Making Sense of China's Excessive Foreign Reserves

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- Why don't Chinese spend their dollars and buy American goods?

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  - However, selling goods at significantly low prices and holding $ as a store of value = lending goods to Americans in return for IOUs that pay negative interest.
  - Why would the Chinese tighten their belts and lend to Americans when they are still struggling with very low per capita income? Shouldn't they borrow from Americans instead?

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  - lack of social safety nets
  - missing insurance markets
  - severe borrowing constraints
- Chinese must save excessively to insure themselves against idiosyncratic uncertainty, such as bad income shocks, unemployment risk, accidents, and many unexpected spending needs such as housing, education, health care, and so on.

Economic Theory Predicts:

- When households face large uninsured risk and are subject to severe borrowing constraints,

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  - in sharp contrast to PIH (Friedman, 1957).

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Figure 1
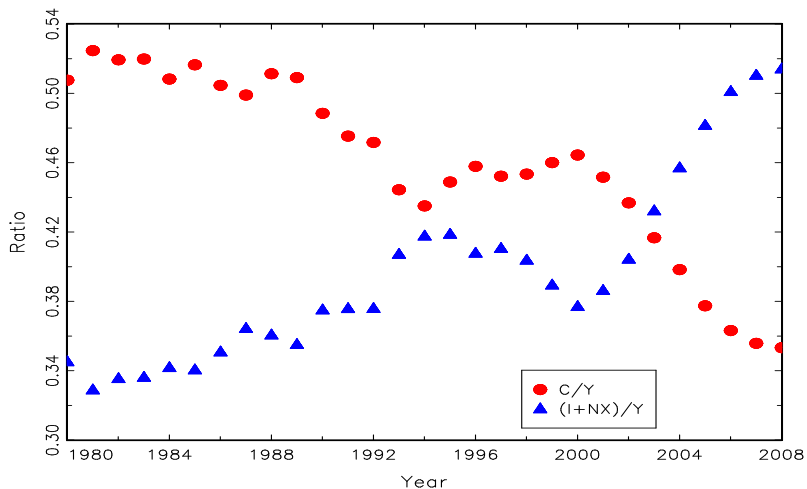
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  - Japan (1960-70s),
  - Hong Kong (1980s),
  - Taiwan and South Korea (1990s),
  - but the gigantic size of China makes the phenomenon far more alarming and astonishing.

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- If the private sectors want to increase spending on American goods, in principle they can exchange dollars back from Gov by selling bonds.
- Therefore, foreign-exchange reserves held by the Gov are effectively owned by the private sector and they reflect nothing but private savings of Chinese households and firms.

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- By forcing China to appreciate its currency may succeed in discouraging Americans from buying Chinese goods, but *will not stop the Chinese households from precautionary saving* and, consequently, China will not buy significantly any more goods from America than they used to.
- Thus, such policy proposal has undesirable consequences—it increases the import prices at the cost of American consumers *yet without stimulating the US exports to China*, hurting the welfare of both Americans and Chinese workers.

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- However, this literature does not directly explain the excessive foreign reserves in China.

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4. Therefore, further valuation of the RMB may lead to catastrophic disasters in the future once China's capital control is lifted.

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- Households can mitigate (bypass) capital controls though working in both nontradable and tradable sectors
    - able to adjust basket of consumption goods for tradable and nontradable by adjusting labor supply.

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- Households are subject to uninsured idiosyncratic shocks $\theta_t(i)$, with support $\theta \in [\underline{\theta}, \overline{\theta}]$ and CDF $F(\theta)$.

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- An competitive financial intermediary pulls the savings from households in sector 1 and rents the capital to firms in the nontradable sector. The competitive factor prices:

$$r_t + \delta = \alpha \frac{Y_{1t}}{K_t} \tag{1}$$

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- Perfect competition and labor mobility across sectors:
  $\frac{1}{e_t} W_{1t} = W_{2t} = A_0 (1+g)^t$, where e = relative price of nontradable (price of good 1 in terms of good 2).

Households

- Labor supply is predetermined before $\theta_t(i)$.
- Household i's problem

$$\max E \sum_{t=0}^{\infty} \beta^t \left\{ \theta_t(i) \left[\log c_{ht}(i) + \log c_{ft}(i) \right] - an_{1t}(i) - an_{2t}(i) \right\}$$

subject to

$$c_{ht}(i) + (1+g) s_{t+1}(i) \leq (1+r_t) s_t(i) + W_{10} n_{1t}(i) \qquad (3)$$

$$s_{t+1}(i) \geq 0 \qquad (4)$$

$$P_t^* c_{ft}(i) + (1+g) m_{t+1}(i) \leq m_t(i) + P_t^* W_{20} n_{2t}(i) \qquad (5)$$

$$m_{t+1}(i) \geq 0, \qquad (6)$$

and $n_{1t}(i), n_{2t}(i) \geq 0$.

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- If there were no borrowing constraints, households would set consumption equal to permanent income by borrowing from outside. Hence, the country would run big trade deficit with F, as predicted by the PIH.

General Equilibrium

1. Sequences of decision rules
   $\left\{ c_{ht}(i), c_{ft}(i), s_{t+1}(i), m_{t+1}(i), n_{1t}(i), n_{2t}(i) \right\}_{t=0}^{\infty}$, such that given prices $\left\{ P_t^*, r_t, W_{1t}, W_{2t} \right\}_{t=0}^{\infty}$, these decision rules maximize each household's lifetime utility.

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2. Sequence of demand functions $\{K_t, N_{1t}, N_{2t}\}_{t=0}^{\infty}$, such that given
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4. The transversality conditions hold: $\lim_{T \to \infty} \beta^T \frac{K_{T+1}}{W_T} = 0$ and
   $\lim_{T \to \infty} \beta^T \frac{\frac{1}{P_t^*} \int M_{T+1}(i) di}{W_T} = 0$.

Household Decision Rules

The decision rules of consumption, asset demand, real balances, and cash-in-hand (x_t) are given by

$$c_{ht}(i) = \min\left\{\frac{\theta_t(i)}{\theta_{1t}^*}, 1\right\} x_{1t} \tag{7}$$

$$c_{ft}(i) = \min\left\{\frac{\theta_t(i)}{\theta_{2t}^*}, 1\right\} x_{2t} \tag{8}$$

$$(1+g) s_{t+1}(i) = \max\left\{\frac{\theta_{1t}^* - \theta_t(i)}{\theta_{1t}^*}, 0\right\} x_{1t} \tag{9}$$

$$(1+g) \frac{m_{t+1}(i)}{P_t^*} = \max\left\{\frac{\theta_{2t}^* - \theta_t(i)}{\theta_{2t}^*}, 0\right\} x_{2t} \tag{10}$$

$$x_{1t} = \theta_{1t}^* \left[\beta \frac{1+r}{(1+g) W_{10}}\right]^{-1} \tag{11}$$

$$x_{2t} = \theta_{2t}^* \left[\frac{\beta}{(1+g)(1+v) W_{20}}\right]^{-1}, \tag{12}$$

Household Decision Rules

- The cutoff variables $\{\theta_{1t}^*, \theta_{2t}^*\}$ are determined by the following two equations,

$$1 + g = \beta\,(1 + r)\,R(\theta_{1t}^*) \tag{13}$$

$$1 + g = \frac{\beta}{1 + v}R(\theta_{2t}^*), \tag{14}$$

where the function $R(\cdot)$ is given by

$$R(\theta^*) \equiv \int_{\theta < \theta^*} dF(\theta) + \int_{\theta \geq \theta^*} \frac{\theta}{\theta^*} dF(\theta) > 1. \tag{15}$$

- Note $\frac{\partial R}{\partial \theta^*} < 0$. That is, with a higher cutoff, the liquidity constraint is less likely to bind, thus the liquidity value of savings is lower.

Discussion

- Consider tradable sector: Since $R(\cdot)$ is bounded below by 1 and above by $R(\underline{\theta}) = \frac{E\theta}{\underline{\theta}} > 1$, $\exists$ a minimum $v_{\min} = \frac{\beta}{1+g} - 1$ such that if $v \leq v_{\min}$, the optimal money demand is infinity (Friedman Rule); and a maximum $v_{\max} = \frac{\beta}{1+g} \frac{E\theta}{\underline{\theta}} - 1$ such that if $v \geq v_{\max}$ the optimal money demand for dollars is zero.

- In $1 + g = \frac{\beta}{1+v} R(\theta_{2t}^*)$, the LHS is the marginal cost of saving — the opportunity cost of not consuming the rising income is proportional to the income growth rate. The RHS measures the effective rate of return to saving, including the real interest rate ($\frac{\beta}{1+v}$) and the liquidity premium.

- In equilibrium the liquidity premium R is an increasing function of income growth $g \Longrightarrow\Longrightarrow$ "High Growth Leads to High Saving."

Aggregation

- By the law of large numbers, aggregate (or average) consumption, saving, and asset demand are given by

$$c_{ht} = D(\theta_1^*) x_{1t} \tag{16}$$

$$c_{ft} = D(\theta_2^*) x_{2t} \tag{17}$$

$$(1 + g) s_{t+1} = H(\theta_1^*) x_{1t} \tag{18}$$

$$(1 + g) \frac{m_{t+1}}{P_t^*} = H(\theta_2^*) x_{2t}, \tag{19}$$

where $D(\theta^*) = \int_{\theta < \theta^*} \frac{\theta}{\theta^*} dF(\theta) + \int_{\theta \geq \theta^*} dF(\theta) \in (0, 1)$ and $H(\theta^*) = \int_{\theta < \theta^*} \frac{\theta^* - \theta}{\theta^*} dF(\theta) \in (0, 1)$. Note $D(\cdot) + H(\cdot) = 1$.

- Optimal hours worked $\{N_{1t}, N_{2t}\}$ can be solved by

$$W_{10} N_1 = (1 - H(\theta_1^*)) x_1 > 0 \tag{20}$$

$$W_{20} N_2 = (1 - H(\theta_2^*)) x_2 > 0. \tag{21}$$

Aggregate Saving Rate

- Define $\wp_j$ as disposable income in sector j:

$$\wp_{1t} = rS_t + W_{10}N_{1t} = X_{1t} - S_t \tag{22}$$

$$\wp_{2t} = W_{20}N_{2t} = X_{2t} - \frac{M_t}{P_t^*} \tag{23}$$

- The saving rate for each sector is the ratio of net changes in asset position and disposable income:

$$\tau_1 = \frac{S_{t+1} - S_t}{\wp_{1t}} = \frac{(1+g)\,s_{t+1} - s_t}{x_{1t} - s_t} = \frac{gH(\theta_1^*)}{1 + g - H(\theta_1^*)} \tag{24}$$

$$\tau_2 = \frac{M_{t+1} - M_t}{P_t^* \wp_{1t}} = \frac{(1+g)\,m_{t+1} - m_t}{P_t^* x_{2t} - m_t} = \frac{gH(\theta_2^*)}{1 + g - H(\theta_2^*)}. \tag{25}$$

- The saving rate is an increasing function of the rate of income growth, $\frac{d\tau}{dg} > 0$, provided that g is not too large.
- Intuition:

Calibration

- Pareto distribution,

$$F(\theta) = 1 - \theta^{-\sigma}$$

with $\sigma > 1$ and $\theta \in (1, \infty)$. An infinite value of θ indicates life-threaten medical need. But the probability of such events is infinitely small.

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- Set $\sigma = 1.25$ so that the model implied consumption uncertainty ($var(\log c_t(i))$) matches developing economy and the implied Gini coefficient $= 0.4$. Let $t =$ one year and

Table 1. Parameter Values

β	α	δ	v	σ
0.96	0.3	0.1	0.03	1.25

Figure 2
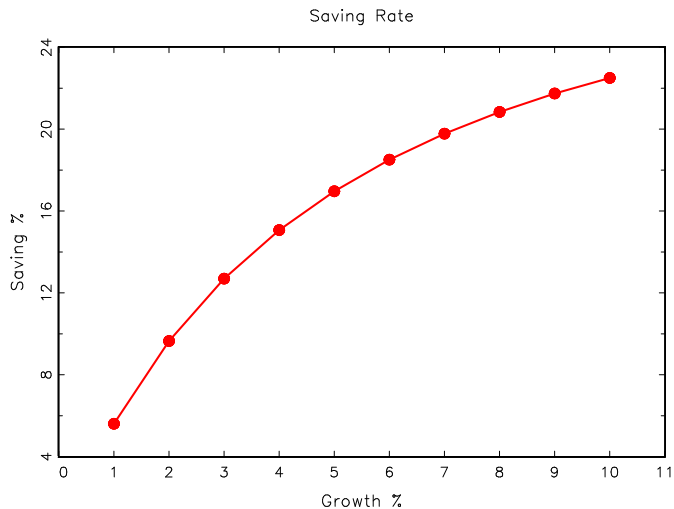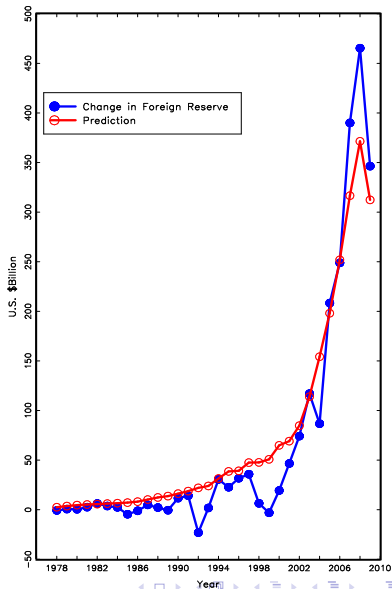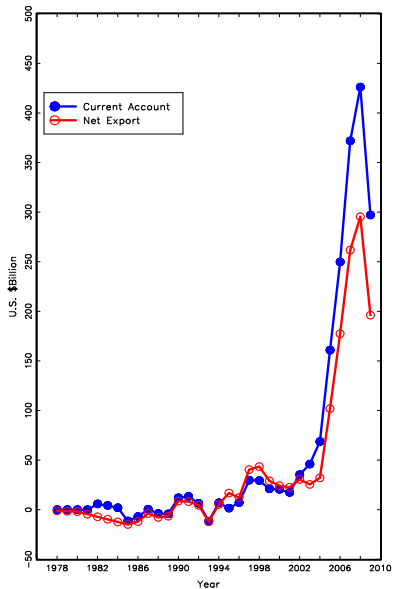

Figure 2. Saving Rate as a Function of Growth.

Given the average growth rate of export income in China (about 20% per year between 1978-2009), our model implies a precautionary saving rate of 26% in the tradable sector. Based on this information, multiplying China's total exports ($P_t^* Y_{2t}$) by 0.26 would generate the predicted year-to-year changes in foreign reserves in the model (Figure 3):

Figure 3

Exchange Rate Determination: Thought Experiment

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- Dollar supply

$$S = \alpha + \theta e = 275 + \theta e$$

Dollar demand

$$D = \beta - \theta e = 425 - \theta e;$$

where $\theta = 18$. Given $e = 7(\yen/\$)$, $S = \$401$ billion and $D = \$299$ billion. Trade surplus $= \$102$ billion, about 25% of export income (as in China).

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- The market-clearing exchange rate would be $e^* \approx 4.2(\yen/\$)$ $\implies$ 40% appreciation as suggested by Paul Krugman.

Thought Experiment

1. However, precautionary-saving demand for dollars (American assets) by Chinese households has been ignored. Suppose all workers in the tradable sector choose to hold dollars as a saving device. This amount of asset demand for dollars is about 25.4% of the export income (or $0.254 \times 401 = 102$ billion in our framework), which implies $\beta = 425 + 102 = 527$ and $e^* = 7(\text{¥}/\$)$, instead of $4.2(\text{¥}/\$)$.

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- In addition, if all precautionary savings in China are counted and translated into demand for Foreign assets, there would be a huge pressure for dollars to appreciate against RBM. Ex: Assume annual household saving rate in China is 25% of GDP—about 5 times larger than the ratio of trade surplus-to-GDP, which translates into $5 \times 102 = \$510$ billion excess demand for $\$$ in our framework. So $\beta = 527 + 510 = 1037$ and $e^* = \frac{1037 - 275}{2 \times 18} = 21.167(\yen/\$)$. That is more than 200% depreciation.

Thought Experiment

- Even if the optimal portfolio of a typical Chinese household is to hold $\frac{1}{2}$ savings in dollars and $\frac{1}{2}$ in RMB, then total demand for dollars from both sectors 1 & 2 $= \frac{102+510}{2} = \$306$ billion, which implies $\beta = 425 + 306 = 731$ and $e^* = \frac{731-275}{2\times18} = 12.667(\yen/\$)$, a more than 80% depreciation of RMB.

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- Further suppose Americans want to invest half of their savings in Chinese assets. The ratio of personal saving to GDP in the United States is 2.5%, and the ratio of total trade deficit-to-GDP is 5%, out of which about 30% is due to imbalance with China. So the extra supply of dollars in the bilateral exchange market $= \frac{0.5\times2.5}{0.3\times5} \times 102 = 85$, which implies $\alpha = 275 + 85 = 360$ and $e^* = \frac{731-360}{2\times18} = 10.306(¥/\$)$, still a more than 47% depreciation.

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Conclusion and Policy Implications

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1. China's excessive foreign reserves are not the consequence of a linked exchange rate or a undervalued home currency, but the outcome of an inefficient financial system in conjunction with rapid income growth—typical for all emerging economies.

2. The fundamental determinates of the exchange rate include not just excess demand of tradable goods but also excess demand of international assets. Therefore, taking into account the inefficient financial system in China and the excessive amount of precautionary savings of Chinese households, the current exchange rate of RMB has been significantly overvalued, instead of undervalued.

- Based on these insights, we may conclude that forcing the RMB to further revalue may not only destroy China's export industry but also lead to bigger economic disasters in the future when capital controls are lifted.

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- A final question is: If the RMB has already overvalued, why has the RMB been appreciating in recent years? The answer lies in

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  - This policy can also pave the way for a floating exchange rate in the future.