

ECONOMIC GROWTH AND THE ROLE OF CURRENCY UNDERVALUATION

SONG ZHICHENG

SINGAPORE MANAGEMENT UNIVERSITY

2010

Economic Growth and the Role of Currency Undervaluation

by
Song Zhicheng

Submitted to School of Economics in partial
fulfillment of the requirements for the Degree of
Master of Science in Economics

Supervisor: Prof. Hoon Hian Teck

Singapore Management University
2010

Copyright (2010) Song Zhicheng

Economic Growth and the Role of Currency Undervaluation

Song Zhicheng

Abstract:

In this paper, we demonstrate that currency undervaluation benefits national economic growth based on cross-national and sectoral evidences. Weak currency effectively stimulates a country's participation in the international trade market, and facilitates national economic component transformation, both in its value creation process and output allocation phase. We study three manifestations of exchange rate undervaluation as an accelerator to economic development. The currency depreciation effect is both significant and economically sizeable. We first show the positive relationship between the national and sectoral economic growth rates and the extent of real exchange rate undervaluation. This level-based effect implies that a 50 percent undervaluation, approximately a standard deviation of our depreciation measure, is associated with a contemporaneous growth boost ranging from 0.7 percentage points to 7.5 percentage points per annum for various sectors. We then show that exchange rate depreciation stimulates national growth through economic component change: we establish that currency undervaluation tends to facilitate the development of tradable-intensive economic activities at the expense of squeezing some other non-tradable-intensive economic activities and exchange rate depreciation encourages savings, contributing to capital accumulation, which may further counteracts the negative impact of a weak currency on consumption and service sectors through a spillover effect. Finally, we construct a tradability index for 21 out of 23 manufactures. According to this measure, we actually demonstrate that the undervaluation effect is stronger in sub-sectors in which goods are more tradable in the international market. Our results are robust to controlling for a variety of alternative explanations and to instrumenting exchange rate undervaluation to alleviate concerns of reverse causality.

Keywords: Currency Undervaluation, Real Exchange Rate, Economic Growth, Component Change

Contents

Acknowledgements	ii
1 Introduction	1
2 Literature Review	3
3 Estimation Strategy	6
3.1 Sectoral Level Effect	6
3.2 Component Change and Economic Growth	10
3.3 Tradability Effect	12
4 Data	13
4.1 Primary Variables	13
4.2 Control Variables	13
4.3 ISIC Sectoral Data	14
5 Empirical Results	15
5.1 Undervaluation and Sectoral Growth	15
5.2 Undervaluation and Component Change	19
5.3 Undervaluation and tradability	22
6 Policy Discussion	23
7 Conclusions	24
8 Appendix: Figures	26
References	29

Acknowledgements

I would like to express my gratitude to all those who helped me during the writing of this thesis. My deepest gratitude goes first and foremost to Professor Hoon Hian Teck, my supervisor, for his constant encouragement and guidance. He has walked me through all the stages of the writing of this thesis. Without his consistent and illuminating instruction, this thesis could not have reached its present form.

Second, I would like to express my heartfelt gratitude to Professor TSE Yiu Kuen, who provided me with this great opportunity to study here in Singapore Management University. I am also greatly indebted to Professor Do Quoc-Anh, Professor Davin Chor, and Professor Ruanjai Suwantaradon, who shared with me their wisdom and professional knowledge.

Last my thanks would go to my beloved parents for their loving consideration and great confidence in me all through these years. I also owe my sincere gratitude to my friends and my fellow classmates who gave me their help and time in listening to me and helping me work out my problems during the difficult course of the thesis.

1 Introduction

The real exchange rate misalignment is often cited as a key factor of economic growth. Competitive currencies ^① have been thought stimulating and sustaining most East and Southeast Asian economic miracles in the last 30 years. More recently, several other countries have also followed this path. Chile, Uganda and Mauritius in the 1980s and India and China in the 1990s have all benefited from competitive real exchange rates, which fostered exports and output growth. Most Latin American and African countries, on the other hand, have suffered from severe balance of payment crises due to exchange rate overvaluation.

From the empirical perspective, there exists an extensive body of literature that relates economic growth with real exchange rate level. On the one hand, bad exchange rate policy, in the form of an overvalued exchange rate, has been much analyzed. A persistently overvalued currency leads to factor misallocations, loss in efficiency, higher inflation, and hence lower GDP growth [Reference see, Razin and Collins (1999)[20], Johnson, Ostry, and Subramanian (2007)[12], Prasad, Rajan, and Subramanian [19].]. On the other hand, the parallel theoretical and analytically equivalent conclusion - that exchange rate undervaluation is helpful to growth - is also documented by Johnson, Ostry, and Subramanian (2007)[12], Rodrik (2008)[22], Gala (2008)[10] and Bhalla (2008)[2] based on the cross-national evidence.

Among these two arguments, the former is widely accepted. Overvalued exchange rates are associated with shortages of foreign currency, rent-seeking and corruption, unsustainably large current account deficits, balance-of-payment crises, and stop-and-go macroeconomic cycles, all of which are damaging to economic growth. However, the currency undervaluation effect is under a lot of suspicion. There may exist an equilibrium exchange rate level, which adapts to the national economic environment and hence is optimal to the economic growth. Given assumptions like that, real exchange rate depreciation as an alternative form of currency misalignment, may also hurt the economic development.

Even though empirical studies reveal lots of evidence that there exist various kinds of positive relationship between currency undervaluation and national economic growth, as mentioned by Rodrik (2005)[21], when government policy (currency depreciation here) responds systematically to economic or political objectives (economic growth here), the standard growth regression in which economic growth is regressed on policy tells us nothing.

^① In this paper competitive currency, weak currency, currency undervaluation, currency depreciation, and real exchange rate undervaluation are adopted interchangeably to express the same meaning.

ing about the effectiveness of policy and whether government motives are good or bad. A wide-ranging discussion of the shortcomings of these growth regressions include: parameter heterogeneity, outliers, omitted variables, model uncertainty, measurement error, and endogenous problem. Rodrik at last declares that we need to look for direct evidence about the channels through which policies are hypothesized to operate.

To the best of our knowledge, while there is a budding theoretical literature explaining the mechanism through which economic growth is accelerated by currency undervaluation, and empirical findings revealing the negative correlation between economic growth and the real exchange rate, few empirical studies have been taken to explicitly collect the evidence on the undervaluation effect mechanism.

This paper argues that currency undervaluation indeed benefits the national economic growth as well as the development of its various component sectors. We collect the empirical evidences that real exchange rate depreciation increases gross domestic savings and contributes to capital accumulation, facilitates international trade development, stimulates countries' economic component reform, and hence boosts national productivity as well as sectoral development.

The structure of this paper is organized as follows. The next section, Section 2, reviews the typical empirical study and summarizes some prevailing ideas explaining how currency undervaluation may impact different parts of economy and hence facilitate economic growth. Section 3 presents our empirical estimation strategy for measuring and demonstrating the currency depreciation effect. Three manifestations of real exchange rate depreciation as an accelerator to economic growth are investigated: various sectors of national economy benefit from currency undervaluation, national economy goes under component reform, and sectors in which products are more tradable in the international trade market take a comparative advantage from the weak currency. Section 4 describes the data sets adopted in this paper. Section 5 explains our empirical results. In section 6, we discuss the currency undervaluation policy. Finally, Section 7 concludes.

2 Literature Review

Among those empirical studies mentioned before, Rodrik (2008)^[22] claims that for most developing countries, high-growth periods are associated with undervalued currencies. The real exchange rate seems to play a fundamental role in the process of economic growth. Following Rodrik's general idea, define the real exchange rate as ^① :

$$\ln RER_{it} = \ln(XRAT_{it}/PPP_{it}), \quad (2.1)$$

where i is an index for countries and t is an index for (5-year) time periods. Nominal exchange rate ($XRAT$) and purchasing power parity conversion factors (PPP) are expressed as U.S dollar per units of local currency^②. On the one hand, when RER is smaller than one, it indicates that the value of the currency is more depreciated than is indicated by purchasing power parity. On the other hand, as per Balassa-Samuelson, in practice non-traded goods are also cheaper in poorer countries, so the general living cost in these countries should be relatively lower, which requires an adjustment of RER:

$$\ln RER_{it} = \alpha + \beta \ln RGDPC H_{it} + f_t + u_{it}, \quad (2.2)$$

whereby generating the Balassa-Samuelson-adjusted real exchange rate (\widehat{RER}). Coefficient β captures the Balassa-Samuelson effect and is supposed to be positive. Rodrik indeed demonstrates empirically that $\hat{\beta}$ equals to 0.24, which confirms a 2.4 percentage real exchange rate appreciation per 10 percent of income increase. Accordingly, the the corresponding real exchange rate undervaluation index is calculated as follows:

$$\ln UNDV_{it} = \ln \widehat{RER}_{it} - \ln RER_{it}. \quad (2.3)$$

The baseline specification takes the form (panel data, fix effect, within estimate):

$$growth_{it} = \alpha + \beta \ln RGDPC H_{it-1} + \delta \ln UNDV_{it} + f_i + f_t + u_{it}. \quad (2.4)$$

^① Rodrik's definition of RER is in fact an "external" RER, which is the ratio of the overall price levels between two economics. There exists an alternative "internal" real exchange rate definition as $RER_I = R_N/R_T$. It's a domestic economy ratio of the price of nontradable goods to the price of tradable goods. For both definitions, a rise in the RER constitutes an appreciation. Reference see Bhalla (2008)^[2].

^② In fact, Rodrik defines his PPP and XRAT as national currency units per U.S. dollar, but hereafter we just follow the conventional definition, refreshing some specification, with the original major idea and conclusion unaffected. Specifically, purchasing power parity conversion factor is the number of units of U.S dollar required to buy the same amount of goods and services in the United States as 1 local currency would buy in the domestic market. Nominal exchange rate is the number of units of U.S dollar required to change for 1 local currency. By our definition, the RER captures the comparable domestic living cost across countries. According to the law of one price, reasonable RER should be one for all countries.

Adopting the model to estimate for the panel as a whole, the regression yields a highly significant estimate for δ : 0.017. By grouping countries according to the income level, Rodrik further demonstrates that the poorer the country, the stronger the stimulant devaluation effect operates. And also, Rodrik provides a few evidences that competitive currency promotes the economic growth through the compositional changes in the structure of economic activity.

Woodford (2009)^[26] expresses some doubt on Rodrik's judgment. In the first place, according to his criticism, the original measure of undervaluation is in fact equal to

$$\ln UNDV = 0.24 \ln RGDPC H_{it} - \ln RER_{it},$$

and since lagged per capita income is also included in the measure of national economic growth rate as

$$growth_{it} = 0.2 [\ln RGDPC H_{it} - \ln RGDPC H_{it-1}],$$

Rodrik's basic specification is actually equivalent to a regression of $growth_{it}$ on the variable

$$-\ln RER_{it} + 1.2 growth_{it}$$

and lagged per capita income $\ln RGDPC H_{i,t-1}$. Therefore, the positive correlation evidence demonstrated by Rodrik seems trivial. Secondly, the Balassa-Samuelson effect is expected to create a correlation between income and the real exchange rate in a relative higher frequency and in an indirect mechanism. It's a mechanism according to which both the income and the relative price of tradable are affected by a third variable like productivity growth in the tradable sector. From this point of view, Rodrik's adjusted UNDV index looks unnecessary and biased. Last but not least, even granting the existence of a positive correlation between the level of a country's real exchange rate and its growth, it needs more evidence of a causality so as to support Rodrik's position.

When it comes to the theoretical explanation on currency undervaluation effect, exchange rate is discussed widely to affect economy through various channels. It scales the national price system to the world's, influences key macro price ratios such as those between tradable and non-tradable goods, capital goods and labor, and even exports and imports. The exchange rate is an asset price, partially determines inflation rates through the cost side and as a monetary transmission vector, and can have significant (both short and long run) effects on effective demand.

Frenkel and Taylor (2007)^[9] presents five channels through which economy is boosted by exchange rate polity:

Resource allocation: Through its effects on the price ratios, the exchange rate can significantly influence resource allocation. Through effects on both resource allocation and aggregate demand, a relatively weak rate can help boost employment.

Economic development: Often in conjunction with commercial and industrial policies, the exchange rate can be deployed to enhance overall competitiveness and thereby boost productivity and growth.

Finance: The exchange rate shapes can be used to control expectations and behavior in financial markets. Exchange rate policy mistakes can easily lead to highly destabilizing consequences.

External balance: The trade and other components of the current account usually respond to the exchange rate, directly via substitution responses and to shifts it can cause ineffective demand.

Inflation: The exchange rate can serve as a nominal anchor, holding down price increases via real appreciation and/or maintenance by the authorities of a consistently strong rate.

Gala (2008)^[10] analyzes the connections between real exchange rate and development focusing on macro programming aspects of development, instead of the more traditional trade and industrial policy discussions. The conclusion is two-fold:

In the short term, for given productivity levels, a relatively undervalued currency causes lower real wage and higher capital return, hence avoids savings displacement and contributes to capital accumulation.

In the long run, weak currency would encourage the development of the non-traditional tradable sector, helping countries go through component change and increasing productivity and employment. Moreover, the development of a non-traditional tradable sector may further increase real wage, counteracting the negative effects of depreciation on consumption.

Considering the limitation of Rodrik's empirical work and the existent theoretical channels through which currency undervaluation may facilitate economic growth, we want to find more detailed and explicit evidence that depreciation benefits economic growth through some mechanism.

3 Estimation Strategy

In this section we lay out our empirical framework for each of the three questions that we intend to address: the effect of currency undervaluation on sectoral growth, the undervaluation effect on economic component change and its contribution to national economic growth, and the differential effect of currency undervaluation in tradable-intensive sectors.

3.1 Sectoral Level Effect

3.1.1 Baseline Specification

We first investigate the effect of exchange rate depreciation on economic activities. As mentioned before, Rodrik’s panel evidence suffers serious suspicion partially from his “trivial” growth on growth regression model as well as the endogenous problem.

In this paper, we divide the whole economy into several sectors, by three standards of classification: agriculture, industry (including manufacture), and service departments categorized according to value added activities, import and export as components of international trade, and consumption and saving (investment) in terms of income allocation.

By separating the whole economic performance, we assume that each economic activity only impacts the real exchange rate to a relative weak, undefined extent. Therefore, significant positive correlation, if exists, between Rodrik’s undervaluation index and the sectoral growth may provides a much more persuasive evidence supporting the undervaluation stimulus standpoint. Our baseline specification takes the form:

$$SecGrowth_{it} = \alpha + \beta \ln SecLevel_{it-1} + \delta \ln UNDV_{it} + f_i + f_t + u_{it} \quad (3.1)$$

where *SecLevel* is the level of economic performance of particular sector. Specifically, value added level is adopted to capture the performance of each sector in production category, while total value involved in a particular sector describes the scale of corresponding economic activities in the other two categories. *SecLevel*_{*it*-1} captures the previous level of sectoral performance as the conventional standard convergence term. *f_i* and *f_t* are sets of country and time period dummies. Our primary interest lies in δ . Given the fixed-effects framework, what we are estimating is the “within” effect of undervaluation, namely the impact of changes in undervaluation on changes in (sectoral) growth rates within countries. We expect to see a significant and positive coefficient δ , which would confirm our basic idea

that weak currency benefits economic growth.

3.1.2 Further Checks

To further check the robustness of our results, we extend our concerns on sample periods division, nonlinear currency misalignment effect, long term effect, measurement error, omitted variables, reverse causality and income effect,.

Sample periods division Although we've already tried to capture the different time period fixed effect using time dummy variables. Here, we further check if the undervaluation effect holds true across different historical periods.

To that end, we separate the whole time frame into three pieces. Year 1972 is chosen as a divide because the Bretton Wood system actually collapsed in Aug.1971, when the United States unilaterally terminated convertibility of the dollar to gold. We further truncate our sample at year 1991 simply for generating one more subperiod.

Nonlinearity Property As there exist divergent opinion towards the effect of currency undervaluation and currency overvaluation, here we discriminate these two alternative currency misalignment by a D_U dummy. When a currency is calculated as depreciated, we define $D_U = 1$, and $D_U = 0$ when currency is calculated as overvalued. Then we pursue the following specification:

$$SecGrowth_{it} = \alpha + \beta \ln SecLevel_{it-1} + \delta \ln UNDV_{it} + \gamma D_U \times \ln UNDV_{it} + \eta D_U + f_i + f_t + u_{it} \quad (3.2)$$

In this setting, if γ is significantly different from zero, one cannot deny that there may exist a nonlinearity property between currency misalignment and economic growth when the real exchange rate goes from overvaluation to undervaluation.

Long term effect We are concerned that our finding of undervaluation effect may not hold true if we change the sample data frequency. Therefore, we adopt 5-year average data for the same basic specification, to check if the currency depreciation effect is still unaffected.

Omitted variables We check that the currency underestimation effect is indeed independent of the impact of other variables which are correlated with undervaluation and also affect sectoral growth. For this purpose, we add controls for government consumption stimulation, $Govcsp$, the extent to which a country is involved in the international trade, $Open$, the human capital abundance index, Edu , the domestic interest rate level, $Interest$, the relative price of a country's export to import, TOT , the domestic price level, $Inflation$, a measure of the rule of law, ROL , and a measure of control of corruption, COC .

Measurement error There are some potential concerns with relying exclusively on $\ln UND V$ suggested by Rorik. Therefore, we include an alternative measure of currency misalignment^① based on the concept of behavior equilibrium exchange rate (BEER), following Koske (2008)^[14]. This BEER approach first captures the equilibrium exchange rate from the economic fundamental perspective, and then calculates the misalignment of the exchange rate as deviation from the equilibrium rate. Specifically, we capture the long term equilibria relationship from the following regression:

$$\ln REER = \alpha + \ln Fundamental_{it} \times \beta + f_i + f_t + u_{it}, \quad (3.3)$$

and from which we estimate the behavioral equilibrium exchange rate as:

$$\ln BEER = \ln \widehat{REER}. \quad (3.4)$$

Then, we calculate the currency undervaluation as the deviation of REER from the estimated BEER:

$$\ln UND V2 = \ln BEER - \ln REER. \quad (3.5)$$

As for the economic fundamentals, we include the variables with traditional economic meaning as follows:

Real GDP per capita (RGDPCH) as a proxy for the demand of non-tradable goods. The underling assumption is that economies with higher real GDP per capita spend a higher share of their income on services. The variable is assumed to be positively related to the real exchange rate, with a rise in the demand for non-tradable goods putting upward pressure on the price of non-tradable goods, thus leading to an appreciation of the real exchange rate.

Government consumption as ratio to GDP (CGOVGDP). As government consumption primarily falls on non-tradable goods, the same logic explained RGDPCH applies here.

The terms of trade (TOT). A rise in terms of trade leads to an improvement in the current account and, hence, permits a real appreciation of the currency in order to restore equilibrium.

The sum of exports and imports over GDP as a measure of openness (OPEN). Openness is expected to be negatively related to the real exchange rate. A rise in openness is assumed to exert competitive pressure on an increasing range of tradable goods in the domestic economy, thereby leading to a decline in prices and wages and hence, to a depreciation of the

^① Some researchers also calculate misalignments based on the difference between black market and official exchange rate, which is the so-called black market premium.

real exchange rate.

Increase in the price of a basket of goods and services that is representative of the economy as a whole (Inflation). Price inflation usually leads to wage inflation, so that companies can retain good workers. Unfortunately, the wages creep up more slowly than do the prices, because companies are reluctant to increase these fixed costs. Higher prices combined with stagnant wages means a relative higher living cost, hence higher real exchange rate.

Reverse causality We are concerned that sectoral economic activities may have an impact on currency valuation on top of the effect of currency depreciation on the sectoral economic growth. Considering that it is difficult to think of an exogenous regressor that influences the real exchange rate without plausibly also having an independent effect on growth, we rule out the conventional instrumental variables approach. Therefore, in order to alleviate the concern with reverse causality problem, we adopt lagged values of regressors ($\ln UNDV_{it-1}$ as in our case) as instruments for right-hand side variables. It, at least, allows to control for any simultaneous effect of sectoral economic activity on currency valuation.

Income effect We check whether the effects we find and attribute to currency undervaluation are robust to the development level of countries. To that end, we separate the whole sample into two groups: developing samples with annual national income level between US\$1000 and US\$8000 and developed samples with annual national income greater than US\$8000. By regressing the specification *equation*(5), we compare undervaluation coefficients based on the alternative samples, to see if there exists significant difference.

Also we investigate in a more detail way to measure to what extent income level would impact the undervaluation efficacy on the sectoral growth. For this purpose, we group our panel data sample according to the annual national income level, and index each group with a develop level measure *Deve*. Notably here that, since countries like Singapore and Japan had been experienced a flying development in the past 50 years, the same country would be assigned to different development groups at different periods according to its development status in quo. After that, we extend our regression specification as following:

$$SecGrowth_{it} = \alpha + \beta \ln SecLevel_{it-1} + \delta \ln UNDV_{it} + \gamma Deve * \ln UNDV_{it} + f_i + f_t + f_d + u_{it} \quad (3.6)$$

where f_d are dummies for the status of national economic development. In this specification, we will see a significant coefficient γ , either positive or negative, if exchange rate depreciation effect does vary according to different income level.

3.2 Component Change and Economic Growth

3.2.1 Comparative Advantage and Component Change

Now we turn to tests of the channel through which real exchange rate facilitates the whole economy as well as the economic sectors. To confirm our hypothesis that currency undervaluation favors some economic sectors more than the others, so as to cause the component change of the national economy, we show that component share of GDP for different sectoral activities are indeed affected by the currency depreciation in different way.

First of all, we start with our intuition to see if the undervaluation efficacy on industry and agriculture is bigger than that on service sector. For this purpose, we pool the alternative sector and service observations together, and do a sector, country, and time 3-dimension regression as following:

$$SecGrowth_{sit} = \alpha + \beta \ln SecLevel_{sit-1} + \delta \ln UNDV_{it} + \gamma D_s * \ln UNDV_{it} + \eta D_s + f_i + f_t + u_{sit} \quad (3.7)$$

where D_s is a sector dummy with $D_s = 1$ for the conventional tradable-intensive sectors and $D_s = 0$ for service department, which is traditionally treated as a non-tradable-intensive sector. In this specification, our primary interest lies in the coefficient γ . We actually expect a significant positive γ , demonstrating that exchange rate depreciation increases the growth rate more in higher tradable-intensive sectors.

And also we testify the common sense that export expands at the expense of import shrinking in terms of its component share within total trade volume. To that end, we adopt the following specification:

$$ShareChange_{it} = \alpha + \beta \ln SecShare_{it-1} + \delta \ln UNDV_{it} + f_i + f_t + u_{it} \quad (3.8)$$

where $ShareChange_{it} = SecShare_{it} - SecShare_{it-1}$ corresponds to import/export component change within the whole international trade quantity. According to the common sense, we expected to see a positive δ when export is considered and negative δ when it turns to import.

Given the assumption that some sectors growth faster than the others when currency is depreciated, we expect the national economy goes under a component change process. Therefore, we regress the component share change of each sector on the undervaluation

separately:

$$CptChange_{it} = \alpha + \beta \ln SecShare_{it-1} + \delta \ln UNDV_{it} + f_i + f_t + u_{it} \quad (3.9)$$

where $CptChange_{it} = SecShare_{it} - SecShare_{it-1}$ are percentage change of component share of particular economic sector (or percentage change in ratio of particular economic activity size over GDP). As before, we concern with the sign and significance of the coefficient δ . We explain a significantly positive δ as a confirmative component expansion effect, while treat a significantly negative δ as a component contraction effect.

Here, similar to our work for the sectoral level effect, we check whether the component change effects we find and attribute to currency undervaluation are consistent for different status of countries' development. To that end, we again separate the whole sample to two groups as what we did previously.

3.2.2 Component Reform and Spillover Effect

If everything comes in accordance with our expectation that undervaluation has different impacts on different sectors and that the different impacts indeed cause component change of national economy, in order to confirm our assumption that undervaluation benefits economic growth, it still needs to demonstrate that the assumed undervaluation facilitated component change is good for economic development.

To that end, we regress the economic growth on the undervaluation facilitated component change:

$$RgdpchGrowth_{it} = \alpha + \beta \ln RGDPC_{it-1} + \delta \ln CptStatus_{it-1} + u_{it} \quad (3.10)$$

where $\ln CptStatus$ corresponds to various economic component status and $RgdpchGrowth$ is adopted here to reflect the development of national productivity.

Last but not least, we check if undervaluation impacts the sectoral economic activities in a direct way. That is, so far from our study, even through all the assumptions are confirmed, it's still possible that currency depreciation does not actually affect some of the economic department in the first place. But instead, undervaluation accelerates the growth of certain sectors, through which the other sectors are affected indirectly. In order to check the existence of the inter-sectoral spillover effect, we includes a national growth term or sectoral growth term into the basic specification *equation(5)*. We can rule out the possibility of complete spillover effect only if the $\ln UNDV$ coefficient δ is still significantly positive.

3.3 Tradability Effect

A more concrete investigation to manifest our hypothesis that exchange rate depreciation favors more on tradable-intensive sectors, that currency undervaluation has a constructional transformation effect, and that weak real exchange rate benefits economic growth, involves a tradability measure. We claim that real exchange rate accelerates the economic growth at least partially through its trade with the rest of the world: with a more competitive currency, country trade more with the other countries; given the assumption that currency undervaluation effect operates more efficient for the tradable-intensive product, real exchange rate depreciation will actually update the national economic component structure, and improve the national development as a whole.

Specifically, we propose the following specification so as to authenticate the tradability effect:

$$SecGrowth_{sit} = \alpha + \beta \ln SecLevel_{sit-1} + \delta \ln UNDV_{it} + \gamma I_{tra} * \ln UNDV_{it} + f_s + f_i + f_t + u_{sit} \quad (3.11)$$

where the I_{tra} index actually captures our “tradability” idea. The larger the index, the more tradable it reflects for the products of particular sectors. Therefore, we in fact expect a significantly positive coefficient γ in this specification.

And it's worth noting that the tradability index I_{tra} here in our specification is invariable across countries and time periods. By pursuing this approach, we actually assume the tradability is a natural property which is independent of particular country's trade activity. We prefer this setting because when I_{tra} is calculated from the whole collective sample set, it generally rules out the traditional endogenous problem, which, otherwise, may leave our specification under unnecessary suspicion.

4 Data

Data for the empirical investigation generally comes from the Penn World Tables (PWT 6.2 and 6.3), the World Development Indicator (WDI), the Organisation for Economic Co-operation and Development Statistics (OECD.Stat) and the Quality of Government Datasets (QoG)^①. The combined data set consists of a maximum of 184 countries and involves a time frame from 1960 to 2008.

4.1 Primary Variables

National data comes from PWT 6.2 and 6.3, containing nominal exchange rate (Xrat), purchasing power parity (PPP), and real gross domestic product per capita (rgdpch: constant price, chain series). The time frame covers from 1950 to 2008.

Shares of GDP data are collected from WDI database, covering period from 1960 to 2004. As we mentioned earlier, this part of data can be divided into three categories. Observations in the productive category, namely, value added data (% of GDP) for agriculture (agri), industry (indu), manufacture (manu), and service (serv) are reported. Specifically, according to the data collection in WDI, manufacture is actually a subsector of industry. And the sum of agriculture share, industry share and service share come out to be unit. From the international trade perspective, imports of goods and services as percent of GDP (impo) and exports of goods and services as percent of GDP (expo) are collected as well as the total trade share as sum of both import and export shares. When it comes to the national income allocation, the total GDP is divided into two parts as final consumption expenditure (fcsp) share and gross domestic savings (dsav) share. More detailed division for consumption contains household final consumption expenditure (hcsp) and general government final consumption expenditure (gcsp).

4.2 Control Variables

Control variables adopted in this paper include openness to trade (Open), government consumption (Govcsp), terms of trade index (ToT, good and service, Yr1995=100), real interest rate (rir), consumer price inflation (inflation), average schooling year aged 15 and over (Edu: 5-year frequency), “Rule of Law” measuring the extent to which agents have

^① The institute was established in 2004 by Soren Holmberg and Bo Rothstein at the Department of Political Science at Goteborg University, and aims at conducting and promoting research on the causes, consequences and nature of good governance or the quality of government.

confidence in and abide by the rules of society (RoL) and “Control of Corruption” measuring perceptions of corruption. All these data come from QoG database, which are compiled by researchers at the Quality of Government (QoG) Institute, based on various existent datasets.

4.3 ISIC Sectoral Data

As mentioned above, we intend to demonstrate the assumption that undervaluation benefits more to the sectors whose products are more tradable in the international market. To this end, we need to quantify the property of international trade ability for products from different sectors.

Since it’s difficult to collect detailed sectoral output data for a large sample of countries, and it’s even more difficult to match the output data classification with the sectoral trade data category, in this part of empirical study, we base on OECD.Stat database. Well organized in the Structural Analysis (STAN) dataset, sectoral imports, exports and output sequences according to the International Standard Industrial Classification (ISIC) are reported for 30 OECD countries. And the time period covers from 2000 to 2007.

In this paper, we divide sectoral export volume by the corresponding output volume so as to calculate the tradability index (I_{tra1}). For the purpose of robust test, we also replace the export volume by the average of import and export volume and calculate an alternative tradability index (I_{tra2}). It’s worth noting that we calculate the tradability indices as the ratio of total 8-year sectoral export (resp. trade) volume over the total 8-year sectoral output quantity for all the OECD countries as a whole.

Considering the fact that OECD shares 72% of world gross national income (GNI), and that OECD accounts for 61% share of world trade, we think it’s well-founded to capture the product trade intensity based on its economic activity. And also, by calculating tradability indices the way we propose, we actually assume that product trade intensity is a natural property, which does not vary across countries and time periods.

5 Empirical Results

5.1 Undervaluation and Sectoral Growth

5.1.1 Basic Evidence

We start with documenting the sectoral growth effect of the real exchange rate depreciation. In Table 1 we report the undervaluation effect based on *equation*(5). Column (1) reports the undervaluation effect on the country-level economic growth. Columns (2) through (4) include the sectors categorized by value added activities. Columns (5) through (7) contains the trade activities. And columns (8) and (9) include the economic classification from the income allocation perspective.

For the national economy as a whole, according to our finding, 50 percent of currency undervaluation, which corresponds roughly to one standard deviation in $\ln UNDV$, is associated with a significant contemporaneous growth boost of 1 percentage point per annum. As for all the economic divisions, depreciation accelerates the sectoral growth significantly. In the value added category, depreciation effect varies from about 1.4 percent for service sector to 3.2 percent for industry sector, based on our sample. As for the trade category, undervaluation manifests a huge impact as large as 6 percent increase in growth rate. When it comes to the income allocation category, savings increase to the largest extent 7 percentage points with final consumption increase around 1 percent.

It's interesting and a little bit counter-intuitive that currency depreciation can even benefits the growth of consumption and import. We will further discuss it later.

5.1.2 Further Evidence

Sample periods division We first divide the whole sample data set into three groups, and again do the regression as specified in *equation*(5) on each of the sub-samples. Following the basic evidence in Table 1, we report the sub-sample evidence. It turns out that the real exchange depreciation benefits the economy no matter before or after the collapse of Bretton Wood system. And the intensity of this undervaluation effect seems quite stable especially when we compare the last two sample periods, in both of which about 20 years observations are considered.

Nonlinearity Property With respect to the divergent currency misalignment effect problem, our findings as presented in Table 2 indeed shed some light. According to the result, among productive sectors such as industry and service, undervaluation efficacy weaken when the exchange rate falls in the real depreciation range. In other words, overvaluation hurts industrial and service growth to a larger extent than that undervaluation can facilitate the growth.

Nevertheless, as for the international trade category, things are exactly reverse. When currency is depreciated, a further depreciation would accelerate growth rate of trade to a larger extent relative to the case when currency is originally overvalued.

Even through we indeed find out some nonlinearity relationship, it is still worth pointing out that the undervaluation effect we clarify from the basic specification is robust, considering the sum of the undervaluation efficacy as $\delta + \gamma D_U$ is always significantly positive across all the considered sectors.

Time frequency We now turn to consider the undervaluation effect in a long term framework. Table 3 reports the long-term undervaluation effect on economic growth. It turns out that, except for the final consumption part, where there exists no long-term effect any more, the currency depreciation contribution to economic growth holds true in the long run for all the remaining economic activities, but with a relative weakened impact.

Omitted variables Here we show that the effects we find and attribute to corruption are indeed independent of effects of other variables that correlated with currency valuation as well as sectoral economic size. Table 4 reports the robustness test for additional covariates for the national economy and all the productive sectors. We pay more attention to these sectors because from this perspective we would capture more on the value added side of an economy, which is actually the engine of national development.

Among all the controls we include in the specification, government consumption and openness turns to be significantly positive related with the development of all the economic sectors. It confirms, at least to some extent, the conventional assumption that government spending and openness to international trade are helpful to the economic growth. Human capital captured by average schooling years comes out facilitating the national economy as well as the manufacture and service sectors significantly. This is in line with the common sense that higher educated labor force would contribute more effectively to the labor-intensive sectors. And inflation generally hurts the economy.

According to our findings, for the national development and the growth of industry

and agriculture sectors currency undervaluation actually holds its own mechanism through which economic activities are affected and this mechanism is indeed independent of other variables. However, for the service sector, whose products are conventional thought non-tradable intensive, the domestic price indices, like interest and inflation then would play a more important role and weaken the currency depreciation effect.

Measurement error As for the alternative measure of real exchange rate depreciation, the first part of Table 5 reports the regression of the real exchange rate on the economic fundamentals. It turns out that all the five fundamentals are significantly related with the real exchange rate and have the expected signs as described before.

As shown in the middle part of Table 5, currency undervaluation effect is robust to the alternative measurement of the real exchange rate depreciation. Apart from the final consumption activity, all the other sectors benefit significantly from the currency depreciation.

Also included at the bottom of Table 5, we report the correlation between $\ln UNDV$ and $\ln UNDV2$. It demonstrates that both indices are actually quite consistent with the measurement of the real exchange rate depreciation.

Reverse Causality Then, we come to check the causal relationship between the development of economic activity and the real exchange rate depreciation. We instrument the undervaluation level using a one-year lag of $\ln UNDV$ and Table 6 reports the result from the IV estimation.

Column (1) presents the first stage regression, where $\ln UNDV$ is regressed on its one year lag. Unsurprisingly, lagged undervaluation level comes out very significant and with a coefficient close to 1. Yet, the coefficient is significantly lower than 1, implying that there is variation in undervaluation that remains unexplained by lagged terms. Results from the IV in columns (2) through (5) confirm our baseline results for the whole economy and those productive sectors, with all the undervaluation coefficients significantly positive. Therefore, when we rule out simultaneous reverse causality, undervaluation still accelerates production growth.

However, when we pay more attention to contrast this reverse causality test results with the basic specification results as shown in Part I Table 1, we find that both the magnitudes and significance of the undervaluation efficacy are decreased considerably. This is actually quite understandable. Because when we instrument the undervaluation index using its lagged term, we actually rule out the unexplained depreciation, and this unexpected currency undervaluation is likely to fuel the economic growth also.

Situation is similar for final consumption and gross domestic savings. Columns (9) and (10) actually demonstrate that undervaluation benefits not only savings but also final consumption, even when we rule out the possibility of simultaneous reverse causality.

The really confusing results come from column(6) and (7), where depreciation has no impact on international trade volume and export size. These results are obviously in contradiction with all the previous empirical evidence, which confirms the traditional intuition that undervaluation facilitates the trade, especially for export.

Here, we provide a possible explanation. We can see that the undervaluation is actually highly predicted by its previous level, given a high R square. And because international trade sectors are very sensitive to the exchange rate fluctuation, the predictable depreciation may actually be expected by the trade sectors and companies could have already digested the effect of the predicted currency undervaluation. And only the unexpected part of undervaluation can bring about instantaneous boost.

Income Effect Two problems should be solved under this income effect consideration. On the one hand, we check whether the undervaluation effect is robust to the national development level. That is, we want to make sure that there exist undervaluation effect no matter what development status a country has reached. On the other hand, we intend to measure the extent to which the income level will impact the undervaluation efficacy.

For answering the first problem, we separate our sample into two categories as developing group versus developed group. The same basic specification *equation*(5) is estimated again while dummy variables for the development level are also added. The empirical results are shown in the first two parts of Table 7.

For the developing countries, based on our findings, undervaluation effect are all significant. While at the same time, for the developed countries, although national economy and industry, agriculture, gross domestic savings as well as all the traded related activities retain the benefit from undervaluation, depreciated exchange rate actually hurts service sector, and loses its impact on final consumption sector.

According to this comparison, the manifestation of undervaluation seems to depend, at least to some extent, on the national current status of income level. Therefore we turn to the second problem. We are now even concerned with the income effect on the extent to which undervaluation can accelerate the economic growth. The third part of Table 7 reports the income effect specified as in *equation*(10). Generally speaking, national income advantage indeed weakens the undervaluation contribution to the economic growth.

Specifically, among the productive sectors, except for the service sector, where higher income level would significantly and sizeably weaken and even reverse the undervaluation effect, all the other sectors seems to take the advantage of exchange rate depreciation unaffected by their national income level. As for the international trade and consumption activities, the income level effect seems negligible. And for the income allocation category, the force of undervaluation effect suffers a lot from the increase of income level. While depreciated currency benefits the domestic savings independent of the national development level.

Convincingly, when we combine our conclusions for the first and second problems, our finding looks quite consistent. In specific, given that income effect is negligible for sectors like agriculture, industry, savings as well as all the trade categories, there exists no significant difference when we compare the undervaluation efficacy between two sub-sample results. And considering the fact that income effect has a significant and sizable force for the manifestation of undervaluation effect as for service and consumption growth, we think it's reasonable that the currency depreciation may hurts the growth of service sector or leaves the consumption department unaffected, as for the developed countries.

5.2 Undervaluation and Component Change

So far, we've done with the sectoral undervaluation effect. We now turn to compare the undervaluation efficacy across sectors, and look for component change evidence.

Specifically, from the previous empirical results confirming the undervaluation effect on the size of sectoral activities, we can find that exchange rate depreciation benefits some sectors more and with higher robustness relative to other sectors. In this part, we turn to construct the evidence that currency undervaluation indeed impacts tradable-intensive sectors more compared with nontradable-intensive sectors, and that weak exchange rate encourages economic component reform so as to enhance the national productivity.

5.2.1 Comparative Advantage and Component Change

First of all, it's of interest to check our assumption that tradability of production actually plays an important role for the undervaluation to manifest its impact, columns (1) through (3) of Table 8 report out comparison within those productive sectors. According to the conventional opinion, service sector is relative nontradable-intensive compared with industry, manufacture, and, maybe, agriculture sector. According to our findings, it comes out that

industry and manufacture indeed take a comparative advantage from undervaluation relative to service sector, while agriculture sector does not.

Also at the same time, we are concern with the common sense that weak currency encourages export and consume more domestic products. To that end, columns (4) and (5) looks deep into the international trade structure. Based on the specification *equation*(12), the empirical results actually confirm that export growth faster than import from the undervaluation, providing a persuasive support to the competitive currency theory.

Given the evidence that some sectors growth faster than the others when currency is depreciated, we expect various components of the national economy may go through a significant change when undervaluation occurs. Therefore, we regress the component share change of each sector on the undervaluation separately.

Our empirical evidence is based on specification *equation*(13). And the result as reported in Table 9 is affirmative. In the first part, columns (A1) through (A3) report the component ratio change of national economy, from the value added perspective, stimulated by the real exchange rate depreciation: industry sector expands roughly 2.1 percentage points relative to its original share, corresponding to one unit standard deviation of $\ln UNDV$, while service sector is squeezed by about 0.5 percent as to its original share. Agriculture share is not significantly affected by the currency undervaluation.

Columns (A4) through (A6) actually confirm that international trade volume, no matter for the export or import, increase enormously relative to the growth of gross domestic product from the currency undervaluation. And from the income allocation perspective, columns (A7) and (A8) in fact verify our assumption that weakened currency urge people saving more for investment.

Similar to what we've done in the previous subsector, we divide our sample to two groups as developing-country sample and developed-country sample. And the empirical results are reported in Part II and Part III of Table 9. As for the value added category and international trade category, empirical results are generally the same as the whole sample results. Only the service department in the developing countries seems insensitive to the exchange rate depreciation. It's the case possibly due to the fact that service sectors in developing countries focus more on the local affairs like renting business, health care and education, while globalized economic activities like financial intermediation and international transportation play a major role in service sectors in developed countries. The former is obviously less sensitive to the exchange rate adjustment.

It's interesting to compare the undervaluation effect on income allocation between developing countries and developed countries. Columns (I7) and (I8) say that undervaluation encourages saving larger ratio of income to investment in the developing countries, while column (D7) and (D8) actually claims that the same effect may not be so significant for developed countries. Chances are undervaluation is indeed an effective policy tool in the developing countries that people are guided to save more when their purchasing power are weakened. And then, the business world would benefit from the abundant capital from savings.

5.2.2 Component Reform and Spillover Effect

Since we've demonstrated that currency depreciation would facilitate some sectors more than the others and hence lead to economic component change, we now turn to check whether this undervaluation facilitated component reform trend is good for the national productivity growth.

Table 10 presents the empirical results. Columns (1) through (6) in the first part actually say that the increase of the relative size of industry over service, saving over consumption, trade over national income, which are all the response corresponding to the currency depreciation, are all good for productivity growth. And moreover, the expansion of industry and savings are also favorable factors.

The second part of Table 10 reports the regression results when we instrument the corresponding component change with our $\ln UNDV$ measurement. And the result is further confirmative.

Therefore, our findings actually support our assumption that the undervaluation stimulated economic component reform enhances national productivity.

Finally in the subsection, we check our concerns with the spillover effect according to empirical result shown in Table 11. We first include the national growth rate as an additional control to see if $\ln UNDV$ is still significant in its explanative power. According to the results in columns (1) through (8), only the undervaluation effect on consumption growth comes out to be suspicious. It seems more persuasive to claim that the consumption is actually impelled by the national economic growth. More specifically, undervaluation stimulates the growth of some economic sectors, which in turn drive the growth of the whole economy. As a result, the wealth effect works and the consumption benefits indirectly from the undervaluation effect.

Among the productive sectors, we add in sectoral growth rate control to the basic specification for discriminating the spillover effect. As reported in Part II of Table 11, even though there indeed exists significant and sizeable positive cross-sector correlation, weak exchange rate still remains to be an important accelerator for the development of each productive sector.

5.3 Undervaluation and tradability

We turn to find a more direct evidence to demonstrate that undervaluation effect is stronger in sectors in which goods are more tradable in the international trade market. To that end, We construct two measures of tradability indices as ratio of export over output (I_{tra1}) and total trade over output (I_{tra2}). We capture the tradability effect based on the specification *equation*(15). The empirical results are shown in Table 12.

Columns (1) and (2) present the results for the basic specification. columns (3) through (6) report estimate alleviating our concern with omitted variables. And columns (7) through (9) pursue the robust test for reverse causality. All the coefficients for the interacted term are significant positive, which means the tradability indeed plays an unnegligible role for undervaluation to affect economic growth.

6 Policy Discussion

The point of this paper so far has been that real exchange rate depreciation favors economic growth through an economic component change mechanism which tends to enhance the national productivity as a whole. There is actually a hypothesis that the real exchange rate is a policy variable and can be carried out effectively by the policy maker. We are in need of this critical hypothesis if we want to go further to suggest that countries should sustain a depreciated real exchange rate so as to take an advantage of the documented relationship between undervaluation and economic growth.

Unfortunately, strictly speaking, this hypothesis is not true as the real exchange rate is a relative price and is determined in general equilibrium along with all other relative prices. Even though governments have a variety of instruments at their disposal to influence the level of the real exchange rate, and the evidence is that they use them. The problem is maintaining a more depreciated real exchange rate requires higher saving via fiscal policy (a large structural surplus), incomes policy (redistribution of income to high saves through real wage compression), saving policy (compulsory saving schemes and pension reform), capital-account management (taxation of capital account inflows, liberalization of capital outflows), or currency intervention (building up foreign exchange reserves). To the best of our knowledge, there are at least two aspects of difficulties for countries to implement those policy so as to sustain a real exchange rate undervaluation.

7 Conclusions

In this paper we have investigated the relationship between currency undervaluation and the economic growth from a sectoral and component perspective. We actually discovered some empirical evidence that shed light on the mechanism through which real exchange rate depreciation facilitates the economic growth. To the best of our knowledge, this is the first empirical study where undervaluation effect on GDP components is analyzed separately. And it is also the first attempt to testify some of the theoretical explanation about how undervaluation may impact economic growth.

Our empirical conclusion actually consists of three aspects. Firstly, we proposed a sector-by-sector approach to confirm the prevailing argument that real exchange rate undervaluation benefits economic growth. These results are robust to controlling for omitted variables, alternative sampling frequency and undervaluation measurement, to separating the sample into currency undervaluation and overvaluation subgroups, and to instrumenting exchange rate undervaluation to alleviate concerns of reverse causality. More importantly, we also demonstrate that undervaluation effect works in every historical period, no matter before or after the collapse of the Breton Wood system; that currency depreciation boosts economic development both for the developing countries and the developed countries, even though for some economic sectors the undervaluation efficacy decreases or even reverses as the national income increases.

Secondly, our results based on the component share of GDP show that industry sector, gross domestic savings and trade department including both the exports and the imports expand distinctly as the currency undervaluation increases. While, at the same time, scales of service sector and final consumption in percentage of GDP decrease significantly. A more detailed comparison within the value added sectors and trade department reveals that industry (including manufacture) sector indeed takes a comparative advantage from currency undervaluation relative to service sector, and that the exports actually expand its component share of international trade at the expense of squeezed import share. More importantly, we further demonstrate that the undervaluation stimulated component change enhances the national productivity. And that although primary results indeed present a significantly positive relationship between undervaluation and sectoral growth, spillover effect in fact plays an important role here, which suggests that depreciation does not facilitate all the sectors directly and simultaneously - the development of service department and the final consump-

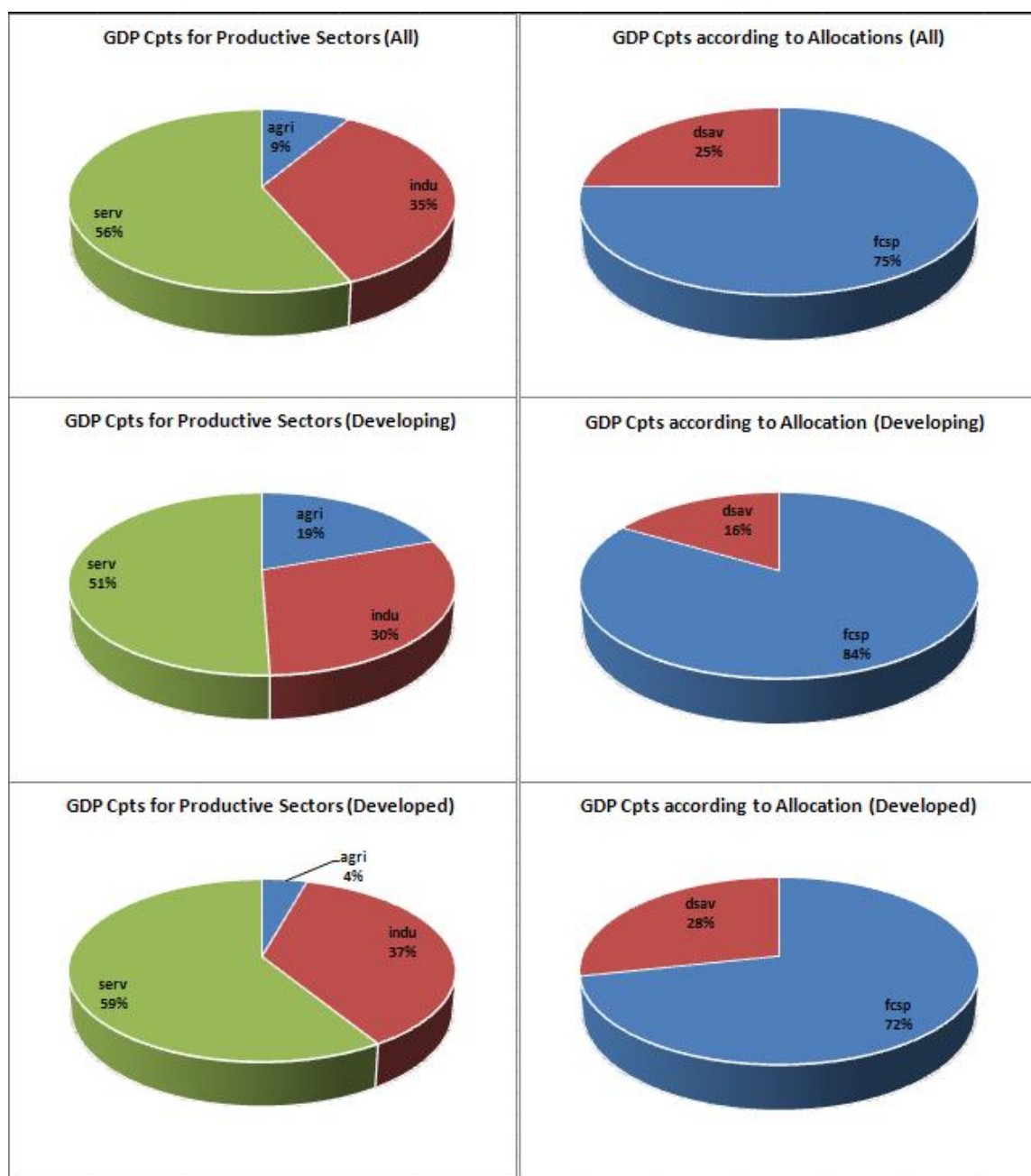
tion growth actually benefit from the undervaluation stimulated industrial growth and national productivity improvement instead of the undervaluation itself.

Thirdly, our detailed investigation within manufacture sector confirms that sub-sectors in which products are more tradable in the international trade market are at a comparative advantage to benefit from currency undervaluation. This result contributes to the understanding of the fact that real exchange rate depreciation manifests different impact on different sectors.

In a broader perspective, study on the undervaluation effect on economic growth is far from the end. Several aspects can be extended based on our primary research work. Firstly, we adopt Rodrik (2008)^[22] Balassa-Samuelson effect based undervaluation measure in our study. In order to justify this measurement, we need sectoral productivity data to double check if Balassa-Samuelson effect is included into our consideration is a proper specification. Secondly, we use OECD countries and sub-sectors within manufactory sample to testify our assumption that sectors producing more tradable goods benefit more from currency undervaluation. If there exists a more comprehensive sample, a further test on the assumption is meaningful. Thirdly, even granting the undervaluation effect on economic development, it's by no means equal to say that countries can actually sustain a currency depreciation as a persistent policy tool for stimulating its development.

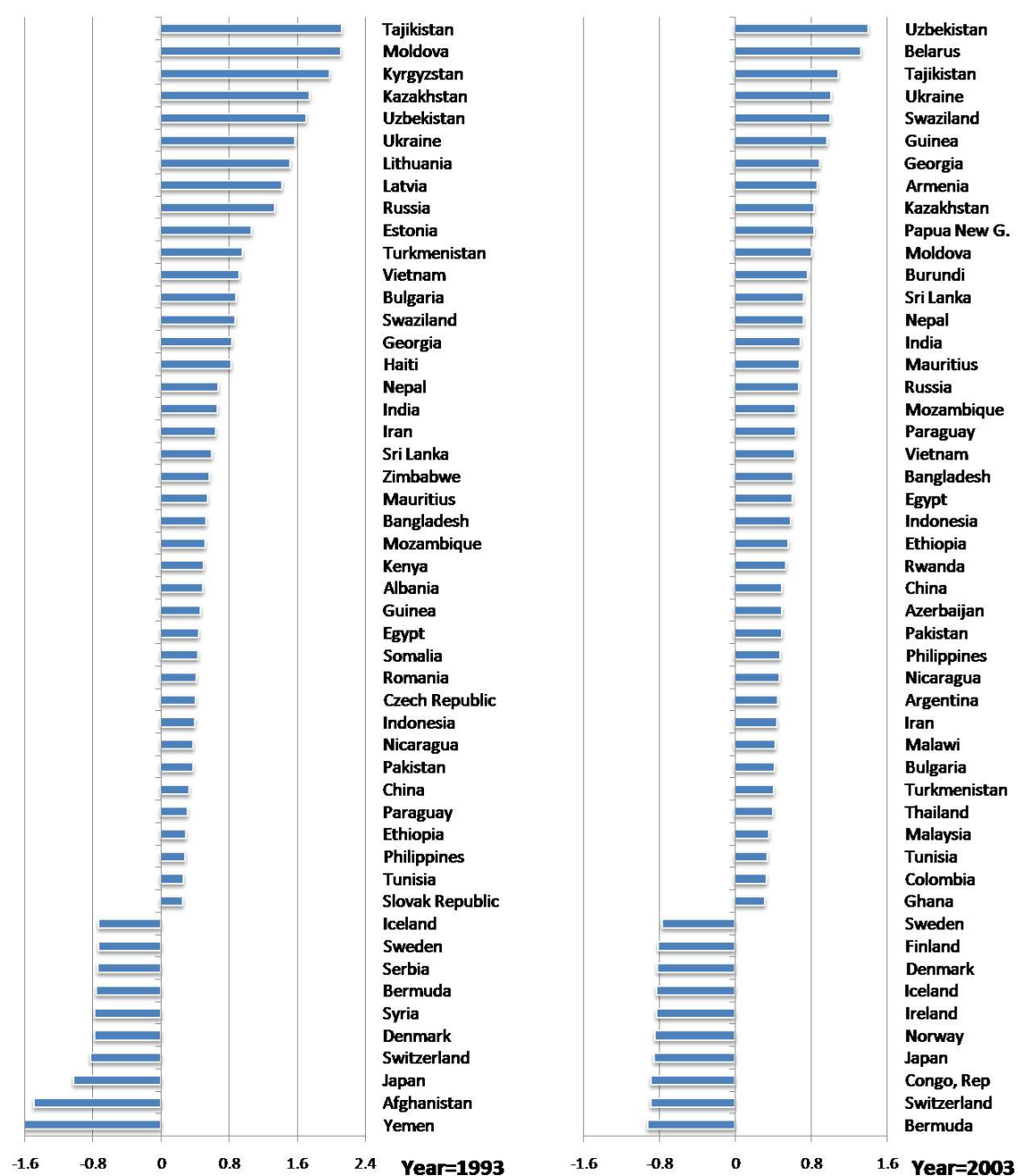
8 Appendix: Figures

Figure 1: GDP Component Shares



Note: GDP component shares for all sample, developing (-ing) country sample and developed (-ed) country sample.

Figure 2: Measure of Undervaluation



Note: Positive value demonstrates a currency depreciation, while negative corresponds to overvaluation. Only the top 30 depreciated and the top 10 overvalued currencies are reported.

Figure 3: Alternative Tradability Measures

Note: ISIC 2-Digit Code Explanation

- | | |
|--------------------------------------------------------------------------------------------|--------------------------------------------------|
| 15 - Food products and beverages | 16 - Tobacco products |
| 17 - Textiles | 18 - Wearing apparel; Dressing and dyeing of fur |
| 19 - Tanning and dressing of leather; Luggage, handbags, saddlery, harness and footwear | |
| 20 - Products of wood and cork, except furniture; Articles of straw and plaiting materials | |
| 21 - Paper and paper products | |
| 22 - Publishing, printing and reproduction of recorded media | |
| 23 - Coke, refined petroleum products and nuclear fuel | |
| 24 - Chemicals and chemical products | 25 - Rubber and plastics products |
| 26 - Other non-metallic mineral products | 27 - Basic metals |
| 28 - Fabricated metal products, except machinery and equipment | |
| 29 - Machinery and equipment n.e.c. | 30 - Office, accounting and computing machinery |
| 31 - Electrical machinery and apparatus n.e.c. | |
| 32 - Radio, television and communication equipment and apparatus | |
| 33 - Medical, precision and optical instruments, watches and clocks | |
| 34 - Motor vehicles, trailers and semi-trailers | 35 - Other transport equipment |

9 Appendix: Tables

Table: 1 Growth effect of Undervaluation (Annual.)

Part.I	rgdpch	agri	indu	serv	trad	expo	impo	fcsp	dsav
All Sample	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Pre Level	-.038*** (.003)	-.170*** (.008)	-.092*** (.005)	-.073*** (.005)	-.106*** (.006)	-.127*** (.006)	-.131*** (.006)	-.095*** (.006)	-.313*** (.010)
lnUNDV	.021*** (.003)	.054*** (.008)	.063*** (.007)	.028*** (.006)	.109*** (.007)	.126*** (.010)	.102*** (.008)	.017*** (.005)	.010*** (.026)
Observations	7047	4701	4687	4685	5428	5428	5428	5237	4671
R-squared	0.12	0.14	0.16	0.12	0.17	0.16	0.15	0.12	0.20
Part.II	rgdpch	agri	indu	serv	trad	expo	impo	fcsp	dsav
Bef.1972	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Pre Level	-.139*** (.013)	-.422*** (.046)	-.400*** (.033)	-.323*** (.033)	-.396*** (.027)	-.392*** (.028)	-.449*** (.027)	-.418*** (.031)	-.592*** (.033)
lnUNDV	.033*** (.008)	.103* (.056)	.200*** (.050)	.171*** (.053)	.248*** (.045)	.282*** (.051)	.223*** (.052)	.102*** (.031)	.016 (.130)
Observations	1766	479	463	463	879	879	879	760	711
R-squared	0.19	0.27	0.43	0.39	0.33	0.32	0.35	0.31	0.46
Part.III	rgdpch	agri	indu	serv	trad	expo	impo	fcsp	dsav
1972~1991	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Pre Level	-.076*** (.007)	-.268*** (.015)	-.160*** (.010)	-.136*** (.012)	-.199*** (.011)	-.200*** (.011)	-.249*** (.013)	-.208*** (.012)	-.457*** (.019)
lnUNDV	.034*** (.005)	.049*** (.012)	.100*** (.012)	.017* (.009)	.174*** (.012)	.205*** (.016)	.159*** (.014)	.026*** (.008)	.135*** (.047)
Observations	3060	2245	2238	2237	2488	2488	2488	2475	2205
R-squared	0.21	0.21	0.25	0.19	0.29	0.27	0.26	0.22	0.27
Part.IV	rgdpch	agri	indu	serv	trad	expo	impo	fcsp	dsav
Aft.1991	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Pre Level	-.186*** (.012)	-.337*** (.017)	-.280*** (.014)	-.285*** (.015)	-.336*** (.015)	-.349*** (.016)	-.360*** (.016)	-.304*** (.016)	-.562*** (.022)
lnUNDV	.034*** (.008)	.047*** (.017)	.092*** (.016)	.024* (.013)	.190*** (.017)	.202*** (.023)	.168*** (.017)	.029*** (.010)	.188*** (.052)
Observations	2221	1977	1986	1985	2061	2061	2061	2002	1755
R-squared	0.24	0.24	0.28	0.26	0.30	0.27	0.30	0.26	0.34

Note: Standard errors are in parentheses, with *, **, and *** denoting significance at the 10%, 5% and 1% levels respectively. The same rule applies for all tables in this paper without specific explanation.

Part I reports our basic evidence of the undervaluation effect, which argues that real exchange rate depreciation benefit economic growth. The following three parts again support the statement and testify the undervaluation effect under various phases of time period.

Table: 2 Robustness Test: Nonlinearity Property Test (Annual.)

Part.I	rgdpch	agri	indu	serv	trad	expo	impo	fcsp	dsav
All Sample	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Pre Level	-.037*** (.003)	-.169*** (.008)	-.092*** (.005)	-.073*** (.005)	-.108*** (.006)	-.129*** (.006)	-.132*** (.006)	-.0937*** (.006)	-.314*** (.010)
lnUNDV	.024*** (.004)	.063*** (.011)	.078*** (.011)	.038*** (.010)	.078*** (.011)	.080*** (.014)	.079*** (.012)	.024*** (.007)	.064* (.039)
$D_U \times \ln UNDV$	-.007 (.007)	-.019 (.019)	-.033* (.018)	-.025* (.015)	.072*** (.019)	.106*** (.024)	.052** (.021)	-.015 (.012)	.079 (.065)
Observations	7047	4701	4687	4685	5428	5428	5428	5237	4671
R-squared	0.12	0.14	0.16	0.12	0.17	0.16	0.15	0.12	0.20

Note: General speaking, according to the results, there exists significant nonlinearity property related to currency undervaluation and overvaluation for several sectors. As for valuated categories, undervaluation efficacy weaken when currency falls in depreciated status. While for the international trade categories, things are exactly reverse.

Table: 3 Robust Test: Long Term Effect (Ave.)

	rgdpch	agri	indu	serv	trad	expo	impo	fcsp	dsav
Countries	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
lnPRV	-.030*** (.003)	-.088*** (.007)	-.063*** (.005)	-.041*** (.005)	-.048*** (.004)	-.056*** (.004)	-.054*** (.005)	-.045*** (.004)	-.111*** (.006)
lnUNDV	.017*** (.003)	.037*** (.006)	.045*** (.007)	.015*** (.005)	.059*** (.006)	.070*** (.007)	.051*** (.006)	.008** (.004)	.038** (.017)
Observations	1303	857	854	854	992	992	992	957	858
R-squared	0.44	0.43	0.55	0.48	0.49	0.48	0.46	0.46	0.48

Note: Pursuing the same basic specification based on a 5-year average data frequency, we find the undervaluation effect holds true in the long run.

Table: 4 Robustness Test: Omitted Variables

	rgdpch				agri				indu				serv			
	(I)	(II)	(I3)	(I4)	(III)	(II2)	(II3)	(II4)	(III1)	(III2)	(III3)	(III4)	(VI)	(V2)	(V3)	(V4)
Pre Level	-.035*** (.004)	-.114*** (.009)	-.062*** (.006)	-.236*** (.019)	-.079*** (-.040)	-.271*** (.015)	-.208*** (.012)	-.424*** (.031)	-.065*** (.005)	-.159*** (.015)	-.120*** (.009)	-.263*** (.025)	-.054*** (.006)	-.110*** (.010)	-.101*** (.009)	-.176*** (.028)
lnUNDV	.022*** (.004)	.015*** (.006)	.019*** (.005)	.062*** (.014)	.040*** (.008)	.066*** (.014)	.071*** (.011)	.247*** (.036)	.047*** (.008)	.074*** (.013)	.064*** (.010)	.092*** (.029)	.013*** (.007)	.008 (.010)	-.003 (.007)	.047* (.024)
Govcsp	.097*** (.019)	.260*** (.035)	.152*** (.031)	.602*** (.099)	.004 (.044)	.103 (.073)	-.022 (.084)	.329 (.259)	.155*** (.046)	.428*** (.069)	.347*** (.080)	.608*** (.210)	.223*** (.041)	.384*** (.056)	.510*** (.068)	.751*** (.182)
Open	.144*** (.058)	.369*** (.090)	.195*** (.080)	.224 (.187)	-.573*** (.123)	-.010 (.188)	-.430*** (.187)	-.633 (.476)	.610*** (.132)	1.28*** (.175)	.562*** (.173)	.001*** (.000)	.258*** (.113)	.291** (.134)	.254* (.136)	.070 (.322)
Edu	.035*** (.015)				.021 (.033)				.043 (.034)				.085*** (.029)			
Interest		.094 (.059)				.707** (.246)			-.041 (-.224)					1.61*** (.175)		
TOT			.494 (.299)				-.401 (1.02)				.514 (.932)				-1.15 (.734)	
Inflation			-.109*** (.027)				-.116 (.074)				-.159*** (.067)				-.127** (.053)	
ROL				.019 (.013)				-.011 (.034)				-.017 (.027)				.065*** (.029)
COC				-.001 (.011)				.018 (.029)				.006 (.023)				.006 (.020)
Num. of obs.	800	2444	3284	881	576	2177	2606	806	574	2174	2605	806	574	2174	2605	805
R-squared	0.54	0.26	0.20	0.38	0.40	0.23	0.19	0.37	0.53	0.24	0.20	0.36	0.40	0.24	0.18	0.29

Note: We include in controls for government consumption, country's openness, human capital, real interest rate, terms of trade, consumer price inflation, rule of law and control of corruption. The currency depreciation effect comes out quite robust to the those additional covariates except the service sector, where interest and inflation seem to affect the growth rate on top of exchange rate.

Table: 5 Robust Test: Measurement Error (Ave.)

Part.I	rgdpch	Govcsp	ToT	Inflation	Open	R-squared.
β Coeff. ($T - stat.$)	.286*** (4.34)	.679*** (2.66)	.138*** (3.48)	.133*** (3.93)	-.492*** (-6.99)	0.88 -
Part.II	rgdpch	agri	indu	manu	serv	trad
	(1)	(2)	(3)	(4)	(5)	(6)
Pre Level	-.826*** (-48.7)	-.694*** (-16.0)	-.598*** (-17.6)	-.514*** (-12.0)	-.588*** (-16.4)	-.777*** (-32.2)
lnUNDV2	.112*** (2.66)	.219*** (3.91)	.314*** (4.62)	.212*** (2.48)	-.004 (-0.07)	.287*** (3.81)
Num. of obs.	586	446	444	360	444	567
R-squared	0.86	0.59	0.68	0.57	0.71	0.77
	expo	impo	gcsp	hcsp	gsav	dsav
	(7)	(8)	(9)	(10)	(11)	(12)
Pre Level	-.780 (-32.1)	-.787*** (-30.9)	-.778*** (-34.2)	-.742*** (-31.8)	-.810*** (-15.3)	-.839*** (-27.0)
lnUNDV2	.414*** (4.93)	.185** (2.42)	.050 (0.73)	.053 (1.22)	.396** (2.40)	.307** (2.51)
Num. of obs.	567	567	570	540	375	509
R-squared	0.76	0.76	0.78	0.77	0.60	0.71
Part.III Regression of lnUNDV on lnUNDV2						
Coeff. (T-stat.)	.910*** (27.2)		Numm. of Obs.	593	R-squared	0.88

Note: Adopting the behavior equilibrium exchange rate approach to remeasure the currency undervaluation, according to Part.I, real exchange rate are closely related to the fundamental economic variables.

Currency depreciation effect as shown in Part.II is robust to the alternative measure of undervaluation.

Further check of the consistency of our alternative measurement of depreciation, Part.III actually confirms the close positive correlation between the two measures.

Table: 6 Robustness test: Reverse Causality (Annual.)

	1.st stage	IV Estimation								
	lnUNDV	rgdpch	agri	indu	serv	trad	expo	impo	fcsp	dsav
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Pre Level		-.049*** (.004)	-.166*** (.008)	-.102*** (.006)	-.106*** (.006)	-.168*** (.007)	-.168*** (.007)	-.216*** (.007)	-.147*** (.007)	-.341*** (.011)
L.lnUNDV	.918*** (221)									
Pred.lnUNDV		.008** (.003)	.038*** (.009)	.015* (.008)	.017** (.007)	.002 (.008)	.003 (.011)	.015* (.009)	.009* (.005)	.099*** (.030)
Govcsp		8.86*** (1.69)	3.05 (4.51)	11.3** (4.62)	40.4*** (3.88)	18.3*** (4.01)	11.9** (5.33)	33.4*** (4.36)	36.6*** (2.75)	66.7*** (14.2)
Open		.268*** (.050)	-.625*** (.121)	.815*** (.121)	.315*** (.096)	3.16*** (.134)	3.05*** (.176)	3.62*** (.145)	.518*** (.076)	1.93*** (.450)
Observations	7047	6623	4504	4481	4479	5200	5200	5200	5015	4458
R-squared	0.87	0.12	0.14	0.15	0.14	0.22	0.18	0.23	0.16	0.21

Note: In order to alleviate the concern of reverse causality, we instrument the *lnUNDV* using its 1-year lag value. It turns out that *lnUNDV* is quite predictable from its previous level. Undervaluation effect is robust to the reverse causality test, except for the trade and export sectors. It's the same case even if we drop the control of *Open*.

Table: 7 Robustness Test: Income Effect (Annual.)

Part.I	rgdpch	agri	indu	serv	trad	expo	impo	fcsp	dsav
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Developing Countries									
Pre Level	-.203*** (.007)	-.236*** (.011)	-.176*** (.009)	-.161*** (.009)	-.217*** (.010)	-.247*** (.010)	-.228*** (.010)	-.273*** (.010)	-.437*** (.016)
lnUNDV	.032*** (.003)	.052*** (.010)	.075*** (.010)	.034*** (.008)	.141*** (.010)	.162*** (.013)	.131*** (.011)	.033*** (.005)	.109*** (.037)
Observations	4684	3078	3061	3057	3468	3468	3468	3371	2825
R-squared	0.26	0.19	0.21	0.18	0.23	0.23	0.21	0.26	0.27
Part. II	rgdpch	agri	indu	serv	trad	expo	impo	fcsp	dsav
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Developed Countries									
Pre Level	-.708*** (.010)	-.177*** (.015)	-.333*** (.015)	-.312*** (.014)	-.240*** (.013)	-.271*** (.014)	-.235*** (.014)	-.370*** (.015)	-.470*** (.017)
lnUNDV	.012*** (.003)	.055*** (.020)	.056*** (.011)	-.028*** (.010)	.169*** (.012)	.199*** (.015)	.136*** (.015)	-.016* (.010)	.085*** (.032)
Observations	2363	1623	1626	1628	1960	1960	1960	1866	1846
R-squared	0.78	0.22	0.42	0.41	0.38	0.34	0.29	0.37	0.39
Part.III	rgdpch	agri	indu	serv	trad	expo	impo	fcsp	dsav
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Income effect test									
Pre Level	-.245*** (.006)	-.198*** (.009)	-.184*** (.007)	-.181*** (.007)	-.215*** (.008)	-.244*** (.008)	-.223*** (.008)	-.282*** (.008)	-.428*** (.012)
lnUNDV	.034*** (.004)	.049*** (.010)	.070*** (.010)	.045*** (.008)	.141*** (.010)	.157*** (.013)	.139*** (.011)	.047*** (.006)	.088** (.036)
ITA	-.000 (.000)	-.001 (.001)	.001 (.001)	-.004*** (.001)	-.000 (.001)	.000 (.001)	-.002 (.001)	-.005*** (.001)	.002 (.004)
Observations	7047	4701	4687	4685	5428	5428	5428	5237	4671
R-squared	0.30	0.17	0.22	0.20	0.24	0.23	0.21	0.27	0.26

Note: Part I and Part II compare the undervaluation effect in the developing samples ($Deve \in (0, 8)$) with that in the developed samples ($Deve \in (8, 41)$). Development status dummies are also included in the regression. It comes out undervaluation effect is generally robust to the countries' income level.

Part III further measures the magnitude of income effect, if significant. According to our finding, undervaluation effect fades away and even reverses for service and final consumption sectors as income level increases.

Table: 8 Comparison between Sectors: Refined Sample. Annual.

	Comparison with Serv.			Share of Trade	
	indu.	manu.	agri	impo	expo
	(1)	(2)	(3)	(4)	(5)
Pre Level	-.058*** (-18.4)	-.053*** (-15.9)	-.010*** (-4.97)	-.252*** (-29.0)	-.298*** (-31.5)
lnUNDV	.034*** (5.91)	.022*** (3.22)	.019*** (3.00)	-.016*** (-4.59)	.018*** (3.31)
$D_s * \ln UNDV$.022*** (3.70)	.019*** (2.59)	-.003 (-0.50)		
Observations	7974	7974	7974	5470	5470
R-squared	0.11	0.09	0.06	0.18	0.18

Note: Combine the service data with industry, manufacture and agriculture data, respectively, and do regression with another sector-specified dimension. The coefficients of the interaction terms are significantly positive for industry and manufacture cases, which means those two sectors indeed take a comparative advantage over service sector from the depreciated currency.

Structural change comparison within trade confirms that undervaluation drives the structure of trade to a more export-oriented pattern.

Table: 9 GDP Component Structure: Refined Sample. Annual.

Part.I	agri (A1)	indu (A2)	serv (A3)	trad (A4)	expo (A5)	impo (A6)	fcsp (A7)	dsav (A8)
All Sample								
Pre Level	-1.81*** (0.13)	-3.56*** (0.19)	-5.87*** (0.18)	-12.8*** (0.56)	-8.16*** (0.35)	-5.30*** (0.24)	-13.0*** (0.60)	-2.61*** (0.12)
lnUNDV	.017 (0.14)	.847*** (0.15)	-.403** (0.17)	5.79*** (0.48)	2.88*** (0.32)	2.97*** (0.25)	-.872*** (0.25)	.619** (0.25)
Observations	4712	4712	4712	5470	5470	5470	4644	4644
R ²	0.09	0.15	0.14	0.16	0.14	0.17	0.15	0.15
Part.II	agri (I1)	indu (I2)	serv (I3)	trad (I4)	expo (I5)	impo (I6)	fcsp (I7)	dsav (I8)
Developing Countries								
Pre Level	-3.49*** (0.25)	-3.02*** (0.21)	-5.69*** (0.36)	-12.3*** (0.67)	-8.32*** (0.44)	-4.79*** (0.26)	-21.4*** (1.01)	-2.49*** (0.14)
lnUNDV	-.147 (0.20)	.584*** (0.18)	-.068 (0.20)	5.63*** (0.61)	2.95*** (0.41)	2.81*** (0.30)	-.901*** (0.31)	.582* (0.32)
Observations	3082	3082	3082	3498	3498	3498	2792	2792
R-squared	0.12	0.14	0.14	0.17	0.16	0.17	0.21	0.17
Part.III	agri (D1)	indu (D2)	serv (D3)	trad (D4)	expo (D5)	impo (D6)	fcsp (D7)	dsav (D8)
Developed Countries								
Pre Level	-.701*** (0.07)	-8.76*** (0.57)	-7.28*** (0.53)	-18.0*** (1.20)	-8.87*** (0.62)	-9.18*** (0.60)	-10.9*** (0.81)	-4.03*** (0.30)
lnUNDV	-.044 (0.13)	1.43*** (0.37)	-1.44*** (0.40)	11.1*** (1.08)	4.29*** (0.69)	6.69*** (0.63)	-1.47*** (0.53)	1.28** (0.53)
Observations	1630	1630	1630	1972	1972	1972	1852	1852
R-squared	0.31	0.27	0.25	0.24	0.18	0.25	0.21	0.21

Note: Part I reports the undervaluation effect on component change based on the whole refined sample. And Part II and Part III compare the effect in developing and developed countries, categorized as noted in Table 2. It comes out currency depreciation indeed increases the component share of industry, encourages larger ratio of income going into savings, facilitates the international trad growing ahead of the national economy. These conclusions are robust to the development status.

Table 10: Structure and Productivity

Part.I	RgdpchGrowth					
	(1)	(2)	(3)	(4)	(5)	(6)
<i>lnPrev</i>	-.047*** (.004)	-.053*** (.004)	-.057*** (.004)	-.050*** (.004)	-.043*** (.004)	-.050*** (.004)
<i>ln(Indu/Serv)</i>	.016*** (.004)					
<i>ln(Dsav/Fcsp)</i>		.012*** (.001)				
<i>lnTrade</i>			.030*** (.004)			
<i>lnIndushare</i>				.026*** (.005)		
<i>lnServshare</i>					-.009 (.006)	
<i>lnDsavshare</i>						.011*** (.002)
Obs.	4805	4890	5550	4810	4809	4890
R^2	0.13	0.16	0.14	0.13	0.13	0.15
Part.II	RgdpchGrowth					
	(IV1)	(IV2)	(IV3)	(IV4)	(IV5)	(IV6)
<i>lnPrev</i>	-.046*** (.004)	-.044*** (.004)	-.053*** (.004)	-.046*** (.004)	-.046*** (.004)	-.044*** (.004)
<i>ln($\widehat{Indu/Serv}$)</i>	.091*** (.014)					
<i>ln($\widehat{Dsav/Fcsp}$)</i>		.079*** (.015)				
<i>ln(\widehat{Trade})</i>			.089*** (.014)			
<i>ln($\widehat{Indushare}$)</i>				.133*** (.021)		
<i>ln($\widehat{Servshare}$)</i>					-.289*** (.045)	
<i>ln($\widehat{Dsavshare}$)</i>						.102*** (.019)
Obs.	4805	4890	5550	4810	4809	4890
R^2	0.14	0.15	0.14	0.14	0.14	0.15

Table: 11 Robustness Test: Spillover Effect (Annual.)

Part.I	agri	indu	serv	trad	expo	impo	fcsp	dsav
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Pre Level	-.184*** (.008)	-.287*** (.008)	-.303*** (.008)	-.267*** (.008)	-.296*** (.009)	-.259*** (.009)	-.405*** (.009)	-.464*** (.012)
lnUNDV	.052*** (.008)	.072*** (.007)	-.010* (.005)	.127*** (.007)	.146*** (.009)	.111*** (.008)	-.003 (.004)	.087*** (.024)
lnrgdpch	.061*** (.009)	.376*** (.012)	.352*** (.010)	.319*** (.013)	.408*** (.016)	.272*** (.013)	.342*** (.008)	.772*** (.035)
Observations	4701	4687	4685	5428	5428	5428	5237	4671
R-squared	0.15	0.30	0.31	0.26	0.25	0.22	0.35	0.28
Part.II	agri	agri	indu	indu	serv	serv	expo	impo
	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Pre Level	-.172*** (.008)	-.175*** (.008)	-.093*** (.005)	-.155*** (.007)	-.077*** (.005)	-.138*** (.007)	-.331*** (.008)	-.343*** (.009)
lnUNDV	.055*** (.008)	.055*** (.008)	.057*** (.008)	.075*** (.007)	.017*** (.006)	.002 (.006)	.083*** (.009)	.058*** (.007)
lnindu	.002 (.006)					.085*** (.006)		
lnserv		.023*** (.007)		.124*** (.008)				
lnagri			.021** (.008)		.032*** (.007)			
lnimpo							.347*** (.010)	
lnexpo								.240*** (.007)
Observations	4681	4680	4678	4683	4676	4682	5428	5428
R-squared	0.14	0.14	0.16	0.20	0.12	0.16	0.31	0.31

Note: Controlling the inter-sectoral interaction, we intend to distinguish the spillover effect. According to our finding in Part I, when we rule out the spillover effect, we actually reveal a significantly negative correlation between service growth and the undervaluation, and currency depreciation seems not affect the final consumption in a direct way. Part II. further confirms the conclusion that undervaluation benefits service growth only through its facilitation on the other departments.

Table: 12 Tradability Effect with Robust Test (Anu.)

	Tradability Eff.		Additional Covariates Test				Causality Test		
	I_{tra1}	I_{tra2}	I_{tra1}				1st stage	IV_{tra1}	IV_{tra2}
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Pre Level	-.006** (-2.06)	-.006** (-2.02)	-.002 (-0.70)	.002 (0.75)	-.001 (-0.45)	-.001 (-0.23)		-.006* (-1.79)	-.006* (-1.77)
lnUNDV	.272*** (5.76)	.274*** (5.76)	.298*** (4.47)	.298*** (6.04)	.189** (2.08)	.295*** (5.69)		.132** (2.06)	.133** (2.06)
lnUNDV Lag							.911*** (227)		
I_{tra} *lnUNDV	.092*** (3.00)	.095** (2.41)	.191*** (5.53)	.126*** (4.03)	.129*** (4.01)	.122*** (3.65)		.164*** (4.97)	.180*** (4.25)
Govcsp			.072 (1.32)					.472 (.854)	.474 (.856)
Open			.189*** (2.52)					.215*** (3.02)	.215*** (3.01)
Interest				-1.01*** (-1.93)					
Unemployment				1.14 (0.47)					
CPI					-.116 (-1.12)				
Edu.						-.095 (-1.23)			
Num of obs.	3607	3607	1988	3302	3320	3050	4872	2152	2152
R-squared	0.14	0.14	0.17	0.14	0.14	0.13	0.94	0.17	0.16

Note: Two measures of international trade ability indices are included for examining the tradability effect. For brevity of the table, additional covariates tests for I_{tra2} are not reported, which are generally the same with those for I_{tra1} . Sector dummies are also in the regression.

In the basic specification, coefficients of the interaction term turn out significantly positive, which confirms the argument that undervaluation benefits more the sectors in which products are more tradable-intensive.

The conclusion is robust to the controls and instrument.

Table: 13 Data and explanation

Name	Explanation	Source
rgdpch	PPP converted real GDP per Capita, constant price, chain series	Penn World Table
PPP	Purchasing power parity	Penn World Table
Xrat	Nominal exchange rate	Penn World Table
agri	Agriculture, value added, level% of GDP	WDI
indu	Industry, value added, level% of GDP	WDI
manu	Manufacture, value added, level% of GDP	WDI
serv	Services, etc., value added, level% of GDP	WDI
trad	International trade of goods and services, level% of GDP	WDI
expo	Exports of goods and services, level% of GDP	WDI
impo	Imports of goods and services, level% of GDP	WDI
fcsp	Final consumption, government and household, level% of GDP	WDI
dsav	Gross domestic savings, level% of GDP	WDI
Open	Openness to trade as trade over GDP	Penn World Table
Govcsp	Government consumption, level% of GDP	Penn World Table
ToT	Terms of trade index, goods and service, Yr1995=100	QoG
rir	Real interest rate	QoG
Infla	Consumer price inflation	QoG
Edu15	Average schooling year aged 15 and over	QoG
RoL	Rule of Law, extent to which agent have confidence in and abide by the rules	QoG
CoC	Control of corruption	QoG
ISIC-2digit sectoral data: import, export, and output		OECD
RER	Real exchange rate, xrat/ppp	Calculated
I_{tra}	Index of tradability	Calculated

Note: WDI stands for the World Development Indicator, QoG stands for the Quality of Government Datasets, and OECD stands for the Organisation for Economic Co-operation and Development Statistics.

Table: 14 Summary statistics: Annual.

	Obs.	Mean	St.Dev	Min.	Max.	Obs.	Mean	St.Dev	Min.	Max.	
Primary variables: Economic scales						Control variables for sector growth					
rgdpch(ln)	7334	8.28	1.12	5.14	11.3	Govcsp(10 ³)	7152	1.34	1.45	.018	15.2
agri(ln)	4900	6.28	.621	2.95	8.32	Open(%)	6876	73.0	46.8	.850	428
indu(ln)	5456	6.98	1.44	1.26	10.7	Interest(%)	2586	4.93	20.9	-97.8	789
manu(ln)	4211	6.14	1.45	1.35	9.09	ToT(10 ⁰)	3294	108	31.0	21.0	353
serv(ln)	4884	7.58	1.32	2.05	10.6	Inflation(%)	3294	49	513	-98.9	11750
trad(ln)	5636	7.85	1.43	3.28	11.8	ROL(unit)	1590	-.064	.996	-2.64	2.08
expo(ln)	5636	7.03	1.56	2.57	11.2	COC(unit)	1590	-.035	.998	-2.09	2.60
impo(ln)	5636	7.23	1.36	2.60	11.1	Edu(year)	906	4.78	2.82	.116	12.0
fesp(ln)	5435	8.15	1.02	5.72	10.5						
dsav(10 ³)	5435	1.87	-3.15	14.8	36.8	Tradability indices					
						<i>I_{tra1}</i> (unit)	21	.323	.321	.027	1.39
						<i>I_{tra2}</i> (unit)	21	.290	.250	.040	1.03
Exchange rate variables											
lnRER	7406	.690	.571	-2.04	5.20						
lnUNDV	7334	0	.045	-.306	.398						
Note:											

Note:

Bibliography

- [1] ACEMOGLU D, JOHNSON S, ROBINSON J, et al. 2003. Institutional causes, macroeconomic symptoms: volatility, crises and growth[J]. *Journal of Monetary Economics*, 50:49–123.
- [2] BHALLA S. 2008. Economic Development and the Role of Currency Undervaluation[J]. *Cato Journal*, 28(2):313–340.
- [3] CHOW H. 2005. A VAR Analysis of Singapore's Monetary Transmission Mechanism[M]: 274–298.
- [4] CHOW H. 2007. Singapore's Exchange Rate Policy: Some Implementation Issues[J]. *The Singapore Economic Review*, 52(3):445–458.
- [5] CHRISTIANO L, EICHENBAUM M, EVANS C, et al. 1998. Monetary policy shocks: what have we learned and to what end?[M].
- [6] DEVEREUX M. 2003. A Tale of Two Currencies: The Asian Crisis and the Exchange Rate Regimes of Hong Kong and Singapore[J]. *Review of International Economics*, 11:38–54.
- [7] DOLLAR D. 1992. Outward-oriented developing economies really do grow more rapidly: evidence from 95 LDCs, 1976-1985[J]. *Economic development and cultural change*, 40(3):523–544.
- [8] EASTERLY W. 2005. National policies and economic growth: a reappraisal[J]. *Handbook of Economic Growth*, 1(part 1):1015–1059.
- [9] FRENKEL R, TAYLOR L. 2007. Real exchange rate, monetary policy and employment[J]. *Policy matters: economic and social policies to sustain equitable development*.
- [10] GALA P. 2008. Real exchange rate levels and economic development: theoretical analysis and econometric evidence[J]. *Cambridge Journal of Economics*, 32(2):273.
- [11] GENBERG H. 2005. External shocks, transmission mechanisms and deflation in Asia[C]//. HKIMR Working Paper.
- [12] JOHNSON S, OSTRY J, SUBRAMANIAN A. 2007. The prospects for sustained growth in Africa: Benchmarking the constraints[J]. NBER working paper.
- [13] KIM S, PARK Y. 2005. Inflation Targeting in Korea: A Model of Success?[C]//. Conference paper for Monetary Policy Approaches and Implementation in Asia.
- [14] KOSKE I. 2008. Assessing the Equilibrium Exchange Rate of the Malaysian Ringgit: A Comparison of Alternative Approaches[J]. *Asian Economic Journal*, 22(2):179–208.
- [15] MCCALLUM B. 2007. Monetary Policy in East Asia: the Case of Singapore[C]//.

-
- [16] PARK D, OH J. 2005. Korea's Post-Crisis Monetary Policy Reforms[J]. *Review of Pacific Basin Financial Markets and Policies*, 8(4):707–731.
- [17] PARRADO E. 2004. Singapore's Unique Monetary Policy: How Does it Work?[C]//. MAS Staff Paper No.31.
- [18] PASQUALE D, LUCIO S, ILIAS T. 2009. An Economic Evaluation of Empirical Exchange Rate Models[J]. *The Review of Financial Studies*, 22(9):3491–3530.
- [19] PRASAD E, RAJAN R, SUBRAMANIAN A. 2007. Foreign capital and economic growth[J]. *Brookings Papers on Economic Activity*, 1:153.
- [20] RAZIN O, COLLINS S. 1999. Real exchange rate misalignments and growth[J]. *The economics of globalization: policy perspectives from public economics*.
- [21] RODRIK D. 2005. Why we learn nothing from regressing economic growth on policies[J]. *Harvard University*.
- [22] RODRIK D. 2008. The real exchange rate and economic growth[J]. *Brookings Papers on Economic Activity*, 2:365–412.
- [23] SIMS C. 1980. Macroeconomics and Reality[J]. *Econometrica*: 1–48.
- [24] STEFAN G, PETRA G. 2006. Monetary Policy Regimes and Macroeconomic Outcomes: Hong Kong and Singapore[C]//. BIS Working Papers No.204.
- [25] TEH K, SHANMUGARATAM T. 1992. Exchange Rate Policy: Philosophy and Conduct over the Past Decade[M]//. LIM L, TOH M. *Public Policies in Singapore: Changes in the 1980s and the Future* Signposts:285–314.
- [26] WOODFORD M. 2009. Is an Undervalued Currency the Key to Economic Growth?[J]. *Columbia University*.
- [27] YIP S. 1996. Exchange Rate Management in Singapore[M]//. LIM C. *Economic Policy Management*:237–252.
- [28] YIP S. 2002. Notes and Commentaries Singapore's Exchange Rate Policy: Empirical Foundations, Past Performance and Outlook[J]. *The Singapore Economic Review*, 47(1):173–182.