

Addressing China's Trade Surplus

A Consumption vs. Appreciation Approach

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Much controversy surrounds China and its abnormal and sustained trade balance. Indeed, many believe that China is actively manipulating its currency as a means to drive the cost of its goods down in comparison to the rest of the world and have called for the growing country to drastically appreciate the yuan. This paper seeks to understand the supposed effects that a large appreciation of the yuan would have on the Chinese economy as a whole. Furthermore, the paper also looks at an alternative solution for decreasing the trade balance by means of increasing China's relatively low amount of domestic consumption. Ultimately, using Ray Fair's advanced multi country macroeconomic model, it can be shown that a major appreciation of the yuan only decreases China's trade balance at the dramatic cost of GDP while increases in consumption actually increase GDP slightly as well decrease the trade balance.

Introduction

The growth in the Chinese economy over the past 30 years is nothing short of remarkable. Once an isolated command economy years behind the modern world, a series of institutional and market reforms starting in the late 70's helped the country to grow at an average annual rate of 9% a year, making China the second largest economy in the world by 2011.¹ Of the many factors that have guided China towards becoming the biggest economic success story in the past 100 years, global trade has perhaps had the biggest impact. In 2005, China was officially the third largest trading nation in the world with trade (exports and imports) accounting for a staggering 64% of its GDP.²

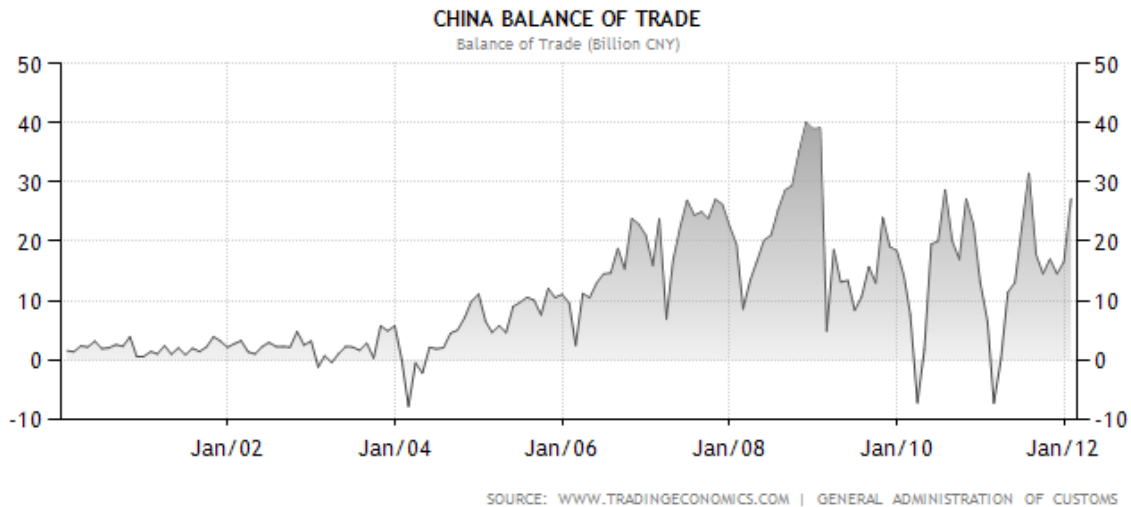
What is perhaps the most notable aspect of China's rise to a global trading power is the fact that it has been able to sustain consistent positive trade balances during the last 2 decades. More so, these positive trade balances have increased tremendously in the past 8 years, at some points reaching upwards of \$40 billion (quarterly) USD. And while China has surely benefited from such an unusually high and sustained trade surplus, it has faced ever-increasing pressure from other countries and global institutions urging it to take appropriate action in order to shrink the balance to a more sustainable level.

Specifically, many political leaders and economists are of the opinion that China has been manipulating the exchange rate of the *yuan* in order to gain the advantages that come with a positive balance of trade. In an effort to lower the price of its exports while simultaneously increasing the price of foreign imports, it has been suggested that China is purposely keeping the value of its currency artificially low in comparison with the USD and other major currencies

¹ The World Bank, 2011

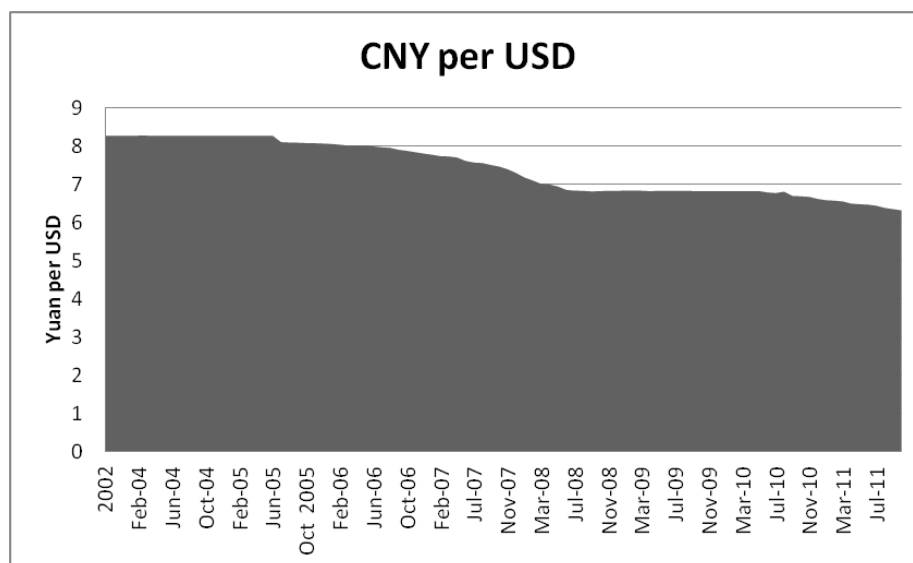
² Naughton

which, given the internationally agreed upon Bretton Woods system, would make them a currency manipulator.



And although China has received criticism from most of its global trading partners, none has been more vocal than the United States. In its 2011 end of the year report on U.S. trade, the Department of Treasury stopped just short of calling China a currency manipulator by saying that “the real exchange rate of the renminbi (RMB) is persistently misaligned and remains substantially undervalued”. In September of 2011, the United States Senate passed resolution 1619 which, among other things, specifically called for U.S. trade sanctions against China if it fails to properly address “the current misalignment that exists between the *yuan* and USD”. Of course, discontent towards China’s alleged currency manipulation is not contained within Washington. Several trade and manufacturing groups whose interests lie with a shrinking trade surplus in China have called for ever-increasing pressure from the U.S. government, WTO, and European Union to be placed on China.

Naturally, China has pushed back against such accusations with quite some force. For example, the People's Bank of China (PBC) is quick to point out that the *yuan* has indeed appreciated over the years, with the most recent significant change happening at the beginning of 2008 when the *yuan* to USD ratio appreciated from 7.75 to 6.75. Furthermore, despite the currency's modest to moderate appreciations over the years, the PBC fundamentally believes that the country's relatively young banking sector is not fully prepared to deal with the potential strain that may come with floating the *yuan* completely, and instead believes that such a process should happen slowly over time.³ Of course, perhaps the main reason for the Chinese government's aversion to revaluing the exchange rate comes from the potential lost growth that would occur due to a reduction in exports. To put it in the words of the government, "any significant appreciation of the renminbi will erode China's export competitiveness overnight and impact the livelihood of tens of millions of workers".⁴



³ See [a series of articles by Ronald McKinnon](#) about the exchange-rate policy in Japan and China; particularly the article by Ronald McKinnon, Brian Lee, and Yi David Wang, "The Global Credit Crisis and China's Exchange Rate," Stanford Center for International Development Working Paper number 391, Stanford University, June 2009.

⁴ Premier Wen Jiabo to a group of European leaders in 2009

It seems as if the lines are clearly drawn, and there is little indication of movement on either side. Both parties, those for revaluation and those against it, seem pretty sure of the consequences that would come with a massive revaluation. Western economies such as the U.S. believe that an appropriate appreciation would help to decrease China's massive trade surplus while simultaneously helping its trade deficit decrease. China, with a rigid and bold desire to sustain high GDP growth, is unwilling to take any action that would potentially compromise the health of the economy. Unfortunately, beyond the political posturing and speculation on both sides, there has been little work done to quantitatively evaluate the effect that an appreciation of the *yuan* would have on both the Chinese and global economy. Furthermore, in the rush to have China arrive at a sustainable balance of trade, there has been an all-consuming focus on a *yuan* appreciation without regard to other courses of action that could possibly contribute to more balanced trade without adverse macroeconomic effects.

The purpose of this paper is to move the discussion surrounding China's exchange rate and calls for its revaluation from speculation towards quantitative analysis. First, using Ray Fair's dynamically sophisticated model of the global economy, an attempt will be made to model the effect that a large-scale appreciation of the *yuan* will have on not only the Chinese economy, but also on the U.S. Such analysis will hopefully allow us to judge the cost, benefits, and effectiveness of such a policy action. It is the intent of the paper to answer such questions as: Does an appreciation of the *yuan* actually close the trade gap? What is predicted to happen to Chinese GDP as a result? Is the U.S. made better off by a revaluation policy?

Going even further, this paper seeks to examine if there are any other effective means by which the Chinese could close their persistent positive trade balance besides revaluing the *yuan* directly. Specifically, the Fair Model will once again be used, but instead of changing the

exchange rate, the model will be used to test the effects that a change in Chinese domestic consumption has on the trade balance. The theory behind why changing consumption may be better than directly revaluing the *yuan* will be discussed in length further into the paper.

Literature Review

The most substantial amount of work done on the topic of quantitatively measuring the effects of a *yuan* revaluation was done by Xiaohe Zhang in his 2004 paper titled *The Economic Impact of the Chinese Yuan Revaluation*. Indeed, much of this current paper's initial approach takes shape from Mr. Zhang's past work. This includes the use of the Fair Model as a means to understand predicted effects of a large-scale *yuan* appreciation.

In his research, Zhang concluded that a lone appreciation of the *yuan* by 20% would indeed have an adverse effect on several macro variables in China, including a predicted decrease in both GDP as well as the general price level. Thus, an attempt to revalue the *yuan* as a means to close the trade gap has a deflationary effect. Yet, what is more surprising is the predicted effect on the U.S.'s economy. As in China, Zhang and the results of the Fair Model seem to indicate adverse effects within the U.S. economy due to an appreciation. This seems to stand in opposition to a general belief that a stronger *yuan* would be good for the U.S. by means of higher exports from the country.

While Zhang's work was exceptionally novel and interesting, his conclusions are probably not relevant today given the time period of his research. Since the paper's publishing, China underwent a fairly substantial revaluation in 2008. While it was not of the magnitude used by Zhang, it was nevertheless a significant one that yielded results quite contrary to what was initially predicted. Since the revaluation in 2008, China has continued along its exceptional growth path while still seeing moderate to high trade surpluses despite a more valuable *yuan*.

Indeed, it seems as if the revaluation had little effect. And, since the Fair Model is continuously updated with yearly and quarterly macroeconomic data, it can be assumed that, if Zhang's specific model was ran today, it would yield different results due to the model's continuous adjustments to real-world behavior. Thus, it is necessary to test the model to see just what effects a change in the exchange rate would have given the accumulation of new data over the past decade.

As mentioned before, others have suggested that revaluing the *yuan* may not be the only policy option on the table. Given the fact that China refuses to appreciate its currency as a means to achieve trade stability, it is important to think of other policies and what their effect could be on the Chinese economy as well as the global economy. One such alternative view is that China should focus on reducing net savings by means of higher domestic consumption and government spending as opposed to simply readjusting the exchange rate.

Wiemer in *Don't Revalue the Yuan Yet* (2010) and *Chinese Saving Dynamics* (2012) advocates very strongly against the notion that a currency appreciation is a cure-all for trade imbalances that exist in China, and instead argues for an increased consumption approach. The idea put forth is that China's positive trade balance is a direct result of excessive saving over domestic investment and consumption. Whereas most countries spend their export revenues on increasing their imports, China's lack of domestic consumption allows for these export revenues to be invested abroad by means of foreign asset acquisition, namely U.S. Treasury Bonds. In simpler terms, if export revenues are not going to be spent by the Chinese people, then they must be spent some other way. This fact, Wiemer argues, is why China is able to sustain sufficient positive trade balance.

Thus, if the government can enact policies to spur domestic consumption, then it may be the case that China's trade gap will decrease without a direct change in the exchange rate. By consuming more and saving less, the Chinese people would need to turn towards foreign imports to meet domestic demand as domestic production would be unable to keep up. It is this effect of the interplay between saving and domestic consumption that may be able to explain why countries like the U.S. actually have trade deficits. For example, the U.S. has long-been criticized for its lack of savings. In the U.S. there is a high level of domestic consumption that depends on both domestic and foreign production. If perhaps the U.S. decreased consumption and opted to save more, it would find itself in the same position as China, with a positive trade balance.

Perhaps the most useful aspect of Wiemer's work is that it approaches the issue of China's trade imbalances from a demographic point of view. Whereas it is sometimes easy to attempt to explain macro phenomenon in China using standard economic theory that seems to work for Western countries, Wiemer believes that the political and demographic differences inherent in China make it a special case and thus it should be approached as such.

The notion that China may be able to solve its long-term trade imbalances as well as increase consumption per capita is appealing and opens itself up for further exploration. As noted before, there are long-standing fears that a sudden appreciation of the *yuan* would lead to a downturn in the Chinese economy by way of decreased exports. A consumption approach may prove to be the most ideal course of action if it can lead to a stable trade balance as well as avoid any unnecessary adverse macro shocks to the rapidly growing economy.

The Fair Model

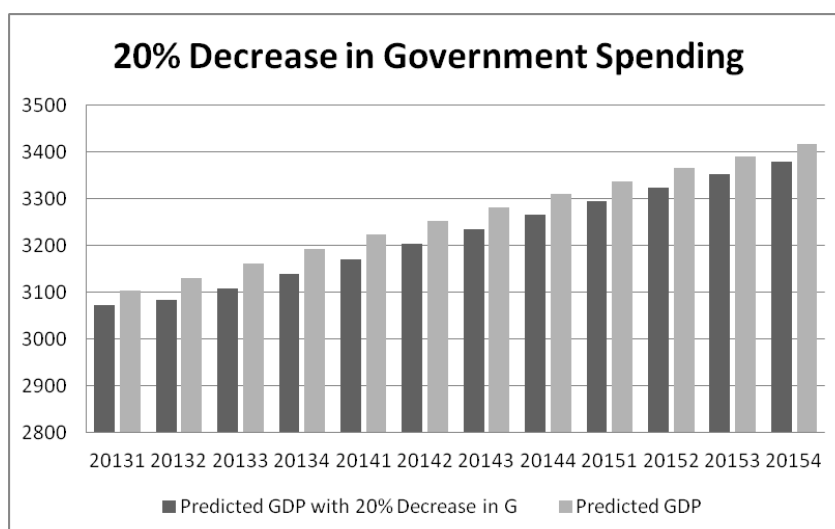
In order to analyze the potential effects of a *yuan* revaluation as well as an increase in domestic consumption within the Chinese economy, Ray Fair's multi-country econometric model is used. The multi-country model is actually a descendent of Fair's original U.S. macroeconomic model developed between 1974 and 1976 as a tool to examine the effects of fiscal and monetary policy. Over time, as international data became more available and computing power increased, Fair developed the multi-country model which seeks to understand and predict how changes in one country's economy can affect the international macroeconomy as a whole. Both Fair's U.S. and multi-country models are regularly used by economists and policy makers alike in order to help establish a clearer picture of the effects of policy. Extensively tested and analyzed over the years, the Fair Model is widely regarded as one of the most reliable and economical grounded macro models available. Several important and insightful papers that use the Fair Model have been published over the years.⁵

The multi-country model works by examining how changes in various exogenous (and occasionally endogenous) variables within a country change a predicted path for a given economy. Within the model, there are 39 countries and up to 63 stochastic equations that are used to model everything from a country's predicted real GDP to its net exports and imports. The individual equations used for each variable are highly nuanced and based off of rigorous economic theory. This includes the wide-use of various econometric time series estimation models including autoregressive integrated moving average (ARIMA) models. The data used to model future variable behavior are regularly updated (usually on a quarterly basis) in order to ensure that current global macroeconomic trends are accounted for. Indeed, with the addition of new data, each stochastic equation undergoes a series of sensitivity tests to ensure that the model

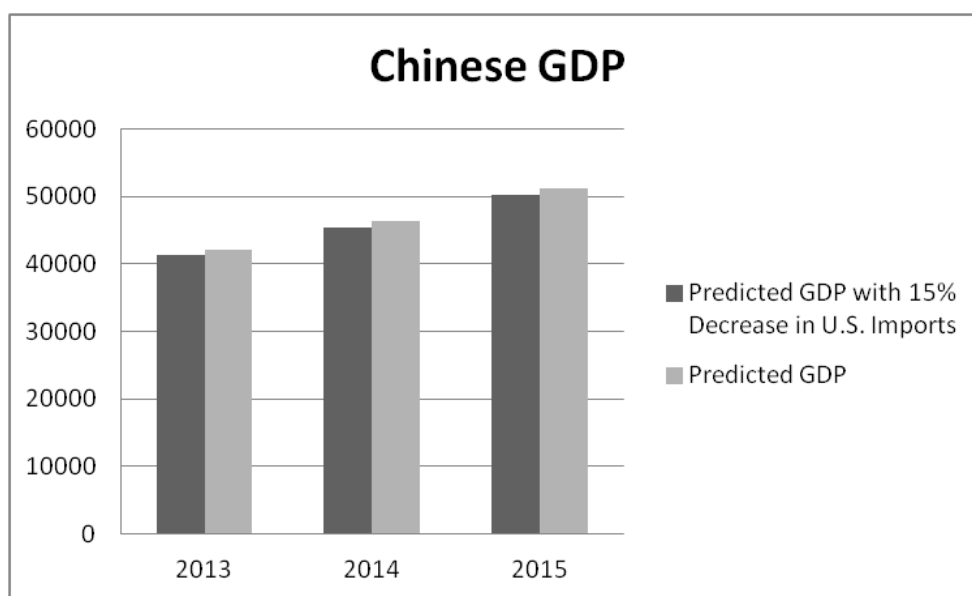
⁵ For an extensive list please visit <http://fairmodel.econ.yale.edu/main3.htm>

continues to act as a reliable and unbiased estimator. It is not uncommon for the functional forms or the equations of the model to change in light of changing relationships or global macro shocks.

Because the model predicts the future path of a country's economy *ceteris paribus*, it is often times used to examine what is predicted to happen when certain exogenous shocks occur to an economy. When a variable is changed from what it is predicted to be, the model uses the new values to estimate the difference between what the model now predicts and what it predicted before. For example, given past data, the model has predicted values for government spending within the U.S. over the next decade. However, if we were to change the predicted values of government spending manually from say 2013 to 2015, we would expect that this manipulation would also cause changes in other predicted macro variables within the U.S. and abroad over that time period. Namely, total U.S. output is directly affected by how much the government chooses to spend. Thus, by changing what is otherwise expected to be an exogenous variable, we can see what the likely effects on the macro economy are. The results of an exogenous shock to the U.S. government's purchase of goods are shown below. In this case, total government spending was decreased by 20%. As expected, this creates a noticeable decrease in overall GDP during the period of the change.



Of course, this being a multi-country model, we can also evaluate the effects that changes in U.S. macro variables have on other countries. For example, imagine what would happen if the predictions for total U.S. imports over the next 3 years were cut back by 15%. It should be expected that the effects of such a dramatic change would not be isolated to just the U.S. economy. Indeed, the U.S. receives its imports from other countries, so an acute reduction in total imports demanded by the U.S. (for whatever reason) would certainly be responsible for macro phenomenon in other countries, namely its trading partners. Below are the predicted effects of a 15% decrease in U.S. imports on total Chinese output. Not surprisingly, this supposed reduction in U.S. imports causes drastic consequences for China. China is one of the United States' largest suppliers of imports, so a reduction of this size would certainly cause a significant decrease in the total amount of exports for China, which in turn would lead to a decrease in total Chinese GDP.⁶



⁶ The y-axis is denominated in 100 million 2005 USD's.

A Change in the Exchange Rate

The previous changes to the Fair Model yielded relatively predictable results. That is, it is not too hard to see that a country's GDP would fall as a result of a significant decrease in government spending or why a country's total production would decline when one of its largest trading partners decreases its demand for imports substantially. Yet, the purpose of this paper is to incite changes within the Fair Model whose effects aren't readily understood. For example, while standard macro theory may suggest certain results from a significant *yuan* revaluation, we can't pretend to know with great confidence the full scope of the effects on a global macro level. Where it may be true that a higher exchange rate leads to fewer exports for a given country, it is less clear what happens to other economies that are tightly bound to the Chinese economy, namely the United States.

The first change to the model will include an appreciation of the *yuan*. In the Fair Model, all foreign currency exchange rates are relative to the U.S. dollar. At this point in time, the *yuan* to USD rate of exchange is roughly 6.29. That is, 1 USD is approximately equal to 6.29 *yuan*. Any decrease in the *yuan* to USD exchange rate would be described as an appreciation of the *yuan*, with a depreciation being the result of an increase in the exchange rate. For the purposes of this paper, we will be interested only in the effects of an appreciation of the *yuan* relative to the USD.

Many favor a significant appreciation of the *yuan* as a means to decrease total Chinese exports and thereby increase total imports. In theory, this approach should indeed lead to a total decrease in goods exported, holding all else equal. When a country's currency appreciates relative to other foreign currencies, the prices of its exports relative to other countries also increase. Thus, it is more expensive to import from the country, and, holding all else equal, this

will tend to decrease the country's total exports. Of course, since total exports are one positive component of a country's total production, an appreciation has the effect of decreasing real GDP.

Despite all of the discussion over the supposed benefits inherent to an appreciation of the *yuan* as a mechanism to decrease China's unstable trade balance, there is a dearth of concrete empirical suggestions. By how much should China revalue the *yuan* to meet the expectations of the global community at large? Of course this does not mean that there is a lack of opinion as to how undervalued the *yuan* is. The literature will show that the perception by many economists is that the *yuan* is undervalued on an order of 15 to 35% (Frankel 2006, Zhang and Pan, 2004, Chang and Shao, 2004, Goldstein and Lardy, 2003, among others). Indeed, in his original paper Zhang tested for an appreciation of 20% in his model. Thus, within the model, he allowed for the predicted *yuan* to USD ratio to decrease by 20% which would seem to indicate that he was assuming that the *yuan* was undervalued by that much. However, this value was not derived using substantial economic theory or empirical analysis. Instead, most economists offering an opinion use immensely simple metrics and heuristic tests to arrive at a "ball park" amount.

Even almost a decade after Zhang's work, there is still a lack of concrete agreement as to what a proper appreciation should be in order to substantially decrease China's trade balance, rather only a broad range. To this point, this paper will use a range of appreciation values. Specifically, a revaluation of 10%, 15%, and 20% will be tested in order to gain a broad understanding of the nature of the model in terms of how it predicts macro changes when a country's exchange rate is adjusted. A 20% appreciation will serve as the upper bound mainly to ensure that the model's predictive abilities are not stretched too far. As with most large macroeconomic models, the predictions created are merely calculations based on observed past relationships between variables. To input an appreciation above 20% would run the risk of

possibly over-extending the model beyond its limit of producing reliable and economically grounded results.

In order to understand the effects of the exchange rate change, the following variables will be examined for both China and the U.S.: total production (real GDP) and net imports/exports. While the Fair Model allows for many more macro variables to be examined, the aforementioned will be useful enough to develop a broad picture of the introduced changes. For example, changes in GDP will help to establish how the overall health of an economy is influenced and, of course, the net export/import calculation will be needed to judge whether or not a change in the value of the *yuan* does indeed decrease China's trade surplus or not.

A Change in Domestic Consumption

As mentioned before, there is a lack of focus on other policy initiatives that could help China to decrease its trade balance while potentially avoiding negative consequences. A calculated change to China's total domestic consumption is where this paper's analysis really begins to offer a meaningful contribution to macroeconomics. If the Fair Model can show that an increase in Chinese consumption can lead to a decreased trade imbalance all the while keeping Chinese production fairly stable, then there may be more room for discussion as to what course of action China should take next.

Of course the notion of introducing a sudden change in Chinese domestic consumption parameters can be a bit problematic given its endogeneity. Countries regularly change their currency's exchange rate relative to other currencies by various fiscal and monetary policies. In all likelihood, it is fairly reasonable to assume that if the Chinese wanted to appreciate the *yuan* by 15%, for example, then they would be able to do it. That is, the exchange rate is simply reliant on the value that the world currency market places on it relative to another currency. If

the People's Bank of China wanted to peg the *yuan* to USD ratio to 4, then it would simply have to be willing to trade its currency (whose amount in circulation they control) by this ratio. This act alone would eventually lead to a realized exchange rate of 4 *yuan* to 1 USD.

However, it's not that obvious that the Chinese government would be able to manipulate their consumption rate to a point needed to decrease their trade surplus. In basic microeconomic theory, how much a household consumes in the present is a complex function based on various utility functions and the interplay between the advantages of either consuming today or saving until tomorrow. While much economic literature is devoted towards the intersection of government policy and private economic acts such as saving and consumption, there still seems to be a lack of consensus on just how much influence policy can have. To this point, we will just have to assume that government policy is indeed able to change the consumption rate within its economy. Of course, if there is any country that may be able to directly influence such things as domestic consumption, it may very well be China. Indeed, something such as the population growth rate in a country is thought to be another entirely exogenous variable, removed from government influence. However, China's one child policy introduced in the 80's shows that a country's government can indeed control such things.

Like changing the exchange rate, there is some question as to how much consumption should be increased. The novelty of an increased consumption approach all but guarantees that no rigorous and meaningful economic work has been done to determine an appropriate amount. We do know that the Chinese on average save more than 20% of their income than other world countries. Of course this is an average value, and when compared to the lowest saving countries (like the U.S.), China's average domestic consumption rate is extraordinarily below some.

Again, like the change to the value of the *yuan*, the level of Chinese consumption within the Fair Model will be changed multiple times in order to test the ability of the model as well as to get an idea of different results. Specifically, the changes will be a 5%, 10%, and 15% increase in domestic consumption. However, in order to do this, some nuance must be applied. Whereas the exchange rate will be changed from its current level to its new level in the same year, the changes in consumption will occur over two years. Yes, it is possible to tell the model to adjust consumption upwards by say 15% in 2013 and then examine the effects of this change in 2014 and onward, but this is departure from reality is too much to allow.

As we've already established, there may be some doubts as to whether a country's government could actually enact policy that ultimately increases consumption by a certain amount. However, once we acknowledge this and decide that it may be possible any way, it is unrealistic to believe that if such a policy existed, it would be able to increase the rate of consumption all within a year. That is to say, we shouldn't expect a policy enacted in 2012 to lead to full fruition in the very next year. Thus, within the model, the various levels of increased consumption will be tested on a gradual basis. For example, to achieve the increase of 5%, the model will be changed so that in 2013 the predicted values of Chinese domestic consumption will be increased by 2.5%, with another 2.5% increase following in 2014. In this way, we are allowing for a gradual adjustment that is seemingly more realistic. As for the 10% increase and 15%, these will be phased evenly over the course of three years starting in 2013 and ending in 2015. Of course, there is no way to really know if even these changes can be made over the time allotted, but this approach is far more realistic than an assumption based on expedited policy effects.

Lastly, it's worth noting just exactly how the change in consumption is implemented within the Fair Model. Normally, consumption is viewed as an endogenous variable which is dependent on other variables, namely a country's GDP. The consumption function within the Fair Model is no different than the one assumed by general macroeconomic theory and can be written as such:

$$C = c_0 + c_1 Y^d$$

where consumption is a function of an economy's autonomous consumption (c_0) plus the total disposable income multiplied by the marginal propensity to consume (mpc).

The change induced in the model will concern changing the predicted value of the economy's mpc. Recall that the mpc is the proportion of additional income that an individual desires to consume. For example, if a household earns one extra dollar of disposable income, and the marginal propensity to consume is 0.65, then of that dollar, the household will spend 65 cents and save 35 cents.

By definition, a higher mpc leads to more consumption and less saving. By increasing the predicted mpc of the Chinese economy during our prediction period (2013-2016), we are forcing consumption to increase and savings to decrease within the economy. This is exactly what Wiemer proposes as the solution to achieve a stable balance of trade within the country. It should be noted that we are not introducing more production into the economy (i.e. we are not changing disposable income). Rather, we are simply telling the model to change the way in which the predicted level of disposable income is divided between consumption and saving. The same results would occur if we were to change the savings rate within the Chinese economy.

The Results

Strictly speaking, a substantial appreciation of the *yuan* is harmful to the overall health of the Chinese economy. Tables I-III show the percentage changes to GDP, total exports, and total imports for the various ranges of appreciation. Keep in mind when analyzing the tables that the changes are calculated by comparing the difference between the predicted path of the economy sans any shocks and the predicted path once the changes are made. Thus, for example, the Fair Model predicts that a 10% appreciation of the *yuan* to USD exchange rate will lead to roughly a 9% decrease in the total production predicted for 2013.

Table I: The Effects of a 10% Appreciation

China	% GDP Change	%Import Change	%Export Change	% Current Account Balance Change
2013	-9.21	-2.59	-14.97	-73.10
2014	-10.47	-5.56	-14.43	-55.34
2015	-10.58	-7.97	-13.70	-40.03
2016	-10.16	-9.57	-12.97	-28.65

Table II: The Effects of a 15% Appreciation

China	% GDP Change	%Import Change	%Export Change	% Current Account Balance Change
2013	-11.07	-3.13	-17.95	-87.56
2014	-12.55	-6.70	-17.28	-66.11
2015	-12.67	-9.56	-16.39	-47.77
2016	-12.16	-11.46	-15.52	-34.23

Table III: The Effects of a 20% Appreciation

China	% GDP Change	%Import Change	%Export Change	% Current Account Balance Change
2013	-13.28	-3.78	-21.50	-104.68
2014	-15.02	-8.06	-20.65	-78.77
2015	-15.14	-11.45	-19.58	-56.87
2016	-14.52	-13.69	-18.52	-40.79

Not surprisingly, the negative effects associated with an appreciation are magnified as the valuation percentage increases. Notice, however, these effects are non-linear. This simply comes from the fact that the Fair Model is not necessarily a combination of standard linear OLS equations. Instead, the relationships depicted within the model are based on rigorous economic theory that attempts to use economic intuition as a means to connect variables. To this point, very few if any economic relationships exhibit a truly linear relationship. Therefore, we shouldn't necessarily expect that incremental changes in variables lead to equal or constant incremental changes in the affected variables.

The predicted percentage decreases in total GDP go hand in hand with even larger predicted decreases in total exports. As predicted by standard macroeconomic theory, a substantial appreciation of the *yuan* leads to a sharp curtailment in the amount exported by the country. Again, as a country's exchange rate increases, the cost of its goods become relatively more expensive to other nations while, at the same time, foreign goods become relatively less expensive. Of course, the model does predict a net decrease in the total imports of the country as well. However, the magnitude of these decreases is much smaller relative to the drop in total

exports. It is this decrease in exports that is largely to blame for China's predicted decrease in production.

Table IV: Effects of yuan Revaluation on U.S. GDP

U.S.A.	% GDP Change due to 10% increase in <i>yuan</i>	% GDP Change due to 15% increase in <i>yuan</i>	% GDP Change due to 20% increase in <i>yuan</i>
2013	0.15	0.21	0.29
2014	0.16	0.22	0.30
2015	0.10	0.14	0.19
2016	0.09	0.13	0.17

The induced appreciation in the Chinese *yuan* seems to have a negligible effect on the predicted value of U.S. GDP. Table IV suggests that the difference between the Fair Model's predicted value for U.S. GDP before the exchange rate shocks and after is less than half of one percent in the positive direction. Thus, although the Fair Model indicates that revaluing the *yuan* has a predicted positive effect on U.S. GDP, this effect is, in comparison to the effect on Chinese GDP, extremely small.

Compared to Zhang's results for a 20% appreciation, the data depicted in Tables I-IV are of the same magnitude and sign for the most part. Using a prediction period of 2005-2008, Zhang found that an initial appreciation of the *yuan* led to an average decrease of predicted Chinese GDP on the order of 12% over the 4 year period. This value is very close to the average predicted GDP decrease of 14% seen in Table III. Factoring global economic changes that have occurred since 2003 (when Zhang wrote his paper) and the Fair Model's propensity to account for such changes, a difference of 2% is very valid.

Of course, there are some differences. While both this paper's results and those of Zhang indicate very small effects on U.S. GDP, their signs are different. Whereas, Table IV predicts slightly positive changes in U.S. GDP after appreciating the *yuan*, Zhang predicts slightly negative effects for U.S. GDP for three out of the four prediction years. Nevertheless, these predicted changes are still less than one half of a percent, even if they are negative.

These results would tend to indicate that we shouldn't expect much change to U.S. GDP (either up or down) should a large *yuan* appreciation take place. As indicated by Tables I-III, massive appreciations of the *yuan* have such a significant negative effect on aggregate output that both the total amount of imports and exports are predicted to decrease. Of course, exports decrease significantly more which is why we see a decrease in the trade balance over all. Thus, an appreciation doesn't even increase demand for foreign exports, which would have potentially been one way the U.S. could benefit. By sending more exports to China, the U.S.'s trade balance would have increased. However, it is interesting to point out that even if China's demand for foreign exports was predicted to increase, there may still be little effect on U.S. GDP. As mentioned earlier, due to its extremely low savings rate, the U.S. is unable to export a large amount of goods. Instead, most domestic production is consumed within. Thus, without significant changes to the U.S. savings rate, we should not expect the U.S. to export much more than it already does. Again, the amount a country exports is bounded by the interplay between how much a country's citizenry are willing to either consume or save, as goods not consumed can be sent abroad as exports.

In regards to optimally addressing China's trade surplus, it appears massive appreciations of the *yuan* are not the answer for finding an optimal solution for China which does not jeopardize the country's growth. As expected, appreciating China's currency does have a

tendency to lower the country's trade balance. However, this effect comes at the price of the country's GDP, which, for the highest revaluation, is predicted to decrease by as much as 14% from the Fair Model's base value. And, although the U.S. is among the strongest proponents of a Chinese currency revaluation, it appears that they stand little to gain and indicated by the negligible effects to GDP.

On the other hand, results from the Fair Model do indicate that an increase in Chinese domestic consumption has the effect of significantly decreasing the predicted trade imbalance ran by China while keeping growth at a healthy rate.

Table V: The Effects of a 5% Increase in Consumption

China	% GDP Change	%Import Change	%Export Change	% Current Account Balance Change
2013	0.85	0.73	-0.03	-3.59
2014	1.55	1.91	-0.08	-9.26
2015	1.29	2.60	-0.13	-12.65
2016	1.04	2.94	-0.15	-14.38

Table VI: The Effects of a 10% Increase in Consumption

China	% GDP Change	%Import Change	%Export Change	% Current Account Balance Change
2013	1.70	1.46	-0.06	-7.16
2014	3.10	3.81	-0.17	-18.49
2015	2.57	5.20	-0.25	-25.30
2016	2.08	5.90	-0.29	-28.80

Table VII: The Effects of a 15% Increase in Consumption

China	% GDP Change	%Import Change	%Export Change	% Current Account Balance Change
2013	2.54	2.18	-0.08	-10.72
2014	4.65	5.70	-0.25	-27.69
2015	3.86	7.81	-0.38	-37.97
2016	3.11	8.87	-0.43	-43.27

The trade balance decreases a significant amount in all three of the consumption increase scenarios, with the magnitude increasing with the higher percentage change in consumption. The decreasing trade surplus is a result of predicted decreases in China's exports along with increases in the total amount imported. And while the magnitude of the predicted decreases in the trade surplus are not as large as those predicted by currency appreciation, the failure of increases in consumption to create significant drops in predicted output seem to make the consumption approach a more viable option for China to pursue if they are serious about decreasing their trade balance.

Concluding Remarks

Using Ray Fair's advanced multi-country macroeconomic model, it can be shown that an appreciation of the *yuan* and increases in domestic consumption both have the effect of decreasing China's relatively large trade surplus. This is of little surprise as basic economic theory already predicts the results produced by the model. However, the predicted differences in the effect of either change on China's GDP suggest that an increase in consumption is perhaps the best path for China. Whereas, increasing consumption leads to a predicted decrease in China's trade balance as well as slight increases in output, an appreciation of the *yuan* is predicted to decrease the trade surplus only at great cost to Chinese production. Furthermore, the positive effects on other countries such as the U.S. which positions itself as a strong advocate for Chinese currency reform are very minimal and do not compare to the drastic negative effects predicted for China should a massive appreciation occur.

Of course, the Fair Model, despite its complexity and foundation upon theory, is still a macroeconomic model nonetheless. Although the results indicated by the changes introduced to the model seem to be in line with general economic theory, the magnitude and effect of these

changes should be carefully scrutinized and not taken as certain. Indeed, there are many nuances and reactionary policies that the model can't predict. Nevertheless, such work as presented in this paper is a good starting place for establishing deep and rigorous dialogue in regards to China's future.

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