The Role of Macroeconomic Policy in Explaining China's Current Account Surplus

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Abstract

China has seen a large increase in its current account surplus since opening up its economy in the mid 1990s. This paper assesses how much of China's current account surplus can be explained by government policy of capital controls, sterilized interventions and an exchange rate peg. These policies are incorporated into a standard two country model. I find that around half of the movement in China's current account can be explained by these policies. In the absence of these policies, China would have run a noticeable current account deficit of around 8 percent of GDP.

1 Introduction

According to standard growth theory, a developing nation that is expected to experience strong growth should borrow from the rest of the world to increase its capital stock. In other words it runs a current account deficit. Since opening up its economy in the mid 1990s China has experienced strong output and productivity growth. Chinese total factor productivity growth has averaged around 4.5 percent per year since 2000, by way of comparison the figure for the US is 1.2 percent (Tian and Yu, 2012). However China has run a current account surplus. China's current account surplus is large across a number of metrics. In 2007 China's current account surplus peaked at 10 percent of GDP. A year later it stood at US\$421 billion. This was the largest current account surplus of any nation that year and larger than the combined current account balances of the next two largest surplus countries, Japan and Germany.

A number of explanations have been put forward as to why China has a high savings rate and is consequently running a current account surplus. There is convincing evidence that demographic factors (see Curtis et al. (2011), Horioka and Wan (2007) and Modigliani and Cao (2004)), financial market frictions (see Blanchard and Giavazzi (2006), Buera and Shin (2009) and Chamon and Prasad (2010)) and the absence of a social welfare system (see Chamon and Prasad (2010) and Meng (2003)) have contributed to an increase in Chinese savings.[1] One thing that all these explanations have in common is that they emphasize the role of private agents in influencing national savings.

Another factor that could influence the current account - and one that is particularly evident in China - are the government's exchange rate and capital account policies. Surprisingly the literature has not focused on the role of these policies in explaining China's current account surplus.[2] In this paper I quantitatively measure the effect that Chinese authority's macroeconomic

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[1]See Yang (2012) for a review.

[2]An exception is Jeanne (2012), who shows how an economy can undervalue its exchange rate using capital account policies. While Jeanne (2012) does talk about China's macroeconomic policies, his paper does not quantitatively analyze this policy as I do here.

policies have had on the current account, taking into consideration the sustained total factor productivity growth experienced by China.[3] In particular, since 1994 Chinese authorities have maintained an exchange rate peg in one form or another, to meet the People's Bank of China's stated objective "to maintain the stability of the value of the currency." This peg has been maintained through the central bank undertaking sterilized interventions and in the presence of binding controls on both capital inflows and outflows.[4] The amount of foreign currency reserves that China has accumulated through its sterilized interventions is large, accounting for around 50 percent of GDP. This large level of reserves suggests that the Chinese government's macroeconomic policies are having a non-trivial effect on the current account.

Indeed, one contribution that I make in this paper is to provide an explanation for the accumulation of foreign reserves, which account for the vast majority of China's foreign assets (Figure 1). Since the previous literature has focused on the role of private agents, it cannot provide an explanation for the accumulation of the foreign reserves. The second contribution I make is to provide an explanation for shorter term movements in the current account. For example, while demographic factors are important for understanding the trend increase in Chinese savings, it cannot explain short term movements in the current account. In this paper, policymakers accumulate foreign exchange reserves to stabilize the exchange rate. Since there is pressure on the exchange rate to change on a high frequency basis this will translate to policy that can affect the current account at a higher frequency.

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[3]Another strand of the literature has looked at the normative case for real exchange rate undervaluation (see Costinot et al. (2011) and Korinek and Serven (2010)). I take China's macroeconomic policies as given and focus on how these policies affect the current account.

[4]Sterilized interventions refer to Chinese authorities trading foreign currency denominated assets in order to influence its exchange rate while keeping the domestic money supply unchanged. For example, say a country decides to devalue its currency. The government would then sell its currency and purchase a foreign currency denominated asset. By taking currency out of the central bank and placing it in circulation the government increases the money base and puts upward pressure on inflation. But by undertaking sterilization, the government can unwind the effect of this operation on the money base. In this example, it would sell bonds to domestic households to reduce inflationary pressures. Adler and Tovari (2011) find that sterilized interventions tend to be more effective for countries with more closed capital accounts.

I incorporate these Chinese-style policies of an exchange rate peg, capital controls and sterilized interventions into a standard standard two country model. In the model, policymakers undertake interventions by buying or selling foreign currency bonds to maintain a pegged exchange rate. These interventions are then sterilized by authorities trading a domestic currency bond with Chinese households. Capital controls prevent private agents from accessing foreign assets and hence from undoing the effects of the government's intervention. Essentially policymakers accumulation of foreign assets through interventions and the imposition of capital controls lead to the government, rather than households, determining the net foreign asset position of the economy.

I find that China's exchange rate and capital control policies have had a noticeable effect on the current account. China runs a current account surplus with these policies and a current account deficit in the absence of these policies. I find that if China had a floating exchange rate and open capital account, that it would have run a sizable current account deficit, of around 8 percent of GDP, in response to the sustained total factor productivity shock it had experienced. Expected productivity increases lead to Chinese households borrowing internationally to smooth their consumption. International borrowing and productivity growth lead to an appreciation of the currency encouraging the consumption of imports but muting exports. Hence China also runs a trade deficit.

Imposing an exchange rate peg and capital controls leads to China running a current account surplus. This is because in the absence of these policies the currency appreciates. With an exchange rate peg, authorities aim to prevent a currency appreciation by purchasing foreign currency bonds. Increased bond holdings cause Chinese households to go from being borrowers to lenders. The relative depreciation of the exchange rate discourages imports but encourages exports. The trade balance increases.

The model can fit some stylized facts about China's macroeconomic policies. In particular, I find that China's capital control and exchange rate policies dampened domestic demand in China by raising savings and encouraged exports. I

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also find that these policies reduced the price of Chinese exports, stimulating domestic demand in the rest of the world. I demonstrate how a nation can influence its exchange rate over an extended period of time, consistent with that observed in China. While estimates from the open economy literature suggest that nominal frictions by themselves are not persistent enough to generate extended deviations in the exchange rate away from its long-run value (see for example Chari et al. (2002)), I show how this can be achieved through the use of capital controls.

Qualitatively the model can match the run up seen in China's current account surplus. Quantitatively I find that around half of the observed increase in China's current account balance can be explained by the government's pegged exchange rate and capital account policies. The maintenance of an exchange rate peg during a period in which the currency would have otherwise appreciated leads to an accumulation of foreign reserves. However, my model suggests a more modest accumulation of reserves of around 15 percent of GDP. This more muted response owes to the fact that the exchange rate is more volatile in the data than in the model. Hence policymakers in the model need to accumulate less foreign reserves to dampen movements in the exchange rate.

The next section outlines China's exchange rate and capital account policies. The model with and without, capital controls, sterilized interventions and an exchange rate peg is presented in Section 3. Data on the total factor productivity process in China and the model's calibrations are presented in Section 4. Results are outlined in Section 5. Section 6 shows sensitivity analysis. Section 7 concludes.

2   An Overview of China's Exchange Rate and Capital Account Policies

In 1994, China ended a period in which its currency was not readily convertible and fixed its exchange rate to the US dollar. In 1996, China liberalized trans-

actions on the current account, with restrictions on access to foreign currency for importers and exporters being eliminated. The exchange rate remained fixed until mid 2005, when China pegged its exchange rate to a basket of currencies and allowed some appreciation in the yuan. The government allowed the yuan to float within a narrow band around the central parity published by the People's Bank of China. This band was further widened in 2007 and 2012, but still only allows for modest daily movements in the renminbi.

While transactions on the current account have been liberalized, the capital account in China is largely closed. The Chinese government imposes restrictions across nearly all categories of capital inflows and outflows. The Chinn and Ito (2008) index which measures the restrictions a country imposes on transactions in its external accounts places China in the bottom 10th percentile out of 182 countries in their sample in terms of capital account openness.

Financial inflows by foreigners into China are quite restricted (an exception is foreign direct investment inflows which have largely been liberalized). In terms of equities, foreign investors can trade "B shares" in the Shanghai and Shenzhen stock markets. However, these shares make up only a tiny fraction of the shares available in the stock market. In particular, the market capitalization of B shares have accounted for on average about one and 2.7 percent of the total stock market capitalization of the Shanghai and Shenzhen markets respectively. Foreign investors can also access a limited range of bonds and equities through the Qualified Foreign Institutional Investor scheme. However, presently only about 100 foreign institutions have been licensed to participate in this program and the amount that they are allowed to invest domestically in China is small. Approved investment funds accounted for an amount that was equivalent to just 0.5 percent of China's A-share market capitalization (those stocks that are available to Chinese nationals) in 2010 (Lardy and Douglass (2011)). Other than through these programs foreign investors cannot invest in domestic debt securities or have bank deposits in China.

The Chinese government also heavily restricts the financial outflows of Chinese residents. Through the Qualified Domestic Institutional Investor scheme

Chinese nationals can access foreign assets. However access to this scheme is subject to authorization and the amount that Chinese nationals are allowed to invest is small. In 2010 the quota on this scheme was equal to just 1.5 percent of household savings (Lardy and Douglass (2011)).

The composition of China's foreign assets and liabilities show the effects of these restrictions on capital inflows and outflows. As Figure 1 indicates, the vast bulk of China's foreign assets take the form of official reserves, while foreign liabilities are primarily composed of foreign direct investment.

The literature finds that China's capital controls have been binding. For example, Ma and McCauley (2008) and Cappiello and Ferrucci (2008) find large and persistent differences between onshore yields of the renminbi and its offshore counterparts. Ma and McCauley (2008) argue that capital controls have allowed Chinese authorities to retain some monetary policy autonomy, finding persistent dollar to renminbi interest rate differentials and little co-movement between these series during the period of in which China maintained a peg. Similarly, Aizenman et al. (2008) finds that monetary policy in China is relatively independent of movements in foreign interest rates.

In the model outlined below, it is assumed that capital controls prevent Chinese households from accessing foreign assets. Rather the Chinese economy's holdings of foreign bonds will be determined through the government's sterilized interventions to maintain an exchange rate peg. This is in line with various measures that point to China's restrictions on capital flows being tight and the government's ability to influence the size of capital flows. Capital market restrictions also means that the government has independent monetary policy, despite the exchange rate being pegged, consistent with results from the empirical literature.

3   The Model

There are two countries, home and foreign, denoted by H and F respectively. The world economy is populated with a continuum of infinitely lived agents

of unit mass. The population in the segment [0, n) live in the home country
and those in the segment (n, 1] reside in the foreign country. Agents in each
country make consumption and investment decisions and own monopolistically
competitive firms. These firms produce differentiated products and are subject
to frictions in adjusting their prices.

The home country can be thought of as China, while the foreign country is
proxied by the US. Two models are set up. The first is a baseline specification
where the capital account in both countries is open and the exchange rate is
floating. This model provides a base with which to compare China's current
policies. The second model modifies the baseline specification to incorporate
sterilized interventions and capital controls in the home country in conjunction
with a pegged exchange rate. Total factor productivity processes in both coun-
tries are assumed to follow a unit root process, with the actual productivity
growth experienced by China and the US being fed into the model.

Since the two countries have similar equilibrium conditions, only the equilib-
rium conditions for the home country are outlined, unless the two differ.

3.1 Baseline specification: Open capital markets and a floating exchange rate

3.1.1 Goods aggregates

Households in the home country assemble and have access to a homogenous
good, Y, which can be used for consumption and investment. Y is a CES
aggregate of a domestically produced good Y_H and an imported good Y_F:

$$Y_t = [\omega^{\frac{1}{\theta}} Y_{H,t}^{\frac{\theta-1}{\theta}} + (1-\omega)^{\frac{1}{\theta}} Y_{F,t}^{\frac{\theta-1}{\theta}}]^{\frac{\theta}{\theta-1}}$$

where both the domestically produced and imported goods are themselves
made-up of a continuum of differentiated goods produced in the home and for-
eign country respectively, such that $Y_{H,t} = \left[(\frac{1}{n})^{\frac{1}{\sigma}} \int_0^n y(i)^{\frac{\sigma-1}{\sigma}} di\right]^{\frac{\sigma}{\sigma-1}}$ and $Y_{F,t} =$

$$\left[\left(\frac{1}{1-n} \right)^{\frac{1}{\sigma}} \int_n^1 y^*(i)^{\frac{\sigma-1}{\sigma}} di \right]^{\frac{\sigma}{\sigma-1}}.$$

The price of the homogenous good, P, is a weighted average of the price of the home good, P_H, and the foreign good, P_F, in the home country:

$$P_t = [\omega P_{Ht}^{1-\theta} + (1-\omega) P_{Ft}^{1-\theta}]^{\frac{1}{1-\theta}}$$

Demand for the domestically produced and imported good are given by:

$$Y_{H,t} = \omega \left(\frac{P_{H,t}}{P_t} \right)^{-\theta} Y_t, \quad Y_{F,t} = (1-\omega) \left(\frac{P_{F,t}}{P_t} \right)^{-\theta} Y_t \qquad (1)$$

3.1.2   Firms

Intermediate goods firms in the home country monopolistically produce a differentiated product, indexed by i. Global output of this good is given by $Y_H^W(i)$. Final goods producers then costlessly combine these goods into Y_H for consumption at home and Y_H^* for consumption abroad.

Intermediate good producers

Intermediate goods producers use capital, K, and labor, N, in production:

$$Y_{H,t}(i) = K_t(i)^\alpha (A_t N_t(i))^{1-\alpha} \qquad (2)$$

where A_t is a trend shock to productivity, such that $A_t = G_t A_{t-1}$ and $\log G$ refers to the trend of productivity. Trend shocks to productivity are used given the evidence presented in Gopinath and Aguiari (2007), that business cycles in emerging market economies are driven by these shocks.

Cost minimization implies that the firm's real marginal costs, MC, are:

$$MC_t = \frac{W_t}{(1-\alpha)A_t^{1-\alpha}} \left(\frac{N_t}{K_t} \right)^\alpha, \quad MC_t = \frac{R_{K,t}}{\alpha A_t^{1-\alpha}} \left(\frac{K_t}{N_t} \right)^{1-\alpha}$$

where W is real wages and R_K is the real rate of return on capital.

Intermediate goods producers in each country set prices differently. Producers in the home country engage in local currency pricing where firms set prices in the domestic currency for the domestic market while export prices are set in the foreign currency. Foreign intermediate goods producers use producer currency pricing, so that the price of the foreign good is set in terms of the foreign currency for both the home and foreign market. This is consistent with the evidence from Gopinath et al. (2010), who find that the vast majority of US exporters price their exports in US dollars, while virtually all developing country exporters, price their exports to the US in US dollars

Intermediate goods producers in the home country face Calvo frictions in adjusting their prices. It is assumed that when a firm can re-optimize its prices it can do so both in the domestic and foreign market. Each period a fraction ξ of home firms cannot change their prices, while the remaining $1 - \xi$ firms can optimally reset their prices at home, choosing $\tilde{P_{Hi}}$, and abroad, choosing $\tilde{P_{Hi}^*}$. The firms problem is to maximize its profits:

$$max_{\tilde{P_{Hi,t}}, \ \tilde{P_{Hi,t}^*}} \quad E_t \sum_{j=0}^{\infty} \xi^j v_{t+j} [n \tilde{P_{Hi,t}} Y_{H,t+j}(i) + (1-n) S_{t+j} \tilde{P_{Hi,t}^*} Y_{H,t+j}^*(i)$$
$$- P_{t+j} MC_{t+j} (n Y_{H,t+j}(i) + (1-n) Y_{H,t+j}^*(i))]$$

subject to demand for its good, which is given by $Y_{H,t}(i) + Y_{H,t}^*(i) = \left(\frac{P_{H,t}(i)}{P_{H,t}} \right)^{-\sigma} Y_{H,t} + \left(\frac{P_{H,t}^*(i)}{P_{H,t}^*} \right)^{-\sigma} Y_{H,t}^*$. $v_t = \frac{\beta}{P_t U_C(C_t, N_t)}$ is the household's stochastic discount factor. Aggregating over firms, the home country price of the home good is:

$$P_{H,t} = [(1-\xi)(\tilde{P_{H,t}})^{1-\sigma} + \xi(P_{H,t-1})^{1-\sigma}]^{\frac{1}{1-\sigma}} \tag{3}$$

Similarly, for the foreign price of the home good:

$$P_{H,t}^* = [(1-\xi)(\tilde{P_{H,t}^*})^{1-\sigma} + \xi(P_{H,t-1}^*)^{1-\sigma}]^{\frac{1}{1-\sigma}} \tag{4}$$

Intermediate goods producers in the foreign country use producer currency

pricing. This implies that the law of one price holds for foreign produced goods: $P_{F,t}(i) = S_t P^*_{F,t}(i)$, where $P^*_{F,t}(i)$ is the price of the foreign intermediate good in the foreign country. Firms face Calvo frictions in adjusting their prices. Each period a fraction $1 - \xi^*$ of foreign firms optimally reset their prices, choosing $\tilde{P}^*_{Fi}$. The foreign firm's problem is to maximize its profits:

$$max_{\tilde{P}^*_{Fi,t}} E_t \sum_{j=0}^{\infty} (\xi^*)^j v^*_{t+j} \left[\tilde{P}^*_{Fi,t} Y^{W*}_{F,t+j}(i) - P^*_{t+j} MC^*_{t+j} Y^{W*}_{F,t+j}(i) \right]$$

subject to demand for its good, which is given by:

$$Y^{W*}_{F,t}(i) \equiv nY_{F,t}(i) + (1-n)Y^*_{F,t}(i) = \left(\frac{P_{F,t}(i)^*}{P^*_{F,t}} \right)^{-\sigma} \left(\frac{n}{1-n} Y_{F,t} + Y^*_{F,t} \right)$$

where $v^*_t = \frac{\beta}{P^*_t U_C(C^*_t, N^*_t)}$ is the household's stochastic discount factor and Y^*_F refers to foreign consumption of the foreign good.

Aggregating over firms, the price of the foreign produced good is given by:

$$P^*_{F,t} = [(1 - \xi^*)(\tilde{P}^*_{F,t})^{1-\sigma} + \xi^*(P^*_{F,t-1})^{1-\sigma}]^{\frac{1}{1-\sigma}}$$

3.1.3   Households

Households obtain utility from consumption, C, and disutility from labor supply N. Household income can be spent on consumption, investment, I, and purchases of a domestic currency bond, B_H and a foreign currency bond B_F. It is assumed that the domestic currency bond is only available in the home country, while the foreign currency bond can be held by both home and foreign residents. Household income is derived from wages, rental income from capital, interest and profits from firms. The household's problem is to maximize:

$$E_t \sum_{j=0}^{\infty} B^{t+j} \frac{[C^\phi_{t+j}(1 - N_{t+j})^{1-\phi}]^{1-\rho}}{1 - \rho} \tag{5}$$

The household budget constraint and the law of motion for capital are:

$$P_tC_t+P_tI_t+B_{H,t}+S_tB_{F,t}+F_t = P_tW_tN_t+P_tR_{K,t}K_t+S_tR^*_{F,t-1}B_{F,t-1}+R_{H,t-1}B_{H,t-1}+D_t \tag{6}$$

$$K_{t+1} = (1-\delta)K_t + I_t - \frac{\Phi}{2}(\frac{I_t}{K_t} + 1 - \delta - \bar{G})^2K_t$$

where S is the nominal exchange rate, R^*_F is the interest rate on foreign bonds, R_H is the interest rate on domestic bonds and $\bar{G}$ refers to the steady state growth rate of productivity. F represents the costs of adjusting the home household's stock of real foreign bonds and is assumed to take the form $F_t = \frac{\chi}{2}(b_{F,t} - \bar{b_F})^2A_{t-1}P_t$, where $b_{F,t} \equiv \frac{S_tB_{F,t}}{A_{t-1}P_t}$ refers to real bond holdings. It is assumed that these costs are paid in a lump sum to foreign households.

Let λ represent the Lagrangian multiplier on the households' budget constraint. Since home country households have access to both a domestic and foreign currency bond, this implies a relationship between interest rates at home and abroad through expected movements in the nominal exchange rate (or in other words an uncovered interest parity relationship taking into account the costs of purchasing foreign bonds for the home country):

$$E_t\lambda_{t+1}R_{H,t} = E_t\frac{\lambda_{t+1}S_{t+1}R^*_{F,t}}{S_t(1 + \chi(b_{F,t} - \bar{b_F}))} \tag{7}$$

3.1.4 Market clearing

Goods market clearing in the home country implies that $C_t + I_t = Y_t$. Clearing in the bond market is given by $nB_{F,t} + (1 - n)B^*_{F,t} = 0$, where $B^*_{F,t}$ refers to foreign resident's holdings of foreign bonds.

The aggregate economy wide budget constraint is given by:

$$nP_{H,t}Y_{H,t} + (1-n)P^*_{H,t}Y^*_{H,t} - nP_t(C_t + I_t) - nF_t = n(S_tB_{F,t} - S_tR_{F,t-1}B_{F,t-1})$$

The model is closed by specifying a monetary policy rule for the home and foreign country.

3.2 Capital controls, sterilized interventions and a peg

Here I incorporate capital controls, sterilized interventions and a pegged exchange rate into the model outlined above. When the capital account is closed home households no longer have access to the foreign currency bond. This is designed to capture the fact that Chinese residents access to foreign assets is severely limited. Rather the home country government or central bank, which are considered one and the same, determines the economy's bond holdings. The government chooses foreign bond holdings to influence movements in the nominal exchange rate, consistent with the stated objectives of the People's Bank of China. It is assumed that the central bank follows a simple rule for real foreign bond holdings:

$$\frac{S_t B_{F,t}}{GDP_t} - \frac{\overline{SB_F}}{\overline{GDP}} = -v(\Delta S_t - \bar{\Delta S}) \tag{8}$$

where $\Delta S_t \equiv \frac{S_t}{S_{t-1}}$ and bars represent steady state values. This rule is designed to reduce fluctuations in the nominal exchange rate. For example, say that policymakers want to target movements in the nominal exchange rate away from an unchanged value, $\bar{\Delta S} = 1$. If a shock to the economy causes the exchange rate to appreciate then the term in the brackets on the right hand side of equation (8) will be negative, causing policymakers to increase their real bond purchases. By purchasing foreign currency bonds policymakers increase the supply of their currency and demand foreign currency. This puts pressure on the exchange rate to depreciate and hence helps to moderate the initial appreciation in the exchange rate. Since only policymakers trade foreign bonds these can be thought of as the government's foreign reserves in the model.

The government sterilizes its purchases of foreign bonds. The government does this through trading domestic currency bonds, B_H, with home households. It sterilizes its purchases (or sales) of foreign bonds through selling

(or purchasing) domestic currency bonds to (from) households. Sterilization implies an unchanged money supply. While there is no money in the model per se, money shows up as a liability on the central bank's balance sheet. A zero change in the money supply can be thought of as operations that leave the liabilities of the central bank unchanged. Consider the case in Table 1 where the central bank purchases foreign bonds, $S_t B_{F,t}$ in period t. The central bank's assets and liabilities increase by this amount. In period t, the central bank also receives interest on its purchases of foreign bonds in the previous period, $S_t(R^*_{F,t-1} - 1)B_{F,t-1}$ and pays interest to domestic households who purchased domestic bonds sold by the central bank in the previous period, $(R_{H,t-1} - 1)B_{H,t-1}$. Central bank profits, $Z_t = S_t(R^*_{F,t-1} - 1)B_{F,t-1} - (R_{H,t-1} - 1)B_{H,t-1}$, which depend on the interest rate difference between home and foreign bonds, are remitted to households in a lump sum fashion at the end of each period. Let the central bank sell $B_{H,t}$ this period, so as to keep its liabilities unchanged. Then taking into account the fact that it also has to pay a fee F_t to purchase foreign bonds, sterilization implies:

$$B^H_t = S_t B^F_t + F_t - S_t R^{F*}_{t-1} B^F_{t-1} + R_{H,t-1} B^H_{t-1} + Z_t \qquad (9)$$

Table 1: **Central bank balance sheet**

Assets	Liabilities	Equity
$S_t B_{F,t}$	$S_t B_{F,t}$	
$-S_t B_{F,t-1}$	$-S_t R^*_{F,t-1} B_{F,t-1}$	$S_t(R^*_{F,t-1} - 1)B_{F,t-1}$
$B_{H,t-1}$	$R_{H,t-1} B_{H,t-1}$	$-(R_{H,t-1} - 1)B_{H,t-1}$
$-B_{H,t}$	$-B_{H,t}$	

Notes: The equity or profits of the central bank are remitted back to households at the end of each period. Then liabilities at the end of period t are given by: $SB_{F,t} - S_t R^*_{F,t-1} B_{F,t-1} + R_{H,t-1} B_{H,t-1} + Z_t - B_{H,t}$, to which we add the foreign bond fee.

Household hold this $B_{H,t}$ which is determined by the central banks purchases of foreign bonds in a given period, but can no longer hold the foreign bond owing to capital controls. The interest rate on this domestic bond is determined by

policymakers. The household's budget constraint is now given by:

$$P_t C_t + P_t I_t + B_{H,t} = P_t W_t N_t + P_t R_{K,t} K_t + R_{H,t-1} B_{H,t-1} + D_t + Z_t \quad (10)$$

Since households can only trade domestic currency bonds, the uncovered interest parity relationship (equation (7)) no longer holds. Hence capital controls introduce a wedge between foreign and domestic interest rates.

Combining the central bank and household budget constraint (equations (9) and (10)) leads to an economy wide budget constraint:

$$P_t C_t + P_t I_t + S_t B_{F,t} + F_t = P_t W_t N_t + P_t R_{K,t} K_t + S_t R^*_{F,t-1} B_{F,t-1} + D_t \quad (11)$$

The remainder of the model is unchanged from that outlined above.

Capital controls mean that home households no longer hold foreign bonds. The bond holdings rule in equation (8) is meant to capture the idea that it is policymakers that have access to foreign assets and that they trade these assets in order to influence the exchange rate. This in turn allows policymakers to influence household savings. To see this, rewrite equation (11), substituting out profits and ignoring the cost of trading foreign bonds for simplicity:

$$B_{F,t} - R^*_{F,t-1} B_{F,t-1} = \frac{1}{nS_t} \left(n P_{H,t} Y_{H,t} + (1-n) S_t P^*_{H,t} Y^*_{H,t} - P_t(C_t + I_t) \right) \quad (12)$$

The term in brackets on the right hand side of equation (12) represents the trade balance for the home country, which is by identity equal to savings less investment. By simple accounting, if policymakers determine a nation's holdings of foreign bonds (the left hand side of equation (12)), this is also equivalent to policymakers determining a nation's trade balance. Hence poli-

cymakers can influence production, consumption and investment, or in other words the amount of savings undertaken in an economy.

4 Data and Calibration

The increase in China's current account surplus and foreign exchange reserves took place during a period of rapid total factor productivity growth. I want to see if the Chinese government's macroeconomic policies of an exchange rate peg, sterilized interventions and capital controls contributed to the run up in China's current account balance in the presence of the strong productivity growth that the nation experienced.

4.1 Total factor productivity process

The model is made stationary by dividing real variables by lagged total factor productivity.[5] Home variables are normalized by home productivity and foreign variables by foreign productivity.

I follow the approach of Hayashi and Prescott (2002), Imrohoroglu et al. (2006) and Kehoe and Prescott (2002) and solve the model deterministically using the actual (and forecast) path of total factor productivity growth for China and the US.[6] In other words I assume that agents are aware of the future path of productivity. In later sensitivity analysis I look at an alternative way to generate expectations for US and Chinese total factor productivity. I find that this does not qualitatively change the results.

Data on total factor productivity in China is taken from Tian and Yu (2012) who conduct a meta-analysis using around 150 studies of Chinese total factor productivity growth. 1996 is chosen as a starting point for the analysis as

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[5]Variables are also normalized by the price level, with home country prices normalized by the home CPI and foreign prices normalized by foreign CPI.

[6]Hayashi and Prescott (2002) and Imrohoroglu et al. (2006) look at the savings rate in Japan. Kehoe and Prescott (2002) study the Finnish Depression.

total factor productivity growth (not the level) in China around this period was similar to that in the US. In addition, it also represents a period after which Chinese authorities first pegged their exchange rate but before growth in China accelerated. The estimates from Tian and Yu (2012) suggest that total factor productivity growth in China in the second half of the 1990s was similar to that in the US. Productivity growth picked up in the early 2000s and accelerated to average around 5 percent per year in the late 2000s (Figure 2). The estimates from Tian and Yu (2012) stop in 2009. After this period I assume that total factor productivity grows at 3 percent per year for the next twenty years. This is consistent with the average productivity growth experienced by Japan post WWII before productivity growth in Japan stabilized. After this period productivity growth moves to the average rate of productivity growth experienced by the US and remains there thereafter. The assumption that Chinese productivity grows at the same rate as that in the US in the long run follows the argument in Kehoe and Prescott (2002) that long run productivity growth in any nation can be proxied by the average productivity growth of the nation that is the industrial leader, or in other words the US. The amount of time that it takes for productivity growth in China to reach that of the US is roughly equal the amount of time it took for Japanese total factor productivity to stabilize and reach a level similar to that in the US. After this point the level of productivity in China is the same as that in the US.

Data for US total factor productivity is sourced from the BLS. Post 2012, it is assumed that US productivity grows at an annual rate of 1.2 percent, which was the average rate of productivity growth in the US since 1950 (Figure 2).[7]

The model is solved starting from a position where foreign bond holdings in the home country account for 15 per cent of GDP; the share of foreign reserves to GDP in China in 1996.

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[7]One concern with using actual US total factor productivity data is that productivity growth in the US slowed during the financial crisis of 2008. This will affect my estimates of China's current account. However in later sensitivity analysis I show that you can still generate an increase in China's current account when US productivity growth is constant at 1.2 percent per year and Chinese productivity follows the process outlined above.

4.2 Calibration

The model is calibrated at an annual frequency, as most Chinese statistics are reported on an annual basis. Where possible estimates for the home country's parameters are sourced from studies of the Chinese economy.

The share of the population in the home country is set at 0.15, in line with the average of China and US GDP shares over the period studied. For the utility function, ϕ is set at 0.34 following Rabanal et al. (2011). ρ is set equal to 1. β is set at 0.9879, implying a steady state annual interest rate of 5 percent. Values are the same for the foreign country. The share of domestically produced goods making up the home homogenous good, ω, is set equal to 0.7, while this share in the foreign country, ω^*, is set equal to 0.15, consistent with the share of imports in Chinese and US GDP. The elasticity of demand for domestic intermediate goods, σ, is set at 6. The elasticity of substitution between home and foreign goods, θ, is set at 4. Similarly for the foreign country.

For firms, the evidence points to capital's share of production, α, tending to be relatively high in China. α is set equal to 0.6, in line with Mehrotra et al. (2011) and consistent with the range of estimates contained in Bai et al. (2006) and Hu and Khan (1997). Capital's share in the foreign country, α^* is set at 0.3 in line with capital's share in the US. Capital depreciation tends to be higher in China than the US. For the foreign country capital depreciation, δ^* is set at an annual rate of 0.05. The rate of depreciation in the home country is set at 0.24. This produces a rate of return on capital within the range of estimates found by Bai et al. (2006). This high rate of depreciation is broadly consistent with that used by Mehrotra et al. (2011). A small level of capital adjustment costs are assumed for the foreign country with $\Phi^* = 10$. Given evidence that adjustment costs are higher in China (see Mehrotra et al. (2011)), the parameter for the home country is set at 30. For the pricing parameters, it is assumed that $\xi^* = 0.32$, which is consistent with a quarterly parameter value of 0.75. ξ is set equal to 0.5, consistent with the quarterly value of 0.85 in Mehrotra et al. (2011).

The level of total factor productivity in China in 1996 is set to be 55 percent

of that in the US. This is in line with estimates from Hsieh and Klenow (2009) of how much Chinese total factor productivity would improve by if factor misallocations in China were reduced to that observed in the US. It is assumed in the long run, that Chinese total factor productivity reaches that of the US. Steady state inflation is assumed to equal 2.5 percent in both countries, consistent with what was observed in the US since the mid 1990s.

Monetary policy in both countries follow a Taylor rule.[8] Interest rates are assumed to be persistent in both countries, with the AR(1) coefficient on interest rates being set equal to 0.73, consistent with a quarterly coefficient of 0.9[9]. For the US, this is consistent with estimates in Clarida et al. (1998). For China, Zhang (2009) finds that reserve requirement ratio, a measure of the tightness of monetary policy in China, tends to be persistent through time. For the home country, the coefficient on inflation is set equal to 1.35 following estimates in Mehrotra et al. (2011) and Zhang (2009). The same coefficient for the foreign country is set at 1.5. The coefficient on the gap between actual and long-run productivity - a measurement of the output gap - is set at 0.15 in both countries.

In the model with capital controls, the parameter which determines the responsiveness of bond holdings to movements in the exchange rate, v, is estimated by ordinary least squares using observed movements in the nominal exchange rate and the reserves to GDP ratio. I find $v = 3.7$, with a standard error of 1.2. Note, this regression averages over the fixed exchange rate regime and the regime where Chinese authorities allowed modest daily movements in the currency. This was done for simplicity and is easier to model than the alternative of having the exchange rate regime change during the sample period.

Note that aim of this paper is to explain the current account balance in China from the mid 1990s to the late 2000s. Parameter values are likely to have remained relatively stable over this period. However as China continues to

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[8]In later sensitivity analysis I show that using a money supply rule instead of an interest rate rule has little effect on the models results.

[9]This corresponds to a quarterly AR(1) coefficient on the interest rate of 0.9, with $0.9^3 = 0.729$.

industrialize it is likely that some of these parameter values will change. For example, depreciation may decrease as the quality of China's capital stock improves. I address this issue in later sensitivity analysis by looking at what occurs with different parameter values and find that the results are qualitatively unaffected.

5 Results

I find that if China had a floating exchange rate and open capital account that it would have run a noticeable current account deficit - of around 8 per cent of GDP - in response to the sustained total factor productivity growth that the nation experienced (Figure 3). China runs a trade deficit and borrows from the rest of the world.

I find that imposing capital controls and an exchange rate peg has a noticeable effect on China's current account position. The current account now moves to surplus, owing to an increase in the trade balance and lending by China to the rest of the world.[10] The model can qualitatively match the run up observed in China's current account surplus post 2004. Quantitatively, I find that around half of the movement in China's current account can be explained by its capital control and exchange rate policies.[11] Thus the model suggests more modest movements in the current account compared with that observed in the data. The model suggests a peak in the current account of around 2 per cent of GDP, compared with the 10 percent peak in the data. Similarly, the model suggests foreign reserves accounted for around 15 percent of GDP, compared with reaching 50 percent in the data. Reasons for these differences are discussed in Section 5.2.

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[10]Using the real exchange rate, instead of the nominal exchange rate, in the bond holdings rule (equation (8)) produces a similar result.

[11]In the absence of these policies, the model predicts that China runs a current account deficit of 8 percent of GDP. With these policies, China runs a current account surplus of 2 percent of GDP. The actual current account surplus peaked at 10 percent of GDP, suggesting that the model can explain about half of the peak in the current account.

Nevertheless, the results demonstrate how the Chinese government's exchange rate and capital account policies can have significant effects on national savings; with China going from being an international borrower to an international lender in the presence of these policies.

5.1 Explaining movements in the current account

To understand why China moves from being an international borrower to an international lender, it is useful to consider impulse responses with and without capital controls and an exchange rate peg (Figure 4).

Starting with the case of a flexible exchange rate, agents in the home country are aware that productivity will increase in the future. To smooth consumption they start borrowing against future increases in their income. Increased borrowing leads to an initial appreciation of the nominal exchange rate and a longer appreciation of the real exchange rate. Home country production rises owing to an increase in productivity and also because of an increase in domestic demand. Both consumption and investment rise as a result of an increase in household income owing to foreign borrowings. Increased domestic demand also translates into a higher demand for imports from abroad, with the appreciation of the exchange rate making imports cheaper. Home country exports fall as stronger growth in the home country compared with the foreign country causes home firms to direct production towards internal consumption and investment. Increased imports and fewer exports leads the home country to run a trade deficit. This combined with international borrowing leads to a noticeable current account deficit in the home country.

The positive technology shock in the home country has the opposite effect in the foreign country. Greater consumption and investment at home corresponds to lower consumption and investment abroad. Foreign households start lending to home country households as home households demand more goods in response to the productivity shock.

These results are consistent with what is implied by growth theory: that

a developing country that starts with off with a lower level of total factor productivity but expects future productivity growth should borrow from the rest of the world and in doing so run a current account deficit. Foreign capital should flow into this country as investors chase the higher rates of return that result from productivity growth. This result is also broadly consistent with the empirical literature which uses panel data to study the determination of current account balances across countries. For example, Chinn and Ito (2007) and CaZorzi et al. (2012) suggest a lower current account balance for China than observed in the data.

With capital controls and an exchange rate peg, the government trades foreign bonds to reduce movements in the nominal exchange rate. In the absence of these policies, the nominal exchange rate appreciates in the home country. In the presence of an exchange rate peg, policymakers in the home country aim to prevent this appreciation. This requires policymakers to purchase foreign currency bonds.[12] By purchasing foreign currency bonds policymakers increase the supply of home currency, causing a relative depreciation of the nominal exchange rate. This also translates into a depreciated real exchange rate. The results suggest the real exchange rate under the peg is initially around 1 per cent more depreciated compared with the floating exchange rate case. While the empirical literature suggests a wide range of estimates of the extent of renminbi devaluation, this estimate is similar to that obtained from empirical studies that have focused on the effects of cross-country productivity differentials on the real exchange rate (see Cheung et al. (2010) for a review).

As noted before, by choosing the level of foreign bond holdings, policymakers can influence the level of savings in an economy. With the exchange rate peg in place, policymakers induce home households to go from being borrowers to savers, with the average interest rate in the home country being higher on average than that under a floating exchange rate.[13] Greater bond holdings

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[12]Note the impulse responses are drawn as deviations from the model's initial steady state. In this steady state, foreign bonds account for 15 percent of GDP. While the impulse response for foreign bonds does dip slightly below its steady state value under sterilized interventions, it does not do so by enough to imply borrowing by Chinese authorities.

[13]The fact that the home country interest rate is initially higher under the floating ex-

reduce domestic demand in the home country relative to the floating exchange rate case, with consumption and investment being on average, 5 and 1 percent lower respectively. The depreciation of the real exchange rate reduces the international purchasing power of households lowering demand for imports. Exports, however are higher owing to increased demand from abroad. Since home country exporters price their goods in terms of the foreign currency, exporters are able to lower the price of their goods in terms of the foreign currency, to stimulate demand, but still earn higher revenues in terms of the home currency. Increased savings through international lending and a higher trade balance leads the home country to now run a current account surplus.

An increase in saving in the home country leads to a decrease in savings in the foreign country. Household borrowings increase foreign income in the near term leading to an increase in foreign consumption and investment. Higher domestic demand is met by an increase in domestic production and an increase in imports. Import purchases are also encouraged by the fact that the price of the imported goods falls in foreign currency terms.

5.2   The model and the data

The model can fit some stylized facts about China's exchange rate and capital account policies. The model suggests that these policies temper domestic demand in China by increasing savings while encouraging exports. Conversely, domestic demand overseas increases through cheaper imports and international borrowing. The model shows how these policies contribute to China running a current account surplus instead of a deficit.

As noted earlier, the model underestimates the extent to which reserves increased. The reason for the more muted change in reserves has to do with the exchange rate. The left hand side of Table 2 shows the exchange rate movements suggested by the model and that in the data. During the earlier

change rate reflects stronger inflation under this scenario. Since domestic demand is higher under the floating exchange rate, so is inflation.

Table 2: **Exchange Rate Changes & Return Differences**

	Average annual percentage change in the exchange rate				Interest rate wedge	
	Nominal		Real		% pt difference	
	Data	Model	Data	Model	Data	Model
1996-2003	-0.11	0.11	1.03	-0.02	0.78	0.01
2004-2012	-2.93	0.21	-3.53	0.15	1.46	1.92

Notes: The left hand side of the table shows average annual moments in the exchange rate. The right handside shows the average annual wedge between home and foreign interest rates, where this wedge is defined as $w_t = R_{H,t} - E_t \Delta S_{t+1} R_{F,t}$.

period in the sample, 1996 to 2003, the model and the data both suggest small movements in the nominal exchange rate. In the latter part of the sample, 2004 to 2012, exchange rate movements in the data and the model diverge. While the model suggests a modest depreciation in the exchange rate, the data shows an appreciation of the exchange rate. In the model with an exchange rate peg, the government's rule for foreign bond holdings has a negative relationship between reserves and movements in the exchange rate. This negative relationship is designed to reduce exchange rate volatility. The model suggests a depreciation of the nominal exchange rate. The strong positive growth in productivity projected into the future causes home country households to increase imports. Although, exchange rate and capital control policies lead to fewer imports and more exports compared with the case where these policies are absent, the model still predicts a negative trade balance prior to 2006. Consistent with a negative trade balance, the exchange rate depreciates. This is why the model cannot generate an upward path for reserves. In order for reserves to increase, the nominal exchange rate would need to appreciate, with foreign bonds being bought to slow down this rate of appreciation.

The more modest accumulation of foreign reserves in the model, corresponds to a smaller current account surplus in the model compared with the data. Movements in the current account in the model are driven by changes in productivity. To the extent that there are other economic shocks hitting the economy, the model will miss some of the variation that is present in the data.

The presence of capital controls has implications for differences in rates of return between the home and foreign country. Capital controls lead to a wedge opening up between domestic and foreign interest rate returns. In other words uncovered interest parity no longer holds. This wedge, w, is defined in the model as the difference between the return on a home bond and the return on a foreign bond taking into account movements in the exchange rate. From equation (7) and ignoring the costs of trading foreign bonds, it is given by:

$$w_t = R_{H,t} - E_t \Delta S_{t+1} R_{F,t} \tag{13}$$

This wedge can also be estimated on the data. The difficulty in doing this is that interest rates in China do not necessarily reflect market rates, given the high degree of government intervention in the financial sector. Following Jeanne (2012) I make the assumption that investors would like to invest in the asset with the highest interest rate, which corresponds to lending in the interbank market. Specifically I use the interest rate on loans of less than 20 days in the Chinese interbank market. I use the US Federal Funds rate for the foreign country. The right hand side of Table 2 shows this wedge in the model with capital controls and in the data. I find that this wedge is positive in the model on average and that it has increased over time. This result is not surprising, given that to induce home households to save the home interest rate must rise. The wedge in the data will likely reflect a number of factors in addition to productivity differentials. However the data also implies that this wedge that is positive on average and that it has increased over time. The higher return on Chinese assets in both the data and the model with sterilized interventions suggests that foreign capital wants to flow into China, consistent with results from the model with an open capital account.

6   Sensitivity Analysis

Here I look at how the model's results change under different parameter values, monetary policy rules and total factor productivity assumptions. Overall I find

that none of these changes substantially affect the results outlined above.

6.1   Monetary policy rule and parameters

As is typical in the literature, I closed the above model with a Taylor rule. However, there has been debate as to what is an appropriate monetary policy rule for China (see for example Burdekin and Siklos (2008), Wang and Handa (2007) and Zhang (2009)). As a robustness check of the Taylor rule I now incorporate money into the model. The model is closed with a money supply rule, consistent with the fact that Chinese authorities target money supply growth. I amend the model as follows. Money balances are incorporated into utility: $E_t \sum_{j=0}^{\infty} B^{t+j} \frac{[C_{t+j}^{\phi}(1-N_{t+j})^{1-\phi}]^{1-\rho}}{1-\rho} + \frac{1}{1-v}\left(\frac{M_t}{P_t}\right)^{1-v}$ and the household budget constraint becomes: $P_t C_t + P_t I_t + B_{H,t} + S_t B_{F,t} + M_t + F_t = P_t W_t N_t + P_t R_{K,t} K_t + S_t R_{F,t-1}^* B_{F,t-1} + R_{H,t-1} B_{H,t-1} + M_{t-1} + D_t$. Note the utility function takes this form in order to enable the model to be normalized around a balanced growth path and to ensure the neutrality of money. Monetary policy in the home country now follows a money supply rule: $M_t = g_{M,t} M_{t-1}$, where $g_{M,t}$ is money supply growth.[14] I assume that money supply growth follows the rule: $g_{M,t} = \overline{\pi}\overline{G} + 0.7 g_{M,t-1} - log(\frac{\pi_t}{\pi}) - 0.5 log(\frac{G_t}{G})$. At steady state money supply growth is equal to the combined rate of steady state inflation and productivity growth. Away from steady state, money supply growth responds to changes in lagged money supply growth, inflation and the output gap which is proxied for by the gap between actual and long run productivity. Parameter values are taken from Zhang (2009), who estimates money supply rules for China.[15] Foreign monetary policy is unchanged.

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[14]Note that for simplicity I assume that central bank interventions do not lead to changes in the money supply. Money supply growth can be changed via the central's bank money supply rule but not through foreign exchange interventions. This is consistent with evidence presented in Lavigne (2008) that the majority of foreign exchange interventions are sterilized.

[15]Note that since the mid 2000s the People's Bank of China has also actively used the reserve requirement ratio faced by banks as a monetary policy tool (Chen et al., 2012). Having a reserve requirement ratio in the model would involve the complication of introducing a financial sector. However given that changes in the reserve requirement ratio leads to changes in the amount that banks can lend and hence to changes in the money supply, we can think of the money supply rule in the model as being a rough proxy for this effect.

As noted in Section 4.2, it is likely that some of the parameters describing the Chinese economy will change as China industrializes.[16] As a way of addressing this concern I look at what would occur when the parameters in the home country take on the same values as those in the foreign country. Given that the parameter values for the foreign country are reflective of an advanced nation that has industrialized, these values are likely to be more stable than those for the home country. It also provides a proxy for where the parameter values of home country could stabilize.

The effect on the current account from changes to monetary policy and the model's parameters are shown in Figure 5. Four scenarios are shown: (i) a money supply rule for the home country with the home country described by China specific parameters, (ii) a money supply rule with US parameter values for both countries, (iii) an interest rate rule for both countries and Chinese parameters for the home country and (iv) an interest rate rule and US parameter values for both countries.

I find that these changes do not qualitatively affect the results. I do find that if the Chinese economy is described by the same parameter values as the US economy that it would have run a larger current account deficit in the presence of a floating exchange rate and open capital account (regardless of the monetary policy rule adopted). This larger current account deficit owes to a larger appreciation of the home country exchange rate which discourages Chinese exports. The imposition of capital controls and an exchange rate peg leads to China running a current account surplus, with the surplus being larger under a money supply rule.

6.2   Total factor productivity

The main results showed what occurs when actual Chinese and US total factor productivity was fed into the model. Following the literature I made the

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[16]Ideally, one would allow the parameters to vary in the model. However allowing for time-varying parameters is not straight forward and would require forecasts of how a range of parameters vary over time.

assumption that agents in both countries are aware of the future path of productivity. Here I look at an alternative scenario. I instead assume that agents are aware of the starting level of productivity in both nations and of the relationship governing productivity growth across countries. In particular, agents in the foreign country believe that productivity will grow at 1.2 per cent annually, the average rate of total factor productivity growth observed in the US. Following the growth literature (see for example Cameron (2005) and Sala-i Martin (1996)), I assume that productivity growth in the home country is given by:

$$\Delta logA_t \quad = \quad \phi_0 + \phi_1(logA_{t-1} - logA_{t-1}^*) + \epsilon_t \tag{14}$$

I set $\phi_0 = 0.012$, following the arguments in Kehoe and Prescott (2002), to ensure that in the long run productivity growth is the same in the home and foreign country. This restriction cannot be rejected by the data. The coefficient ϕ_1 describes the rate at which productivity growth in the home country moves to reduce productivity differentials. In order to calibrate this parameter I estimate equation (14) using Japanese and US total factor productivity data.[17] Japanese instead of Chinese productivity data is used because it is available for a longer time frame and because a period of industrialization and convergence of total factor productivity to that in the US is observed in the Japanese data. Japan also adopted similar policies to China during its industrialization. I find that $\phi_1 = -0.09$ (with a standard error of 0.02).

The bottom of Figure 6 shows the path of home country productivity growth when agents are aware that total factor productivity in the home country is initially 55 per cent of that in the foreign country and then know that future productivity growth will be given by equation (14). This suggests an earlier peak in productivity growth, with this peak being a little lower than that from Tian and Yu (2012). The top two panels of Figure 6 show the current account balance as a share of GDP for this path of productivity growth. By way of comparison what occurs when home country productivity follows the

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[17]Japanese data is taken from Hayashi and Prescott (2002) and the EU KLEMS database.

estimates in Tian and Yu (2012) while foreign country productivity grows at 1.2 per cent annually is also shown.

As before I find that in the absence of capital controls and an exchange rate peg, that China would have run a current account deficit. With capital controls and an exchange rate peg, the current account moves to surplus. The difference in the timing of the peaks and troughs in the current account to GDP ratio reflects the fact that productivity growth following equation (14) peaks earlier than that suggested by estimates in Tian and Yu (2012).

7 Conclusion

China has run a large current account surplus, both in absolute terms and given that it is a developing nation that has been rapidly industrializing. The purpose of this paper was to see how the Chinese government's macroeconomic policies of capital controls and sterilized interventions to maintain an exchange rate peg affected the current account. The existing literature has emphasized the role of private agents in determining savings in China. In contrast to this literature, in this paper I emphasize how the government's macroeconomic policies can influence savings. I find that the Chinese government's macroeconomic policies have had a noticeable effect on the current account. China goes from running a current account deficit in the absence of these policies to running a current account surplus with these policies. Overall I find that the Chinese government's macroeconomic policies can explain around half of the movement in China's current account.

I find that in the absence of these policies - when the exchange rate is floating and the capital account is open - that China would have run a sizable current deficit of around 8 percent of GDP. This is because if households expect strong productivity growth into the future, they will start borrowing from the rest of the world to smooth their consumption. International borrowing causes the exchange rate to appreciate. This result is consistent with standard growth

theory, which predicts that a developing country that experiences strong productivity growth should run a current account deficit.

Under China's current macroeconomic policies, the economy's holdings of foreign bonds is determined by the government's sterilized interventions to maintain an exchange rate peg. Capital controls prevent private agents from undoing the governments interventions. I find that these policies cause China to run a current account surplus. Here in order to prevent an appreciation of the currency, policymakers start purchasing foreign currency bonds putting pressure on the currency to depreciate. Since households are now required to hold these bonds, savings increase. Further a depreciation of the currency dampens imports and hence consumption and investment.

The model can fit some stylized facts about China's macroeconomic policies. It suggests that these policies dampened domestic demand in China while stimulating exports. Conversely cheaper Chinese exports stimulated demand in countries outside of China. However, the model does suggest a more modest increase in foreign reserves than observed in the data. Lower exchange rate volatility in the model compared with the data, means that policymakers in the model do not have to purchase as many foreign currency bonds to stabilize the exchange rate.

Although previous theories of why savings are high in China are all likely to have played a role in explaining China's current account, one contribution that this paper makes is to show that any explanation of China's current account surplus should also take into account the government's macroeconomic policies. One avenue for future research would be look at incorporating all these theories - demographics, financial market frictions, the social security system and macroeconomic policies - into a single model to assess the relative contribution of each of these factors.

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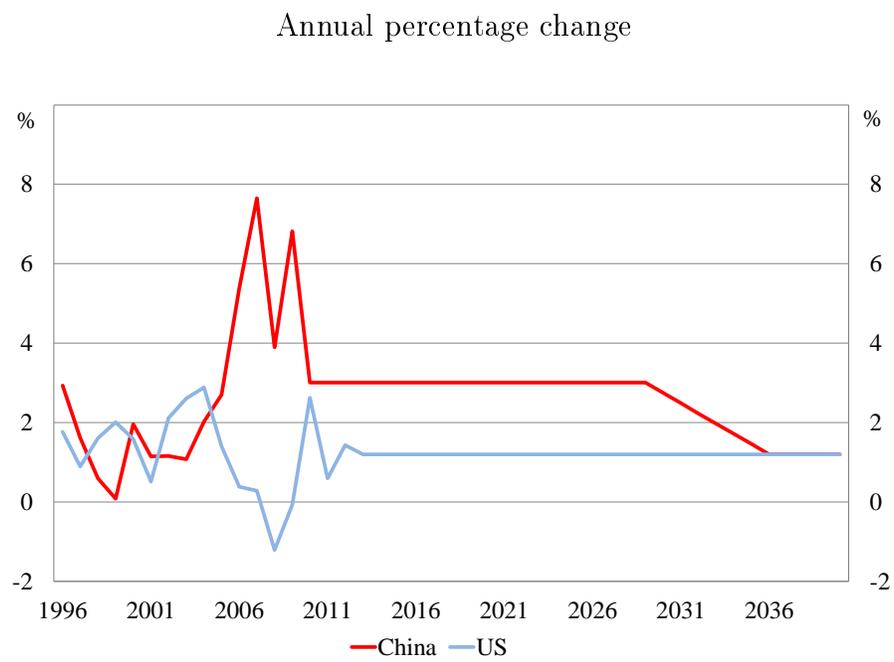
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Figure 1: The Composition of China's Foreign Assets and Liabilities

Foreign Assets

Foreign Liabilities
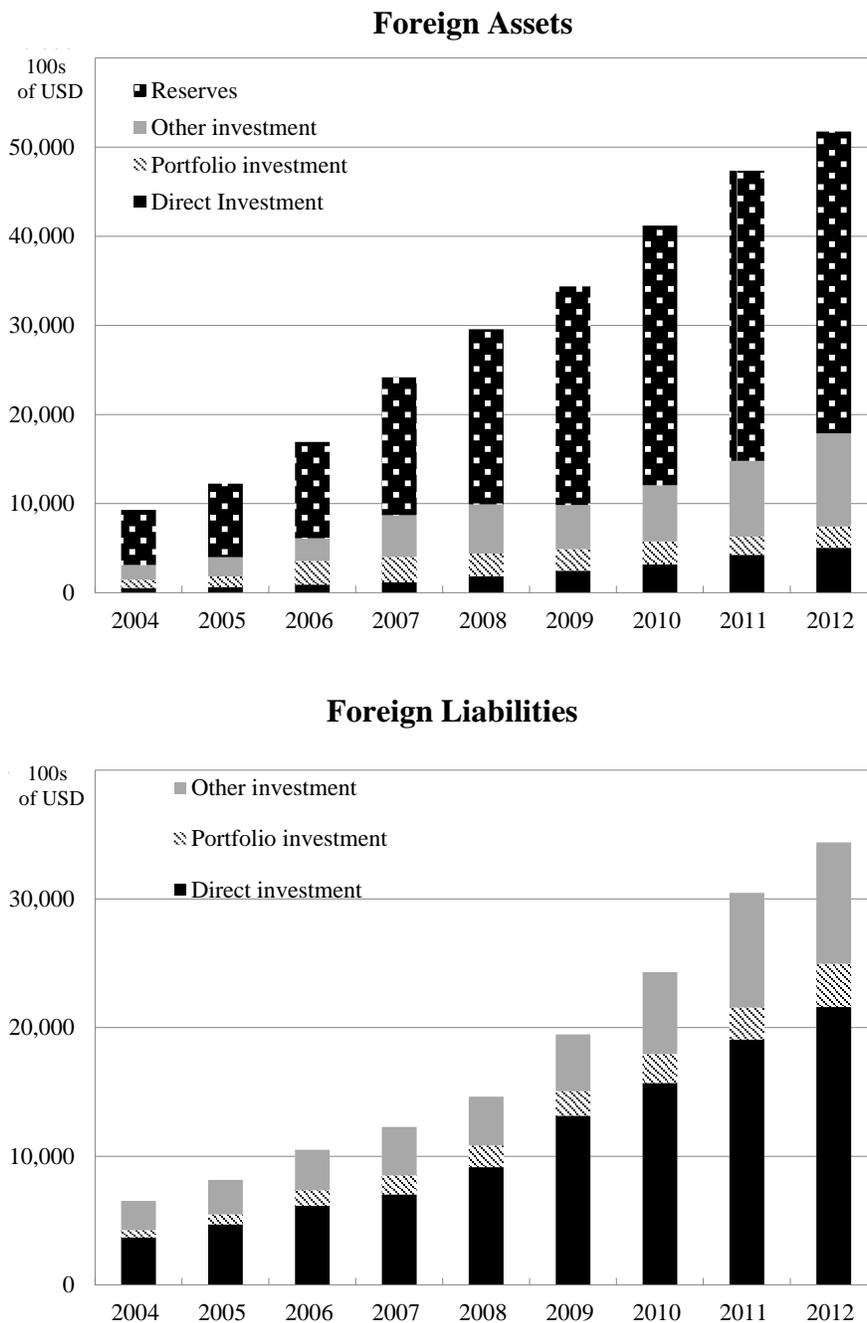
Source: State Administration of Foreign Exchange

Figure 2: Total Factor Productivity Growth for the US and China

Annual percentage change

Source: Tian and Yu (2012) and author's computations.

Figure 3: Model and Data

The current account and trade balance as a share of GDP

Acutal Current Account Balance

Acutal Trade Balance

Current Account Balance: Capital Controls and Peg

Trade Balance: Capital Controls and Peg

Current Account Balance: Floating Exchange Rate

Trade Balance: Floating Exchange Rate
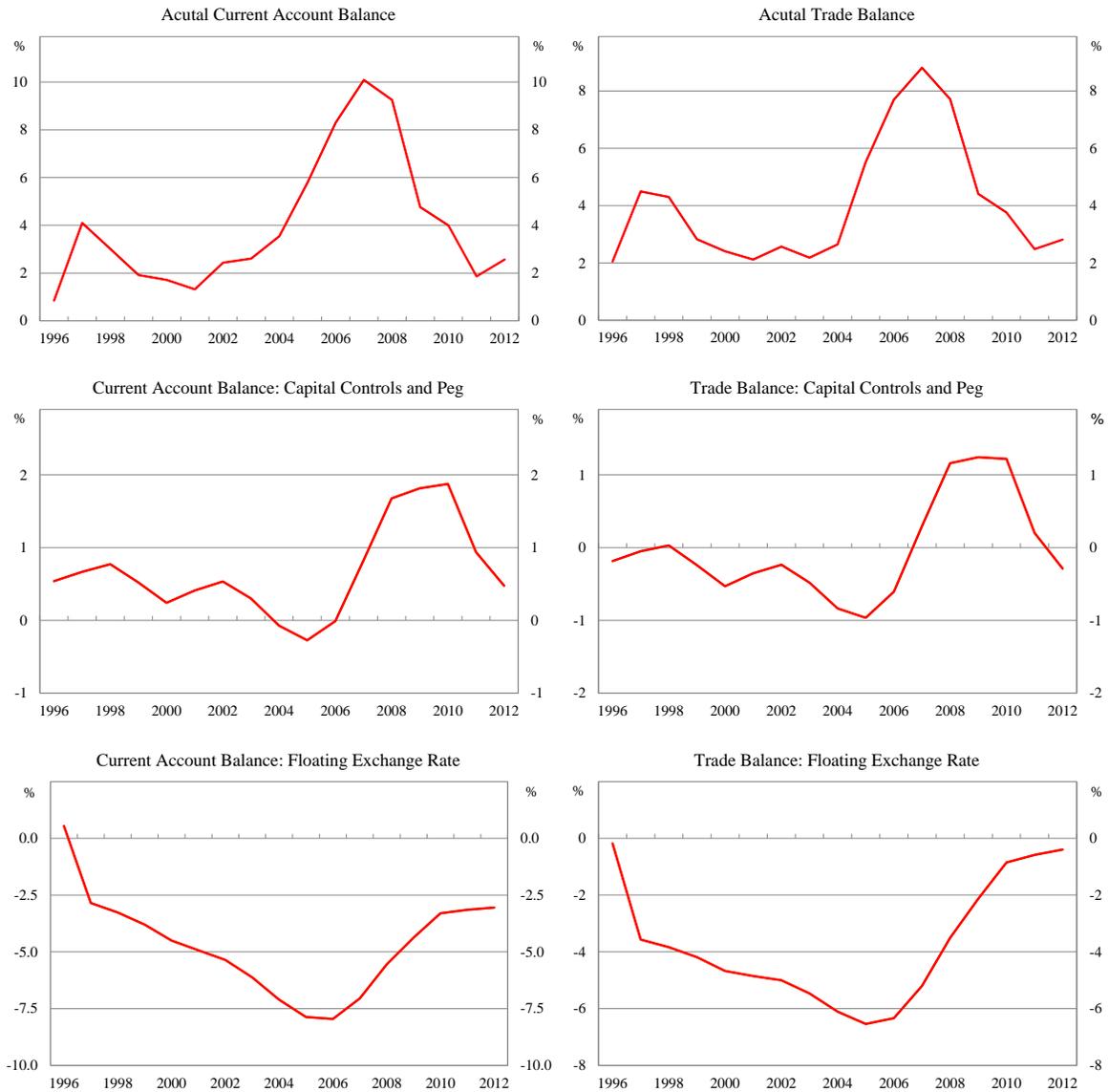
Notes: The middle row shows the current account and trade balance as a share of GDP under sterilized interventions, capital controls and an exchange rate peg. The bottom row shows the current account and trade balance under a floating exchange rate and open capital account.

Figure 4: Impulse Responses: Anticipated technology shock
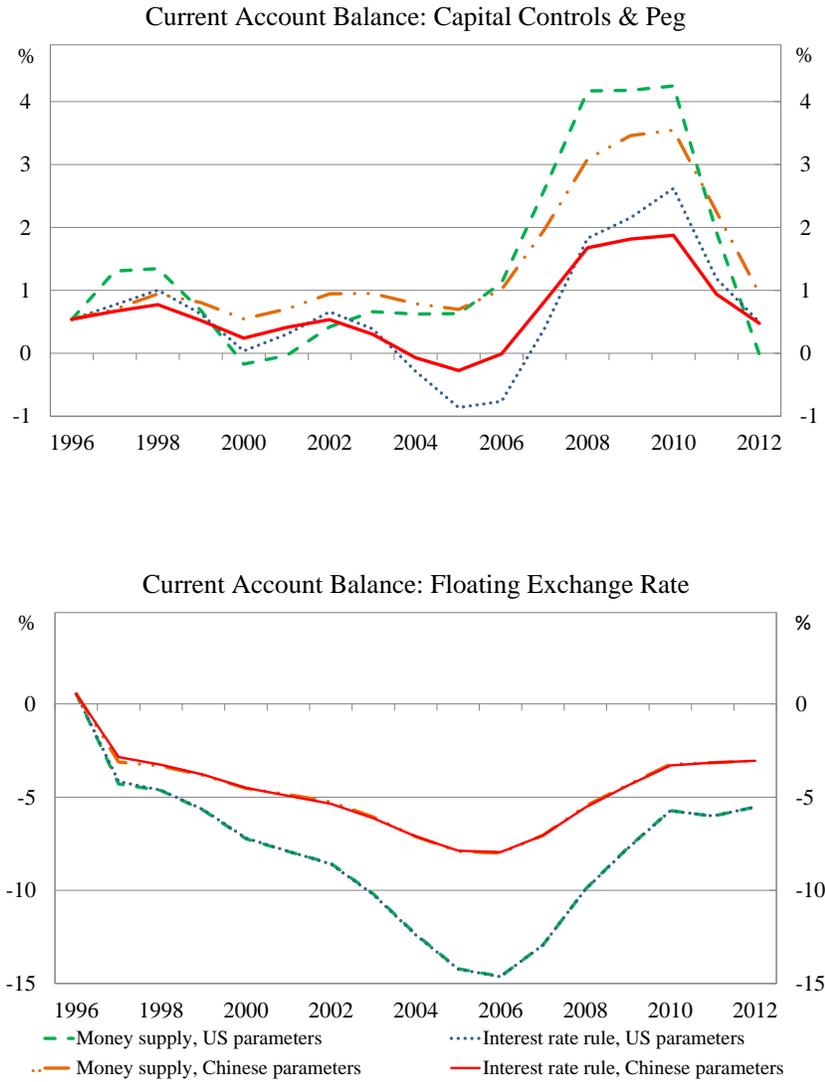
Deviations from initial position
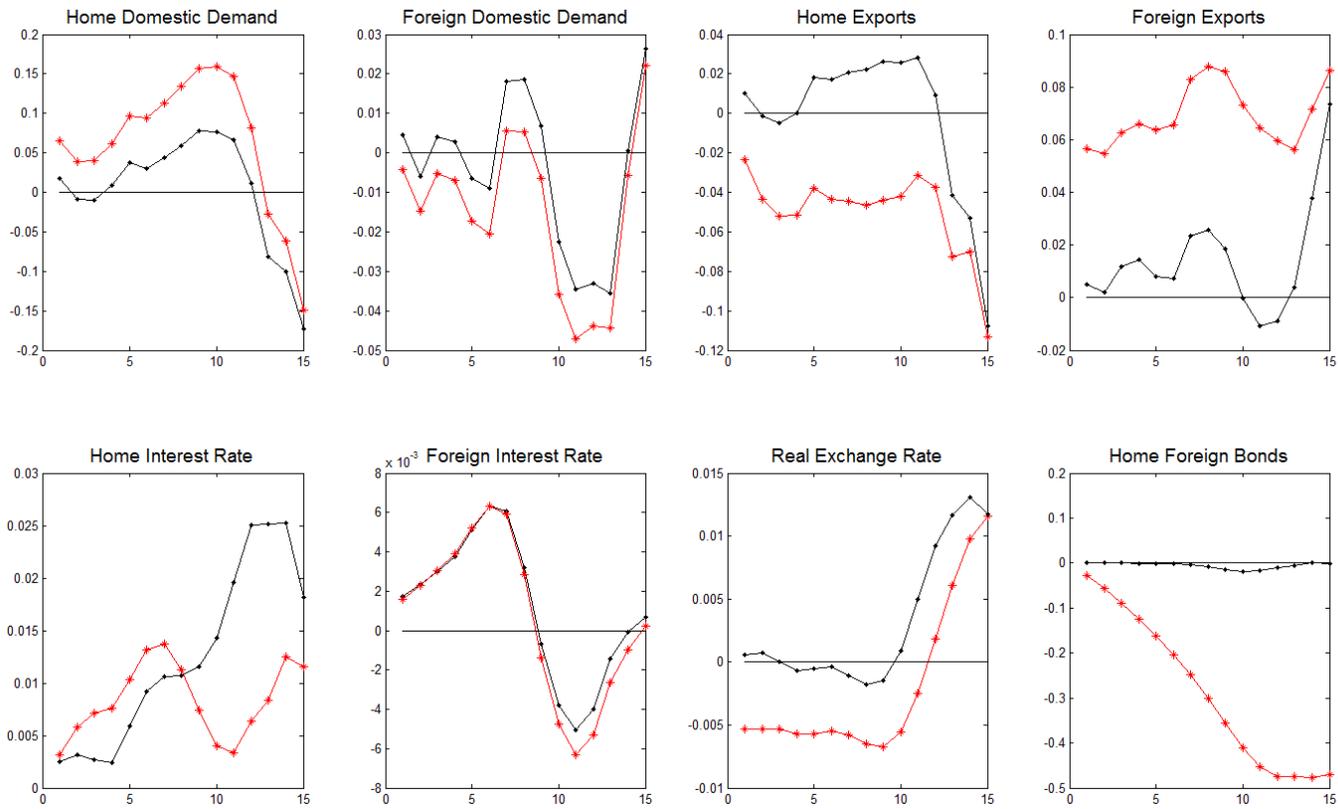
Notes: Annual data.

Figure 5: Sensitivity Analysis: Monetary policy rules and parameters

The current account balance as a share of GDP

Current Account Balance: Capital Controls & Peg

Current Account Balance: Floating Exchange Rate

- - - Money supply, US parameters   ······ Interest rate rule, US parameters
-·-· Money supply, Chinese parameters   —— Interest rate rule, Chinese parameters

Notes: The top graph shows the current account balance as a share of GDP under sterilized interventions, capital controls and an exchange rate peg. The bottom graph shows the current account balance under a floating exchange rate and open capital account. The lines represent different scenarios for the home country's monetary policy rule (either a money supply or interest rate rule) and the home country's parameters (either Chinese specific or US parameter values).

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Figure 6: Sensitivity Analysis: Total factor productivity processes

The current account balance as a share of GDP

Current Account Balance: Capital Controls & Peg

Current Account Balance: Floating Exchange Rate

Alternative TFP Processes for China

—— Observed Chinese TFP and constant US TFP - - - Estimated productivity relationship
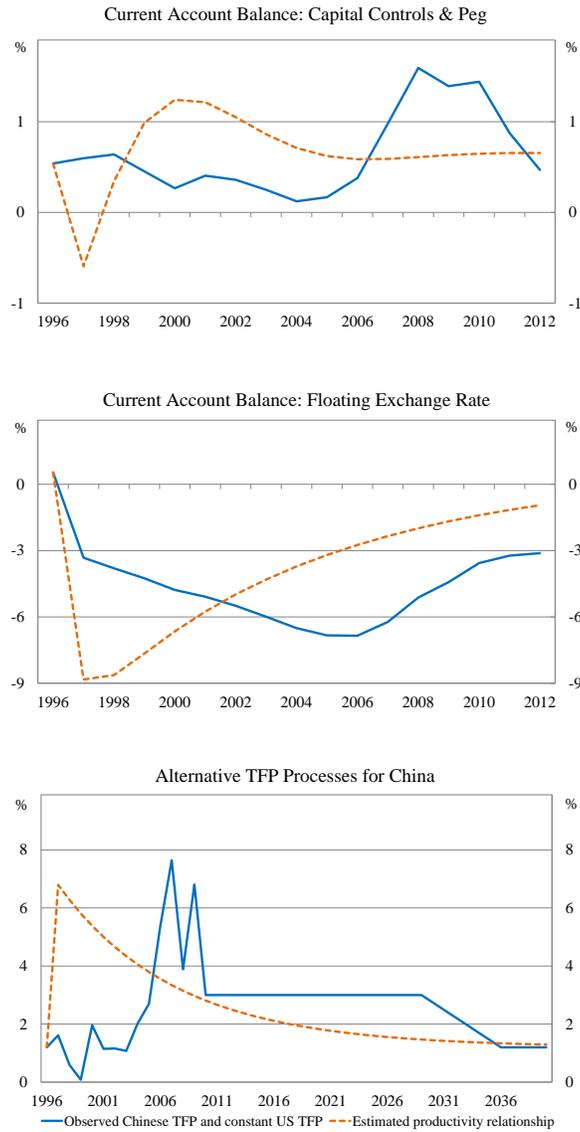
Notes: The top graph shows the current account as a share of GDP under sterilized interventions, capital controls and a peg. The middle graph shows that under a floating exchange rate and open capital account. The bottom graph shows alternative productivity processes. The blue lines shows what occurs using the Tian and Yu (2012) estimates for China and constant US TFP growth of 1.2 percent. The orange lines shows what occurs when productivity in China follows equation (14).