

How would Renminbi's Real Appreciation Affect the Structure and Productivity of the Chinese Economy?

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Abstract

It is generally accepted that China needs to shift from its past mode of export-led growth and start to rely more on domestic demand. What role could the real appreciation of the Chinese yuan play in this regard? We attempt to quantify the impact on the structure and productivity of the Chinese economy of the real appreciation of the Chinese yuan. It is argued that the potential of the service sector to generate income and jobs may be significantly under-estimated by official statistics, as a result of the under-estimation of household consumption of services. While there is no evidence of large under-valuation for the Chinese yuan, we do find that a real appreciation in the order of 20%, perhaps over 4-5 years, would bring the Chinese price level in line with the world average level, after the Balassa-Samuelson effect is factored in. In turn, such a real appreciation could increase the service share of employment by 7% and raise aggregate labor productivity by 6-8%.

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1. Introduction

Two challenges facing China have drawn extensive attention from economists and policy makers. One challenge is that the Chinese yuan has been under enormous pressures for appreciation since 2002. Starting July 2005, China opted for a strategy of slow and steady appreciation of the Chinese yuan against the US dollar in the context of developing forward markets and increasing exchange rate flexibility. By May 2007, the Chinese yuan had appreciated 7.15% against the US dollar.

The other challenge is to restructure the Chinese economy so as to reduce its dependence on the demand of exports and investment for economic growth. The key is to stimulate domestic demand and expand the service sector. The State Council issued a document in March 2007 to spell out the main targets and basic principles for speeding up the development of the service sector. The document set the target that by 2010, the service share of value added in GDP be raised by 3% from the level in 2005 (39.9%), the service share of employment by 4% from the 2005 level (31.3%).

These two challenges are, of course, related. However, most of the current literature is preoccupied with the issue of whether the real appreciation of the Chinese yuan is essential or not for correcting global imbalances (*e.g.*, Chang and Shao 2004, Coudert and Couharde 2005, Frankel 2005, Gao 2006, Goldstein 2006, Huang and Wang 2004, McKinnon 2004, and Obstfeld 2006). There have been few studies that attempt to quantify the impact on the structure and growth of the Chinese economy of the real appreciation of the Chinese yuan. The present paper attempts to fill such a void.

We approach this problem in three steps. First, we raise some important issues regarding the size of the Chinese service sector, which appears dwarfish by international standard. Is the Chinese service sector really as undersized as reported in official statistics? What is the real potential of the service sector in generating income and employment? We argue that the Chinese service sector may well be significantly under-estimated. It is plausible that in 2005, the service share of value added might well be as high as 50% of GDP, rather than 40% as reported by the National Statistical Bureau (NBS). In other words, the base from which to expand the service sector is much larger than what is commonly presumed.

Second, we examine the relationship between the real exchange rate and the service share of employment by running pool regressions, using the data from World Bank's World Development Indicators (WDI) database. Pool regression using cross-country data is a valuable approach for estimating long-run structural relationships for at least two reasons. On the one hand, large sample sizes enhance the power of statistical inferences. On the other hand, the experience of other countries can serve as the informative reference for China. The alternative to pool regressions with cross-country data is to do regressions with the time series data of China alone. That approach suffers from the drawbacks of poor data quality and short time spans. We have found that the real appreciation has, in fact, a very powerful impact in stimulating service employment. Specifically, a 3% increase in the real exchange rate of the Chinese yuan would raise the service share of employment approximately by 1%.

Finally, we propose a framework for measuring the impact on the level and growth of productivity of the real appreciation of the Chinese yuan. Conceptually, the

real appreciation of the Chinese yuan and the expansion of the service sector may raise the level of productivity from three sources. First, the real appreciation of the Chinese yuan may lead to an improvement in the terms of trade for China. In turn, that would raise the real income of the Chinese people. With no change in total employment, that would be a gain in productivity. Second, the increased labor cost resulting from real appreciation and expanding service employment may pressure the export sector to exit from many low value-added activities, thus raising the level of labor productivity. In turn, labor mobility would transmit the gain in labor productivity as reflected in real wage gains to the rest of the economy. Finally, with an expansion in the scale of the service sector, there may be more room for raising productivity through specialization, rationalization and economies of scale and scope.

The rest of the paper is organized as follows. In section 2, we discuss the statistical issues regarding the size of the service sector. Then in section 3, we estimate the effect on the service share of employment of real currency appreciation. Finally in section 4, we proceed to estimate the impact on aggregate production growth of the structural adjustment.

2. The Potential of the Service Sector

Measuring the size of the service sector is a challenge for all economies. But this task is more difficult and complex in China. This is because on the one hand, China is still a developing economy with very low incidence of income tax returns, and on the other hand, the legacy of central planning has a lasting influence on the way statistical data is collected and compiled. Though China began to move towards a market economy through reform and opening in 1978, it formally adopted the

system of national product accounts recommended by the United Nations only in 1993 (Xu 2004). It is well known that the data on the service sector was highly problematic. That is why in 2005, China conducted the first national economic census that was specifically designed to improve the deficiency of service sector data.

On the basis of the 2005 national economic census, the NBS has revised the value added of the service sector in 2004 upwards by almost 50% from 4,372.1 billion yuan to 6,501.8 billion yuan. Accordingly, the service share of value added in GDP was raised from 31.9% to 40.7%. It is interesting to observe that in the *Statistical Yearbook of China 2006*, the NBS does not make any adjustments for the past series of employment by sector, despite the fact that the new data from the 2005 national economic census reveals a significant discrepancy between the employment in 2004 of the service sector and the number from the census result.

How reliable is the revised service sector data as published in *Statistical Yearbook of China 2006*? There is no question that the 2005 national economic census has greatly improved the quality of data, especially the service sector data. However, we suspect that the under-estimation bias regarding the service share of value added may still be significant. In comparison with other developing economies at comparable levels of per capita income, China's service sector still appears small. For example, it is reasonable to compare China with the group of middle-income economies (excluding China) with a population larger than 10 million. For the year of 2005, the mean and median of the service share of value added of that comparison group are 57.4% and 57.7%, while the mean and median of the service share of employment are 54.0% and 56.5% (computed with the WDI data).

More importantly, our suspicion is based on the implausible profile of the household consumption as reflected in the revised data. With a long delay, the NBS published, in *Statistical Yearbook of China 2006*, their adjustment of the expenditure side of GDP, which were also backtracked to 1993. Table 1 presents the data revision the NBS has made for both the production side and expenditure side of GDP. What is shown is the ratio of a series as published in *Statistical Yearbook of China 2006* to that as published in *Statistical Yearbook of China 2005*. (both downloaded online from the NBS website). On the production side, the bulk of the revision is in the data of the service sector. The service share of value added in GDP is raised from 31.9% to 40.7%. For the years of 1993-2003, a simple straight line method is applied. On the expenditure side, adjustments have been made for all the three components of domestic demand, though so far, the NBS has not explained what principles are applied in making such adjustments. Household consumption in 2004 is adjusted upwards by 8.2%, gross investment of 2003 by 8.6% and most puzzlingly, government expenditure in 2004 by 41.1%. Part of the reason is a sizeable 22% upward adjustment of government expenditure in 1993, presumably on the basis of new available data.

We have searched for the possible reasons behind the adjustment of household consumption. We have found no change in the data of per capita urban and rural consumption. It appears that the adjustment of the household consumption series is based on an adjustment of the urban and rural weights. Is the revised series of household consumption appropriate? Is there a connection, or a kind of required consistency, between the series of household consumption and the value added of the service sector?

To demonstrate the weakness of the revised series of household consumption, we have done a comparison between China on the one side and the United States and Canada on the other. The variable of interest is the ratio of retail trade (it is called retail sales of consumer goods in China) to household consumption. In the United States and Canada, the value of retail trade is a major source of data for estimating household consumption of goods. In these two countries, the published data decomposes household consumption into goods consumption and service consumption. In China, however, the NBS does not publish the same breakdown of household consumption.

In Table 2, the first two rows list the Chinese data. The first row is based on the revised data published in *Statistical Yearbook of China 2006*, while the second row on the initial data published in *Statistical Yearbook of China 2005*. Rows 3 and 4 show the same ratio for Canada and the United States. Let us examine the Chinese data first. For the year of 2004, the ratio of retail trade to household consumption is 0.87 with the initial data, but is raised to 0.95 with the revised data. For all the years of 1993-2003, this ratio is raised similarly. Since retail trade ought to be very close to household consumption of goods, it implies that the service share of expenditure in household consumption is reduced to implausible levels, in view of the tremendous actual expansion of the service sector during the period of 1993-2004.

In contrast, the data of the United States and Canada presents a very different picture. The ratio of retail trade to household consumption was very stable around 0.48 in both countries. Rows 5 and 6 show the ratios of retail trade to household consumption of goods for Canada and the United States. Though these two variables are not exactly equal to each other, they are not far apart. For the

United States, this ratio averaged around 1.16, while for Canada, it was around 1.04. Together with rows 3 and 4, they imply that the goods expenditure share averaged 46% of total household consumption for Canada and 42% for the United States.

The contrast between China on the one side and the United States and Canada on the other reflects a more fundamental difference in the method of estimating GDP. In China, the production approach has remained to be the primary method for estimating the level of nominal GDP and the growth of real GDP. The expenditure approach only plays a supplementary role. In particular, the growth of real GDP is not estimated by the expenditure approach, as it is common in most countries. As far as the expenditure approach is concerned, the Chinese method of estimating household consumption differs substantially from that used in other countries, especially with regard to the role of retail trade. As a result of that methodological difference, the service share of household consumption appears to be too small to be plausible. And in turn, the under-estimation of the service component of household consumption may lead to an under-estimation of the value added of the service sector.

To demonstrate the size of the potential under-estimation of household consumption, we have done a simple simulation and report the result in Table 3. The following assumptions are made:

1. The ratio of retail trade to goods consumption is 1.1, which is below that of the United States but above that of Canada. This assumption appears to be reasonable, judging from the results of the simulation.
2. The service share of consumption takes the value shown in row 9. The number is derived as follows. First, from *Statistical Yearbook of China 2006*, we obtain the

service share of household expenditure for urban and rural residents for the years of 1990, 1995, 2000, 2004, 2005. The service share of household expenditure is the sum of expenditure shares on accommodation, education, health care, and transport and communication. The household expenditure survey data published by the NBS does provide a clear breakdown into goods and services. We conjecture that our measure as defined above should be approximately right. Second, we use the proportion of urban and rural populations to get a weighted average of the national service share of household expenditure. Third, the service share of consumption expenditure is regressed on the log of a time trend. The regression provides a reasonably good fit. The series in row 9 is the predicted value of that regression. The result of our illustration will not be affected if the actual series (not available to us) is used instead.

3. Household consumption is derived according to the following formula. Let RT be retail trade, HC be household consumption, HCG be goods consumption, σ be the service share of household consumption. Then, $HC = HCG / (1 - \sigma) = RT / [1.1 \times (1 - \sigma)]$.
4. The difference between the adjusted household consumption based on retail trade and the official series of household consumption reflects the under-estimation of household consumption. This amount is added to the official series of GDP to get a measure of the adjusted GDP.
5. The missing part of household consumption all belongs to service consumption. Therefore, it can be added to the official series of service value added to get an adjusted series of service value added.

The above assumptions need not be literally true. But they appear reasonable enough to make the results of our illustration credible.

In Table 3, rows 1-7 reproduce the official statistics as published in *Statistical Yearbook of China 2006*. The important point to notice is that the service share of value added was 40.7% in 2004 and 39.9% in 2005, while the share of household consumption in GDP was 39.9% in 2004 and 38.6% in 2005. Rows 8-14 show our adjustment of household consumption on the basis of retail trade and the service share of household expenditure. Row 8 derives the value of goods consumption from the value of retail trade. Using the service share of consumption in row 9, row 10 shows the adjusted value of household consumption. Row 11 is the difference between row 10 and row 6, which can be interpreted as the under-estimation of household consumption. Row 12 shows the value of row 11 as a percentage of GDP in row 1, row 13 shows the ratio of the adjusted household consumption to the adjusted GDP, and row 14 shows the ratio of the adjusted service value added to the adjusted GDP.

The result of our illustration is striking and provocative. For the year of 2004, household consumption is 6,383.4 billion yuan according to the official revised series, but 9,365.6 billion yuan after our adjustment. The difference is as large as 46.7% of the official revised series of household consumption and 18.7% of the official series of GDP, representing the missing service consumption. When the value of the missing service consumption is added to the official series of household consumption and service value added, the adjusted household consumption becomes 49.4% GDP and the adjusted service value added becomes 50.0% of GDP (row 14). These two

numbers should be contrasted to the numbers of 39.9% (row 7) and 40.7% (row 3) as computed from the official data.

It should be pointed out that the size of our adjustment is contingent on the value of household consumption in the official data, since it is a difference. To illustrate this point, the NBS has revised the value added of the service sector for the year of 2004 to 6,501.82 billion yuan by 2,129.76 billion yuan. Suppose that this addition is allocated solely to household consumption, a very reasonable conjecture, household consumption for 2004 would be 8,029.21 billion yuan instead of 6,383.4 billion yuan as in the official data. Then, the required adjustment of household consumption would be much smaller, 1,336.4 billion yuan, or 16.7% of 8,029.21 billion yuan.

How plausible is the result of our illustration? There are two pieces of evidence that lends credibility to our adjustment. The first piece of evidence is that the adjusted value of household consumption is very close to the official series for the years of 1993-95. In other words, our adjustment method produces a result very similar to the data for early years published by the NBS. Therefore, it is very likely that the discrepancy between the official revised series of household consumption and our series is due to the inadequacy method applied by the NBS in revising the expenditure side of GDP, not because of the unreliability of our adjustment method.

The second piece of evidence is the comparison with other developing economies at comparable levels of per capita income. The last row (row 15) in Table 3 shows the average of the service share of value added in GDP for the group of middle-income economies (excluding China) with a population larger than 10 million persons. For that group, the service share of value added in GDP increased slightly

from 50% in 1993 to 54% in 2005. In comparison with this group of economies, the number 50% for the service share of GDP in 2004 according to our adjustment appears more reasonable than the number 40% according to the official data. Of course, the estimation of GDP is far more complex than is assumed in our illustration, which lacks numerous detailed adjustments required in preparing the official GDP data. Nevertheless, the basic thrust of our argument warrants serious consideration and debate among statisticians and economists.

Another relevant consideration in comparing the official series and our adjustment is that the official series of household consumption has been known to be plagued with problems of inconsistency and deficiency. Holz (2004) attempted to reconstruct the series of household construction according to various official guides. But he could not reach a series matching the official series and he has found evidence of under-estimation in the official series.

To recapture the above analysis, the service sector may well be much larger than what is reported in official statistics. This implies that the potential of the service sector in generating income and jobs may well be under-estimated. Nevertheless, we do believe that even with the correction of the service sector data as suggested above, there is no question that the Chinese service sector is significantly under-developed, relative of the level of China's per capita income. There are, of course, many reasons for the under-development of the Chinese service sector. The legacy of past central planning is one important factor, because service activities are not even regarded as "productive" by central planners. Another factor is the influence of state monopoly or dominance in many service activities. However, the existing literature has, by and large, left out or neglected a reason

that, we believe, is the critical constraining factor for China today: the low real exchange rate or low wages.

The Role of Real Appreciation of the Chinese Yuan

The real exchange rate (RER) is defined as a ratio of the price levels measured in the same currency between two economies. The empirical measure used in the present study comes from the WDI database and is a ratio of two countries' prices measured in the US dollar. We take two steps in estimating the relationship between the real exchange rate and the size of the service sector. In the first step, we estimate an extended purchasing power parity (PPP) model that incorporates the Balassa (1964) and Samuelson (1964) (BS) effect with the cross country data from the WDI database. It is a well-known empirical fact that the real exchange rate tends to rise with the relative per capita income between an economy and the United States. The BS effect is a widely accepted explanation for that empirical fact. The residual (RES) from the pool regression provides us a measure of the relative price level of an economy, independent of the relative per capita income. We call it the deviation of a real exchange rate from the world average level. Some interpret the residual as the misalignment of a real exchange rate and use it as an estimate for the under-valuation of the Chinese yuan. As will be explained below, we do not find such a common explanation appropriate. In the second step, we regress the service share of employment (LBS) on the RES variable with the log of per capita income being the conditioning variable. In this way, the effect of the real exchange rate on the service share of employment can be estimated more precisely.

Table 4 lists the level of the real exchange rate of the Chinese yuan (column 1) as well as some other variables that will be explained below for the years of 1993-2005. This time period corresponds to the period during which the United Nations system of national product accounts was formally applied and the foreign exchange market was unified and an adjustable peg to the US dollar was implemented. In 2001 (the year the US dollar peaked in recent years), the real exchange rate of the Chinese yuan was 0.240, meaning that the price level of China was 24% of that of the United States. In 2005, the real exchange rate rose marginally to 0.253. There is no denying that the Chinese price level is low, indeed. Unfortunately, many naïve observers regard this as *prima facie* evidence for the under-valuation of the Chinese yuan. They ignore, maybe unintentionally, that the BS effect can account for the pattern that price levels are generally lower in poor countries than in rich countries.

Now let us examine carefully the BS effect from the cross-country experience embodied in the WDI data. Following Rogoff (1996), the BS effect can be modeled as a positive relationship between the RER variable and the ratio of per capita income (YPC) of a country to that of the United States. Per capita income is measured in current international dollar¹ (it makes no difference if per capita income is measured in 2000 international dollar). We have estimated a linear pool regression model. Since the basic intent of such a regression model is to estimate the BS effect from cross-country variation, the time series properties of data have no particular significance. The pool regression is simply a pooling of cross-section regressions for individual years. To account for over-time variation, we allow that the intercept to

¹ According to World Bank terminology, the international dollar is the dollar accounting unit based on purchasing power parities instead of market exchange rates.

vary from year to year. Technically, it is done by adding a period fixed effect term (δ_t). The estimation method is OLS, which is appropriate since there is no serious issue of endogeneity with regard to the regressor. We also find that the assumption of homoscedasticity for the disturbance term is appropriate for this linear model, as will be elaborated below. The result of a pool regression is reported below. The numbers in bracket are standard errors of coefficients.

$$\begin{aligned} \text{RER}_{it} = & 0.287 + 0.900(\text{YPC}_i/\text{YPC}_{US}) + \delta_t & (1) \\ & (0.004) \quad (0.011) \end{aligned}$$

Sample period: 1985-2005, Cross-section number: 169, Observation number = 3395, $R^2 = 0.67$, SE (standard error) = 0.17, SD (Standard deviation) = 0.30.

Consistent with the results of previous studies, we have found a highly significant income slope that reflects the BS effect. In other words, the cross-country experience suggests that the real exchange rate tends to rise with relative per capita income. Though our model has the same variables as in Rogoff (1996), Coudert and Couharde (2005), there is a significant specification difference from their models. Our model is specified in the linear form but their models are specified in the log-linear form. Chang and Shao (2004) take a rather unusual approach in regressing ($1/\text{RER}$) on the absolute level of per capita income, using only data for the single year of 2001. It is no surprise that they have encountered a serious problem of heteroscedasticity.

Which is a better model specification: a linear form or a log-linear form? To resolve this issue, we compare the two specifications with a common metric. Since the dependent variable is measured in different scales between these two

specifications, the two specifications cannot be compared directly in terms of the usual measures of goodness of fit such as R^2 and standard error. What we have done is to estimate the log-linear model with the same data and the same sample first. The estimated slope for the log of relative per capita income is 0.342, very close to 0.366 reported in Rogoff (1996). Then we compute the residual equivalent to the linear model, using the formula: $\text{residual} = Q_{it} - \exp[\ln(Q_{it}) + \log\text{-residual}]$. Now the residual series from the two models are directly comparable. The result is: standard error is 0.172 for the linear model and 0.371 for the log-linear model. The comparison indicates that the linear model specification is superior and the log-linear model may entail a serious specification problem. Chart 1 plots the fit of the linear model for the two years of 2002 and 2005. The year of 2002 is significant because in February of that year the US dollar peaked and started to depreciate against other major currencies. The year of 2005 is the latest year in the WDI database. As shown, the linear model provides a good fit with the data.

How should the predicted value and residual (RES) of the extended PPP model be interpreted? In previous studies, the predicted value is regarded without questioning as the equilibrium level in the sense of PPP. Accordingly, the residual is interpreted as the misalignment of an exchange rate. In fact, this interpretation is wrong. The predicted value of the extended PPP model simply means the world average price ratio to the US level for a given relative per capita income. It is critical to realize (largely neglected in previous studies) that the estimated residual for the United States (RES_{USA}) is not zero. In fact, the mean and median of RES_{USA} are 18.8% and 19.8% below the world average price level with a standard deviation of 2.9%. This result is consistent with casual observation that prices in the US are

generally much lower than those in the rest of the world, especially than those of other OECD economies, after the BS effect is accounted for. What explains the average price discrepancy (RES_{USA}) between the United States and the rest of the world? By itself, the extended PPP model does not provide an answer to this question. It would be an interesting topic for future research.

The correct measure of the misalignment of a real exchange rate should be the variable of $(RES_i - RES_{USA})$, which reflects the price discrepancy between an economy and the United States, given the relative per capita income (YPC_i/YPC_{USA}). In Table 4, columns 2-4 list the values of RES_{CHN} , RES_{USA} , and $(RES_{CHN} - RES_{USA})$. Furthermore, columns 5-7 list the mean, median and standard deviation of the variable, $(RES_i - RES_{USA})$ of the world sample. These results may be surprising to many observers involved in the debate on the under-valuation of the Chinese yuan. Relative to the world average (the predicted value of the extended PPP model), the real exchange rate of the Chinese yuan appears to be low. After the BS effect is factored in, the Chinese price level was 9.5% below the world average in 2001 and 20.4% below the world average in 2005. However, it is important to observe that the US price level was also well below the world average for all the years in 1993-2005. Therefore, relative to each other, as shown in column 4, the price discrepancy in the sense of exchange rate misalignment was, in fact, close to zero in 2002-2005. Such a pattern is not unique to China. Approximately, after factoring in the BS effect, the price discrepancies between India, Indonesia and Philippines on the one side and the United States on the other are all close to zero.

It should be acknowledged that the size of the estimated $(RES_i - RES_{USA})$ variable is dependent on the value of the estimated coefficient for relative per capita

income. The flatter the regression line is, the smaller the BS effect would become and the larger the $(RES_i - RES_{USA})$ misalignment would get. How robust is the estimated coefficient (0.900) for relative per capita income? To address this concern, we also estimated the cross-country model individually for each year of 1985-2005. Chart 2 plots the over-time variation of the BS effect coefficient. Apparently, the pool estimate of 0.9 is fairly representative of most years. In comparison, the year of 2001 used in Chang and Shao (2004) does not appear to be very typical.

Next let us proceed to the second step. The objective is to estimate the effect on the service share of employment (LBS) of the real exchange rate. We use the RES variable as the measure of the real exchange rate (deviation), which reflects the variation of the real exchange rate conditioned on a given level of relative per capita income. Of course, the RES variable is not the only determinant of the dependant variable (LBS). What are the other major determinants of the service share employment? A well-known empirical fact is that the service share of employment tends to rise with the level of per capital income. Therefore, we use the log of per capita income (YPC) in current international dollar as the conditioning variable. The log form provides the functional flexibility that the LBS variable is concave in the YPC variable, consistent with the empirical fact.

What is conceptual link between the real exchange rate affect the service share of employment? This is an important relationship that has not been studied adequately so far in the literature. Conceptually, real appreciation of a currency in the sense of the domestic price rising faster than the foreign price has two effects in boosting domestic demand for non-tradables, mostly services. First, there is the relative price effect that tilts the profit incentive away from the export sector towards

the non-traded sector. Second, there is an income effect, especially if real appreciation is brought about through faster wage growth. Fundamentally, we argue that there exists a systematic chain of causal relationships that run from distribution of income between labor and capital via the real exchange rate to the sectoral composition of output and employment, and further to external balance. Take for example the case of China. A low real exchange rate reflects low prices of the products made in China. In turn, low prices are a result of low wages, which reflects, in turn, an income distribution highly unfavorable to labor. Because of low wages, especially the low wages of migrant workers, the demand for non-tradables, mostly services such as housing, education and health, is suppressed. Consequently, the service sector becomes under-sized and under-developed. Since a large fraction of the profits earned in China actually is reaped by foreign investors, who do not consume in China, large external surpluses are a natural consequence. As the real exchange rate rises, it would be reflected in rising real wages, to a certain extent at the expense of profits. In turn, rising real wages would boost the demand for non-tradables, so the service share of employment would expand and, we would argue, China's external surplus would shrink accordingly.

We estimated three versions of this model by varying the group of economies included in the pool regression. Version A includes all the economies with available data. The number of the included economies is 127. The sample period is the same as above, 1985-2005. That combination yields 1515 observations. The regression result is reported below. The estimation method is OLS and the period fixed effect is included. The number in bracket is coefficient standard error.

$$LBS_{it} = -46.757 + 0.175RES_{it} + 11.368\ln(YPC_{it}) + \delta_t \quad (2A)$$

$$(2.650) \quad (0.017) \quad (0.294)$$

Sample period: 1985-2005, Cross-section number: 127, Observation number = 1515, $R^2 = 0.548$, $SE = 0.104$, $SD = 0.154$.

The pool model provides a good fit with the data. Both estimated coefficients are significant and have the expected sign. In particular, the estimated coefficient for the RES variable implies a sizeable effect on the service share of employment. For a 10% increase in the real exchange rate, the service share of employment would rise by 1.75%.

To further sharpen the estimate of the real exchange rate effect on the service share of employment, Version B of the pool model is estimated with the group of economies that include only 68 middle-income economies. Total observations are down to 788. The estimation result is reported below.

$$LBS_{it} = -45.825 + 0.346RES_{it} + 11.457\ln(YPC_{it}) + \delta_t \quad (2B)$$

$$(7.564) \quad (0.030) \quad (0.886)$$

Sample period: 1985-2005, Cross-section number: 68, Observation number = 788, $R^2 = 0.277$, $SE = 0.120$, $SD = 0.139$.

Notice that the estimated coefficient for the RES regressor is raised from 0.175 to 0.346, while the estimated coefficient for the variable of $\ln(YPC)$ is basically unaffected. Finally, we further narrow down the reference group for China by including only those middle-income economies with a population larger than 10 million. The new group has 56 economies and total observations are 728. The estimation result for the version C of the pool model is reported below.

$$LBS_{it} = -48.939 + 0.395RES_{it} + 11.818\ln(YPC_{it}) + \delta_t \quad (2C)$$

(8.094) (0.032) (0.946)

Sample period: 1985-2005, Cross-section number: 56, Observation number = 728,
 $R^2 = 0.295$, $SE = 0.119$, $SD = 0.140$.

Now, the estimated coefficient for the RES is further raised to 0.395, implying that a 10% real appreciation would raise the service share of employment by 4%.

To recapture the above discussion, the cross-country evidence suggests that the real exchange rate has a very powerful effect on the service share of employment. Based on the last two RES coefficient estimates, a 3% increase in the real exchange rate would raise the service share of employment approximately by 1%. In 2005, total Chinese employment was 758.25 million. Accordingly, 1% of total employment is 7.6 million. Suppose that China maintains a steady rate of real appreciation of 5% a year and keeps it for four years. There would be a total cumulative appreciation of 21%, a target within current market expectations. According to our estimation as reported above, real appreciation by such a magnitude would raise the Chinese price level to the world average given the current level of relative per capita income. In turn, the cumulative 21% of real appreciation would help to raise the service share of employment by 7%, or to create 53 million new jobs in the service sector. This is a sizeable expansion of urban employment, more than adequate to offset potential job losses in the manufacturing export sector. Of course, there is a caveat that one needs to be aware of. In general, a long-run relationship estimated with cross-country data is not always a reliable basis for projecting a over time trend movement for an individual economy. Nevertheless, this projection does help to illustrate the effect of real yuan appreciation in more concrete terms that can be readily appreciated by policy makers.

The Impact on Productivity

Now we are in a position to say something about the impact on productivity of yuan's real appreciation. Before we get into detailed estimation, it is useful to clarify the conceptual framework for our analysis. Conceptually, the real appreciation of the Chinese yuan is, by its nature, a change from one static (or long-run) equilibrium to another static equilibrium. Assuming no change in employment, any change in aggregate output resulting from yuan's real appreciation is also a change in aggregate productivity. Since the change is typically effected within a time span of several years, sometimes it is also common to refer to the change in productivity per year as productivity growth. However, it should be clarified that we do not claim that Yuan's real appreciation would raise productivity growth permanently in the long run.

How much would be the impact of yuan's real appreciation on productivity? Quantifying such an effect is, of course, an extremely demanding complex undertaking. We do not claim to have a complete answer. However, it is still possible to sketch out four main channels through which aggregate labor productivity may be raised.

The first channel is the price effect of real appreciation. Other things being equal, real appreciation implies that goods made in China are worth more relative to goods made abroad. The direct price effect on productivity can be approximated as follows. Let Y be GDP, A domestic absorption, X be the value of exports, M the value of imports, P_X export price normalized to be unity, P_M import price. Let $P_T = P_M/P_X$ be the relative price of imports in terms of exports. GDP in terms of the unit of domestic goods and services can be expressed as: $Y = A + X - P_T M$. The price effect on Y of

real appreciation works through P_T . So far in our discussion, the real exchange rate (RER) is defined as a ratio of two prices in the same currency, *i.e.*, $RER = \text{NER} \times (P_{\text{CHN}}/P_{\text{USA}})$, where NER is the nominal exchange rate and P_i is the price level of a country. There is a small technical complication in relating RER to P_T . Abstracting from this small complication, it is approximately true that $\Delta RER/RER \approx -\Delta P_T/P_T$. In other words, one intuitive way to visualize the effect of real appreciation is that imports become cheaper in terms of domestic goods. Therefore, an approximate measure of the impact on GDP (or productivity) is $\Delta Y/Y = (\Delta RER/RER) \times (M/Y)$. In 2005, the ratio of imports to GDP was 31.9%. Accordingly, the effect on aggregate productivity of 21% real appreciation would be $6.7\% = 0.21 \times 0.319$. If the adjusted value of GDP as in Table 3 is used, the import share would be smaller (26.5%) and the effect on aggregate productivity would be $5.6\% = 0.21 \times 0.265$.

The second channel is that rising labor cost induced by real appreciation would pressure the export sector to move up along the value added chain and exit from many labor-intensive low-value added activities, thus raising labor productivity. Rising labor cost may exert an extremely powerful pressure for innovations in products, processes and business structures. Of course, it is no longer possible to make an informed *ex anti* estimate of such an effect. It all depends how the Chinese export sector would perform under pressure. However, it is useful to gain some insight about such an effect from the experience of other economies. Xu (2007) studies in detail how the real appreciation of the Taiwan dollar affected the economic performance of Taiwan. From 1985 to 1992, the Taiwan dollar experienced a cumulative appreciation of 58%. From hindsight, the appreciation by such a magnitude may have overshoot and the exchange rate policy could have been better

managed. By 1998, the value of the Taiwan dollar fell back to 120% of the 1985 level from the peak in 1992. In the short run, the currency appreciation caused severe pains in terms of a slow down of export production and the bursting of an asset price bubble in 1990. However, under pressures of rising labor costs, the export sector managed to be re-structured through relocating overseas, mostly to the mainland China, and climbing up the ladder of the value chain. The successful restructuring is reflected in a significant gain in labor productivity. From 1981 to 2004, the average growth of manufacturing labor productivity was 4.8%. In sub-periods, it was 3.9% in 1981-85, 5.8% in 1986-92, 4.5% in 1993-98 and 4.6% in 1999-2004. It is unmistakable that the structural transformation forced upon or accelerated by the Taiwan dollar appreciation resulted in a significant improvement in labor productivity growth in 1986-92. Taiwan's experience is a relevant guide for projecting the positive impact of real appreciation on China's labor productivity in the manufacturing export sector.

The third channel is the sectoral relocation of labor. In the previous section, we have estimated that according to the experience of other middle-income economies, a 21% real appreciation may help to raise the service share of employment by 7%, or generating 53 million new jobs in the service sector. How would the relocation of labor at such a scale affect productivity? To help us make an informed estimate, it is useful to know something about the employment situation in China. Table 5 presents the data on the annual changes in total employment and the breakdown into agriculture, industry and service for the years of 1993-2005. Observe that between 2003 and 2004, there was data break resulting from the adjustment based on the 2005 national economic census. In view of the data break,

it is no longer possible to make meaningful econometric projections on the basis on the past trends. The relevant facts to observe are that on average, the annual increment in total employment is 7 million a year. In the recent two years of 2004-2005, the reduction in agricultural employment was close to 13 million a year. Together, the annual addition to urban employment is about 20 million. Roughly speaking, this 20 million of labor was equally split between the two sectors of industry and service in 2004 and 2005.

How would the 21% yuan appreciation alter the sectoral composition of employment? Where would be the source of labor for the projected 53 million new jobs in the service sector? No one can know the real answer, *ex anti*. There are many possible configurations, depending on how industrial employment, especially the employment in the export sector, would react to the pressure of rising labor costs. Hua (2007) has argued that real appreciation would have a significant negative impact on manufacturing employment. But hypothetically, a plausible but rather extreme case would be that the annual addition to urban employment (20 million) all goes into the service sector. The 53 million new jobs projected in the above analysis should provide ample room to absorb the annual addition to urban employment for at least 2.5 years. Of course, this is just an extreme scenario. A more realistic configuration of sectoral employment would be a more gradual path, but very likely departs from the even split between industry and service observed for the years of 2004-2005.

With regard to the impact on aggregate productivity of such a pattern of sectoral relocation of labor, it is difficult to come up with a firm estimate. By itself, the impact on aggregate productivity is likely to be small, because the effect of the

annual transfer of 13 million persons out of agriculture should have been reflected in the figure of productivity growth for the years of 2004-2005. Nevertheless, for two considerations, it is very plausible that the growth of aggregate productivity would be faster, not slower, than that for the years of 2004-2005. One consideration is that rising labor cost induced by the real appreciation would lift the floor of labor productivity in urban employment, not just in the export sector. That is a plus for productivity growth, as evidenced in Taiwan's experience mentioned above. The other consideration is that as the urban-rural per capita income widens further and recent measures to reduce and remove labor mobility barriers are implemented, it is likely that the pace of labor leaving agriculture may accelerate beyond 13 million persons a year. Given the urban-rural differential in labor productivity, that is another plus to boost aggregate labor productivity.

Finally, beyond the three channels analyzed above, there is also substantial potential to raise labor productivity in the service sector through specialization, economies of scale and scope, and business consolidation. Of course, as Baumol (1967) argued, the service sector is, in general, less susceptible to productivity growth than the manufacturing sector. Therefore, over time as the service share of employment gets larger, it is inevitable that the pace of labor productivity growth would slow down eventually from the present level (the growth of real GDP per worker averaged at 8.8% a year in 1993-2005).

To sum up our guesstimate, we conjecture that if China could manage a steady real appreciation in the order of 21% (or 5% a year) over a time span of four years, 53 million new jobs could be generated in the service sector and aggregate labor productivity be raised by about 6-8%.

Conclusion

In the present paper, we have presented the case for a large positive role that the real appreciation of the Chinese yuan could play in re-structuring the Chinese economy towards a sustainable balance between domestic and external demands. In this process, the service sector has a strategic role to play. We have suggested that the service sector does have the required potential. Though the service sector appears under-sized in terms of official data, its under-size is more in appearance than in reality. This is because official data may significantly underestimate household consumption of services. Nevertheless, there is no question that the Chinese service sector is under-developed. Though it has not been studied much in the literature, we argue that there is a systematic relationship between the real exchange rate and the relative size of the service sector. More fundamentally, the relationship reflects the logical connection between income distribution between labor and capital on the one side and the relative size of the service sector. A primary cause for the under-development of the Chinese service sector is that wages, especially those of migrant workers (about 100 million), are too low. Therefore, the demand of workers, or the poor in general, for many personal services, especially for education, health and accommodation, is suppressed. Accordingly, through raising labor income, the real appreciation of the Chinese yuan, preferably through faster wage growth and inflation, would stimulate the demand for services, creating jobs in the service sector. We conjecture that the 21% real appreciation could raise the service share of employment by 7% and productivity by 6-8%.

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Tables and Charts

Table 1, Revision of GDP Data, Ratio to the Values Reported in *Statistical Yearbook of China 2005*

| | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 |
|----------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Production side | | | | | | | | | | | | |
| Gross domestic product | 1.020 | 1.031 | 1.040 | 1.048 | 1.061 | 1.077 | 1.093 | 1.109 | 1.127 | 1.144 | 1.157 | 1.168 |
| Agriculture | 1.001 | 1.002 | 1.002 | 1.003 | 1.004 | 1.005 | 1.005 | 1.006 | 1.007 | 1.008 | 1.008 | 1.009 |
| Industry | 1.002 | 1.003 | 1.005 | 1.007 | 1.009 | 1.010 | 1.012 | 1.014 | 1.016 | 1.017 | 1.019 | 1.021 |
| Service | 1.059 | 1.090 | 1.120 | 1.148 | 1.180 | 1.223 | 1.261 | 1.302 | 1.346 | 1.391 | 1.437 | 1.487 |
| Expenditure side | | | | | | | | | | | | |
| Gross domestic expenditure | 1.071 | 1.076 | 1.080 | 1.085 | 1.090 | 1.095 | 1.100 | 1.105 | 1.105 | 1.115 | 1.120 | 1.000 |
| Household consumption | 1.047 | 1.050 | 1.053 | 1.056 | 1.059 | 1.063 | 1.066 | 1.069 | 1.072 | 1.075 | 1.079 | 1.082 |
| Government expenditure | 1.220 | 1.236 | 1.252 | 1.269 | 1.286 | 1.303 | 1.320 | 1.338 | 1.356 | 1.374 | 1.392 | 1.411 |
| Investment | 1.048 | 1.056 | 1.067 | 1.071 | 1.053 | 1.060 | 1.073 | 1.072 | 1.062 | 1.077 | 1.086 | 1.000 |

Source: National Bureau of Statistics, Statistical Yearbook of China, 2005 and 2006. Downloaded from <http://www.stats.gov.cn/tjsj/ndsj/>.

Table 2, A Comparison of the Ratio of Retail Trade to Household Consumption

| Row | Description | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|-----|--|------|------|------|------|------|------|------|------|------|------|------|------|------|
| 1 | China (SYC 2006) | 0.87 | 0.85 | 0.83 | 0.84 | 0.85 | 0.85 | 0.85 | 0.85 | 0.87 | 0.92 | 0.92 | 0.93 | 0.95 |
| 2 | China (SYC 2005) | 0.79 | 0.78 | 0.77 | 0.77 | 0.78 | 0.79 | 0.79 | 0.80 | 0.82 | 0.86 | 0.87 | 0.91 | |
| 3 | Canada | 0.47 | 0.48 | 0.48 | 0.48 | 0.48 | 0.48 | 0.48 | 0.48 | 0.48 | 0.49 | 0.48 | 0.48 | 0.48 |
| 4 | US | 0.48 | 0.49 | 0.49 | 0.50 | 0.49 | 0.49 | 0.49 | 0.49 | 0.48 | 0.47 | 0.47 | 0.47 | 0.47 |
| | memo: | | | | | | | | | | | | | |
| | Ratio of retail trade to goods consumption | | | | | | | | | | | | | |
| 5 | Canada | 0.99 | 1.03 | 1.04 | 1.04 | 1.05 | 1.05 | 1.04 | 1.04 | 1.04 | 1.04 | 1.03 | 1.04 | 1.05 |
| 6 | The United States | 1.13 | 1.16 | 1.17 | 1.18 | 1.18 | 1.18 | 1.18 | 1.17 | 1.17 | 1.15 | 1.15 | 1.15 | 1.14 |
| | Ratio of goods to total consumption | | | | | | | | | | | | | |
| 7 | Canada | 0.47 | 0.47 | 0.46 | 0.46 | 0.46 | 0.46 | 0.46 | 0.47 | 0.47 | 0.47 | 0.47 | 0.46 | 0.46 |
| 8 | The United States | 0.43 | 0.43 | 0.42 | 0.42 | 0.42 | 0.41 | 0.42 | 0.42 | 0.41 | 0.41 | 0.41 | 0.41 | 0.41 |

Source:

- 1) National Bureau of Statistics, Statistical Yearbook of China, 2005 and 2006. Downloaded from <http://www.stats.gov.cn/tjsj/nds/>.
- 2) Statistics Canada, CANSIM database.
- 3) United States Federal Reserve Bank – St Louis, Economic Data – FRED@. Downloaded at <http://research.stlouisfed.org/fred2/downloaddata/>.

Table 3, An Illustrative Adjustment of Household Consumption

| Row | Description | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|-----|---|-------------|---------|---------|---------|---------|---------|---------|---------|----------|----------|----------|----------|----------|
| 1 | GDP, billion yuan | 3,533.4 | 4,819.8 | 6,079.4 | 7,117.7 | 7,897.3 | 8,440.2 | 8,967.7 | 9,921.5 | 10,965.5 | 12,033.3 | 13,582.3 | 15,987.8 | 18,386.8 |
| 2 | Tertiary sector, billion yuan | 1,199.2 | 1,628.1 | 2,009.4 | 2,345.6 | 2,716.5 | 3,078.0 | 3,409.5 | 3,894.3 | 4,462.7 | 5,019.7 | 5,631.8 | 6,501.8 | 7,343.3 |
| 3 | Tertiary sector, % of GDP | 33.9 | 33.8 | 33.1 | 33.0 | 34.4 | 36.5 | 38.0 | 39.3 | 40.7 | 41.7 | 41.5 | 40.7 | 39.9 |
| 4 | Retail trade, billion yuan | 1,427.0 | 1,862.3 | 2,361.4 | 2,836.0 | 3,125.3 | 3,337.8 | 3,564.8 | 3,910.6 | 4,305.5 | 4,813.6 | 5,251.6 | 5,950.1 | 6,717.7 |
| 5 | Retail trade, % of GDP | 40.4 | 38.6 | 38.8 | 39.8 | 39.6 | 39.5 | 39.8 | 39.4 | 39.3 | 40.0 | 38.7 | 37.2 | 36.5 |
| 6 | Household consumption, billion yuan | 1,641.2 | 2,184.4 | 2,837.0 | 3,395.6 | 3,692.2 | 3,922.9 | 4,192.0 | 4,585.5 | 4,921.3 | 5,257.1 | 5,683.4 | 6,383.4 | 7,090.6 |
| 7 | Household consumption, % of GDP | 46.4 | 45.3 | 46.7 | 47.7 | 46.8 | 46.5 | 46.7 | 46.2 | 44.9 | 43.7 | 41.8 | 39.9 | 38.6 |
| 8 | Household consumption of goods, R4/1.1 | 1,297.3 | 1,693.0 | 2,146.7 | 2,578.2 | 2,841.2 | 3,034.4 | 3,240.7 | 3,555.1 | 3,914.1 | 4,376.0 | 4,774.2 | 5,409.2 | 6,107.0 |
| 9 | Service share of household consumption* | 22.69 | 22.69 | 27.12 | 30.26 | 32.69 | 34.68 | 36.36 | 37.82 | 39.11 | 40.25 | 41.29 | 42.24 | 43.12 |
| 10 | Household consumption of goods estimated, R8/(1-R9/100), billion yuan | 1,678.1 | 2,190.0 | 2,945.5 | 3,696.7 | 4,221.1 | 4,645.5 | 5,092.5 | 5,717.4 | 6,427.7 | 7,324.4 | 8,132.5 | 9,365.6 | 10,736.1 |
| 11 | Change in household consumption, R10 - R6, billion yuan | 36.9 | 5.6 | 108.5 | 301.1 | 529.0 | 722.5 | 900.5 | 1,131.9 | 1,506.4 | 2,067.3 | 2,449.1 | 2,982.3 | 3,645.5 |
| 12 | Change in GDP, % of R1, R11/R1*100 | 0.010 | 0.001 | 0.018 | 0.042 | 0.067 | 0.086 | 0.100 | 0.114 | 0.137 | 0.172 | 0.180 | 0.187 | 0.198 |
| 13 | New household consumption share, % of GDP | 47.0 | 45.4 | 47.6 | 49.8 | 50.1 | 50.7 | 51.6 | 51.7 | 51.5 | 51.9 | 50.7 | 49.4 | 48.7 |
| 14 | New tertiary sector share, % of GDP | 34.6 | 33.9 | 34.2 | 35.7 | 38.5 | 41.5 | 43.7 | 45.5 | 47.9 | 50.3 | 50.4 | 50.0 | 49.9 |
| 15 | Tertiary sector, % of GDP, average for middle-income economies with a population > 10 million | 49.4 | 49.8 | 51.1 | 51.5 | 52.6 | 54.0 | 54.0 | 53.8 | 54.5 | 54.9 | 54.4 | 54.0 | 54.2 |

Source:

- 1) National Bureau of Statistics, Statistical Yearbook of China, 2005 and 2006. Downloaded from <http://www.stats.gov.cn/tjsj/ndsj/>.
- 2) World Bank's World Development Indicators database.
- 3) Our own calculation.

Table 4, Measures of the Real Exchange Rate, Ratio to the US Price Level

| Description | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| China, level | 0.190 | 0.209 | 0.240 | 0.252 | 0.252 | 0.248 | 0.241 | 0.241 | 0.240 | 0.237 | 0.239 | 0.249 | 0.253 |
| China, residual | -0.157 | -0.147 | -0.157 | -0.155 | -0.137 | -0.122 | -0.121 | -0.108 | -0.095 | -0.111 | -0.156 | -0.188 | -0.204 |
| The United States, residual | -0.177 | -0.180 | -0.215 | -0.220 | -0.198 | -0.176 | -0.164 | -0.146 | -0.125 | -0.130 | -0.167 | -0.201 | -0.212 |
| $RES_{CHN} - RES_{USA}$ | 0.020 | 0.033 | 0.058 | 0.065 | 0.061 | 0.053 | 0.044 | 0.038 | 0.030 | 0.018 | 0.011 | 0.013 | 0.008 |
| Memo: the world sample | | | | | | | | | | | | | |
| Mean, $RES_i - RES_{USA}$ | 0.174 | 0.177 | 0.214 | 0.218 | 0.194 | 0.173 | 0.161 | 0.142 | 0.124 | 0.129 | 0.166 | 0.200 | 0.212 |
| Median, $RES_i - RES_{USA}$ | 0.160 | 0.143 | 0.177 | 0.182 | 0.165 | 0.144 | 0.129 | 0.102 | 0.083 | 0.087 | 0.136 | 0.152 | 0.173 |
| Standard deviation, $RES_i - RES_{USA}$ | 0.146 | 0.142 | 0.164 | 0.157 | 0.147 | 0.146 | 0.150 | 0.164 | 0.159 | 0.160 | 0.155 | 0.168 | 0.178 |

Source:

- 1) World Bank's World Development Indicators database.
- 2) Our own calculation.

Table 5, Annual Change in Employment, Million Persons

| Description | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|------------------|--------|--------|--------|-------|------|------|-------|-------|------|-------|-------|--------|--------|
| Total employment | 6.56 | 6.47 | 6.1 | 8.85 | 8.7 | 8.17 | 7.57 | 6.91 | 9.4 | 7.15 | 6.92 | 7.68 | 6.25 |
| Agriculture | -10.19 | -10.52 | -10.98 | -7.1 | 0.2 | 3.37 | 5.91 | 2.75 | 4.7 | 3.57 | -3.24 | -12.77 | -12.99 |
| Industry | 6.1 | 3.47 | 3.43 | 5.48 | 3.44 | 0.53 | -1.79 | -2.02 | 0.65 | -5.04 | 2.97 | 8.43 | 11.64 |
| Service | 10.65 | 13.52 | 13.65 | 10.47 | 5.05 | 4.28 | 3.45 | 6.18 | 4.05 | 8.62 | 7.19 | 12.02 | 7.6 |

Source: National Bureau of Statistics, Statistical Yearbook of China, 2005 and 2006. Downloaded from <http://www.stats.gov.cn/tjsj/nds/>.

Chart 1, Pool Regression Results for 2002 and 2005

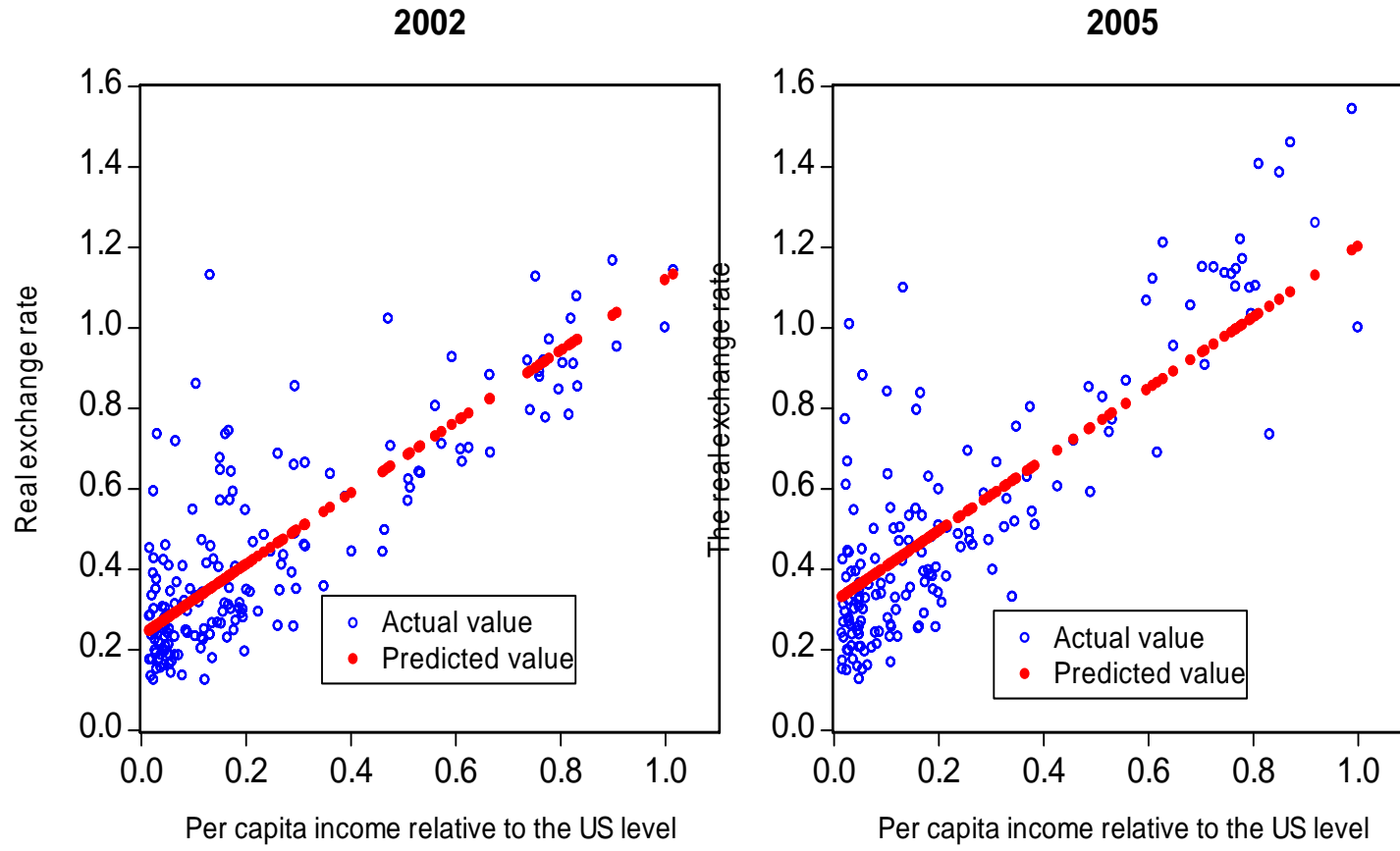


Chart 2, The Variation of the BS Effect Estimate

