THE DETERMINANTS OF GDP PER CAPITA FOR CHINA VERSUS OTHER BRICS ECONOMIES: ARE THEY DIFFERENT?

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Abstract

In this study, we compare the determinants of GDP per capital for China and the other BRICS countries over the 1985-2011 period. Due to missing data, we do not include Russia in the analysis. The variables that we include in the analyses are patent applications by residents, scientific and technical journal articles, exports, household consumption, age dependency ratio, foreign direct investment, energy production, and domestic credit to private sector. Our regression analyses show that, for the sample period, the determinants of GDP per capita are different for China and the other BRICS countries. While scientific and technical journal articles, household final consumption expenditure, foreign direct investment net inflows, exports of goods and services, age dependency ratio, and domestic credit to private sector by banks explain China's GDP per capita in one or both models, the results are mixed for the other BRICS countries.

Keywords: *GDP, emerging markets, China, BRICS*

Clasificare JEL : *O10, O11, O47*

1. Introduction and context of the study

The BRICS economies are becoming more and more important in the global economy as explained by O'Neill (2001), Wilson and Purushothaman (2003), and Leksiutina (2017). Several papers including Macfarlane (2006), Armijo (2007), Cheng et al. (2007), Glosny (2010), Laidi (2011), Pant (2013), Cheng (2015), and Hooijmaaijers (2019) among others focus on the differences among the BRICS countries and discuss the future of BRICS.

On the other hand, several other papers focus on the determinants of growth in developed and developing nations. These include Chirwa and Odhiambo (2016), Barro (2003), Ahuja and Pandit (2020), Ligade (2019), and Hisham et al. (2018). For example, Chirwa and Odhiambo (2016) show that, while in developing countries, foreign aid, foreign direct investment, fiscal policy, investment, trade, human capital development, demographics, monetary policy, natural resources, reforms and geographic, regional, political and financial factors are important, in developed countries, physical capital, fiscal policy, human capital, trade, demographics, monetary policy and financial and technological factors are important. A recent paper, Iyidogan et al. (2018), focus on the BRICS countries as a group and show that research and development expenditure, gross domestic savings, trade openness, and domestic credit to private sector explain growth in these countries.

As we know, China's average annual growth rate over the past 30 years is higher than that of the other BRICS economies. We argue that besides having better values in many common drivers of growth, China may have some different drivers of growth when compared to the other BRICS countries. In our opinion, these different drivers of growth (i.e. different variables) may partially explain China's higher growth rate when compared to the other BRICS economies. In this study, we try to identify how China's drivers of growth differ from those of the other BRICS economies.

Therefore, our main contribution in this paper is differentiating between China and the other BRICS economies when exploring the determinants of growth. Our second contribution is our set of explanatory variables which includes the number of patent applications by residents, the number of technical and scientific journal articles, the household final consumption expenditure as a percent of GDP, the exports of goods and services as a percent of GDP, the age dependency ratio as a percent of working-ag population, the foreign direct investment net inflows as a percent of GDP, the domestic credit to private sector by banks as a percent of GDP, and the energy production in kt of oil equivalent.

The paper proceeds as follows: Section 2 goes over the previous literature. Section 3 explains the data and methodology. Section 4 shows the empirical results. Finally, Section 5 concludes.

2. Literature Review

Several papers focus on the characteristics of the BRICS countries and the future of BRICS. O'Neill (2001) is one of the first to show the growing importance of these countries. The author points out that each country in the group has a bigger GDP than Canada, and that both China and India could easily replace Canada and Italy as G7 countries. The paper contends that China's fiscal and monetary policy is more important to the world when compared to even Germany's policies. Similarly, Wilson and Purushothaman (2003) suggest that, by the year 2025, BRIC economies may account for more than half of the G6 countries, and that they may surpass the G6 by the year 2040.

Leksiutina (2017) examines how a change in economic leadership involving BRICS countries may evolve over time. Iyidogan et al. (2018) examine the determinants of growth in BRICS countries over the 2000-2016 period. They show that research and development expenditure, gross domestic savings, trade openness, and domestic credit to private sector explain growth in these countries. Chirwa and Odhiambo (2016) do a similar analysis for developed versus developing economies. They show that the determinants of growth in developed and developing nations are different. While in developing countries, foreign aid, foreign direct investment, fiscal policy, investment, trade, human capital development, demographics, monetary policy, natural resources, reforms and geographic, regional, political and financial factors are important, in developed countries, physical capital, fiscal policy, human capital, trade, demographics, monetary policy and financial and technological factors are important. Barro (2003) shows that, for his sample of 113 countries, human health and educational attainment, rule of law, and market openness are positively related to growth, while the fertility rate, the ratio of government consumption to GDP, and the inflation rate are negatively related to growth. Ahuja and Pandit (2020) examine 59 developing economies and find that public spending, total investment, trade openness, and tax revenue contribute to GDP growth. Ligade (2019) argues that innovation and research in healthcare is a driver of growth for BRICS countries. Hisham et al. (2018) argue that increased health financing is important for these countries.

Several other papers compare BRICS countries with each other and discuss the future of BRICS. Macfarlane (2006) points out that rather than being an emerging economy, Russia is in fact a more advanced state that deteriorated recently. Armijo (2007) explains that BRICS countries also differ in terms of their management. The author states that there are differences between the authoritarian BRICS countries like Russia and China and the democratic BRICS countries like Brazil and India. Cheng et al. (2007) explains that while these countries are likely to become even more powerful in the near future, they have some country-specific obstacles that may prevent them from becoming a powerhouse. Glosny (2010) argues that the BRICS countries are likely to accept the current economic order due to their relations with the developed nations. Laidi (2011) contends that BRICS countries do not trust each other, therefore they are not very successful in the international front. Pant (2013) argues that BRICS countries cannot successfully translate their economic power to an effective diplomatic power. Cheng (2015) contends that although China's

successful new ventures improve its international status, its lack of human rights and democracy harms its image. Hooijmaaijers (2019) argues that while China is successful in its new initiatives like Asian Infrastructure Investment Bank and Belt and Road Initiative, these new platforms harm its relations with the other BRICS economies.

In this paper, as explained above, we focus on the determinants of growth for China versus the other BRICS economies. How is China's growth dynamics differ from India's, Brazil's, and South Africa's growth dynamics? Are the drivers of growth similar or different? Using the available data from World Bank's website on development indicators, we will explore this issue.

In the next section, we will explain our data and methodology.

3. Data and Methodology

We use World Bank's website (https://data.worldbank.org/indicator) to access the data. Since some of the data for Russia are missing, we exclude Russia from our analyses. Due to data availability at the time we start our research, we examine the 1985-2011 period.

Our dependent variable is *GDPpercap* (GDP per capita in constant 2005 U.S. dollars). Our independent variables are *Patent* (number of patent applications by residents), *Scientific* (number of technical and scientific journal articles), *Household* (household final consumption expenditure as a percent of GDP), *Exports* (exports of goods and services as a percent of GDP), *Agedep* (age dependency ratio as a percent of working-ag population), *Foreigndir* (foreign direct investment net inflows as a percent of GDP), *Domesticcred* (domestic credit to private sector by banks as a percent of GDP), and *Energyprod* (energy production in kt of oil equivalent).

Table 1 shows the summary statistics for the eight independent variables as well as our dependent variable for all four countries.

Table No 1. The Summary Statistics for all Variables for Four BRICS Countries

	Mean	Median	Std	Min	Max
Patent	19,063.97	2,786.00	58,797.09	138.00	415,829.00
Scientific	11,743.76	7,851.05	16,024.38	1,465.00	89,894.40
Household	56.87	60.24	9.06	33.94	68.22
Exports	18.39	16.28	8.98	5.11	39.13
Agedep	58.01	56.31	9.85	36.04	77.29
Foreigndir	1.78	1.03	1.73	-0.67	6.25
Domesticcred	60.88	54.52	31.66	13.96	133.08
Energyprod	485,202.89	247,915.19	535,471.52	101,998.93	2,432,504.85
GDPpercap	2,817.86	3,516.77	2,014.76	327.02	5,820.96

The table shows that the mean annual number of patent applications by residents was 19,063 for these countries (including China). This number ranged from 138 to 415,829. The mean annual number of scientific and technical journal articles was 11,743. This number ranged from 1,465 to 89,894. The mean annual household consumption was 56.87% of GDP (ranging from 33.94% to 68.22%). The mean annual exports was 18.39% of GDP (ranging from 5.11% to 39.13%). The mean annual age dependency ratio was 58.01% of the working-age population (ranging from 36.04% to 77.29%). The mean annual foreign direct investments net inflow was 1.78% of the GDP (ranging from -0.67% to 6.25%). The mean annual domestic credit to private firms was 60.88% of the GDP (ranging from 13.96% to 133.08%). The mean annual energy production was 485,202 in kt of oil equivalent (ranging from 101,998 to 2,432,504). The mean GDP per capita was $2,817 in constant 2005 U.S. dollars (ranging from $327 to $5,820).

Using regression analysis, we will examine whether the determinants of GDP per capita are

different in China versus the other BRICS economies. For China and the other BRICS countries, we will run separate regressions explaining the GDP per capita. We will use two models:

GDP per capita = a + b(Patent) + c(Scientific) + d(Householdcons) + e(Exports) +f(Foreigndir) + g(Energyprod) (1)

GDP per capita = a + b(Patent) + c(Scientific) + d(Householdcons) + e(Exports) +f(Agedep) + g(Foreigndir) + h(Domesticcred) (2)

Later, in the "empirical results" section, we will show that the energy production variable is significantly correlated to both the age dependency variable and the domestic credit variable. Therefore, we will run two separate regressions, one with the energy production variable and without the other two variables, and one with the age dependency and domestic credit variables and without the energy production variable. As we will see, both models have high explanatory power.

4. Empirical Results

Table 2 shows the Pearson correlation coefficients and the p-values. Since we know that the consumption, expenditure and savings variables are correlated, we will only include the "householdcons" variable in our regression analyses. Table 2 shows that "energyprod" is significantly correlated to both "agedep" and "domesticcred" variables, therefore as explained in the data and methodology section, we will run two separate regressions, one with the "energyprod" variable and one with the "agedep" and "domesticcred" variables.

Table No. 2. Pearson Correlation Coefficients

	Patent	Scientific	House.	Exports	Agedep	Foreigndir	Domestic.
Scientific	-0.237	1					
	0.243						
House.	-0.056	-0.013	1				
	0.784	0.950					
Exports	-0.020	-0.143	-0.195	1			
	0.922	0.487	0.341				
Agedep	-0.284	-0.261	0.269	-0.097	1		
	0.160	0.198	0.184	0.637			
Foreigndir	0.154	-0.094	-0.283	-0.096	0.291	1	
	0.454	0.647	0.161	0.642	0.150		
Domestic.	-0.124	0.080	-0.239	-0.291	0.097	-0.024	1
	0.546	0.699	0.239	0.149	0.637	0.909	
Energy.	0.272	0.112	-0.163	0.134	-0.403	-0.110	-0.367
	0.178	0.586	0.426	0.513	0.041	0.591	0.065

Table 3 shows the results of the regressions for China and the other BRICS countries using both models. The second column shows that China's GDP per capita during the sample period is significantly and positively explained by "Scientific", "Householdcons", and "Foreigndir" variables. The regression coefficient for the number of scientific and technical journal articles is 0.0340 and it is statistically significant (p=0.0002). The regression coefficient for household final consumption expenditure (% of GDP) is 38.6319 and it is also significant (p=0.0005). Similarly, the coefficient for foreign direct investment, net inflows (% of GDP) is 65.4983 and it is also

significant (p=0.0002). For China, this first model shows that the coefficient for patent applications, residents is -0.0018 and significant (p=0.0264). The remaining variables are statistically insignificant. The R-square value for China using the first model is 0.9956.

Table No. 3. GDP Per Capita in China vs Other BRICS countries

Variable	China	China	Other BRICS	Other BRICS
Intercept	-2,034.8258	-3,291.5854	6,430.6398	23,865.0000
	0.0026	0.0042	0.0146	<.0001
Patent	-0.0018	-0.0016	0.0364	0.2680
	0.0264	0.0238	0.6697	0.0063
Scientific	0.0340	0.0419	0.2442	-0.3960
	0.0002	<.0001	<.0001	<.0001
Household	38.6319	30.2603	-29.1797	-152.2925
	0.0005	0.0003	0.4572	0.0020
Exports	2.0908	12.3404	92.5376	0.6356
	0.7350	0.0128	<.0001	0.9603
Agedep		26.2667		-143.3191
		0.0673		<.0001
Foreigndir	65.4983	45.2082	235.5323	47.2589
	0.0002	0.0003	0.0007	0.5910
Domesticcred		5.5423		-6.3561
		<.0001		0.2229
Energyprod	0.0004		-0.0227	
	0.3644		<.0001	
R-square	0.9956	0.9982	0.9015	0.8807
Pr>F	<0.0001	<0.0001	<0.0001	<0.0001
N	27	27	81	81

The third column shows that when the second model is used for China's GDP, six variables are positive and significant, and one variable is negative and significant. According to this second model, during this period, the number of scientific and technical journal articles, household final consumption expenditure (% of GDP), exports of goods and services (% of GDP), age dependency ratio (% of working-age population), foreign direct investment, net inflows (% of GDP), and domestic credit to private sector by banks (% of GDP) all positively and significantly explain China's GDP per capita. The coefficient for the number of scientific and technical journal articles is 0.0419 (p<0.0001). The coefficient for household final consumption expenditure (% of GDP) is 30.2603 (p=0.0003). The coefficient for exports of goods and services (% of GDP) is 12.3404 (p=0.0128). The coefficient for age dependency ratio (% of working-age population) is 26.2667 (p=0.0673). The coefficient for foreign direct investment, net inflows (% of GDP) is 45.2082 (p=0.0003). Finally, the coefficient for domestic credit to private sector by banks (% of GDP) is 5.5423 (p<0.0001). Similar to the first model, the coefficient for patent applications, residents is negative and significant (coef.=-0.0016, p=0.0238). The R-square value for China using this second model is 0.9982.

The fourth column shows the results of the regression that explain the other BRICS countries' GDP per capita using the first model. The table shows that these countries' GDP per capita during the sample period is significantly and positively explained by "Scientific", "Exports", and "Foreigndir" variables. The regression coefficient for the number of scientific and technical journal articles is 0.2442 and it is statistically significant (p<0.0001). The regression

coefficient for exports of goods and services (% of GDP) is 92.5376 and it is also significant ($p<0.0001$). Similarly, the coefficient for foreign direct investment, net inflows (% of GDP) is 235.5323 and it is also significant ($p=0.0007$). The remaining variables are statistically insignificant. The R-square value for the other BRICS countries using this first model is 0.9015.

Finally, the last column shows the results of the regression that explain the other BRICS countries' GDP per capita using the second model. In this model, the coefficient for the patent applications variable is positive and significant, but the coefficients for the number of scientific and technical journal articles, the household final consumption expenditure (% of GDP), and the age dependency variables are negative and significant. The R-square value for the other BRICS countries using this second model is 0.8807.

5. Conclusions

In this study, we first examine the determinants of GDP per capital for China and then we do the same for the group of remaining BRICS countries which include Brazil, India, and South Africa. The variables that we include in the analyses are patent applications by residents, scientific and technical journal articles, exports, household consumption, age dependency ratio, foreign direct investment, energy production, and domestic credit to private sector.

Before starting the analyses, we first look at the correlations between our variables. We find that energy production is significantly correlated to both age dependency ratio and domestic credit to private sector. Because of that, we run two separate regressions for both China and the remaining BRICS countries: one that includes energy production, and one that includes age dependency ratio and domestic credit to private sector.

Our regression analyses show that, for the sample period, the determinants of GDP per capita are different for China and the other BRICS countries. While scientific and technical journal articles, household final consumption expenditure, foreign direct investment net inflows, exports of goods and services, age dependency ratio, and domestic credit to private sector by banks explain China's GDP per capita in one or both models, the results are mixed for the other BRICS countries. For the other BRICS countries, while in one model, scientific and technical journal articles, foreign direct investment net inflows and exports of goods and services positively explain these countries' GDP, in the other model, patent applications positively explain while scientific and technical journal articles, household final consumption expenditure, and age dependency ratio negatively explain GDP.

We conclude that although China shares many characteristics with the other BRICS countries, it is different with respect to its drivers of growth. China's drivers of growth are the expected factors with expected effects: science, household consumption, FDI, exports, age dependency ratio, and credit to private sector affects China's growth positively. On the other hand, we cannot say the same for Brazil, India, and South Africa. Fewer of these factors explain these countries' GDP per capita growth, and interestingly, some of them have weak effects or even negative effects on growth. These findings indicate that Brazil, India, and South Africa have structural problems that weakens, eliminates, or reverses the linkages between these factors and their growth.

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