The Effect of Exchange Rates on BRICS Countries' Exports and GDP

Halil D. Kaya, PhD
Associate Professor of Finance
Northeastern State University
Broken Arrow
United States

Abstract

In this study, we examine the relation between exchange rates, exports, and GDP for BRICS countries over the 1985-2011 period. It has long been argued that playing with the value of their currencies create an advantage to the countries in exports which in turn is reflected in their GDP per capita measures. In this study, we find that, for the four BRICS countries examined, there is no statistically significant difference between the increase in exports during the periods of increasing exchange rate for the examined country and the increase in exports during the periods of decreasing exchange rate for the examined country. In other words, the BRICS countries do not increase their exports significantly during the years when their currencies went down. Our results also show that, interestingly, these countries' GDP per capita measures (in US$) are significantly lower when their currency values are low. We also find that during these periods, their energy production and scientific achievements also go down significantly. Overall, we reject the hypothesis that lower currency values help these countries. In fact, we contend that lowering their currency values hurt them in several aspects.

Keywords: Exchange Rates · Exports · Gross Domestic Product · GDP · BRICS

JEL Classification: O10 · O11 · O40 · O43 · O53

1. Introduction

In this study, we examine the relation between exchange rates, exports, and GDP for the BRICS countries over the 1985-2011 period. We use World Bank's Worldwide Governance Indicators dataset as our data source. Since this dataset does not have most of Russia's indicators, we excluded Russia from our sample. We focus on the other four BRICS countries: China, Brazil, India, and South Africa.

There are several studies that examine the impact of China's exchange rate on its exports and GDP. For China, these studies find that an increase in the value of renminbi reduces the country's exports significantly. Marquez and Schindler (2007) control for foreign direct investment and for the role of imports of parts to assemble exports and examine the relation between China's real exchange rate and its exports. They find that a 10 percent real appreciation of the renminbi lowers the share of aggregate Chinese exports by nearly one percentage point. They also show that the estimated response of imports is negligible and lacks precision.

Garcia-Herrero and Koivu (2007) show that China's trade balance is sensitive to fluctuations in the real effective exchange rate of the renminbi, although the size of the surplus is such that exchange rate policy alone will be unable to address the imbalance. They show that Chinese imports are reduced with a real appreciation of the renminbi, thereby complicating the issue. They find that the overall reduction in its imports is due to reductions in its imports from other Southeast Asian countries. The authors argue that this finding reflects the vertical integration of Southeast Asia with China. The authors argue that renminbi's appreciation affects the whole region (even if other regional currencies do not appreciate) due to the vertical integration.

Aziz and Li (2007) find that while the aggregate import demand and price elasticities of China have remained relatively stable over the past 10 years, its export elasticities increased over time. The authors contend that much of the increase in the aggregate export elasticities reflects changes in the composition of the country's trade. The authors argue that China's increasing sophistication of exports and the rising domestic content in its processed goods have forced its export elasticities to go up.

Tong and Zheng (2008) show that China's trade surpluses with the USA and the EU have risen rapidly, while it is importing heavily from its Asian neighbors. The authors argue that this diverging pattern of trade relations between China and its main trading partners reflects the continuous expansion and intensification of a complex cross-border production network in Asia. According to Tong and Zheng (2008), due to this phenomenon, the Asian countries and China are now more dependent on each other than ever.

Thorbecke and Zhang (2009) use a panel data set including China's exports of labor-intensive goods to 30 countries. They find that an appreciation of the RMB would substantially reduce China's exports of clothing, furniture, and footwear. They also find that an appreciation among China's competitors would raise China's exports. The authors contend that since Europe is the second leading exporter of labor-intensive products behind China, the large appreciation of the euro relative to the RMB since 2001 has crowded out European exports.

Thorbecke and Smith (2010) show that a 10 percent appreciation in the value of renminbi would reduce its ordinary exports by 12 percent and processed exports by less than 4 percent. A 10 percent appreciation of all other East Asian currencies would reduce processed exports by 6 percent. They also show that a 10 percent appreciation throughout the region would reduce processed exports by 10 percent. They argue that a generalized appreciation in the value of region's currencies would better resolve global imbalances than an appreciation of any of the regional currencies alone.

Cheung et al. (2010) show that renminbi was substantially below the value predicted by their cross country estimates. They also show that Chinese ordinary imports (surprisingly) as well as exports rise in response to a RMB depreciation. However, they contend that considerable uncertainty surrounds both estimates of RMB misalignment and the responsiveness of China's trade flows to changes in exchange rates and output levels. They also contend that their results for trade elasticities are sensitive to econometric specification, accounting for supply effects, and the inclusion of time trends.

Freund et al. (2011) examine the 1997–2005 period and show that a 10 percent appreciation of the renminbi would decrease the value of China's total exports by 9.1 percent in the short run and 5.0 percent in the long run. Xing (2012) look at China's processed exports to 51 countries over the 1993–2008 period and find that a 10 percent increase in the value of the renminbi would lower China's processed exports by 9.6 per cent.

Other studies differentiate between exports of processed goods versus ordinary exports, and find different results for the two types of exports. For example, Pilling (2011) argue that China's exchange rate only affects its ordinary exports (and not its processed exports) because most of the manufacturing cost of China's high-tech production comes from countries such as Japan and South Korea.

In a more recent paper, Thorbecke (2013) differentiates between the two main types of processed goods exports: processing and assembly (PAA) trade and processing with imported materials (PWIM) trade. He shows that an appreciation of the renminbi would cause a large decrease in China's PWIM exports, but would not affect PAA exports. He also notes that an appreciation in the currencies of East Asian supply chain countries, however, would cause both their PWIM and PAA exports to decrease.

Ahmed (2011) differentiates between processed and non-processed exports and examines the sensitivity of Chinese exports to exchange rate changes. His contribution is the inclusion of the 2005-2008 period when the renminbi has appreciated after a long period of stability against the U.S. dollar. He shows that when the source of the increase in the Chinese real exchange rate is appreciations against the currencies of other emerging Asian trading partners, the effect on processed exports is positive but insignificant, while the effect on non-processed exports is significantly negative. He shows that when the source of the increase in the Chinese real exchange rate is appreciations against China's advanced-economy trading partners, the effects on both types of exports are negative.

Therefore, the recent studies (especially Thorbecke (2013) and Ahmed (2011) show that the relation between exchange rate and exports seems to depend on the type of exports (whether processed or non-processed exports) and also on the individual exchange rates between a country's currency and its trading partners' currencies. First, exports of processed goods and exports of non-processed goods are affected differently when the exchange rate changes. Thorbecke (2013) shows that even within processed goods, one needs to differentiate between processing and assembly (PAA) trade and processing with imported materials (PWIM) trade.

Second, the relative exchange rates rather than the exchange rate to U.S. dollar seem to be more relevant. Ahmed (2009) findings imply that a country needs to consider the valuation of its currency against each of its trading partners while considering whether the bulk of its exports to each of these countries is processed goods or non-processed goods.

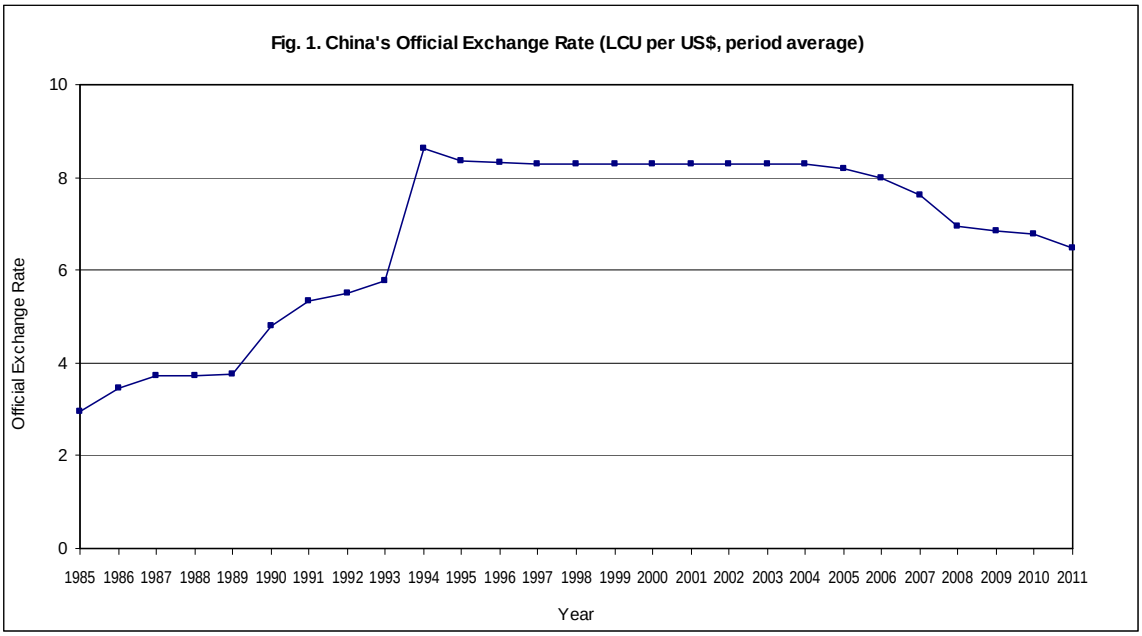
In other words, when designing and implementing policies, a country needs to individually examine its trading activities with each trading partner, determine the impact of an appreciation against each currency on exports to each country, and then build an overall model that shows the impact of various scenarios on the overall exports of the country. Of course, since all the currencies are linked to each other, a country can only try to find the optimal rate that would maximize its exports.

In this study, we extend the analysis to the other BRICS countries as well and examine their exchange rates, exports and GDP. The paper proceeds as follows: Section 2 looks at the trends in these countries' Exports and GDP per capita over time. Section 3 shows the empirical results regarding the relation between exchange rates, and exports and exchange rates and GDP. Section 4 concludes.

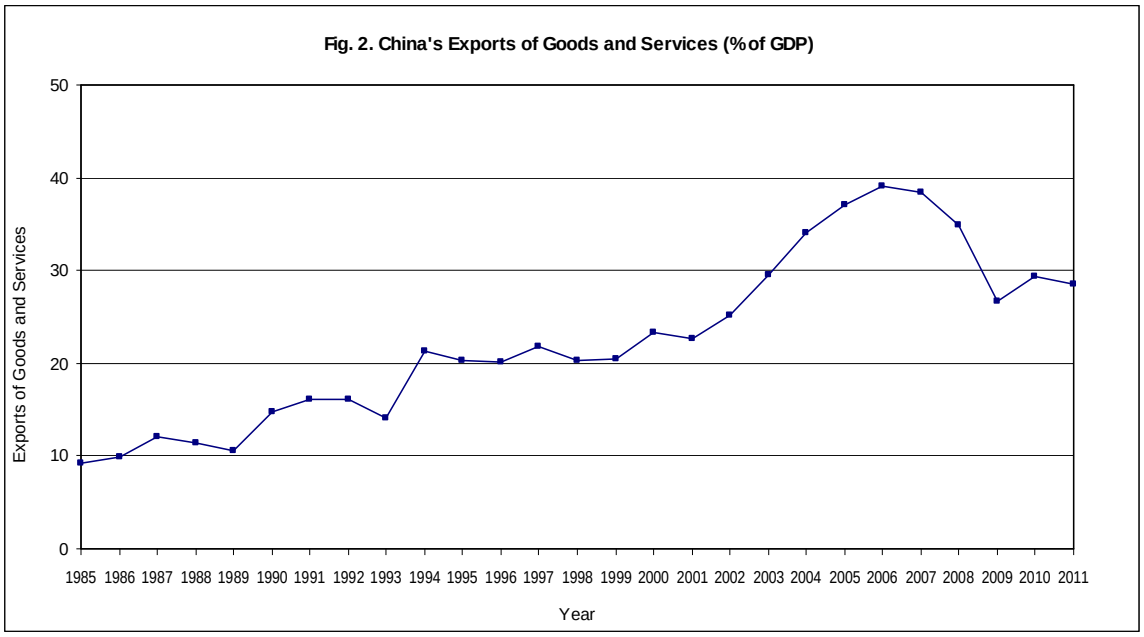
2. Exports and GDP per Capita over Time

We accessed the data on official exchange rates and exports for the BRICS countries through World Bank's Worldwide Governance Indicators dataset. This dataset does not have most of Russia's indicators; therefore we excluded Russia from our sample. We focus on the other four BRICS countries: China, Brazil, India, and South Africa.

Figure 1 shows China's official exchange rate (LCU per US$, period average) over the 1985-2011 period. We are seeing that from 1985 through 1994, the exchange rate went up meaning that Chinese currency's value went down. In 1985, the rate was 2.94. By 1994, it climbed to 8.62. Then, as we know, the Chinese government started to keep it almost fixed against the US$ until 2005-2006. After that, due to the pressures by the US Government, they allowed their currency to appreciate. By 2011, the exchange rate was 6.46.

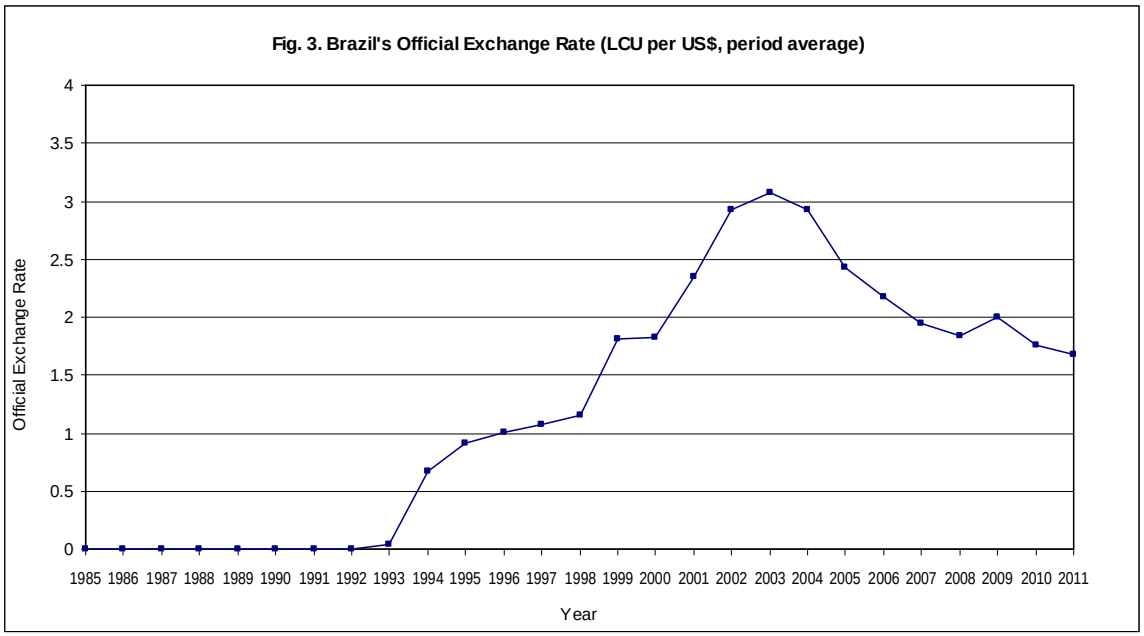


When we look at China's exports of goods and services (% of GDP) in Figure 2, we are seeing that the country's exports gradually increased over the 1985-2006 period. In 1985, its exports were just 9.17% of its GDP. By 2006, this measure climbed to 39.13% of its GDP. After 2006, we are seeing a decline in China's exports until 2009. After 2009, the decline has stopped. In 2011, the country's exports were 28.53% of its GDP.



It is important to note the somewhat parallel movement of the two graphs. After 2005-2006 when China started to allow its currency to appreciate, we are seeing a decline in its exports.

Figure 3 shows Brazil's official exchange rate (LCU per US$, period average) over the 1985-2011 period. We are seeing an increase in the exchange rate (i.e. a drop in the value of Brazilian currency against the US$) from 1985 through 2003. In 1985, the rate was 0.00000000268. By 2003, it increased to 3.08. After 2003, the exchange rate went down (the Brazilian currency went up) continuously until 2011. The rate was 1.67 in 2011.



When we look at Brazil's exports of goods and services (% of GDP) in Figure 4, we are seeing that the country's exports slowly declined (with ups and downs) from 1985 through 1998. In 1985, its exports were 12.25% of its GDP while in 1998 this measure was 6.93%. Between 1998 and 2004, we are seeing an increase in exports. By 2004, its exports were 16.43% of its GDP. After 2004, again we see a decline in exports. By 2011, its exports were 11.89%.

Similar to China, for Brazil, we are seeing that there is some positive correlation between the exchange rate and the exports.

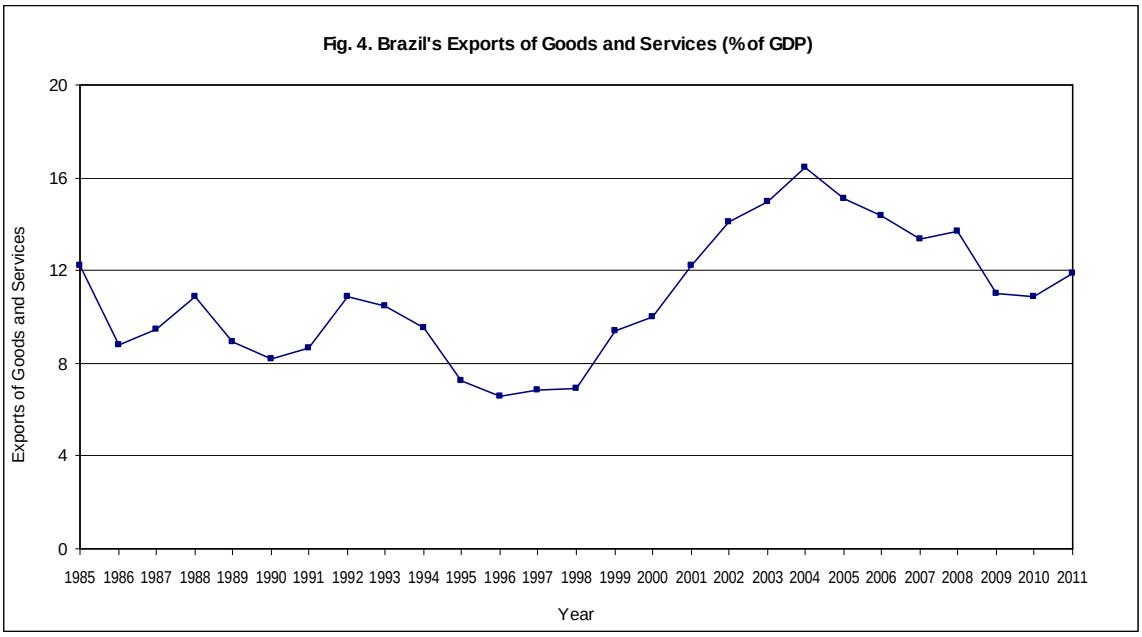
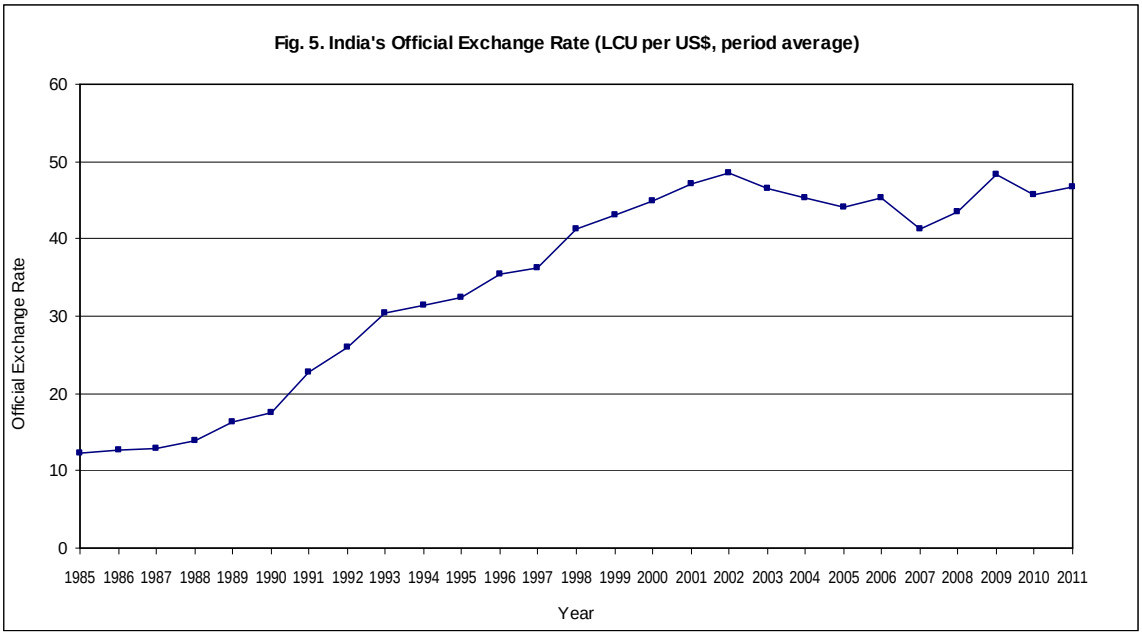


Figure 5 shows India's official exchange rate (LCU per US$, period average) over the 1985-2011 period. We are seeing an increase in the exchange rate (i.e. a drop in the value of Indian currency against the US$) from 1985 through 2002. In 1985, the rate was 12.37. By 2002, it increased to 48.61. After 2002, the exchange rate was almost flat with some ups and downs. In 2011, the rate was 46.67.



When we look at India's exports of goods and services (% of GDP) in Figure 6, we are seeing that the country's exports gradually increased. In 1985, its exports were 5.16% of its GDP while by 2011 this measure was 23.87%.

Similar to China and Brazil, we are seeing that there is some positive correlation between the exchange rate and the exports.

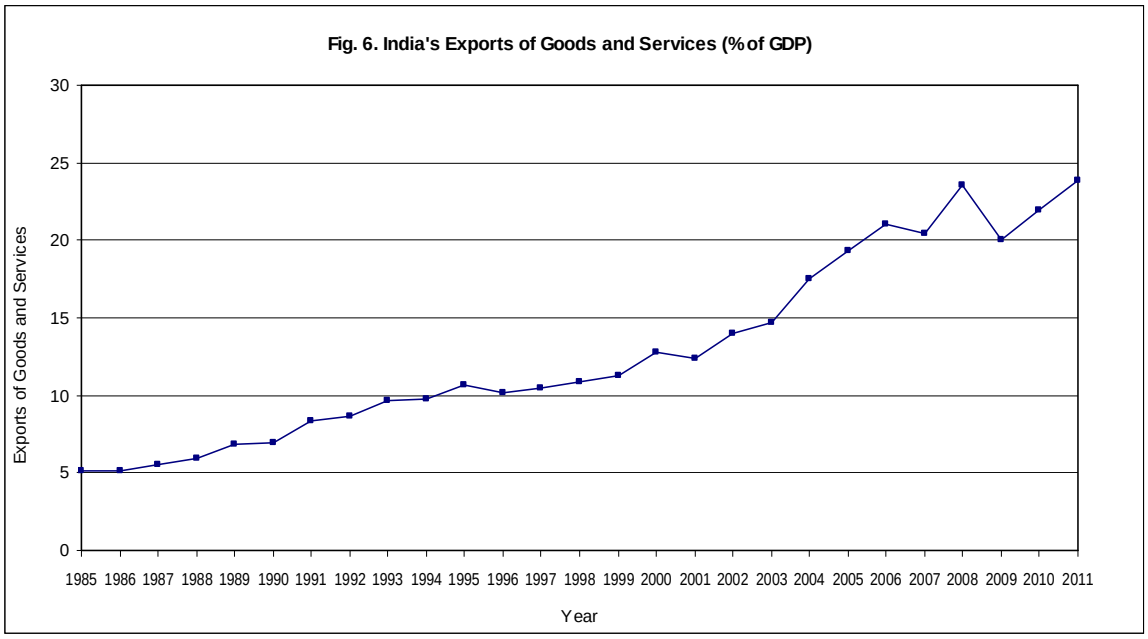
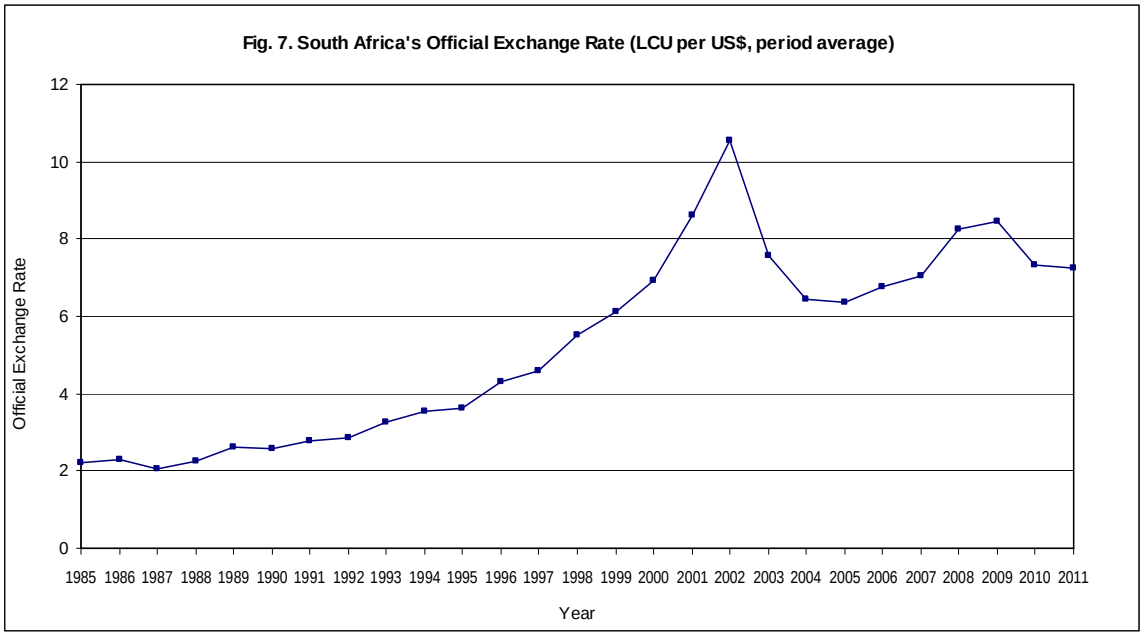
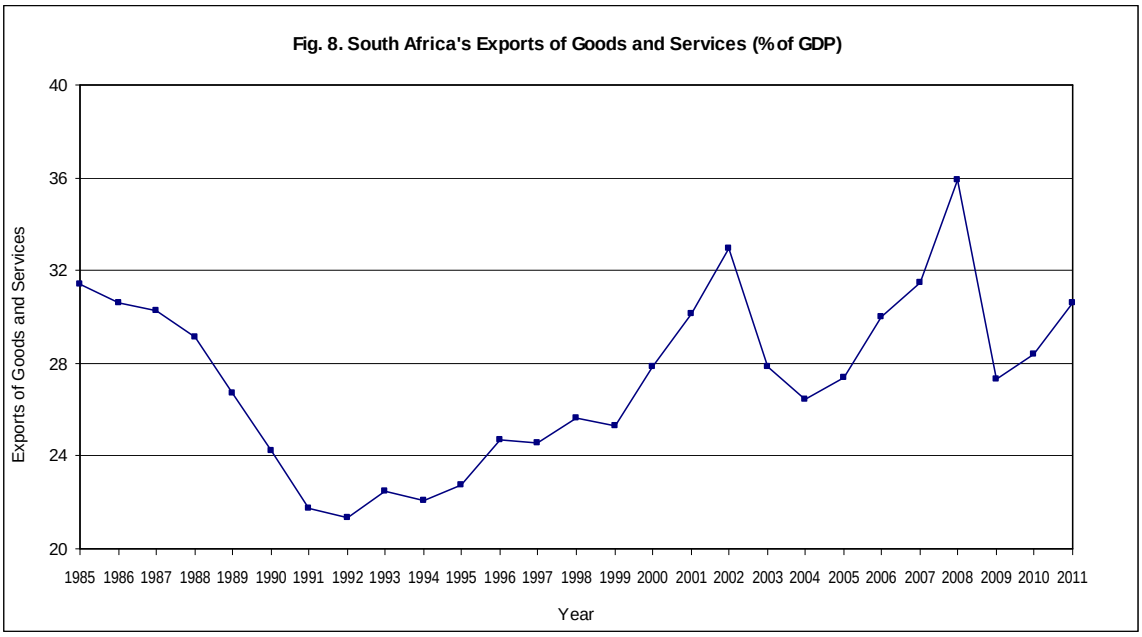


Figure 7 shows South Africa's official exchange rate (LCU per US$, period average) over the 1985-2011 period. We are seeing an increase in the exchange rate (i.e. a drop in the value of Indian currency against the US$) from 1985 through 2002. In 1985, the rate was 2.23. By 2002, it increased to 10.54. After 2002, the exchange rate went down and then had some ups and downs. By 2011, it was 7.26.

When we look at South Africa's exports of goods and services (% of GDP) in Figure 8, we are seeing that the country's exports first went down until 1992. Then, this measure went up until 2002. Then, it had some more ups and downs until 2011. In 2011, its exports were 30.61% of its GDP.

Similar to the other BRICS countries, we are seeing a positive correlation between the exchange rate and the exports for South Africa, although this correlation is not as strong as in the other cases.





3. Empirical Results

Next, we want to see how these countries' exchange rates relate to their development indicators including:

-Exports of goods and services (% of GDP)
-GDP per capita (constant 2005 US$)
-Patent applications, residents
-Scientific and technical journal articles
-Final consumption expenditure (% of GDP)
-General government final consumption expenditure (% of GDP)
-Gross capital formation (% of GDP)
-Gross domestic savings (% of GDP)
-Household final consumption expenditure (% of GDP)
-Age dependency ratio (% of working-age population)
-Foreign direct investment, net inflows (% of GDP)
-Domestic credit to private sector by banks (% of GDP)
-Energy production (kt of oil equivalent)

Our main focus is on exports and GDP per capita, but we also want to look at these other indicators in order to get some insights. Each of these development indicators are accessed through World Bank's Worldwide Development Indicators dataset.

In order to compare each of these countries' performance during increasing exchange rate periods versus decreasing exchange rate periods, we look at the official exchange rate for each country each year and designated each year for each country as either a "decreasing rate year" or an "increasing rate year". Then, we use nonparametric tests to compare these countries' performance across "decreasing rate" periods and "increasing rate" periods.

In our tests, we do not compare the actual values of the indicators but we compare the annual percentage changes in each variable. We do this in order to be more confident in our final results. The annual percentage change in each variable for each country, we believe, is a more reliable indicator compared to the indicator values themselves.

First, in Table 1, we show the Pearson correlation coefficients and their p-values between the Official exchange rate up variable, which we call "officialexcup", and the other variables. As we can see from the table, the "officialexcup" variable is negatively correlated to GDP per capita (at 1% level) and also negatively correlated to Energy production (at 5% level).

In periods when the exchange rate went up (i.e. the local currency went down against the US$), GDP per capita for that country in US$ went down and also the energy production of that country went down.

Table 1. Pearson Correlation Coefficients

	Officialexcup	Note
Exports	0.1376	
	0.1635	
GDP	-0.3927	**negative
	<.0001	
Patent	0.0203	
	0.8378	
Scientific	-0.1178	
	0.2337	
Finalcons	0.1098	
	0.2674	
Gengovfinal	0.1679	
	0.0884	
Grosscap	-0.1239	
	0.2101	
Grossdom	-0.0855	
	0.3880	
Householdfinalcons	0.0582	
	0.5573	
Agedep	0.0726	
	0.4638	
Foreigndir	-0.0941	
	0.3422	
Domesticcred	0.0371	
	0.7088	
Energyprod	-0.2039	*negative
	0.0378	

In Table 2, we show the results of our nonparametric tests (i.e. the Wilcoxon 2-sample tests) that compare these four BRICS countries' selected development indicators across increasing versus decreasing exchange rate periods. We show the p-values for the Wilcoxon test. We also did some other nonparametric tests that gave us similar results. Due to space limitations, we don't show the results of those tests in the table.

As we can see from the table, the difference in the BRICS countries' exports during "decreasing rate" periods vs. "increasing rate" periods is statistically insignificant (p-value=0.1605). While the median value of the annual percentage change in exports during "decreasing rate" periods is -0.008 (-0.8%), the corresponding percentage during "increasing rate" periods is 0.049 (4.9%). There is a difference but the difference is statistically insignificant.

When we look at the percentage change in GDP per capita, we are seeing that the median change during "increasing rate" periods (the currency goes down against the US$) is 0.023 (2.3%), while during "decreasing rate" periods, it is 0.069 (6.9%). The difference is significant at 0.01% level (p-value<0.0001). In other words, in years when the local currency goes up, the median % growth in GDP per capita was 6.9%. In years when the local currency goes down, the median % growth in GDP per capita was only 2.3%. This difference is possibly due to the measurement of GDP in US$. In years when the local currency goes up, GDP per capita for that country grows faster.

When we look at patent applications by residents and also at scientific and technical journal articles, we are seeing that these countries suffered in both areas in years when their currency went down (i.e. increasing rate). In years when the local currency goes up (i.e. decreasing rate), the median % growth in patent applications by residents and scientific and technical journal articles were 0.107 (10.7%) and 0.091 (9.1%), respectively.

On the other hand, in years when the local currency goes down (i.e. increasing rate), the median % growth in these indicators were only 0.020 (2%) and 0.049 (4.9%), respectively. In both "scientific achievement" areas, these countries performed worse during "increasing rate" (i.e. lower local currency value) periods.

We see a similar pattern in energy production. In years when the local currency goes up (i.e. decreasing rate), the median % growth in energy production was 0.043 (4.3%). On the other hand, in years when the local currency goes down (i.e. increasing rate), the median % growth in energy production was only 0.027 (2.7%). In energy production, these countries performed worse during "increasing rate" (i.e. lower local currency value) periods.

Table 2. Decreasing versus Increasing Exchange Rate Periods

	Decreasing		**Increasing**		**Wilcoxon**	
	Mean	**Median**	**Mean**	**Median**	**p-value**	**Note**
Exports	0.009	-0.008	0.045	0.049	0.1605	
GDPpercap	0.063	0.069	0.028	0.023	<0.0001	**negative
Patent	0.098	0.107	0.122	0.020	0.0249	*negative
Scientific	0.093	0.091	0.069	0.049	0.0287	*negative
Finalcons	-0.006	-0.002	0.001	-0.003	0.4915	
Gengovfinal	-0.004	-0.003	0.016	0.007	0.3021	
Grosscap	0.025	0.021	0.002	-0.006	0.1355	
Grossdom	0.013	0.007	-0.001	0.011	0.8204	
Householdcons	-0.007	-0.004	-0.003	-0.006	0.6155	
Agedep	-0.015	-0.012	-0.014	-0.013	0.9287	
Foreigndir	1.110	-0.011	0.439	0.124	0.4786	
Domesticcred	0.045	0.048	0.093	0.016	0.1250	
Energyprod	0.041	0.043	0.028	0.027	0.0330	*negative

Note: ** denotes significance at 1% level and * denotes significance at 5% level.

Next, for robustness, we run additional tests. For Exports, GDP, and the other variables, instead of looking at their annual percentage change, we just classify them categorically into two groups: "up" or "down". For example, if exports went up during that year, we classify that year for that country as "up". Otherwise, we classify that month for that country as "down". We do the same thing for the other variables. So, if GDP per capita went up during that year for that country, we say "up"; otherwise we say "down". In other words, instead of having continuous variables for all of our indicators, here we have categorical variables with two values for each variable.

Table 3 shows the Pearson correlation coefficients with this new definition. We are seeing that GDP, Patent, Scientific, and Agedep are all negatively correlated to Officialexcup at 5% level. These results are similar to Table 2 results except for the fact that here we have Agedep negative instead of Energy production being negative.

Table 3. Pearson Corr. Coef. (Alternative)

	Officialexcup	Note
Exports	0.1750	
	0.0756	
GDP	-0.2314	*negative
	0.0181	
Patent	-0.2058	*negative
	0.0361	
Scientific	-0.2443	*negative
	0.0125	
Finalcons	0.0063	
	0.9496	
Gengovfinal	0.0478	
	0.6301	
Grosscap	-0.1424	
	0.1492	
Grossdom	-0.0063	
	0.9496	
Householdfinalcons	-0.0213	
	0.8303	
Agedep	-0.1966	*negative
	0.0455	
Foreigndir	0.0885	
	0.3716	
Domesticcred	-0.0193	
	0.8458	
Energyprod	-0.0217	
	0.8270	

Since we have categorical variables for both the exchange rate and the indicators, here for nonparametric tests, we use the Chi-Square test. Table 4 shows the results of the Chi-Square tests. Table 4 confirms the results in Table 3. GDP, Patent, Scientific, and Agedep are all negatively correlated to Officialexcup at 5% level.

Table 4. Indicators in Dec. vs Inc. Rate

Chi-Square Test				
	df	**Chi-Square Value**	**p-value**	**Note**
Exports	1	3.1839	0.0744	
GDPpercap	1	5.5690	0.0183	*negative
Patent	1	4.4047	0.0358	*negative
Scientific	1	6.2049	0.0127	*negative
Finalcons	1	0.0041	0.9489	
Gengovfinal	1	0.2374	0.6261	
Grosscap	1	2.1101	0.1463	
Grossdom	1	0.0041	0.9489	
Householdcons	1	0.0471	0.8282	
Agedep	1	4.0202	0.0450	*negative
Foreigndir	1	0.8146	0.3668	
Domesticcred	1	0.0388	0.8439	
Energyprod	1	0.0489	0.8249	

4. Conclusion

In this study, we examine the relation between exchange rates, exports, and GDP for BRICS countries over the 1985-2011 period. We accessed the data through World Bank's Worldwide Development Indicators dataset.

Since the dataset does not have much of the development data for Russia, we eliminated Russia from our sample. In our final sample, we have China, Brazil, India, and South Africa.

Our nonparametric tests show that, for the four BRICS countries examined, there is no statistically significant difference between the increase in exports during the periods of increasing exchange rate for the examined country and the increase in exports during the periods of decreasing exchange rate for the examined country. In other words, the BRICS countries do not increase their exports significantly during the years when their currencies went down.

Our results also show that, interestingly, these countries' GDP per capita measures (in US$) are significantly lower when their currency values are low. Although the exchange rate does not significantly impact exports, overall, an increase in the exchange rate (i.e. a reduction in the value of that country's currency) hurts these countries' GDP per capita which is measured in US$.

We also find that during these periods, their energy production and scientific achievements go down significantly. Overall, we reject the hypothesis that lower currency values help these countries. In fact, we contend that lowering their currency values hurt them in several aspects.

References

Ahmed, S. (2011). Are Chinese exports sensitive to changes in the exchange rate? DIANE Publishing.

Aziz, J., & Li, X. (2007). China's changing trade elasticities. International Monetary Fund.

Cheung, Y. W, Chinn M. D., and Fujii, E. (2010). China's current account and exchange rate. China's Growing Role in World Trade. University of Chicago Press, 231-271.

Freund, C., Hong, C., and Wei, S.J. (2011). China's Trade Response to Exchange Rate. Working Paper, Available at: http://www.aeaweb.org/aea/2012conference/program/retrieve.php?pdfid=556 (accessed 15 July 2012).

Garcia-Herrero, A. and Koivu, T. (2007). Can the Chinese trade surplus be reduced through exchange rate policy? (No. 6/2007). Bank of Finland, Institute for Economies in Transition.

Marquez, J. and Schindler, J. (2007). Exchange-rate Effects on China's Trade. Review of International Economics, 15(5), 837-853.

Pilling, D. (2011). Why Americans Should Love to Learn the Renminbi. Financial Times, 12 October.

Thorbecke, W. (2013). Investigating China's Disaggregated Processed Exports: Evidence that Both the RMB and Exchange Rates in Supply Chain Countries Matter. World Economy, 36(10), 1245-1260.

Thorbecke, W. and Smith, G. (2010). How would an appreciation of the renminbi and other East Asian currencies affect China's exports? Review of International Economics, 18(1), 95-108.

Thorbecke, W. and Zhang, H. (2009). The Effect of Exchange Rate Changes on China's Labour-Intensive Manufacturing Exports. Pacific Economic Review, 14(3), 398-409.

Tong, S. Y. and Zheng, Y. (2008). China's trade acceleration and the deepening of an East Asian regional production network. China & World Economy, 16(1), 66-81.

Xing, Y. (2012). Processing Trade, Exchange Rates, and China's Bilateral Trade Balances. Journal of Asian Economics, 23(5), 540–547.