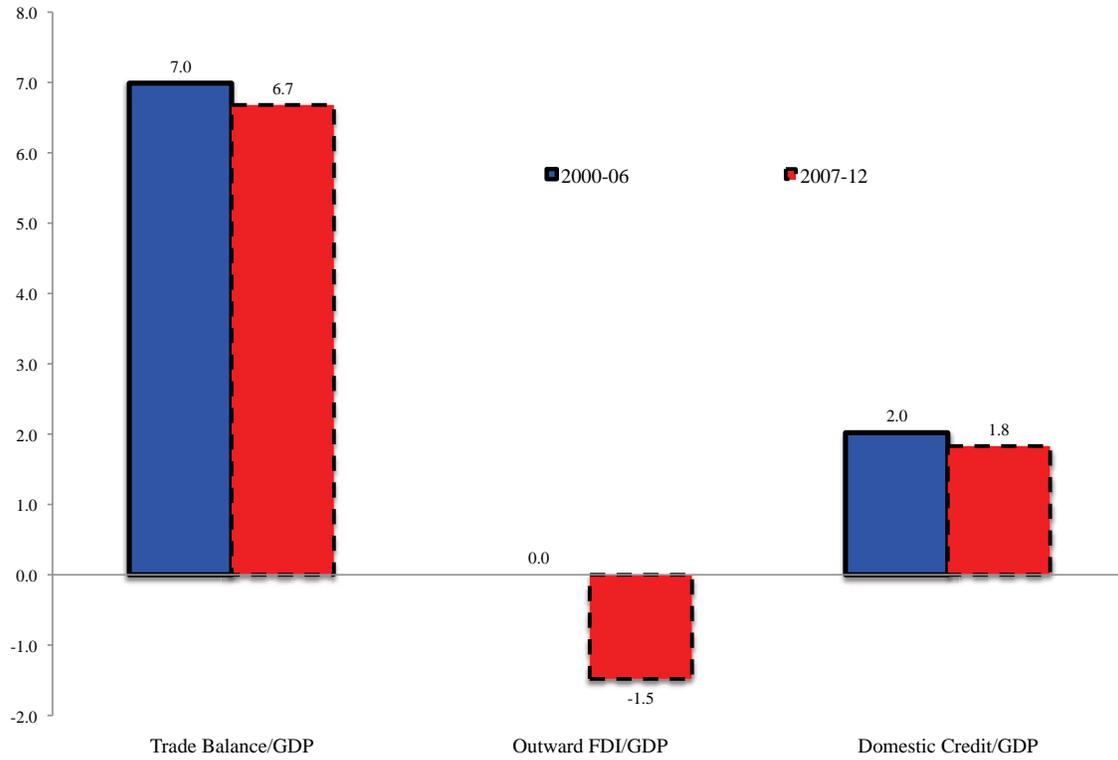


Table 1a: Distribution of Sudden-Stops in Current Accounts (% GDP).

This table reports the distribution of current account reduction (% GDP) for countries that experienced increasing current-account surpluses in the prior three or more years, i.e. incidence of current-account reversals. 'Average size (%)' is the mean reduction in current accounts (%GDP) of reversal countries. The calculation excludes countries with population of less than 10 million.

Year	Drop in 1 Year			Drop in 2 Years		
	average size (%)	# countries with reductions > 4%GDP	countries	average size (%)	# countries with reduction > 4%GDP	countries
1980	.	0		.	0	
1981	.	0		.	0	
1982	.	0		.	0	
1983	.	0		.	0	
1984	-3.7	0		-1.8	0	
1985	-1.1	0		-1.4	0	
1986	-2.5	2	DZ,ET	-3.7	2	IL,MZ
1987	-1.8	1	PH	-4.4	1	TW
1988	-2.7	0		-3.8	3	MA,MY,ZA
1989	-3.1	2	MA,KR	-3.9	1	KR
1990	-1.4	0		-6.1	1	SY
1991	-9.8	1	SY	-13.8	1	SY
1992	-2.2	0		-4.2	1	CO
1993	-1.7	0		-6.3	1	EG
1994	-0.4	0		-2.0	0	
1995	-2.7	1	CI	-1.1	0	
1996	-0.8	0		-2.0	0	
1997	-0.8	0		-3.5	1	SA
1998	-3.0	1	MZ	-7.0	2	MZ,IQ
1999	-2.4	0		-5.0	2	LK,TH
2000	-0.6	0		-2.0	0	
2001	-3.1	1	RU	-4.2	1	RU
2002	-1.6	0		-2.5	0	
2003	-2.1	0		-3.8	3	AR,PK,SY
2004	-1.9	0		-3.0	1	TW
2005	-0.7	0		-2.2	0	
2006	-3.3	1	NG	-5.2	3	NG,SA,UG
2007	-5.4	2	AO,VN	-5.7	4	AO,DZ,PE,VN
2008	-2.4	2	IR,MM	-7.5	4	CN,IR,IQ,MM
2009	-22.5	1	IQ	-16.7	1	IQ
2010	-2.3	1	TR	-4.0	1	TR
2011		0		-0.7	0	
2012	-2.2	1	BF		0	

Table 1b: Distribution of Sudden-Stops in Current Accounts (% World GDP).

This table reports the distribution of current account reduction (% World GDP) for countries that experienced increasing current-account surpluses in the prior three or more years, i.e. incidence of current-account reversals. ‘Average size (%)’ is the mean reduction in current accounts (%GDP) of reversal countries. The calculation excludes countries with population of less than 10 million.

Year	Drop in 1 Year			Drop in 2 Years		
	average size (%)	# countries with reductions > 0.1%GDP	countries	average size (%)	# countries with reduction > 0.1%GDP	countries
1980	.	0		.	0	
1981	.	0		.	0	
1982	.	0		.	0	
1983	.	0		.	0	
1984	-.02	0		-.02	0	
1985	-.01	0		.00	0	
1986	-.01	0		-.01	0	
1987	-.02	0		-.05	1	JP
1988	-.01	0		-.02	0	
1989	-.01	0		-.04	0	
1990	-.02	0		-.09	1	DE
1991	-.02	0		-.03	0	
1992	-.08	1	US	-.12	1	US
1993	.00	0		-.01	0	
1994	-.02	0		-.04	1	JP
1995	-.01	0		-.01	0	
1996	-.01	0		.00	0	
1997	-.02	0		-.03	0	
1998	-.01	0		-.02	0	
1999	.00	0		-.03	0	
2000	-.03	0		-.04	0	
2001	-.01	0		-.02	0	
2002	.00	0		.00	0	
2003	.00	0		-.01	0	
2004	-.02	0		-.03	0	
2005	-.01	0		-.02	0	
2006	.00	0		-.02	0	
2007	-.02	0		-.01	0	
2008	-.03	0		-.07	2	CN,DE
2009	-.10	1	CN	-.12	1	CN
2010	-.05	0			0	
2011	.00	0		-.02	0	
2012	-.01	0			0	

Table 2a: Baseline Estimation.

The panel estimation is done over the specified period and includes country fixed-effects. The variables are first-differenced if they contain (panel) unit-root identified from panel non-stationary tests. Standard errors, clustered by country, are in parentheses; \*\*\* (\*\*, \*) denoting statistically significant at 1 (5,10) percent level.

Dependent Variable = Current Account (%GDP)	1983-2012 coeff. (s.e.)	1983-2006 coeff. (s.e.)	2007-2012 coeff. (s.e.)
Lagged Current Account (%GDP)	-0.42 (0.02)***	-0.44 (0.03)***	-0.54 (0.06)***
Lagged Increase in International Reserves (%GDP)	0.08 (0.02)***	0.06 (0.02)***	0.12 (0.04)***
Lagged Increase in GDP per Head (1,000\$ at PPP)	0.10 (0.09)	0.35 (0.10)***	0.07 (0.19)
Lagged Exports of Natural Resources (%GDP)	0.01 (0.01)	0.02 (0.01)*	-0.02 (0.02)
Lagged Real GDP Growth (%)	-0.24 (0.02)***	-0.17 (0.03)***	-0.15 (0.07)**
Lagged Real Exchange Rate Appreciation	-0.01 (0.00)***	0.00 (0.00)	-0.02 (0.02)
Lagged Change in Stock of Public Debt (%GDP)	-0.07 (0.01)***	-0.02 (0.01)***	-0.14 (0.03)***
Lagged Trade/GDP	2.35 (0.77)***	6.32 (1.07)***	-12.58 (2.48)***
Lagged Increase in US Demand (CA Deficit%GDP)	0.49 (0.04)***	0.26 (0.05)***	0.26 (0.20)
constant	-0.92 (1.18)	-4.34 (1.20)***	5.63 (3.03)*
Observations	1455	995	460
Countries	95	95	95
Country Fixed-Effects	Yes	Yes	Yes
R-sqr	0.55	0.69	0.55
F-Test: H <sub>0</sub> : All the coefficients from 1983-2006 regression are the same as all the coefficients from 2007-2012 regression	F(20,1341)=69.12; Prob>F=0.0000		

Table 2b: Estimation with Post-Crisis Dummy.

The panel estimation is done over the specified period and includes country fixed-effects. The variables are first-differenced if they contain (panel) unit-root identified from panel non-stationary tests. DUM0712=1 for years 2007-2012, =0 otherwise. Standard errors, clustered by country, are in parentheses; \*\*\* (\*\*, \*) denoting statistically significant at 1 (5,10) percent level.

Dependent Variable = Current Account (%GDP)	1983-2012 coeff. (s.e.)
Lagged Current Account (%GDP)	-0.38 (0.03)***
Lagged Increase in International Reserves (%GDP)	0.06 (0.02)**
Lagged Increase in GDP per Head (1,000\$ at PPP)	0.42 (0.10)***
Lagged Exports of Natural Resources (%GDP)	0.01 (0.01)
Lagged Real GDP Growth (%)	-0.19 (0.02)***
Lagged Real Exchange Rate Appreciation	-0.00 (0.00)**
Lagged Change in Stock of Public Debt (%GDP)	-0.04 (0.01)***
Lagged Trade/GDP	2.31 (0.87)***
Lagged Increase in US Demand (CA Deficit%GDP)	0.35 (0.05)***
DUM0712	0.38 (0.52)
DUM0712 x Lagged Current Account (%GDP)	0.02 (0.03)
DUM0712 x Lagged Increase in International Reserves (%GDP)	0.14 (0.05)***
DUM0712 x Lagged Increase in GDP per Head (1,000\$ at PPP)	0.03 (0.15)
DUM0712 x Lagged Exports of Natural Resources (%GDP)	0.01 (0.01)
DUM0712 x Lagged Real GDP Growth (%)	-0.20 (0.05)***
DUM0712 x Lagged Real Exchange Rate Appreciation	0.00 (0.00)
DUM0712 x Lagged Change in Stock of Public Debt (%GDP)	-0.06 (0.02)***
DUM0712 x Lagged Trade/GDP	-0.21 (0.44)
DUM0712 x Lagged Increase in US Demand (CA Deficit%GDP)	-0.28 (0.20)
constant	-1.50 (1.07)
Observations	1492
Countries	97
Country Fixed-Effects	Yes
R-sqr	0.61
F-Test: H <sub>0</sub> : Dummy Variable for 2007-12 and the Interaction Terms are All = 0	F(10,1341)=7.39; Prob>F=0.0000

Table 3a: Surplus versus Non-Surplus Countries.

The panel estimation is done over the specified period and includes country fixed-effects. Countries running current-account surplus have positive (>1.5%GDP) and increasing surplus in the past two years. The variables are first-differenced if they contain (panel) unit-root (identified from panel non-stationary test). Standard errors, clustered by country, are in parentheses; \*\*\* (\*\*, \*) denoting statistically significant at 1 (5,10) percent level.

Dependent Variable = Current Account (%GDP)	Surplus:1983-2006 coeff. (s.e.)	Surplus:2007-2012 coeff. (s.e.)	Non-Surplus:1983-2006 coeff. (s.e.)	Non-Surplus:2007-2012 coeff. (s.e.)
Lagged Current Account (%GDP)	-0.40 (0.11)***	-0.47 (0.14)***	-0.78 (0.03)***	-0.45 (0.06)***
Lagged Increase in International Reserves (%GDP)	0.42 (0.08)***	-0.00 (0.11)	-0.29 (0.03)***	0.17 (0.06)***
Lagged Increase in GDP per Head (1,000\$ at PPP)	1.00 (0.38)**	-0.15 (0.48)	-0.88 (0.15)***	0.66 (0.26)**
Lagged Exports of Natural Resources (%GDP)	-0.13 (0.03)***	-0.08 (0.08)	0.03 (0.01)***	0.02 (0.02)
Lagged Real GDP Growth (%)	-0.14 (0.14)	0.60 (0.27)**	-0.19 (0.03)***	-0.35 (0.07)***
Lagged Real Exchange Rate Appreciation	0.03 (0.04)	-0.19 (0.09)*	-0.02 (0.00)***	-0.01 (0.02)
Lagged Change in Stock of Public Debt (%GDP)	-0.11 (0.07)	0.10 (0.12)	-0.05 (0.01)***	-0.07 (0.04)*
Lagged Trade/GDP	7.28 (3.48)**	10.24 (11.02)	7.61 (1.25)***	-3.28 (2.67)
Lagged Increase in US Demand (CA Deficit%GDP)	1.14 (0.56)**	-2.34 (0.83)***	0.35 (0.07)***	-0.10 (0.28)
constant	-13.67 (11.68)	1.25 (33.28)	1.49 (8.52)	4.62 (5.52)
Observations	127	63	868	397
Countries	46	30	93	94
Country Fixed-Effects	Yes	Yes	Yes	Yes
R-sqr	0.72	0.84	0.93	0.54
F-Test: H0: All the coefficients from 1983-2006 regression are the same as all the coefficients from 2007-2012 regression	F(20,124)=6.57; Prob>F=0.0000		F(20,1152)=31.44; Prob>F=0.0000	

Table 3b: Surplus versus Non-Surplus Countries with Post-Crisis Dummy.  
The panel estimation is done over the specified period and includes country fixed-effects. Countries running current-account surplus have positive (>1.5%GDP) and increasing surplus in the past two years. The variables are first-differenced if they contain (panel) unit-root (identified from panel non-stationary test). DUM0712=1 for years 2007-2012, =0 otherwise. Standard errors, clustered by country, are in parentheses; \*\*\* (\*\*, \*) denoting statistically significant at 1 (5,10) percent level.

Dependent Variable = Current Account (%GDP)	Surplus:1983-2012 coeff. (s.e.)	Non-Surplus:1983-2012 coeff. (s.e.)
Lagged Current Account (%GDP)	-0.44 (0.10)***	-0.38 (0.03)***
Lagged Increase in International Reserves (%GDP)	0.38 (0.07)***	0.19 (0.03)***
Lagged Increase in GDP per Head (1,000\$ at PPP)	0.89 (0.31)***	-0.06 (0.18)
Lagged Exports of Natural Resources (%GDP)	-0.09 (0.03)***	0.01 (0.01)
Lagged Real GDP Growth (%)	-0.04 (0.10)	-0.22 (0.03)***
Lagged Real Exchange Rate Appreciation	-0.03 (0.03)	-0.02 (0.00)***
Lagged Change in Stock of Public Debt (%GDP)	-0.03 (0.05)	-0.02 (0.01)**
Lagged Trade/GDP	6.55 (2.30)***	0.29 (0.94)
Lagged Increase in US Demand (CA Deficit%GDP)	1.40 (0.56)**	0.15 (0.13)
DUM0712	-2.77 (2.38)	-1.36 (0.58)**
DUM0712 x Lagged Current Account (%GDP)	0.20 (0.11)*	-0.03 (0.03)
DUM0712 x Lagged Increase in International Reserves (%GDP)	-0.29 (0.10)***	0.01 (0.06)
DUM0712 x Lagged Increase in GDP per Head (1,000\$ at PPP)	-0.40 (0.33)	0.37 (0.22)*
DUM0712 x Lagged Exports of Natural Resources (%GDP)	0.01 (0.02)	0.00 (0.01)
DUM0712 x Lagged Real GDP Growth (%)	0.05 (0.15)	-0.06 (0.05)
DUM0712 x Lagged Real Exchange Rate Appreciation	0.03 (0.02)	0.00 (0.00)
DUM0712 x Lagged Change in Stock of Public Debt (%GDP)	-0.09 (0.08)	-0.05 (0.03)**
DUM0712 x Lagged Trade/GDP	0.17 (0.97)	0.61 (0.52)
DUM0712 x Lagged Increase in US Demand (CA Deficit%GDP)	-2.58 (0.82)***	-0.40 (0.25)
constant	-5.90 (7.75)	1.67 (1.03)
Observations	190	1265
Countries	47	94
Country Fixed-Effects	Yes	Yes
R-sqr	0.78	0.38
F-Test: H <sub>0</sub> : Dummy Variable for 2007-12 and the Interaction Terms are All = 0	F(10,124)=2.57; Prob>F=0.0073	F(10,1152)=7.52; Prob>F=0.0000

Table 4: Estimation of China's International Reserves using Annual Data, 1980-2012. All variables are lagged and expressed as a share of GDP except for REER appreciation. Variables are expressed as changes. Newey-West standard errors are in parentheses; \*\*\* (\*\*, \*) denote statistical significance at the 1 (5,10) percent level.

Dependent Variable = $\Delta$ International Reserves/GDP	I	II	III	IV	V	VI	VII
	$\Delta IR_t/GDP_{t-1}$						
Lagged Trade Balance/GDP	2.84 (0.77)***					2.14 (1.26)	
Lagged $\Delta$ Inward FDI/GDP		1.93 (0.84)**					
Lagged $\Delta$ Outward FDI/GDP			1.94 (0.99)*			0.28 (1.05)	
Lagged $\Delta$ Domestic Credit/GDP				2.43 (0.57)***		1.76 (0.69)**	
Lagged REER Appreciation					1.47 (0.67)**	-0.41 (0.69)	
Lagged Trade Balance/GDP 2000-06							6.99 (2.83)**
Lagged $\Delta$ Outward FDI/GDP 2000-06							-1.60 (2.55)
Lagged $\Delta$ Domestic Credit/GDP 2000-06							2.02 (0.90)**
Lagged Trade Balance/GDP 2007-12							6.68 (0.88)***
Lagged $\Delta$ Outward FDI/GDP 2007-12							-1.48 (0.68)**
Lagged $\Delta$ Domestic Credit/GDP 2007-12							1.83 (0.51)***
constant	4.58 (0.99)***	4.14 (1.05)***	4.30 (1.05)***	4.99 (1.11)***	4.27 (1.11)***	4.79 (1.00)***	2.89 (1.23)**
Observations	28	32	31	26	31	26	26
R-sqr	0.33	0.17	0.16	0.25	0.09	0.40	0.56