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The U.S., China and the Rebalancing Debate: The Impact of Academic Research

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The U.S., China and the Rebalancing Debate:
The Impact of Academic Research

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I discuss research on China's role in driving the development of global imbalances, and potential impact in rebalancing of the world economy. I focus on three specific, but interrelated, issue areas, concerning: (1) currency misalignment, (2) trade elasticities, and (3) saving-investment/current account norms. I augment discussion of each issue-area with some reflections on how academic research has informed the debate.

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1. Introduction

China has loomed large in policy debates along a number of dimensions. This has been particularly true ever since China's external balances have shifted from balance to surplus (including the current account and trade account), and foreign exchange reserves have increased. China's trade balance and reserve accumulation are depicted in Figure 1. The increasing integration into world trade is illustrated in Figure 2; both exports and imports have nearly returned to pre-recession levels. Figure 3 illustrates the fact that the Chinese trade surplus has been increasing even as the yuan (measured both against the USD and against a broad basket of currencies) has appreciated in real terms.

China has been cast in several roles in the ongoing drama. First, it has been tapped as a villain, as the source of the global imbalances that in turn have been interpreted as the cause of the global financial crisis. See for instance the last Bush Administration *Economic Report of the President* (CEA, 2009):

> • The roots of the current global financial crisis began in the late 1990s. A rapid increase in saving by developing countries (sometimes called the "global saving glut") resulted in a large influx of capital to the United States and other industrialized countries, driving down the return on safe assets. The relatively low yield on safe assets likely encouraged investors to look for higher yields from riskier assets, whose yields also went down. What turned out to be an underpricing of risk across a number of markets (housing, commercial real estate, and leveraged buyouts, among others) in the United States and abroad, and an uncertainty about how this risk was distributed throughout the global financial system, set the stage for subsequent financial distress.
>
> • The influx of inexpensive capital helped finance a housing boom. House prices appreciated rapidly earlier in this decade, and building increased to well-above historic levels. Eventually, house prices began to decline with this glut in housing supply.

The importance of China's current account in global imbalances in the run-up to the global financial crisis is illustrated in Figure 4.[1] Now, it has been implicated variously as the obstacle to global rebalancing of global current account imbalances, or held up as the potential source of growth in the wake of the Great Recession. The latest IMF projections maintain a continued presence of a Chinese (plus emerging Asia) current account surplus out to 2015 (Figure 4).

In this paper, I will review the current state of research on these issues, with a special emphasis on how the academic research has informed the policy debates. My definition of "academic" research is fairly expansive, in that I do not restrict my attention to research conducted by economists in academia. I also include that conducted in think tanks, investment banks, and

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[1] A critique of this hypothesis of global imbalances as primary cause is in Chinn (2010), and Chinn and Frieden (forthcoming).

policy organizations (Federal Reserve, IMF). The criterion for inclusion is that the paper incorporates either an econometric or theoretical component.

I first review the currency misalignment debate, the closely related exchange over the size of elasticities, and finally the research on what should be the current account balance for a country such as China.

2. Defining Currency Misalignment[2]

The literature on the exchange rate misalignment, even when restricted to the Chinese yuan, is voluminous and diverse. Hence, it is helpful to lay out a typology of approaches. Most of these theoretical approaches fall into familiar categories:

- Relative purchasing power parity (PPP)
- Absolute purchasing power parity and the "Penn Effect"
- The productivity approach and the behavioral equilibrium exchange rate (BEER) approach
- The macroeconomic balance effect
- The underlying or basic balance approach

2.1 Relative PPP

Relative PPP asserts that the nominal exchange rate moves with relative price levels in the long run, up to a constant:

$$S = \left(\frac{P}{P^*}\right) \times (1 + \Psi) \quad , \qquad (1)$$

where S is the exchange rate expressed as Chinese yuan per unit of foreign currency, P is the Chinese price index, P^* is the foreign price index, and the constant $(1+\psi)$ accounts for the fact that the indexes are just that – indexes, with given base years. Nobody expects that relative PPP holds in the short run, but it's plausible to argue that it would hold in the long run. Equation (1) as a long run relationship implies that the real exchange rate would revert to the average value $(1+\psi)$:

$$Q \equiv (S \times P^*/P) = (1 + \Psi) \quad , \qquad (2)$$

where Q is the real exchange rate.

Application of this method requires the assumption that at least at some time over the sample period, the exchange rate has been at its equilibrium level – and for the Chinese currency, this is a difficult proposition to maintain. To illustrate this contention, consider the log trade weighted real *value* of the Chinese yuan, in Figure 5 (the series is $\log(1/Q)$).[3] Using the mean

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[2] This section draws on Cheung, Chinn and Fujii (2010b).

[3] The series is spliced at 1994 to an older IMF series which accounts for the fact that some transactions were conducted at "swap market" rates rather than official rates. See the discussion in Fernald, Edison and Loungani (1999).

over the 1980-2009 period leads to the conclusion that the yuan is only slightly undervalued in December 2009 – 7.5% (all misalignment in log terms unless otherwise stated).

Even if one allows for some sort of time trend in ψ, whether the currency is deemed to be overvalued or undervalued depends critically on the sample period used to estimate the trend; using the 1980-2009 sample, one finds a 36% *over*valuation.

Clearly, one can get pretty much any answer one wants by judicious choice of sample period. For instance, using a shorter, 1990-2009, sample, the yuan is overvalued by 13.5% and 1.6% using the mean and trend, respectively. Further note that the standard calculation of the real exchange rate uses consumer price indices (CPIs). One could use alternative deflators, such as producer price indices, or unit labor costs (Chinn, 2006). Doing so would provide alternative conclusions regarding differing estimates of misalignment.[4]

One of the most encouraging developments in the Renminbi misalignment debate of the 2000's is that most of the policy discussion eschewed reference to simple trends and real exchange rates.

2.2 Absolute PPP and the "Penn Effect"

It seems like one could get around the problem of estimating $(1+\psi)$ by using actual prices of identical bundles of goods across countries, rather than price indices. Now P and P^* represent prices of identical bundles of goods

$$S = \left(\frac{P}{P^*}\right) \text{ or } P = S \times P^* \ . \qquad (3)$$

In principle one can see then whether the "price level" differs between countries.

One practical problem is that prices of identical bundles of goods are not usually available on a consistent basis. The "price levels" constructed by Summers and Heston (1991) and reported in the Penn World Tables, or in the related World Bank *World Development Indicators,* circumvent this problem by constructing the price levels in a way that they pertain to similar bundles across countries. One can then examine whether:

$$R \equiv 1/Q = (P/SP^*) \qquad (4)$$

is equal to one across countries.

Figure 6 presents a scatter plot of the observations on R for over 170 countries over the period 1980-2008, using the 2009 vintage of data the World Bank's *World Development Indicators*. If absolute PPP held, then one would expect that the scatter plot of observation to align horizontally. In fact, the scatter of observations slopes upward – in words, higher income countries evidence higher prices.

[4] For the real exchange rate to be stationary, the exchange rate and price indices must be cointegrated with unit coefficients (Chinn, 2000a).

A similar pattern obtains if one uses a bundle called a Big Mac (Parsley and Wei, 2003), popularized by the *Economist*. Express the prices of Big Macs across the globe in dollar terms, and one finds a positive correlation between per capita income and the US dollar price of a Big Mac. *Absolute* PPP using Big Mac's indicates a January 2010 undervaluation of 67%.[5] This is not too dissimilar to the approximately 50% undervaluation (the distance from the 0 line to the China 2008 observation) shown in Figure 6.

The positive exchange rate – income relationship illustrated in Figure 6 is so robust that it has a name – "The Penn Effect", after the Penn World Tables. Instead of viewing the Penn Effect as a problem, one can *exploit* this stylized fact. One can estimate the relationship between (log) *R* and log relative per capita income, and interpret the deviation from this line as the degree of misalignment. The elasticity of the price level with respect to relative per capita income is 0.2. The regression coefficient is plotted in the graph as the solid blue line.[6]

The path of the yuan, and particularly the 2008 end-point, in Figure 6 appears counterintuitive. The yuan is estimated to be ***over***valued by 5% by 2008. Note that while one cannot reject the no-misalignment null, one also can not reject the 20% undervaluation null hypothesis at conventional significance levels.

2.3 The Productivity Approach and the Behavioral Equilibrium Exchange Rate Approach

The most common way of incorporating productivity in exchange rate determination is the Balassa-Samuelson theory, which focuses on the differential between traded and nontraded sectors. To my knowledge, few researchers have attempted to *estimate* the link between sectoral productivity trends and the real exchange rate for China, with the exception of Cheung, Chinn and Fujii (2009b).

The impact of productivity differentials can be illuminated in a highly simplified version of the Balassa-Samuelson model. Suppose the economy price level is the average of the prices of tradable and nontradable goods. If the relative price of nontradables moves inversely with the relative productivity levels in the two sectors, then the faster tradable productivity grows, relative to nontradables (relative to the same ratio in the foreign country), then the stronger the exchange rate.[7]

A highly simplified version of this approach can be expressed as:

$$Q = \left(\frac{A^{T*}}{A^{N*}}\right)^{\alpha} / \left(\frac{A^{T}}{A^{N}}\right)^{\alpha} \quad , \tag{5}$$

where α is the share of nontradables in the total basket of goods, and *A* is total factor productivity in sector *i* (*i* = *N, T*).

[5] The US price is $3.58, while the Chinese price (converted in dollars) is $1.83; in level terms, this is a 50% undervaluation. See *Economist* (2010).
[6] Ferguson and Schularick (2009) apply a variant of this approach to ten emerging market economies relative to the United States. In their case *R* is the dollar wage rate. By this criterion, the yuan is undervalued by 34% to 48% (in level terms).
[7] PPP must hold for traded goods, capital must be perfectly mobile internationally, and the factors of production must be free to move between sectors.

Cheung, Chinn and Fujii (2009b) implement this approach, which is hampered by the onerous data requirements, specifically estimates of productivity levels in the tradable and nontradable sectors.[8] Estimates of equation (5) over the 1988-2004 period imply that the Chinese yuan was undervalued in 2004 by as much as 6.1%, and as little as 1.4%, depending on the productivity series used.

The preceding approach restricted the exchange rate determinants to solely productivity differentials. One can allow for other effects by augmenting the productivity variable with other variables, such as real interest differentials, government spending, or the terms of trade. In addition, more easily obtained proxy measures for the intercountry productivity differential are often substituted in. The resulting composite models have been coined behavioral equilibrium exchange rate (BEER) specifications, and are often used to evaluate equilibrium exchange rates for developed country currencies (Cheung, Chinn and Garcia Pascual, 2005).

Wang (2004), Funke and Rahn (2005) and Wang et al. (2007) use particularly simple BEERs to evaluate the Chinese currency. They relate the real exchange rate to the relative price of nontradables (to proxy for productivity ratios), and other variables such as net foreign assets, foreign exchange reserves, the terms of trade, money growth, or trade openness. These models are also used in the private sector. The Goldman Sachs version (GSDEER) relates the real exchange rate to productivity differentials and the terms of trade.

2.4 The Macroeconomic Balance approach

The Macroeconomic Balance approach takes the perspective from saving and investment rates. Recall the national saving identity:

$$CA \equiv (S - I) + (T - G).$$

In other words, the current account is, by an accounting identity, equal to the budget balance and the private saving-investment gap. This is a tautology, unless one imposes some structure and causality. One can do this by taking the budget balance as exogenous (or use the cyclically adjusted budget balance), and then include the determinants of investment and saving. Then one obtains "norms" for the current account (Chinn and Prasad, 2003). Then, using trade elasticities, one can back out the real exchange rate that would yield that "normal" current account.

The IMF regularly conducts analyses where it calculates equilibrium exchange rates via the Consultative Group on Exchange Rate Issues (CGER) (Lee et al., 2008; Isard et al. 1998). However, the IMF has not publicly reported recent numerical estimates for China's equilibrium exchange rate.

The closely-related Fundamental Equilibrium Exchange Rate (FEER) determines the current account norm on a more judgmental basis (in other words, the current account norm is not estimated econometrically, just imposed per the analysts' priors).

[8] Following Chinn (2000b), average labor productivity is obtained by dividing real output in sector i by labor employment in the same sector. The tradables sector is proxied by the manufacturing sector, while the nontradables is proxied by the "Other" sector.

Cline and Williamson (2010) recently updated their estimates of the FEER based exchange rate. They found that as of March 2009, the degree of undervaluation was about 32.8%, and only slightly larger as of December 2009.

2.5 The Underlying or Basic Balance approach

One could take a more ad hoc approach, asking what is the "normal" level of stable inflows – for instance looking at the sum of the current account and foreign direct investment (the "basic balance"), and see whether that value "made sense". Or one could look at the sum of the current account and private capital inflows after accounting for cyclical factors (the "underlying approach"). If either of the flows are "too large", then the currency would be considered undervalued (since a stronger currency would imply a smaller current account balance).

It is interesting to make two observations. First, note the need for many non-model based judgments. To see this point, recall the balance of payments accounting definition:

$$CA + KA + ORT \equiv 0,$$

where CA is current account, KA is private capital inflows, and ORT is official reserves transactions (+ is a reduction in forex reserves). Saying CA + KA is too big is the same, then, as saying ORT is too small, i.e., reserves are rising "too fast".

Alternatively, running surpluses that are "too large" for "too long" will lead to foreign exchange reserves that are "too large". Obviously, a lot of judgment calls are necessary for this approach.

Once one makes a judgment about what would be an appropriate trade surplus, for instance, then the mechanics of making a judgment about exchange rate misalignment is fairly straightforward – what amount of exchange rate appreciation achieves a given reduction in the trade surplus. In this vein, Goldstein and Lardy estimated the end-2008 undervaluation at 20-25% (in level terms), if the goal is a balance for China's current account (Goldstein and Lardy, 2009, p. 67).[9]

The external balances approach also relies upon a determination of which components of the balance of payments are "persistent". For instance, Prasad and Wei (2005), examining the composition of capital inflows into and out of China, argue that much of the reserve accumulation that has occurred in the preceding years was due to speculative inflow; hence, the degree of misalignment was small. It is doubtful that the same conclusions would be drawn in 2010.

One final observation: the implied exchange rate adjustment (and hence degree of currency misalignment) is *conditional* on the constellation of all other macro policies, including monetary, fiscal and regulatory, in place. If the CA+KA is adjudged to be "too large", one could conclude the exchange rate is "too weak", but one could conclude with equal validity that the

[9] They use the rule of thumb that a 10% appreciation induces a 2-3.5% reduction in the current account.

fiscal policy is "insufficiently expansionary". That is one point that is often forgotten when interpreting misalignment estimates in the basic balance approach.

2.6 Assessing the Assessments

The onset of US-China friction over the valuation of the Renminbi began in earnest in 2003, with the confluence of stagnant employment growth in the US, post-recession, and a widening Chinese trade surplus.[10]

One way to organize the discussion is to note the general characteristics of the estimates. In general (at least up until 2008), estimates based upon PPP or the Penn effect yielded the biggest estimates of yuan misalignment, while single country currency approaches, such as the BEER approaches, typically provided the smallest (Cairns, 2005a,b).

I'll skip the absolute PPP approach because it is well accepted in the academic literature and policy discourse that there are very good reasons for the price level to be higher in high income countries, versus low income countries.

Frankel's 2005 paper was one of the earliest to use the Penn effect in a large cross sectional analysis to measure the extent of misalignment.[11] He found that the Chinese yuan was about 44.8% in logarithmic terms (36.1% undervalued in absolute terms). Extrapolating to 2003, he concluded the gap had widened. Cheung, Chinn and Fujii (2007) exploited this relationship using panel data up to 2004 and found a yuan misalignment in excess of 50%.

In 2008, the International Comparison Program reported the results of a new benchmark survey of prices, conducted in 2005. These new estimates were incorporated into their comprehensive revision of the *World Development Indicators* database. While the estimates for many countries were affected, China's price and income data were substantially modified in light of the new benchmark data (Elekdag and Lall, 2008). The Chinese price level was revised approximately 40% upward, and hence Chinese per capita income downward by roughly the same amount. Using updated data, we found something closer to 10% undervaluation in 2007 (with the 2004 estimated misalignment reduced to 18%). The 2008 yuan *over*valuation of 5% is obtained from the most recent vintage of the *WDI*. While Chinese per capita income has risen about 15% by end-2009, and the equilibrium rate should have risen by about 2.8%, the trade weighted real exchange rate is about the same now as it was in 2008; thus according to Cheung, Chinn and Fujii's calculations, the yuan is currently slightly *over*valued.[12]

Using a smaller sample, Reisen (2009) finds a 12% 2008 undervaluation, and extrapolated a 15% undervaluation in 2009. Wang and Yao (2008) utilize a specification similar

[10] John Snow, "Testimony of Treasury Secretary John Snow Before the Senate Committee on Banking, Housing and Urban Affairs," October 30, 2003. Senators Schumer and Graham first submit a bill to levy tariffs on Chinese imports in Fall 2003, and submit new versions in 2005-07.

[11] Bosworth (2004) uses a smaller sample to evaluate misalignment using the Penn Effect.

[12] According to IMF *World Economic Outlook* database, year on year growth in per capita GDP is about 10% in both 2009 and 2010. Using this growth rate, and the 0.2 coefficient estimate yields the implied 2.8% appreciation.

to Cheung, Chinn and Fujii (2007), augmented by government spending, terms of trade, openness and other variables (similar to Chinn, 1999). Their model is estimated over the 1974-2004 period, for 184 economies. Extrapolating to 2007, they find a 16% undervaluation.

Since the 2008 data revisions, the prominence of the Penn approach in debates of the renminbi's valuation has diminished somewhat. This could be due to the decline in novelty of the approach, or because the message is not as "headline-catching". Subramanian (2010) recently published estimates that contrast with ours. He argues that it is best to estimate the slope coefficient off benchmark data years, with the last one being 2005. Using this approach, he finds the 2005 undervaluation to be 14.5% and 47.5% (in level terms), using the *World Development Indicators* and Penn World Tables, respectively. Extrapolating the path of the equilibrium exchange rate using income growth over the intervening period, he concludes that the current degree of undervaluation is roughly the same as it was in 2005.

Moving to the BEER approach, an interesting aspect of these studies is that the estimated extent of CNY misalignment was never typically large, at least relative to the estimates obtained using the Penn effect. This observation reflects a key difficulty with this approach. If the entire sample period were one in which the Chinese economy were *adjusting* toward a condition under which the Balassa-Samuelson (and other effects) hold -- without actually achieving that condition -- then a single-equation approach would tend to find smaller misalignments than actual.

One way to address this particular concern is to adjust the constant in the BEER equation by some factor. Goldman Sachs has recently incorporated such an adjustment, based upon the Penn Effect. Their assessment is that "the CNY no longer seems strongly undervalued against the dollar" (O'Neill, 2010), with the degree of undervaluation equal to 2.7% against the US dollar and 23.1% against the euro (Stupnytska, Stolper, and Meechan, 2009).

The macroeconomic balance approach and the basic balance approach are, in my view, the most relevant to the ongoing debates over the appropriateness of the value of the yuan. The Peterson Institute for International Economics has been at the forefront of applying the basic balance approach, and – along with the IMF – the macroeconomic balance approach. I think that there has been a certain wariness of the basic balance approach because of the judgment calls that have to be made on what exactly is the sustainable level of external balances. The macroeconomic balance approach has a big policy impact, by definition, to the extent that it is a key input into the IMF's Consultative Group on Exchange Rate (CGER) Assessments. Unfortunately, for obvious reasons, we (in the public sphere) do not have a good feeling for what estimates are generated from this approach.

What was the impact of the academic research on the policy debate? This is a difficult question to answer, particularly with respect to the Chinese side (since much of the debate takes place internally). However, we can see how the academic research was assimilated into the policy debates to get a feeling for how the academic research was mustered to take specific actions (or not take actions, as the case may be). The Bush Treasury's view is summarized in a 2007 Treasury Occasional paper (McCown, Pollard and Weeks, 2007). After reviewing the PPP, BEER and FEER approaches (in a manner strikingly similar to the schema laid out above), the authors remark:

> "different models can produce different estimates of equilibrium. Different models may specify different sets of fundamental variables and produce different levels. One model might find a substantial under-valuation of a currency, while other models might find little or no under-valuation or might even find over-valuation. For example, cyclical or transitory factors may affect the level of an exchange rate so that models that account for these factors will yield different results from those of models that do not. Some would argue that it is reasonable that different models should be used for different economies, reflecting the idiosyncratic factors that influence each economy's behavior. Since there is no broadly accepted "right model," a range of models should be employed when attempting to discern misalignment. If many models and indicators provide similar information, then the basis for rendering a judgment is strengthened." (p. 18).

This paper essentially expands on Appendix II to the December 2006 Treasury Department *Semiannual Report on International Economic and Exchange Rate Policies*.[13] I like to think that the fundamental message of Cheung, Chinn and Fujii (2007) – that each estimate of misalignment is subject to considerable imprecision – is part of the reason why policy-makers have been a little more circumspect in their use of point estimates. It is a message echoed by Dunaway et al. (2006). However, I may be overly optimistic in this regard.[14]

3. Trade Elasticities[15]

Separate from the issue of the degree of exchange rate misalignment is the positive question of how much of an impact will an exchange rate change have on trade flows (although, as in the macroeconomic balance and basic flows approaches, trade elasticities are an important input into the exchange rate misalignment methodologies).

3.1 The Framework

The basic approach is quite straightforward. It involves estimation of separate export and import flow equations for China, relative to the rest of the world.[16]

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[13] All the reports from November 2005 onward are available at http://www.treasury.gov/offices/international-affairs/economic-exchange-rates/

[14] Frankel and Wei (2007) show that domestic variables influence whether a country is declared a currency manipulator, which is at odds with the view that only international macro factors determine the Treasury determination.

[15] This section is drawn from Cheung, Chinn and Fujii (2010a).

[16] I don't address bilateral trade elasticities despite the prominence of the US-China trade balance in political debates because bilateral balances are of limited importance in the open economy

$$ex_t = \beta_0 + \beta_1 y_t^* + \beta_2 q_t + \beta_3 z_t + u_{1,t}, \tag{6}$$

and

$$im_t = \gamma_0 + \gamma_1 y_t + \gamma_2 q_t + \gamma_3 w_t + u_{2,t}, \tag{7}$$

where y is an activity variable, q is a real exchange rate (defined conventionally, so that a rise is a depreciation), and z is a supply side variable. The variable w is a shift variable accounting for other factors that might increase import demand.

3.2 Discussion

Before the jump in the Chinese trade surplus, few academic studies aimed at estimating Chinese trade elasticities, at least over the relevant period. Many of the studies used data spanning the 1980's, which arguably pertained to an economy substantially different from that of the 1990's and 2000's (e.g. Cerra and Dayal-Gulati, 1999; Cerra and Saxena, 2000). With respect to the recent debate, one widely cited estimate from Goldman Sachs was for a Chinese export price elasticity of 0.2 and an import price elasticity of 0.5[17] -- relatively low.

Garcia-Herrero and Koivu (2007) estimate equations (6) and (7). They examine data over the 1995-2005 period, breaking the data into ordinary and processing/parts imports and exports, and relate Chinese exports to the world, imports and the real effective exchange rate, augmented by a proxy measure for the value-added tax rebate on exports, and a capacity utilization variable. In both import and export equations, the stock of FDI is included. One notable result they obtain is that for Chinese imports, the real exchange rate coefficient has a sign opposite of anticipated in the full sample. Additionally, they find that post-WTO entry, Chinese income and price elasticities for exports rise considerably. On the import side, no such change is obvious with respect to the pre- and post-WTO period.

Marquez and Schindler (2009) argue that the absence of useful price indices for Chinese imports and exports requires the adoption of an alternative model specification. They treat the variable of interest as world (import or export) trade shares, broken down into "ordinary" and "parts and components". Using monthly Chinese imports data from 1997 to July 2006, they find ordinary trade-share income "elasticities" ranging from -0.021 to -0.001 (i.e., the coefficients are *in the wrong direction*), and price "elasticities" from 0.013 to 0.021.[18] The parts and components price elasticities are in the wrong direction, and statistically significantly so. Interestingly, the stock of FDI matters in almost all cases. Since the FDI stock is a smooth trend, it is not clear whether to attribute the effect explicitly to the effect of FDI, or to other variables that may be trending upward over time, including productive capacity.

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macroeconomic context. The literature and estimates are discussed in Cheung, Chinn and Fujii (2009b).

[17] O'Neill and Wilson (2003) as cited in Morrison and Labonte (2006).

[18] Marquez and Schindler (2007) conjecture that this counterintuitive result arises from the role of state owned enterprises. They also observe that this result can occur under certain configurations of substitutability between imported and domestic goods.

For export shares (ordinary goods), they find income elasticities ranging from 0.08 to 0.09, and price elasticities ranging from 0.08 to 0.068. For parts and components export share, the income coefficient ranges from a 0.042 to 0.049. Their preferred specification implies that a ten-percent real appreciation of the Chinese RMB reduces the Chinese trade balance between $75 billion and $92 billion.

Thorbecke and Smith (2010) do not directly examine the implications for both imports and exports, but do focus on the impact of RMB appreciation on exports, taking into account the integration of the production chain in the region. Using a sample of 33 countries over the 1994-2005 period, and a trade-weighted exchange rate that measures the impact of how bilateral exchange rates affect imported input prices, they find that a 10% RMB appreciation in the absence of changes in other East Asian currencies would result in a 3% decline in processed exports and an 11% decline in ordinary exports. If other East Asian currencies appreciated in line with the RMB, then the resulting change in the processed exports would be 9%.

Cheung, Chinn and Fujii (2010a) estimate equations (6) and (7) over the 1993-2006 period, using the Stock-Watson (1993) dynamic OLS regression method. The import and export data are examined as aggregates, and as series disaggregated into ordinary and processing and parts trade. The data are converted into real terms using a variety of deflators, including US CPI, PPI for finished goods, and country specific Chinese price indices due to Gaulier et al. (2006),[19] as well as (for Chinese exports) Hong Kong re-export indices. The real exchange rate, q, is the IMF's CPI deflated trade-weighted index, and foreign activity is rest-of-the-world GDP evaluated in current US dollars, deflated into real terms using the US GDP deflator, while y is measured using real GDP (production based) expressed in real 1990 RMB. For z, they assume that supply shifts out with the capital stock in manufacturing. This capital stock measure was calculated by Bai *et al.* (2006).

The results are reported in Table 3. For the aggregate exports (Panel A), the estimated income and price coefficients are not typically significantly significant, although they point in the right direction; only the supply variable coefficient is statistically significant.

As suggested by Marquez and Schindler (2007), the differing behavior of ordinary and processing exports suggests that aggregation is inappropriate. Panel B reports the results for ordinary exports. Here, one finds that the rest-of-the-world activity is not a good predictor of exports, while the price variable is an important determinant. Using either Gaulier et al. (hereafter GUL-K) or HK indices, one finds that the export elasticity of approximately 0.6. At the same time, a one percent increase in the Chinese manufacturing capital stock induces between a 2.2 and 2.5% increase in real exports.

Strangely, the rest-of-the-world GDP does affect positively processing output. Thorbecke and Smith (2007) argue that Chinese processing output is fairly sophisticated in nature; if so, that might explain the greater income sensitivity of such exports.

[19] The GLU-K indices have the drawback of being available only at the annual frequency, and then only up to 2004. We have used quadratic interpolation to translate the annual data into quarterly.

In Table 4, Cheung, Chinn and Fujii turn to examining Chinese imports. Aggregate imports appear to respond strongly to income, and in the expected direction. On the other hand, we replicate Marquez and Schindler's results with regard to the price elasticity. A weaker RMB induces greater imports, rather than less. This is true also for ordinary imports. Only when moving to parts and processing imports does one obtain some mixed evidence, and there the results are still toward finding a wrong-signed coefficient.[20]

Most recently, Ahmed (2009) has used data that spans the recent recession and sharp drop-off and rebound in Chinese imports and exports (1996Q1-2009Q2). Using first differences specifications corresponding to equations (6) and (7), he finds that (in the long run) a one percentage point increase in the annual rate of appreciation of the real exchange rate would have a cumulative negative effect on real export growth of 1.8 percentage points, which is statistically significant. A one percentage point increase in foreign consumption growth would increase export growth by 5.9 percentage points, which is also statistically significant, and appears to be an implausibly large effect. Also, a 1 percentage point increase in the growth rate of the FDI capital stock, comparable to the supply shift term in Cheung, Chinn and Fujii, raises export growth by a cumulative and statistically significant 0.3 percentage points.

In practical terms, the difference in impacts is substantial. Consider estimates of China's export elasticities. Ahmed (2009) finds that after four years, 20% yuan appreciation induces a $400 billion decrease in Chinese exports. In contrast Cheung, Chinn and Fujii (2010) find $50 billion impact.

It is unclear how much these results have affected the debate over the efficacy of exchange rate appreciation on the Chinese trade surplus. After all, the estimates are only intermittently in line with priors. On the other hand, perhaps the humility imparted by the lack of empirical success had a positive impact. Consider that most of the earlier debate (circa 2005) relied upon rule-of-thumb estimates, as noted in policy documents such Congressional Research Service reports.[21]

> A shortcoming of all of the estimates is that they are not the product of theoretically grounded, econometrically estimated economic models. Rather, they are "back of the envelope" estimates based on a few simple "rule of thumb" assumptions. "Rules of thumb" such as the Preeg 10%-$1 billion estimate or the Goldman Sachs import and export elasticities may not be accurate over time or over large changes in the exchange rate.

Perhaps the most important contribution of this literature is that rule-of-thumb estimates are no longer the norm in policy discussions, and the wide dispersion in actual estimates is now acknowledged.

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[20] The Marquez and Schindler results suggest including a role for foreign direct investment as a w variable. However, inclusion of a cumulative FDI variable is insufficient to overturn this result on a consistent basis.

[21] See for instance Morrison and Labonte (2005: 9).

4. Global Imbalances: Saving-Investment Norms

China and other Asian emerging market countries have often been identified as the main causes of the widening U.S. current account deficits. More specifically, these economies' underdeveloped and closed financial markets are alleged to be insufficiently attractive enough to absorb the excess saving in the region, resulting in a "saving glut". Clarida (2005a,b) argues that East Asian, particularly Chinese, financial markets are less sophisticated, deep, and open so that Asian excess saving inevitably flows into the highly developed U.S. financial market. Bernanke (2005) contends that "some of the key reasons for the large U.S. current account deficit are external to the United States" and remediable only in the long run. The saving glut of the Asian emerging market countries, driven by rising savings and collapsing investment in the aftermath of the financial crisis, is the direct cause of the U.S. current account deficit. Therefore, the long term solution is to encourage developing countries, especially those in the East Asian region, to develop financial markets so that the saving rate would fall. Once policies improving institutions and legal systems amenable to financial development and liberalizing the markets are implemented, "a greater share of global saving can be redirected away from the United States and toward the developing nations."

Standing in stark contrast to the saving glut thesis is the more parochial view that a fall in the U.S. national saving, most notably in the form of its government budget deficit, is the main cause of the ongoing current account deficits – the "twin deficit" argument. While the twin deficit effect has been empirically investigated in the literature (e.g., Gale and Orszag, 2004), as far as we are aware, very little investigation has been made to shed light on the effect of financial development on current account balances, with the exception of Chinn and Ito (2007, 2008) and Gruber and Kamin (2009).[22] In this investigation encompassing a sample of 89 countries over the 1971-2004 period, they find that more financial development – measured as private credit as a share of GDP – leads to *higher* saving for countries with underdevelopment institutions and closed financial markets that includes most of East Asian emerging market countries.[23]

Other factors are suggested by the current debate. Bernanke argues that the *openness* of financial markets can also affect the direction of cross-border capital flows. Alfaro et al. (2003), on the other hand, show that institutional development may explain the Lucas paradox, i.e., why capital flows from developing countries with presumably high marginal products of capital to developed countries with low ones. In short, financial development might be mediated by financial openness and institutional development. Hence, we will examine interaction effects as well. Gruber and Kamin (2007) find an important role for financial crises, implicitly supporting the view that reserve accumulation (and accompanying current account surpluses) are driven by self-protection.

4.1 Empirics

[22] Theoretical explanations for this phenomenon now abound. See Caballero, Farhi and Gourinchas (2008a,b) and Mendoza et al. (2009).

[23] Among East Asian countries, most of countries (except for Hong Kong and Singapore) could experience worsening current account balances if financial markets develop further, but that effect is achieved, not through a reduction in savings rates, but through higher increases in the levels of investment than those of national savings.

Chinn and Ito (2007) examine the hypothesis that financial development is an important determinant of current account imbalances, building upon the saving-investment framework in Chinn and Prasad (2003). They use data for 19 industrial and 69 developing countries for the period of 1971-2004, focusing on three variables – the current account balance, and its constituents, national saving, and investment, all expressed as a ratio to GDP.[24] The determinants include the budget balance, demographic variables, relative per capita income, average growth rates, initial net foreign assets, terms of trade volatility, and trade openness, in addition to key variables of interest, namely financial development (proxied by private credit creation as a share of GDP), institutional development (proxied by LEGAL, the first principal component of three ICRG indices), and capital account openness (a de jure measure due to Chinn and Ito, 2006).

Because the economic environment may affect the way in which financial development might affect saving and investment, they include interaction terms between the financial development and legal variables (*PCGDP* times *LEGAL*), interaction terms between the financial development and financial openness variables (*PCGDP* times *KAOPEN*), and interaction terms between legal development and financial openness (*LEGAL* times *KAOPEN*). The financial and legal interaction effect is motivated by the conjecture that deepening financial markets might lead to higher saving rates, but the effect might be magnified under conditions of better developed legal institutions. Alternatively, if greater financial deepening leads to a lower saving rate or a lower investment rate, that effect could be mitigated when financial markets are equipped with highly developed legal systems. A similar argument can be applied to the effect of financial openness on current account balances.

Table 5 displays results from panel OLS regressions with institutional variables. First, as is typically the case, a positive relationship between current account and government budget balances is detected in almost all sample groups. The point estimate on budget balances is a statistically significant 0.15 for the industrialized countries group, (Note that a ±2 standard error confidence interval encompasses values as high as 0.34). Note that China's current account during the 2001-04 period is within the 95% confidence band for the predicted values from this model (Figure 7).

Second, financial development has different, and nonlinear, effects, depending upon the group, and also depending upon the development of the institutional environment and openness to capital flows. For instance, higher financial development results in a smaller current account surplus, but the estimated effect is only statistically significant for the emerging market economies. Further, since the financial development variable (*PCGDP*) is interacted with other institutional variables (*LEGAL* and *KAOPEN*), however, one must be careful about interpretation

[24] One potential problem with developing country data is the possibility of significant measurement error in annual data. To mitigate these concerns, and to focus our interest in medium-term rather than short-term variations in current accounts, we construct a panel that contains non-overlapping 5-year averages of the data for each country. Furthermore, all the variables, except for net foreign assets to GDP, are converted into the deviations from their GDP-weighted world mean prior to the calculation of five year averages. The use of demeaned series controls for rest-of-world effects. In other words, a country's current account balance is determined by developments at home as well as abroad.

of the effect of financial development. Using these estimated nonlinear effects, Chinn and Ito find that only Hong Kong and Singapore are the only East Asian countries for which financial development will cause a negative impact on national savings. Other countries will experience an *increase* in the ratio of national savings to GDP if financial markets develop further.

How does China fit into the estimated impacts on saving and investment? China experienced a remarkable 32.4 percentage point increase in private credit creation (net of change in the world weighted average), in the 2001-04. This financial development *alone* implied a national savings increase of 1.7 percentage points, but also an investment increase of 2.4 percentage points, suggesting a negative effect of financial development on net saving; the directly estimated zero net effect on the current account reflects the uncertainty surrounding these point estimates.

In sum, these results present evidence against part of the argument that emerging market countries, especially those in East Asia, will experience lower rates of saving once these countries achieve higher levels of financial development and better developed legal infrastructure. More open financial markets do not appear to have any impact on current account balances for this group of countries, either. If anything, arguments based upon this thesis have inappropriately extended a characterization applicable to industrialized countries to less developed countries.

Gruber and Kamin (2009) obtain results that are similar to these, in the sense that financial development measured by private credit to GDP fails to show up as an important determinant of current account balances. One similarity across these analyses is the reliance upon private credit to GDP as the proxy measure. In Ito and Chinn (2009), the authors investigate whether alternative measures of financial development change these conclusions.

Generally, they find that for emerging market countries, financial development may lead to deterioration of current account balances *if* the economy exhibits greater than the average openness and a legal system below the top decile. In other cases, this linkage is not apparent. Moreover, greater financial opening tends to make an emerging market economy run a smaller current account surplus, especially if the economy is financially underdeveloped.

4.2 Impact

It would be overstating the case to say these analyses have proved definitively what current account norms should prevail, and how well America's – and China's – behavior can be explained by observable macro variables. However, I think this approach is a step beyond the ad hoc approach that had prevailed until then in some policy circles. From a 2005 Congressional Research Service report:[25]

> "The main source of contention in all of the estimates of the yuan's undervaluation is the definition of an "equilibrium" current account balance. All three estimates are defined as the appreciation that would be required for China to attain "equilibrium" in the current account balance. But there is no

[25] Morrison and Labonte (2005: 9-10).

consensus based on theory or evidence to determine what equilibrium would be; rather, the authors base equilibrium on their own personal opinion."

Another aspect of these analyses does support the view that there is something special about China. Specifically, China's current account balance is under-predicted by these panel regressions. Depending upon the specification, the misprediction is sometimes just barely statistically significant. At the same time, the US current account is also over-predicted. Hence, no strong conclusions can be derived from these regression analyses.[26]

At the same time, these types of analyses have focused attention on the fact that the current account is related to public sector savings and the gap between investment and private saving. This in turn has meant a greater degree of attention to the determinants of the private saving-investment balance as a critical factor, rather than on elasticities and income, arising from a simple Keynesian/Mundell-Fleming approach.

In this regard, private sector analysts and policymakers cite research which highlighted the importance of corporate saving on aggregate private saving, de-emphasizing household saving. One analyst mentioned Kuljis' 2005 World Bank paper as very influential. In my view, this assessment is correct. Economists who stand at the nexus of policy and academia now typically cite the importance of the corporate sector in saving behavior, while not ignoring the trends in the household sector (particularly the decline in the labor share of national income) (Prasad, 2009).

This point has become increasingly central as the debate has moved to whether wage rates are rising. Those familiar with the Lewis-Fei-Ranis model of development will recall that as wages rise, the share of income going to capital decreases. If the propensity to save of labor is less than that of capitalists, then the saving rate should decline (Kroeber, 2010).

5. Concluding thoughts

[To be written]

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[26] That being said, it's hard to avoid this sort of framework for making judgments about the course of current account balances. See Chinn, Eichengreen and Ito (2010).

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Table 1: Studies of the Equilibrium Exchange Rate of the Renminbi

	Relative PPP, Competitiveness	Penn effect	Balassa-Samuelson	BEER	Macroeconomic Balance/External Balance
Time Series	CCF (2009a); Wang (2004)	Bosworth (2004); Frankel (2005);	CCF (2009a)	Zhang (2001); Wang (2004); Funke & Rahn (2005)	Bosworth (2004); Goldstein (2004); Wang (2004)
Cross Section		Coudert & Couharde (2005) Cairns (2005b);			
Panel		Wang and Yao (2008); CCF (2007,2010)			Coudert & Couharde (2005)

Notes: Relative PPP indicates the real exchange rate is calculated using price or cost indices and no determinants are accounted for. Absolute PPP indicates the use of comparable price deflators to calculate the real exchange rate. Balassa-Samuelson (with productivity) indicates that the real exchange rate (calculated using price indices) is modeled as a function of sectoral productivity levels. BEER indicates composite models using net foreign assets, relative tradable to nontradable price ratios, trade openness, or other variables. Macroeconomic Balance indicates cases where the equilibrium real exchange rate is implicit in a “normal” current account (or combination of current account and persistent capital inflows, for the External Balance approach). CCF denotes Cheung, Chinn and Fujii.

Table 2: The panel estimation results of the real exchange rate – income relationship: 2008 vintage data

	USD-based GDP				PPP-based GDP			
	Pooled OLS	Between	Fixed effects	Random effects	Pooled OLS	Between	Fixed effects	Random effects
GDP per capita	.211** (.002)	.196** (.012)	.552** (.008)	.482** (.006)	.194** (.004)	.188** (.019)	.415** (.023)	.302** (.013)
Constant	-.099** (.008)	-.157** (.040)	-	0.623** (.026)	-.276** (.010)	-.310** (.045)	-	-.078* (.035)
Adjusted R^2	0.541	.585	0.894	0.541	0.300	0.365	0.740	0.300
F-test Statistic			82.484**				42.765**	
Hausman test statistic				112.50**				35.122**
Number of observations	3946				4031			

Notes: The data covers 168 countries over the maximum of a twenty seven-years period from 1980 to 2006. The panel is unbalanced due to some missing observations. ** and * indicate 1% and 5% levels of significance, respectively. Heteroskedasticity-robust standard errors are given in parentheses underneath coefficient estimates. For the fixed effects models, the F-test statistics are reported for the null hypothesis of the equality of the constants across all countries in the sample. For the random effects models, the Hausman test statistics test for the independence between the time-invariant country-specific effects and the regressor.

Table 3: Chinese Export Elasticities

Panel A: Aggregate Exports			
	[1]	[2]	[3]
	PPI	GLUK	HK UV
y*	0.57	-0.56	0.31
	(0.40)	(0.53)	(0.40)
q	-0.06	0.26	0.27
	(0.23)	(0.22)	(0.22)
z	1.68***	2.35***	2.06***
	(0.16)	(0.16)	(0.15)
Adj.R^2	0.98	0.98	0.99
SER	0.077	0.080	0.076
Sample	93Q3-06Q2	93Q3-04Q2	93Q3-06Q2
Panel B: Ordinary Exports			
	PPI	GLUK	HK UV
y*	0.04	-1.26	-0.22
	(0.55)	(0.75)	(0.55)
q	0.31	0.61*	0.64*
	(0.32)	(0.31)	(0.32)
z	1.83***	2.51***	2.22***
	(0.22)	(0.22)	(0.22)
Adj.R^2	0.96	0.96	0.97
SER	0.106	0.108	0.105
Sample	93Q3-06Q2	93Q3-04Q2	93Q3-06Q2
Panel C: Processing and Parts Exports			
	PPI	GLUK	HK UV
y*	0.98***	0.26	0.72**
	(0.30)	(0.32)	(0.31)
q	-0.47**	-0.62***	-0.14
	(0.19)	(0.16)	(0.18)
z	1.52***	1.99***	1.91***
	(0.11)	(0.10)	(0.11)
Adj.R^2	0.92	0.99	0.99
SER	0.065	0.060	0.062
Sample	93Q3-06Q2	93Q3-04Q2	93Q3-06Q2

Notes: Point estimates are obtained from DOLS(2,2). Robust standard errors are given in parentheses. *(**)[***] indicates significance at the 10%(5%)[1%] level. The price elasticity estimate should be positive for Chinese exports. PPI indicates US PPI-finished goods is used as the deflator; GLUK indicates the Gaulier *et al.* (2006) consumer good index is used as the deflator; HK UV indicates the Hong Kong unit value index for re-exports to the World is used as the deflator. Supply is the Bai *et al.* (2006) measure of the Chinese capital stock in manufacturing.

Table 4: Chinese Import Elasticities

Panel A: Aggregate Imports			
	[1]	[2]	[3]
	PPI	GLUK	HK UV
y	1.78***	1.41***	2.16***
	(0.06)	(0.04)	(0.06)
q	1.48***	0.39**	1.54***
	(0.38)	(0.19)	(0.32)
Adj.R^2	0.99	0.98	0.99
SER	0.056	0.050	0.055
Sample	94Q4-06Q2	94Q4-04Q2	94Q4-06Q2
Panel B: Ordinary Imports			
	PPI	GLUK	HK UV
y	2.16***	2.40***	2.54***
	(0.26)	(0.32)	(0.27)
q	2.75**	2.25**	2.80**
	(1.18)	(1.06)	(1.19)
Adj.R^2	0.85	0.94	0.94
SER	0.209	0.152	0.196
Sample	94Q4-06Q2	94Q4-04Q2	94Q4-06Q2
Panel C: Processing and Parts Imports			
	PPI	GLUK	HK UV
y	1.68***	0.85***	2.06***
	(0.08)	(0.13)	(0.06)
q	1.15***	-0.25	1.20***
	(0.35)	(0.34)	(0.28)
R2	0.98	0.88	0.99
SER	0.072	0.080	0.060
Sample	94Q4-06Q2	94Q4-04Q2	94Q4-06Q2
Panel D: Processing and Parts Imports			
	PPI	GLUK	HK UV
y	-0.40*	-1.86*	-0.04
	(0.20)	(0.93)	(0.25)
q	-0.13	-1.64***	-0.16
	(0.23)	(0.58)	(0.22)
w	1.10***	1.20***	0.96***
	(0.13)	(0.40)	(0.12)
Adj.R^2	0.99	0.89	0.99
SER	0.037	0.074	0.035
Sample	94Q4-06Q2	94Q4-04Q2	94Q4-06Q2

Notes: Point estimates are obtained from DOLS(2,2). Robust standard errors are given in parentheses. *(**)[***] indicates significance at the 10%(5%)[1%] level. The price elasticity estimate should be negative for Chinese imports. PPI indicates US PPI-finished goods is used as the deflator; GLUK indicates the Gaulier *et al.* (2006) capital goods and parts index is used as the deflator for aggregate, capital goods for ordinary and parts for processing and parts; HK UV indicates the Hong Kong unit value index for re-exports is used as the deflator. The demand shift variable *w* is total real exports.

Table 5: Current account regression with legal development (*LEGAL*)

Dependent variable: 5-yr average of current account (% of GDP): 1971 – 2004					
	(1) Full	(2) IDC	(3) LDC	(4) LDC w/o Africa	(5) EMG
Gov't budget balance	0.159	0.154	0.168	0.251	0.23
	[0.065]**	[0.095]*	[0.079]**	[0.091]***	[0.075]***
Lane's NFA (initial)	0.049	0.069	0.047	0.051	0.041
	[0.005]***	[0.011]***	[0.005]***	[0.006]***	[0.009]***
Relative income	0.062	0.058	0.115	0.16	0.216
	[0.028]**	[0.028]**	[0.096]	[0.106]	[0.103]**
Relative income squared	0.032	-0.097	0.057	0.157	0.166
	[0.038]	[0.120]	[0.102]	[0.121]	[0.111]
Rel. dependency ratio (young)	-0.061	-0.027	-0.076	-0.099	-0.044
	[0.018]***	[0.082]	[0.022]***	[0.030]***	[0.023]*
Rel. dependency ratio (old)	-0.2	0.099	-0.368	-0.331	-0.529
	[0.058]***	[0.098]	[0.096]***	[0.114]***	[0.127]***
Financial Develop. (PCGDP)	-0.008	0.01	-0.043	-0.038	-0.082
	[0.009]	[0.012]	[0.032]	[0.040]	[0.038]**
Legal development (LEGAL)	-0.003	0.002	-0.017	-0.02	-0.018
	[0.004]	[0.007]	[0.008]**	[0.009]**	[0.010]*
PCGDP x LEGAL	-0.003	-0.035	-0.021	-0.025	-0.037
	[0.004]	[0.015]**	[0.011]*	[0.012]**	[0.016]**
Financial open. (KAOPEN)	-0.001	-0.002	0.002	0.005	0.008
	[0.003]	[0.003]	[0.007]	[0.008]	[0.010]
KAOPEN x LEGAL	0.002	0.012	0.002	0.002	0.005
	[0.001]*	[0.003]***	[0.002]	[0.002]	[0.003]
KAOPEN x PCGDP	-0.003	0.002	0	0.002	-0.002
	[0.005]	[0.009]	[0.007]	[0.008]	[0.009]
TOT volatility	-0.013	0.1	-0.015	-0.002	-0.003
	[0.017]	[0.054]*	[0.018]	[0.019]	[0.022]
Avg. GDP growth	-0.123	-0.036	-0.09	-0.107	-0.132
	[0.087]	[0.243]	[0.096]	[0.124]	[0.118]
Trade openness	0.006	0.046	0.005	0	0.004
	[0.009]	[0.014]***	[0.013]	[0.014]	[0.014]
Oil exporting countries	0.041	–	0.04	0.035	0.025
	[0.013]***	–	[0.013]***	[0.012]***	[0.013]*
Observations	471	126	345	234	203
Adjusted R-squared	0.47	0.55	0.46	0.54	0.51

Robust standard errors in brackets, * significant at 10%; ** significant at 5%; *** significant at 1%
The estimated coefficients for the time-fixed dummies and constant are not shown.

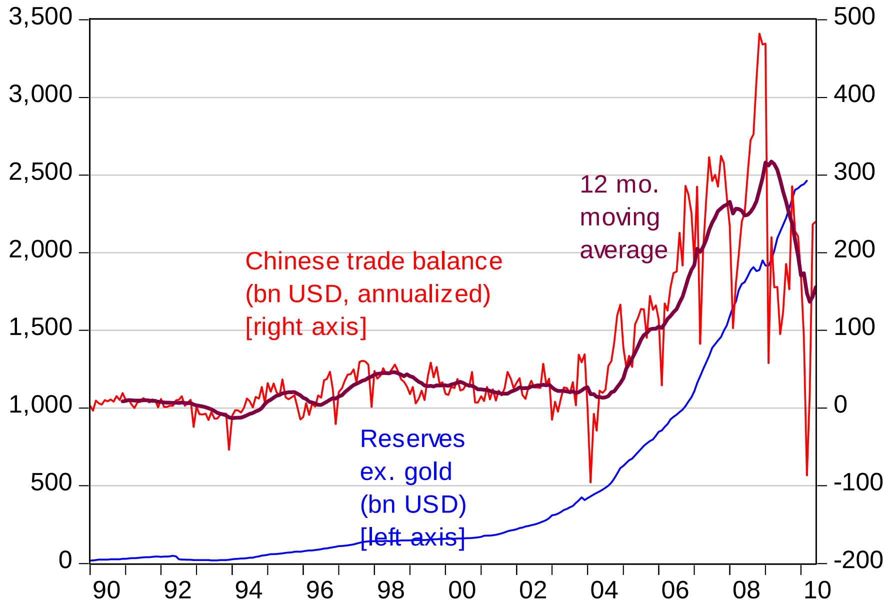

Figure 1: Chinese trade balance, in bn USD, annualized (blue line); and Chinese reserves ex.-gold (bn USD). Source: IMF, International Financial Statistics.

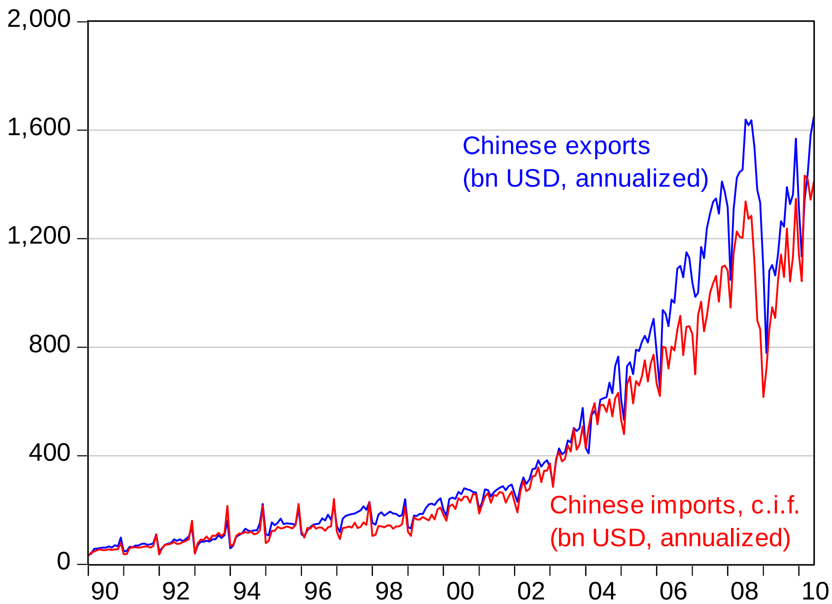

Figure 2: Chinese exports, (blue line); and imports, c.i.f., in bn USD, annualized. Source: IMF, International Financial Statistics.

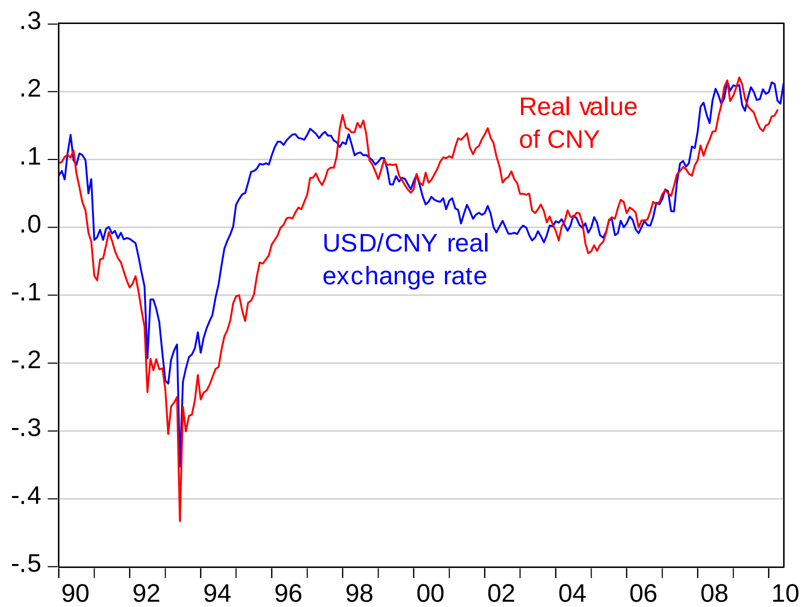

Figure 3: Log USD/CNY real exchange rate (blue line), and log real trade weighted value of CNY (red line), both normalized to 2005=0. Series adjusted to use swap rates instead of official rates pre-1994 (see Fernald, Edison and Loungani, 1999). Source: IMF, International Financial Statistics, and author's calculations.

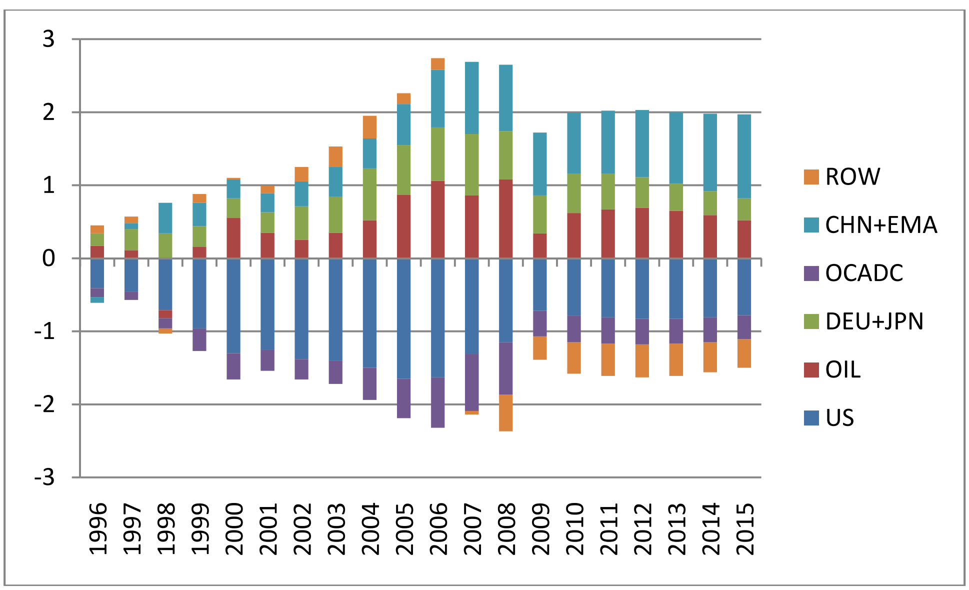

Figure 4: Current account balances as a share of world GDP. 2009-2015 data are IMF projections. US is United States, OIL is oil exporting countries, DEU+JPN is Germany plus Japan, OCADC is other advanced developed countries, CHN+EMA is China plus other emerging Asia, and ROW is rest of the world. Source: IMF, *World Economic Outlook*, April 2010.

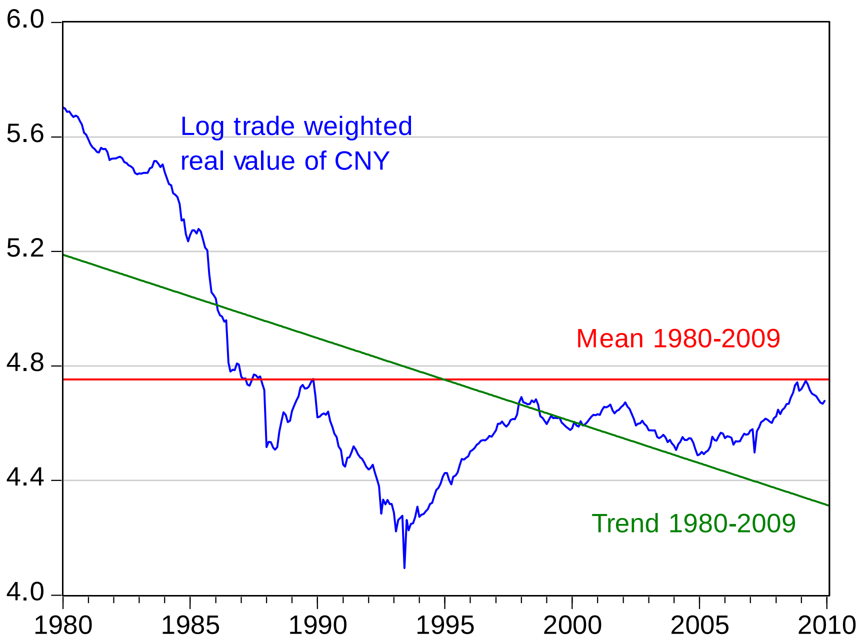

Figure 5: Log trade weighted real value of the Chinese yuan, deflated using CPIs. Upward direction indicates appreciation. Red line is mean value over 1980-2009 period. Green line is linear trend estimated over 1980-2009 period. Source: IMF, *International Financial Statistics*, various issues, and authors' calculations.

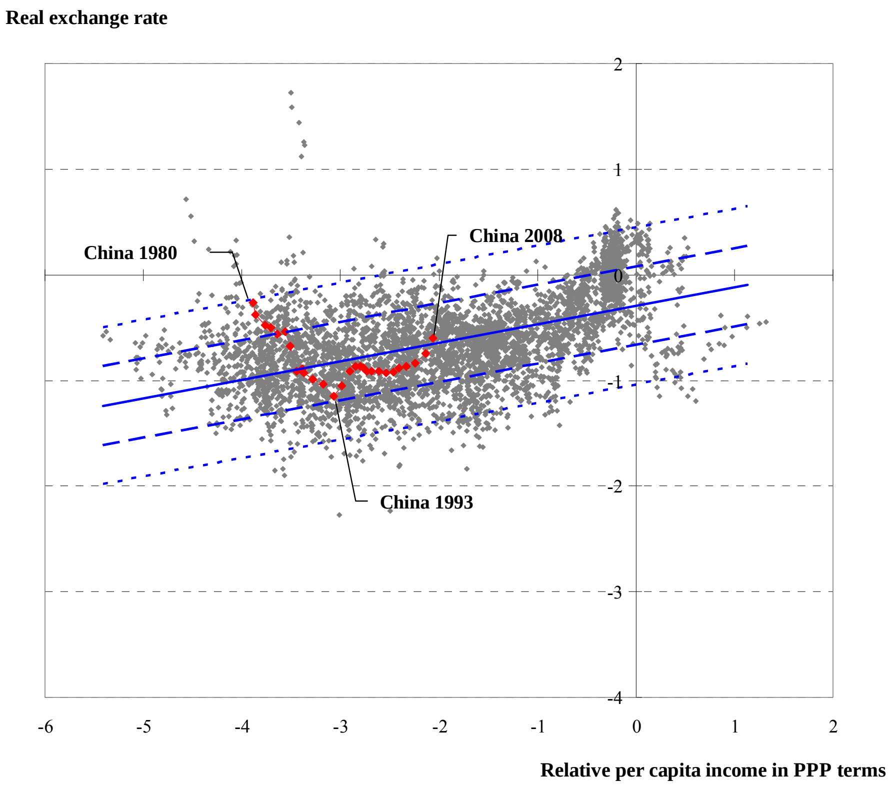

Figure 6: Log real exchange rate *R* and log per capita income relative to US, expressed in PPP terms. Upward direction indicates appreciation. Solid blue line denotes regression line; long (short) dashed lines represent ±1 (±2) standard error bands. Red line denotes path of the RMB over time. Source: World Bank, *World Development Indicators* (accessed March 2010) and author's calculations.

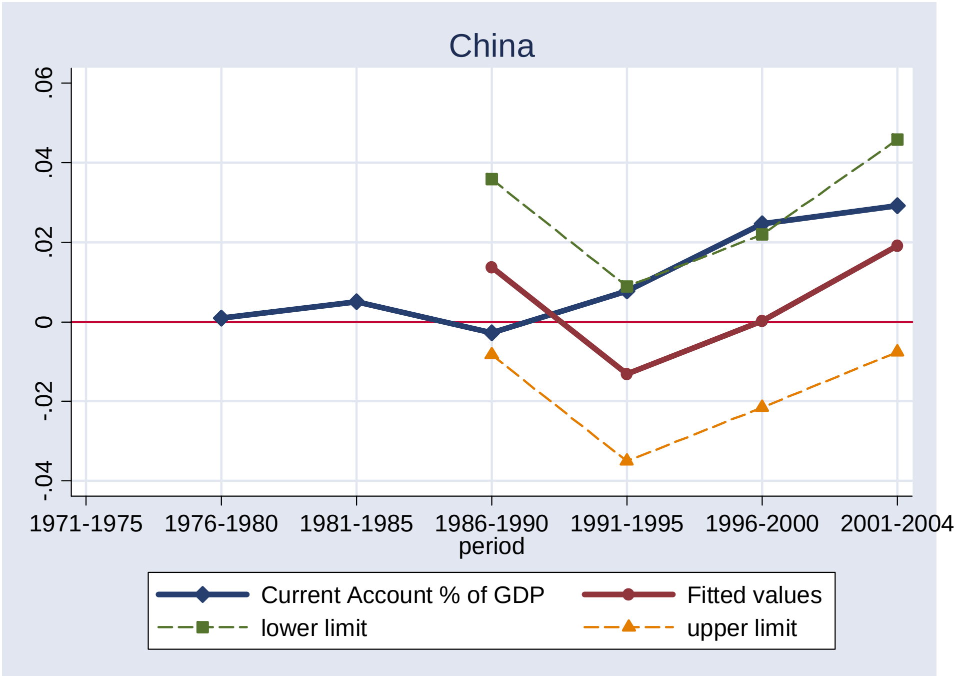

Figure 7: Actual Chinese current account to GDP ratio (blue line), and predicted (red line) and plus/minus 2 standard error band. Source: Chinn and Ito (2008).