ECONOMIC GROWTH IN BRIC COUNTRIES AND COMPARISONS WITH REST OF THE WORLD*

1. Introduction

The causes of economic growth have intrigued economists and policymakers for quite some time. Over time, numerous theories and empirical studies have been generated examining different aspects (for examples, see Solow, 1956; Barro, 1991; Mankiw *et al*., 1992; Romer, 1990; Aghion and Howitt, 1997; and Barro and Sala-i-Martin, 2004 for review of the related literature). Increased globalization in recent times has led to complex cross-country linkages affecting growth that are not easily captured. Overall, while there is some consensus, numerous issues remain either contentious or unexplored (see Levine and Renelt, 1992).

The present research focuses on the growth behavior of four leading emerging economies – Brazil, Russia, India, and China (BRIC). These nations are interesting studies due to their unique attributes. Their growth success, especially of China, and growth potential have received considerable interest in recent years (see Wilson and Purushothaman, 2003; Bird, 2007; Fischer, 2006; Herd and Dougherty, 2007; Hölscher *et al*., 2010; and Russian Analytical Digest, 2011). Policymakers in other nations are interested in identifying components of growth in BRIC nations so that the success of BRIC nations can be replicated elsewhere. BRIC nations are themselves interested in maintaining or even accelerating their growth. However, formal growth investigations of BRIC countries have been few and the present research attempts to make a contribution in this regard.

Even though the four countries in the BRIC group are clubbed, they are quite dissimilar in many respects. There are significant

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differences in resource endowments and comparative advantages within the BRIC group. For instance, China has been a huge growth success over the past two decades and significant causes of its growth can provide useful lessons for nations trying to emulate its growth success (see Maddison, 2009). Brazil and Russia, on the other hand, are uniquely endowed with numerous natural resources which provide them useful growth ingredients. Some research has focused on the resource-growth nexus (Leite and Weidmann, 1999; Stevens, 2003; and Kalyuzhnova *et al*., 2009), although the context in which growth in the present study is being considered appears somewhat unique. Russia is also a transition country and there are some unique issues associated with transition (Havrylyshyn and van Rooden, 2000; Roland, 2000; and Falcetti *et al*., 2005). Further, China, India and Russia have strong education systems ensuring a quality labor force and this can translate into higher economic growth. India has comparative advantage in terms of a relatively large pool of English-speaking workforce that has translated into its success in information technology. Further, geographically, all BRIC nations are among the largest nations in the world in terms of land area and are also the ones with many bordering neighbors. Whereas, on the one hand, the geographic proximity can encourage trade, there can be potentially adverse effects due to illegal migration etc.

We examine the differing growth determinants in BRIC countries in the context of a cross-national study involving more than 100 nations. We also move beyond the BRIC group by examining a broader set of highly growing nations and compare whether factors driving growth in these nations are substantially different from those for low growth nations. Thus, besides the primary focus of this study mentioned above, the size and the recent nature of the underlying data may be viewed as secondary contributions of this work. As part of the exercise, a number of aspects are studied:

(i) determinants of economic growth – medium-term versus short-term growth;
(ii) the role of exports, both aggregated and disaggregated, in fostering economic growth, especially in BRIC countries (Feder, 1983; Gylfason *et al*., 1999; Auty, 2001; and Karras, 2003);
(iii) the role of institutions in growth (Mauro, 1995; Knack and Keefer, 2003; Glaeser *et al*., 2004; Boschini *et al*., 2007);
(iv) determinants of growth across countries with different growth rates; and

(v) possible reverse linkage between institutional quality and growth (Chong and Calderón, 2000)[1].

Within the context of the overall framework and focusing on BRIC countries, the following key questions will be answered:

(a) How do determinants of medium-term economic growth differ from those of short-term growth?

(b) What are the differences between the effects of aggregate versus disaggregated exports on growth?

(c) Is lower institutional quality necessarily an impediment to growth? and

(d) Do various growth factors consistently promote growth across low growth and high growth countries? The formal model follows.

2. Model and data

To arrive at a growth equation and to illustrate the theoretical background, one can start with a simple two-factor aggregate production function with capital (K) and labor (L), with Q denoting the aggregate output or *GDP* of a country (see Goel and Ram, 1994; Goel *et al.,* 2008)

$$Q = g(K, L) \tag{1}$$

Taking the total differential of both sides of (1) and rearranging, one can obtain a growth equation of the form:

$$(\mathrm{d}Q/Q) = (\partial Q/\partial K)(1/Q)\mathrm{d}K + [(\partial Q/\partial L)(L/Q)](\mathrm{d}L/L) \tag{2}$$

Here $(\mathrm{d}Q/Q)$ and $(\mathrm{d}L/L)$ are, respectively, the rates of growth in output and labor, $[(\partial Q/\partial L)(L/Q)]$ is the elasticity of output with respect to labor, $(\partial Q/\partial K)$ is the marginal product of capital and $\mathrm{d}K$ is investment. The labor and capital factors in (2) will be augmented by other factors in the estimated equations below. Two significant aspects of this research deal with examining the linkage between various exports and growth and that between institutional quality and growth.

The data include annual cross-country observations for more than one hundred countries for the year 2007 (or the closest year

[1] The Boschini *et al*. (2007) study, examining resource curse across 80 countries, may be viewed as complementary to present research. The authors do not focus on BRIC nations nor examine the variations across different growth levels.

available). Some of the right-hand side variables are taken with lagged values to make them somewhat predetermined and alleviate concerns about reverse feedbacks[2]. Within the context of this large sample, we try to determine if economic growth in BRIC countries has been somewhat unique. We primarily focus on medium-term growth over 2000-2007 because this is the period that has mainly brought the BRIC nations' growth in focus. The results for determinants of medium-term growth (*GDPgr*) are compared to those for short-term growth dealing with a single year (2007), (*GDPgrSR*).

The growth equations estimated in this section facilitate comparisons with the extant literature, albeit with recent and somewhat different data. Using the theoretical underpinnings of (2), we arrive at our estimation equation for medium-term growth baseline models

$$GDPgr_i = f(GDPpc_i,\ GDI_i,\ LABgr_i,\ EF_i,\ EXP_{ij},\ Brazil,\ China,\ India,\ Russia) \quad (3)$$

$i = 1,2,3\ldots$

$j = AGexp,\ FLexp,\ MNexp,\ ORexp$

The growth relation in (3) is a variant of the endogenous growth theory. The endogenous growth theory, due mainly to Romer (1990), states that nations might be able to affect their growth and that initial resource endowments matter (also see Aghion and Howitt, 1997).

The dependent variable is the percentage growth in the *per capita GDP* of a country. The primary focus is on examining growth in the medium-term from 2000 to 2007 (*GDPgr*). This period roughly begins with the accelerated growth in the BRIC group and ends before the current financial crisis. A one-year growth over 2006-2007 (*GDPgrSR*) is also taken to capture short-term growth as a robustness check.

Here *GDI* captures the investment mentioned in equation (2) above and *LABgr* is the growth in labor (annual average over 2000-2006). *GDI* has generally been found to be a strong determinant of growth, whereas the effect of *LABgr* has been less clear. There was considerable variation in *GDI* (for 2005; as % of *GDP*) within BRIC countries. *GDI* in China and India (44% and 34.8%, respectively)

[2] The main reason for conducting a cross-sectional analysis is that some of the variables employed, most notably the available indices of cross-country corruption perceptions, are not readily amenable to time series interpretation.

was substantially greater than that in Russia and Brazil (20.1% and 16.2%, respectively).

EF is an index of economic freedom in a country. Other things being the same, more economically free nations would be better able to use resources and exploit comparative advantages (de Haan and Sturm, 2000). While all BRIC nations were about 50% economically free, they were below the average of the countries in our sample (about 63%).

The effect of initial *GDP* (*GDPpc00*) might be difficult to pinpoint *a priori*. On the one hand, more prosperous nations might have the infrastructure in place to boost future growth; on the other hand, it might be relatively difficult to generate a higher percentage growth of an already substantial base. The initial *GDP* also captures whether there is any trend towards economic convergence (see Barro and Sala-i-Martin, 2004, pp. 44-50; also see Aghion and Howitt, 1997).

The role of exports (*EXP*) in growth has been well recognized in the literature (see for example, Feder, 1983). Further, the composition of exports might affect growth differently. For example, nations uniquely endowed with natural resources do not necessarily face similar competition in international export markets as nations with manufacturing exports do. These differences could affect the relative growth impacts of the different export types. To account for these issues, we include total exports as percentage of *GDP* (*EXP*); and a country's share of exports in four major categories: agricultural exports (*AGexp*), fuel exports (*FLexp*), manufacturing exports (*MNexp*) and ore exports (*ORexp*).

This issue is especially interesting in the case of the BRIC group as these countries have different but significant export capabilities. Whereas the overall exports in both China and Russia (37.4% and 35.2%, respectively) and those in Brazil and India (15.1% and 19.9%, respectively) were similar in 2005, the composition of exports varies considerably. For instance, China has emerged as a world power in manufacturing exports in recent decades, while Russia is a major player in a number of fuel export markets. In 2005, fuel exports were merely 2.3% of merchandise exports in China, 6% in Brazil and 11.5% in India, while they were 61.8% in Russia. On the other hand, in the same year, manufacturing exports ranged from 91.9% of merchandise exports in China to 18.9% in Russia. Therefore, the relative growth effects of decomposed exports would be illustrative, especially in a study focusing on the BRIC group.

A version of the baseline model adds institutional quality and literacy (*LIT*) as additional growth determinants. Other things being the same, higher quality labor, proxied by the literacy rate, would enhance growth (Barro, 2001).

The quality of institutions in a country is crucial to economic growth. Effective institutions correct market failures and lower transactions costs (see Mehlum *et al*., 2006). Recognizing the difficulties with empirically measuring institutional quality, we employ three measures of institutional quality. One is an index of corruption perceptions from the Transparency International (www.transparency.org), (*CORR*). A high level of corruption would imply underdeveloped or inefficient institutions. However, higher levels of corruption can have positive growth effects when it promotes efficiency (Lui, 1985). As an alternate measure of institutional quality, we include an index of property or patent rights protection (*IPP*), due to Park (2008). Other things being the same, a strong property right protection would imply good institutional quality that would bolster economic growth. Finally, the effect of democracy (*DEM*) on economic growth is examined. Democratic nations have freedom of press and other civil liberties. These factors might enhance growth by protecting rights; on the other hand, growth in more democratic nations might go down as the equity-efficiency tradeoff is bent more towards equity. In addition to the primary focus on BRIC nations, the relative comparison of alternate institutional quality measures may be viewed as a contribution of this research.

Turning to the main focus of this study, dummy variables identifying Brazil, China, India and Russia are included to identify BRIC countries. We also include a *BRIC* group dummy variable to see if as a group the BRIC countries performed differently from rest of the world. A positive sign on the resulting coefficient would imply that, holding other factors constant, growth in these countries was greater[3]. In other words, in the sample of countries considered, growth in BRIC nations was somewhat unique. Details about the variables used, summary statistics and data sources are provided in Table 1.

[3] While we are conducting a cross-country study, one could alternately conduct a growth study of BRIC countries based on time series data for these countries.

TABLE 1 - *Variable Definitions, Summary Statistics and Data Sources*

Variable	Definition (Mean; Std. dev.)	Source
GDPgr	*GDP* per capita growth, annual average 2000-2007, (3.73%; 2.64)	World Development Indicators
GDPgrSR	*GDP* per capita growth, 2007, (4.76%; 3.78)	World Development Indicators
GDI	Gross domestic investment (% of *GDP*), 2005, (23.53%; 6.42)	World Development Indicators
LABgr	Growth in labor force, annual average 2000-2006, (1.76%; 1.49)	ILO LABORSTA Internet EAPEP v5 Economically Active Population Estimates and Projections
EF	Economic Freedom in a country, (percent free), 2007, (62.95%; 9.78)	www.heritage.org
CORR	Corruption Perceptions Index (CPI), Transparency International, (higher value more corrupt), 2007, *CORR=log((10-CPI)/CPI)*, (0.18; 1.09)	www.transparency.org
LIT	Literacy rate (percent of literate population above age 15), 2006, (82.65%; 18.87)	World Development Indicators
GDPpc00	*GDP* per capita in 2000 (PPP, in current intl. dollar units), ($10812.56; 10869.45)	IMF World Economic Outlook Database, 2007
EXP	Exports/*GDP* ratio , 2005, (46.44%; 32.41)	World Development Indicators
AGexp	Agricultural exports (percent of merchandise exports), 2005, (3.84%; 7.07)	World Development Indicators
FLexp	Fuel exports (percent of merchandise exports), 2005, (14.26%; 22.69)	World Development Indicators
MNexp	Manufacturing exports (percent of merchandise exports), 2005, (49.23%; 30.56)	World Development Indicators
ORexp	Ore and metal exports (percent of merchandise exports), 2005, (8.17%; 14.00)	World Development Indicators
DEM	Sum of a country's political rights and civil liberties scores, 2007, (higher score, more democratic), (-5.72; 3.36)	Freedom House
IPP	Index of intellectual property (patent) rights, in natural logs, 2005, (higher value greater protection), (1.24; 0.26)	Park (2008)
Brazil	Dummy variable identifying Brazil	
China	Dummy variable identifying China	
India	Dummy variable identifying India	
Russia	Dummy variable identifying Russia	
BRIC	Dummy variable identifying the BRIC group	
ETHNIC	Ethnic fractionalization (0.42; 0.25)	Alesina *et al*. (2003)
LANG	Language fractionalization (0.36; 0.28)	Alesina *et al*. (2003)
RELIG	Religious fractionalization (0.44; 0.23)	Alesina *et al*. (2003)
GCONS	General government final consumption expenditure (% of *GDP*), 2005, (15.64%; 5.52)	World Development Indicators

Note: all data are by country and by year.

3. Results

The results section first discusses the findings of baseline models that are then augmented to address the questions posed above.

3.1 Determinants of Economic Growth in BRIC: Baseline Models

The OLS estimation results of the baseline growth model are presented in Table 2. The overall fit of these models is decent as shown by the R^2 that is at least 0.33.

Table 2 - *Determinants of Economic Growth in BRIC: Baseline Models* (*Dependent Variable = GDPgr*)

	Model 2.1	Model 2.2	Model 2.3	Model 2.4	Model 2.5
Log(GDPpc00)	-0.74** (2.6)	-0.80** (2.8)	-0.81** (2.8)	-1.01** (2.4)	-1.31** (3.4)
GDI	0.12** (2.1)	0.11* (1.9)	0.11 (1.6)	0.10 (1.4)	0.19** (3.4)
LABgr	-0.72** (3.9)	-0.71** (3.9)	-0.69** (3.7)	-0.53** (2.2)	-0.61** (3.3)
EF	-0.03 (0.8)	-0.02 (0.5)	-0.01 (0.4)	-0.06 (0.9)	0.08** (2.2)
EXP	0.02** (3.3)	0.02** (3.3)	0.02** (3.2)	0.03** (2.1)	
LIT				0.06** (2.9)	
AGexp					-0.01 (0.6)
FLexp					0.06** (3.0)
MNexp					0.03** (2.5)
ORexp					-0.01 (0.4)
BRIC		1.76** (2.0)			1.12 (1.0)
Brazil			0.16 (0.3)	-0.36 (0.6)	
China			2.79* (1.9)	2.09 (1.3)	
India			0.72 (0.8)	1.60* (1.7)	
Russia			3.54** (5.6)	2.30** (2.9)	
R^2	*0.33*	*0.34*	*0.35*	*0.43*	*0.50*
N	*114*	*114*	*114*	*77*	*90*

Notes: see Table 1 for variable definitions. A constant term was included in all OLS regressions but the corresponding results are not reported to conserve space. The numbers in parentheses are t-statistics in absolute value based on robust standard errors. * denotes statistical significance at the 10% level and ** denotes statistical significance at least at the 5% level.

The effect of initial *per capita GDP* (*GDPpc00*) on medium-term growth is consistently negative and statistically significant in the five models in Table 2. With a higher initial *GDP* base it seems that a high *GDP* growth is hard to sustain. The negative sign on *GDPpc00* can be viewed as being consistent with the convergence hypothesis (for example see Sachs and Warner, 1995).

As in other growth studies (see for example, Goel and Ram, 1994; and Barro and Sala-i-Martin, 2004, pp. 531-32), the effect of investment (*GDI*) on growth is positive and significant in a majority of cases. In all models 2.1-2.4, a one percent increase in *GDI* (as percent of *GDP*), has a greater impact on growth than a one percent increase in overall exports. Labor growth (*LABgr*) has a growth-retarding effect, as there might be issues with gainfully employing additional workers. The effect of economic freedom (*EF*) is generally insignificant, but positive and statistically significant in Model 2.5[4].

Aggregate exports (*EXP*) are shown to have a positive and significant growth effect throughout models 2.1-2.4[5]. This supports the notion that a country's exports enable better resource utilization through comparative advantage exploitation and realization of scale economies.

Upon disaggregating exports into four categories in Model 2.5, only manufacturing exports (*MNexp*) and fuel exports (*FLexp*) have positive and significant growth effects. In terms of relative magnitudes, fuel exports have a larger positive impact on growth than a corresponding increase in manufacturing exports. Unique resource endowments provide nations with comparative advantages and possibly larger markups that contribute significantly to growth. However, this is not consistently true across all exports, as the effects of agricultural (*AGexp*) and ore exports (*ORexp*) are statistically insignificant.

To account for labor quality, Model 2.4 adds the degree of literacy (*LIT*) as an additional regressor. The sample size in this case shrinks due to missing observations. The resulting coefficient on literacy is positive and significant – as expected, better labor quality boosts growth. Interestingly, a one percent increase in the literacy rates has the potential to boost medium-term economic growth by twice a one percent increase in the aggregate exports (Model 2.4).

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[4] Economic freedom may alternately be captured by a nation's degree of openness to trade (measured as the ratio of exports and imports to *GDP*). Prior research including openness as an explanatory variable in growth regressions has found the corresponding effect to be statistically insignificant (Barro and Sala-i-Martin, 2004, pp. 529-530).

[5] To account for possible complementarities between exports and economic freedom, a variation of Model 2.3 adding an interaction term between the two variables was also run. The resulting coefficient was positive and statistically significant, confirming that economic freedom might be influencing exports. The effects of other variables were generally in line with what is reported above. Details are available upon request.

Turning to BRIC countries, two variations are considered: using a group dummy variable (*BRIC* in Models 2.2 and 2.5) and individual country dummies (Models 2.3 and 2.4). The sign on the group dummy, *BRIC*, is positive in both instances suggesting that, other things being the same, economic growth in the BRIC group was higher over the 2000-2007 period. However, the resulting coefficient is statistically significant only when aggregate exports are included (Model 2.2).

Of the BRIC countries, the coefficient on *Russia* was consistently positive and statistically significant. *China* and *India* also showed positive growth effects, although the statistical significance was weak in one of the two instances in each case. Interesting, the coefficient on *India* attains statistical significance in the model that takes labor quality into account (Model 2.4). On the other hand, *Brazil* did not show significant growth differences from the rest of the sample over the period 2000-2007. Thus, while overall the BRIC group might seem to have grown significantly higher than rest of the world over the medium term, important within-group differences persist.

3.2 Institutional Quality and BRIC Economic Growth

In this section we examine the role of institutions in fostering economic growth. While it has been recognized for quite a long time that institutional quality can play a crucial role in economic growth, measurement of institutional quality remains a challenge. To somewhat address this issue, we employ three different measures of institutional quality: the degree of corruption (*CORR*), the strength of patent rights (*IPP*) and the degree of democracy (*DEM*)[6]. Since these cross-country measures each come from a single source, they provide comparable benchmarks.

Beginning with the seminal work of Mauro (1995), researchers have been drawn to the connection between cross-country growth and corruption (Bardhan, 1997; Jain, 2001; and Lambsdorff, 2006; for related literature surveys; also see Mo, 2001; Blackburn *et al*.,

[6] There are many proxies for institutions that one can choose from (see Knack and Keefer, 2003; also Williams and Siddique, 2008). In line with the focus of the present study on BRIC nations, we limit our choice to three measures.

TABLE 3 - *Institutional Quality and BRIC Economic Growth (Dependent Variable = GDPgr)*

	Model 3.1	Model 3.2	Model 3.3	Model 3.4	Model 3.5	Model 3.6
Log(GDPpc00)	-0.31 (1.1)	-0.18 (0.6)	-0.27 (0.7)	-0.04 (0.1)	-0.35 (1.22)	-0.16 (0.5)
GDI	0.09 (1.4)	0.10 (1.4)	0.01 (0.1)	0.01 (0.3)	0.10* (1.6)	0.11* (1.7)
LABgr	-0.72** (4.1)	-0.66** (3.7)	-0.49** (2.6)	-0.46** (2.3)	-0.82** (4.4)	-0.82** (4.3)
EF	0.06 (1.2)	0.09* (1.9)	-0.05* (1.8)	-0.22 (0.7)	0.004 (0.1)	0.02 (0.8)
EXP	0.02** (3.3)		0.02** (4.2)		0.02** (2.0)	
CORR	1.18** (3.1)	1.25** (3.3)				
IPP			0.14 (0.1)	-0.98 (0.5)		
DEM					-0.29** (2.5)	-0.37** (3.3)
Brazil	-0.19 (0.4)	-0.70 (1.2)	-0.66 (1.5)	-1.05** (2.1)	0.33 (0.6)	0.07 (0.1)
China	3.58** (2.5)	3.54** (2.3)	5.30** (4.6)	5.68** (4.4)	0.93 (0.5)	0.35 (0.2)
India	1.49 (1.6)	1.11 (1.2)	2.39** (3.0)	2.38** (2.7)	1.35 (1.6)	1.25 (1.5)
Russia	3.04** (5.0)	3.18** (5.0)	3.26** (5.6)	3.57** (5.5)	1.81** (2.1)	1.45 (1.5)
R^2	*0.40*	*0.34*	*0.38*	*0.26*	*0.40*	*0.37*
N	*114*	*114*	*94*	*94*	*114*	*114*

Notes: see Table 1 for variable definitions. A constant term was included in all OLS regressions but the corresponding results are not reported to conserve space. The numbers in parentheses are t-statistics in absolute value based on robust standard errors. * denotes statistical significance at the 10% level and ** denotes statistical significance at least at the 5% level.

2006; Méndez and Sepúlveda, 2006; and Aidt *et al*., 2008)[7]. The main premise is that corrupt acts create bottlenecks and are associated with unproductive transfers (Aidt, 2009; Shleifer and Vishny; 1993). Both of these factors retard growth and corruption control has been espoused by cross-national organizations as a condition for rapid economic growth. However, the efficiency aspects of corruption, whereby corruption expedites governmental procedures, have also been recognized (Lui, 1985; Méon and Sekkat, 2005; Méon and Weill, 2008). Thus the overall effect of corruption on growth would be determined by the relative strength of each effect. In his authoritative review of the literature, Lambsdorff (2006) concludes that the

[7] See Becker (1968) for background on the economics of criminal behavior.

> "link between corruption and *GDP* or the growth of *GDP* has its empirical and theoretical weaknesses", (p. 27) and that some results were "ambiguous", (p. 25).

We contribute to the ongoing debate in this context by focusing on BRIC countries.

We add the cross-country index of corruption perceptions (*CORR*) from the Transparency International to the estimated equation (3). This index has been widely used in cross-country studies over the past decade and a half and provides fairly consistent data[8]. In our sample, Russia fared relatively worse in terms of corruption perceptions than other BRIC countries. However, all nations in the group fared worse than the sample average, suggesting that corruption was a significant problem.

The degree of patent protection can be seen as capturing the role of institutions surrounding the protection of property rights. The protection of intellectual property rights in BRIC nations has been the subject of some debate (Bird, 2007) and the present research will shed light on this aspect in the context of economic growth. Democracy is related to institutions covering the freedom of press and civil liberties. As discussed above, greater democracy would enhance growth when it fosters efficiency at the expense of equity and vice versa. In the BRIC group, India has a longstanding tradition of democracy, while democratic institutions are in their infancy in Russia. China is currently the least democratic nation of the BRIC group.

Results from Table 3 show that, when institutional quality is taken into account, unlike Table 2, initial *GDP* and *GDI* do not have an appreciable impact on economic growth; while the results with respect to *LABgr* are similar. Further, the effect of economic freedom is mixed. Aggregate exports again consistently boost economic growth and this finding is robust across alternate measures of institutional quality[9].

With regard to institutional quality, greater corruption is shown to boost economic growth in both the models where it appears.

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[8] We performed a logarithmic transformation on the corruption index to unbind and to facilitate interpretation (see Table 1).

[9] In consideration of some potential multicollinearity between exports and institutional quality (Leite and Weidmann, 1999; Stevens, 2003; Bulte and Damania, 2008), Models 3.2 and 3.4 in Table 3 were run without *EXP*. The main findings from Models 3.1 and 3.3 remained essentially unchanged.

The resulting coefficient is positive and significant. This result is consistent with the notion that corrupt practices might be boosting efficiency by acting as a grease to speed procedures and circumvent bottlenecks (see Méon and Weill, 2008). Thus, on efficiency grounds, corruption seems to fare well. Whether such corruption turns out to be equitable is a different issue.

When institutional quality is alternately measured by the degree of patent protection (*IPP*), the resulting coefficient fails to show any statistically significant effects. Further, greater democracy (*DEM*) somewhat retarded economic growth. Greater debate and attention to due processes in democracies tend to lower growth relative to instances where solely efficiency aspects are emphasized. This finding provides some justification for differences in the Chinese and Indian growth rates.

Of the BRIC group, growth in *China* and *Russia* was higher in all instances whether institutional quality was measured by the degree of corruption or by the degree of patent protection. The coefficient on *India* was positive in all cases, and statistically significant when patent protection was taken into account (Models 3.3 and 3.4). Finally, the coefficient on *Brazil* was negative and statistically significant in one instance.

3.3 Growth Determinants across Different Growth Levels

In this section we address the question of whether similar influences significantly bear on growth across nations with high and low growth rates. Thus, we are able to move beyond strictly the four nations in the BRIC group. The answer to this question goes to the heart of the design of growth policies and recommendations across nations – can uniform growth recommendations work well across nations with different growth rates? Recognizing the limitations of dichotomous variables, the quantile regression procedure also enables us to alternately examine the determinants of economic growth across nations with different growth rates. For this purpose we employ with quantile regression to Models 2.2 and 2.5, without the BRIC group dummy variable[10]. This focus across different growth rates is unique in the present study. Section 4.1 deals with aggregate exports, while section 4.2 addresses disaggregated exports.

[10] See Koenker and Hallock (2001) for background on the quantile regression.

TABLE 4 - *Determinants of Economic Growth across Different Growth Rates* (*Dependent Variable = GDPgr*)

4.1 (N=114)	(q0.10)	(q0.25)	(q0.50)	(q0.75)	(q0.90)
Log(GDPpc00)	0.14 (0.4)	-0.29 (0.8)	-0.88** (2.7)	-0.91** (2.4)	-1.60** (2.4)
GDI	0.04 (0.8)	0.12** (2.3)	0.10** (2.1)	0.14** (2.2)	0.11 (1.0)
LABgr	0.10 (0.3)	-0.40 (1.3)	-0.66** (3.1)	-0.89** (4.2)	-1.32** (3.6)
EF	0.04 (0.9)	-0.01 (0.3)	-0.01 (0.3)	-0.04 (1.2)	-0.03 (0.5)
EXP	0.01 (1.0)	0.01** (2.3)	0.02** (2.7)	0.03** (2.0)	0.07** (2.8)
Pseudo-R^2	*0.05*	*0.10*	*0.21*	*0.29*	*0.34*
4.2 (N=90)	(q0.10)	(q0.25)	(q0.50)	(q0.75)	(q0.90)
Log(GDPpc00)	0.10 (0.2)	-0.93* (1.7)	-1.04* (1.7)	-1.11** (2.2)	-2.10** (3.0)
GDI	0.03 (0.4)	0.14** (2.8)	0.18** (3.4)	0.16** (2.4)	0.25** (3.0)
LABgr	-0.01 (0.04)	-0.14 (0.4)	-0.57* (1.9)	-0.57** (2.5)	-0.71** (2.3)
EF	-0.01 (0.2)	0.04 (0.8)	0.07** (1.2)	0.09** (2.2)	0.09* (1.8)
AGexp	-0.01 (0.2)	0.02 (0.5)	-0.01 (0.3)	-0.02 (0.6)	-0.03 (0.5)
FLexp	0.02 (1.0)	0.04* (1.9)	0.04 (1.5)	0.07** (2.4)	0.06** (2.4)
MNexp	0.01 (0.2)	0.03* (1.9)	0.02 (1.4)	0.02 (1.3)	0.02 (1.1)
ORexp	-0.02 (0.7)	0.001 (0.02)	-0.03 (0.9)	0.001 (0.1)	-0.03 (1.3)
Pseudo-R^2	*0.10*	*0.15*	*0.21*	*0.37*	*0.50*

Notes: details about the variables are provided in Table 1. Absolute values of t-statistics based on 200 bootstrap standard errors of simultaneous quantile regression are in parentheses. A constant term was included in all models but the corresponding results are not presented to conserve space. Lower quantiles (e.g., q0.10) imply countries with low economic growth. ** denotes statistically significant at the 5% level, and * at the 10% level.

In Section 4.1, *GDPpc00* generally has a negative and significant effect, except in the least growth countries (q0.10). Not unexpectedly, the least growing countries fail to show significant trends towards economic convergence. *GDI* seems effective in most cases, except in the least growth nations, and in the highest growing nations in the case of aggregate exports (Section 4.1). It could be the case that underdeveloped or undeveloped institutions might be behind the ineffectiveness of many growth factors in these low growth countries.

LABgr generally has a negative effect, which becomes significant in higher growth nations (median growth or higher). The effect of economic freedom (*EF*) is consistently insignificant with aggregate exports (Section 4.1), and positive and significant in higher growth nations (Section 4.2). High growth nations might be competitors in

many international markets and fewer bottlenecks might fuel growth in such instances.

The role of aggregate exports is positive and significant in most cases, except the least growing countries. Interesting results emerge, however, when agricultural, ore, fuel and manufacturing exports are separately considered. Like Table 2 (Model 2.5), both *ORexp* and *AGexp* fail to show growth dividends. This is true across nations with different levels of economic growth. Fuel exports positively and significantly contribute to growth in most cases, except in the least and most growing nations; while the effect of manufacturing exports is mostly insignificant, except for moderate growth nations (q0.25). Consistent with the findings in Table 2, the magnitude of the growth contribution of fuel exports is greater than that of manufacturing exports.

A key overall finding from this section is that no single growth determinant consistently contributes to growth across nations with different growth levels. The effectiveness of various factors in affecting growth is partly dictated by the stage of a country's growth. This revelation is a key contribution of the present research and also provides an alternate way (other than dummy variables) to capture the relative differences across slow and fast growing (BRIC) nations. This calls for a move away from blanket growth recommendations across nations and calls for a country or region-specific approach.

In closing, it is possible that there is some reverse causality between institutional quality and growth (Chong and Calderón, 2000; Glaeser *et al*., 2004). For instance, rapidly growing nations might have higher corruption. In other words, bigger potential rents in fast growing economies might encourage bribe seekers. Also, the degree of patent protection might be higher in high growth countries. Finally economic growth might lead to development of democratic institutions. This issue is addressed in section 3.4 below.

3.4 Possible Simultaneity between Institutional Quality and Economic Growth

As mentioned above, there might be simultaneity between institutional quality and growth whereby high growth countries might (i) invite more corrupt practices due to a bigger set of potential rents to be had; or (ii) have stronger patent protection. Conversely, it is possible that low level corruption might be more prevalent in low growth nations due to poor monitoring systems and underdeveloped institutions.

TABLE 5 - *Allowing for Endogeneity of Institutional Quality: IV Regressions (Dependent variable = GDPgr)*

	Model 5.1		Model 5.2		Model 5.3	
Log(GDPpc00)	0.22	(0.5)	-0.38	(0.3)	-0.39	(0.4)
GDI	0.09**	(2.4)	0.002	(0.1)	0.10**	(2.8)
LABgr	-0.74**	(4.4)	-0.47*	(1.9)	-0.81**	(2.6)
EF	0.16**	(2.6)	-0.06	(1.0)	0.004	(0.1)
EXP	0.02**	(2.5)	0.02*	(1.8)	0.02	(1.1)
CORR	2.49**	(2.9)				
IPP			0.84	(0.1)		
DEM					-0.28	(0.5)
Brazil	-0.33	(0.2)	-0.69	(0.4)	0.31	(0.1)
China	4.19*	(1.8)	5.19*	(1.9)	1.06	(0.2)
India	2.15	(1.0)	2.25	(0.9)	1.33	(0.5)
Russia	2.90	(1.3)	3.21*	(1.8)	1.91	(0.5)
F-value	*6.9***		*4.9***		*5.9***	
N	*112*		*93*		*113*	
First-stage F-value	*39.2***		*12.7***		*15.1***	
Sargan overidentification test (p-value)	*6.15*	*(0.10)*	*0.45*	*(0.80)*	*1.52*	*(0.47)*

Notes: see Table 1 for variable definitions. A constant term was included in all 2SLS regressions but the corresponding results are not reported to conserve space. *CORR* was instrumented by *ETHNIC*, *LANG*, *RELIG*, and *GCONS* in Model 5.1; while *IPP* and *DEM* were instrumented by *ETHNIC*, *LANG* and *RELIG* in Models 5.2 and 5.3, respectively. The numbers in parentheses are (absolute) z-statistics of second-stage results. * denotes statistical significance at the 10% level and ** denotes statistical significance at least at the 5% level.

A two-stage least squares regression was estimated with *CORR* instrumented by the additional variables shown in relation (4)[11].

$$CORR_i = h(ETHNIC_i, LANG_i, RELIG_i, GCONS_i) \qquad (4)$$

$i = 1,2,3\ldots$

The instruments for *IPP* and *DEM*, on the other hand, were

[11] Justifications for determinants of corruption can be found in Jain (2001), Lambsdorff (2006) and Treisman (2000).

$$IPP_i, DEM_i = h(ETHNIC_i, LANG_i, RELIG_i) \quad (5)$$
$$i = 1,2,3\ldots$$

ETHNIC, *LANG*, and *RELIG* are, respectively, indices of ethnic, linguistic and religious fractionalizations (see Paldam, 2002 for study of their effect on corruption and Mauro, 1995 for a related choice of instruments; also Alesina *et al*., 2003 for background on the calculation of fractionalization indices). These socio-cultural differences might crucially affect attitudes towards corruption.

Finally, *GCONS* is government size, capturing the size of the bureaucracy as well as the enforcement machinery (Rose-Ackerman, 1999; also see Budak and Goel, 2004). More regulatory barriers provide opportunities for rent seeking, while stronger enforcement machinery increases the probability of detection.

Table 5 reports (second-stage) 2SLS estimation results allowing for the endogeneity of the corruption, *DEM* and *IPP* variables in (5). The Sargan overidentification test confirmed our choice of instruments. The first-stage *F*-tests were also statistically significant.

The overall fit of Model 5.1, endogenizing corruption, seems relatively better than Models 5.2 and 5.3. The effect of initial *GDPpc* is statistically insignificant, that of *LABgr* is negative and significant, and that of exports is positive and significant in both cases. Both economic freedom and *GDI* positively impact growth in Model 5.1, but the corresponding coefficients are not consistently statistically significant in the other two cases.

Turning to the influence of institutions after allowing for possible endogeneity, the results from Table 3 are reinforced. Namely, greater corruption positively and significantly affects growth while the effects of patent protection and democracy are statistically insignificant. The efficiency effect of corruption dominates the bottleneck effect in this case as well. Finally, with respect to BRIC countries, *China* shows consistently positive and statistically significant effects, while that of *Russia* is positive and significant in one instance. The coefficients on *Brazil* and *India* fail to attain statistical significance. This shows that growth in China, and to some extent in Russia, has been remarkable.

In sum, when possible reverse causality from corruption to growth is taken into account, the previous results regarding the relation between institutional quality and growth hold, while the effects of other influences are similar to earlier findings. In addition to the robustness of our results across three measures of institutional quality and the inclusion of BRIC group versus individual country dummies, we consider two robustness checks.

3.5 Robustness Checks

We perform two robustness checks to analyze the validity of our findings. These deal with examining growth over a shorter time period and checking the influence of outlying observations on the key results.

3.5a Short-Term versus Long-Term Growth

As a robustness check of our medium-term growth model estimated in Table 2, we also examine determinants of short-term growth[12]. The general pattern of findings is similar when a short-term growth model, explaining economic growth over 2006-2007 period is estimated. Two versions, with and without labor quality, are considered. The corresponding results are presented in the Appendix. As expected, the explanatory power is lower as many influences on growth take some time to have an effect. In Model A.1 exports show a positive growth impact, while *LABgr* exhibits a negative effect. The effects of other variables, while similar in signs to those in Table 2, were statistically insignificant. In Model A.2, greater literacy is shown to pay growth dividends even over the short term, while *GDPpc00* is now statistically significant. The other variables failed to achieve statistical significance.

Of the BRIC nations, China stood out, even more so than it did in Table 2. It seems that Chinese growth might be even more remarkable over the short term. The results for *Brazil* and *India* echoed those from earlier and *Russia* was statistically significant in one of the two cases.

3.5b Sensitivity of Findings to Outliers

Another robustness check was performed to check the effect of outliers on our results. For this purpose, Hadi's procedure was applied to *GDPgr* and *CORR* and only one country in the sample (Azerbaijan) emerged as an outlier. Models 3.1 and 3.2 were rerun after dropping the outlier and the results were very similar to what is reported in Table 3[13].

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[12] Admittedly, our characterization of the time periods for short-term and long-term growth is somewhat arbitrary. However, the term BRIC gained prominence only in the new millennium.

[13] Details are available upon request.

4. Concluding remarks

Using data for over 100 nations and employing a fairly standard growth model, this paper examines the determinants of economic growth in BRIC countries relative to rest of the world. The growth success of BRIC nations in recent years has intrigued policymakers and researchers in recent years. However, little formal research exists that focuses on these countries, and this work makes a contribution in that regard. A number of questions are addressed:

(a) How do determinants of medium-term economic growth differ from those of short-term growth?

We find that the general pattern of findings is unchanged over the medium and short term (Table 2 and Appendix). Exports and literacy boost growth, while there is support for convergence and labor growth has perverse effects. *GDI* has generally positive effects, while greater economic freedom shows little statistical significance. The convergence hypothesis was supported. BRIC countries as a group showed better growth than rest of the world. However, important within-group differences were found, with China and Russia mostly showing remarkable growth, India sometime showing positive growth and Brazil almost never standing out.

(b) What are the differences between the effects of aggregate versus disaggregated exports on growth?

While aggregate exports in most cases showed positive growth effects, the story was somewhat mixed when exports were disaggregated into four key categories: agricultural exports, fuel exports, manufacturing exports and ore exports (Tables 2 and 4). Both agricultural and ore exports consistently failed to show any statistically significant impacts on growth. On the other hand, fuel and manufacturing exports exhibited positive growth effects. We further find that the growth dividends from fuel exports were almost double those from manufacturing exports. These findings were robust to a nonparametric analysis that enabled evaluation of growth determinants across countries with different growth rates. The patterns for BRIC nations were similar to those discussed above. Finally, our findings were unable to find support for the resource curse hypothesis (see Stevens, 2003; Boschini *et al*., 2007; Bulte and Damania, 2008).

(c) Is lower institutional quality necessarily an impediment to growth?

We employed three measures of institutional quality: the degree of corruption, the degree of cross-country patent protection and the extent of democracy (Tables 3 and 5). With respect to corruption,

it turns out that the efficiency aspects of corruption overpowered any negative consequences resulting in positive association between growth rates and corruption. In other words, the greasing effects are supported over the sanding aspects of corruption (see Méon and Sekkat, 2005; Aidt, 2009). Greater democracy lowered growth, suggesting that that efficiency considerations were somewhat compromised at the expense of equity issues. The degree of patent protection, on the other hand, failed to exert any appreciable effect on growth. Only corruption effect was significant after allowance was made for possible reverse linkages from economic growth to institutional quality.

(d) Do various growth factors consistently promote growth across low growth and high growth countries?

The answer to this question is negative – the factors driving growth in high growth and low growth nations are not necessarily similar (Table 4). Our findings exclusively show that the determinants of growth were sensitive to prevailing growth rates. Not surprisingly, no effective growth-promoting strategy seemed to work in the lowest growth nations (i.e., bottom 10 percent of our sample). For instance, the contribution of aggregate exports is positive and significant in most cases, except the least growing countries. A key overall finding from this section is that no single growth determinant consistently contributes to growth across nations with different growth levels. This revelation is a key contribution of the present research and also provides an alternate way (other than dummy variables) to capture the relative differences across slow and fast growing (BRIC) nations. This calls for a move away from blanket growth recommendations across nations and calls for a country or region-specific approach.

To sum up, while as a group the BRIC nations have shown higher growth than rest of the world, there are significant within-group differences. China and Russia mostly showed higher growth, *ceteris paribus*, while India showed positive growth in some cases. On the other hand, we were unable to find Brazil performing better than the rest. The main policy lesson from this is that, given the dissimilar composition of the BRIC group, the lessons for other nations looking to boost growth by emulating BRIC nations might be limited. Such nations would have to pay careful attention to their own comparative advantages.

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ABSTRACT

We study economic growth in four emerging economies – Brazil, Russia, India, and China (BRIC). Questions addressed are: (a) How do medium-term growth determinants differ from short term determinants? (b) What are differences between growth effects of aggregate versus disaggregated exports? (c) Does lower institutional quality hinder growth? and (d) Do similar factors promote growth across low growth and high growth countries? Results show that while BRIC nations have higher growth, there are significant within-group differences. China and Russia mostly showed higher growth, while India sometimes showed positive growth, and Brazil did not outperform the rest. A nonparametric analysis with a broader set of high-growth nations provides some novel insights. Policy implications are discussed.

Keywords: Economic Growth, BRIC Countries, Exports, Institutions, Corruption, World

JEL Classification: O40, O57, P52

RIASSUNTO

Crescita economica nei paesi BRIC e confronti con il resto del mondo

In questo lavoro si studiano quattro economie emergenti: Brasile, Russia, India e Cina (BRIC). I problemi affrontati sono: (a) le determinanti della crescita nel medio periodo sono diverse da quelle della crescita nel breve periodo?; (b) quali differenze ci sono fra gli effetti della crescita delle esportazioni aggregate e delle esportazioni disaggregate?; (c) una qualità istituzionale scadente può rallentare la crescita?; (d) la crescita è stimolata da fattori simili sia nei paesi a crescita lenta che in quelli a crescita elevata? I risultati mostrano che, sebbene i paesi dell'area BRIC presentino tutti tassi di crescita elevata, vi sono differenze significative all'interno dell'area stessa. Alcuni risultati nuovi sono forniti dall'analisi non-parametrica su un più ampio set di paesi ad alta crescita economica. Inoltre vengono discusse le relative implicazioni politiche.

APPENDIX

Determinants of Economic Growth in BRIC: Short-Term Growth (Dependent variable = *GDPgrSR*)

	Model A.1		Model A.2	
Log(GDPpc00)	-0.59	(1.3)	-1.14**	(2.1)
GDI	0.05	(0.5)	0.03	(0.2)
LABgr	-0.54*	(1.9)	0.07	(0.2)
EF	-0.08	(1.4)	-0.09	(0.9)
EXP	0.03**	(2.4)	0.03	(1.2)
LIT			0.13**	(4.4)
Brazil	0.52	(0.6)	-0.24	(0.2)
China	5.41**	(2.2)	5.21*	(1.9)
India	2.03	(1.3)	4.67**	(3.2)
Russia	2.65**	(2.8)	1.30	(1.0)
R^2	*0.18*		*0.33*	
N	*114*		*77*	

Notes: see Table 1 for variable definitions. A constant term was included in all OLS regressions but the corresponding results are not reported to conserve space. The numbers in parentheses are t-statistics in absolute value based on robust standard errors. * denotes statistical significance at the 10% level and ** denotes statistical significance at least at the 5% level.