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ECONOMIC REFORMS, HUMAN CAPITAL, AND ECONOMIC GROWTH IN INDIA AND SOUTH KOREA: A COINTEGRATION ANALYSIS

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By employing a multivariate time series model, this study advances theoretical and empirical research on the role of economic reforms and human capital accumulation in the post-reform economic growth. We construct two indexes – a human capital index and a composite economic reform index – and perform a cointegration analysis of a long-run equilibrium growth path in India and South Korea twelve years after the implementation of reform. The significant positive effect of human capital accumulation is revealed in both India and South Korea. The impact of economic reforms is found to be heterogeneous across countries: the effect is positive, significant, and sizable in South Korea, while it is negative and relatively small in India. This result is suggestive of different degrees of efficiency of reform measures implementation in two countries.

Keywords: Economic Growth, Human Capital, Economic Reforms, India, South Korea
JEL classification: O10, O15, O47, O53

1. INTRODUCTION

It is widely believed that technological change and capital accumulation play a key role in economic growth. At the same time, growth economists recognize that the development process usually decelerates without organized markets, and as a result, society gets deprived of a substantial part of growth benefits. Taking into account the importance of economic reforms for market organization, we investigate the role of economic reforms and the role of human capital on economic development of two Asian economies – South Korea and India – in their respective post reform period.

In the 1950s, South Korea was a poor developing country. Its GDP per capita at the end of Korean War was less than $800. In less than forty years, South Korea's GDP per capita increased more than ten times, to $7235. India is a good study in contrast. In the

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middle of twentieth century, India's GDP per capita was slightly lower than South Korea's. India, like South Korea, prior to reform implementation, was a labor-abundant economy, closed to international trade. Its capital stock per worker was $786, and degree of openness was 10.4%. Today, India is still a poor, labor-abundant economy, with a deprived state of demographic and social developments. Considering these two Asian economies, it is interesting to explore the factors that worked behind their divergent paths of economic growth and explain the considerable differences between them.

Experts generally credit South Korean economic success to pragmatic market reforms (World Bank, 1993). However, Rodrik (1996) attributes South Korean economic growth to market-oriented policies and the reduced role of government intervention. He also argues that the success of reforms in South Korea could be explained by a better-educated labor force that might have simplified the establishment of a competent bureaucracy and have enhanced the productivity of interventions aimed at increasing private investment. Furthermore, Edwards (1992), and Levin and Renelt (1992) point out that market reforms are associated with growth only in those economies that have appropriate human capital to absorb new developments efficiently. According to Nehru *et al*. (1995), South Korea has the highest average education stock and the highest growth rate of education stock among developing countries, while India is at a relatively low level in both categories. To this end, Harvie and Pahlavani (2006) indicate that it is the impressive investment in human capital (education, in particular) that has boosted South Korea's economic growth far beyond the level of other South and East Asian economies. So, which factor – policy reform or human capital – has been more important for growth? This question has not been addressed yet. We aim to investigate this issue in deeper detail in this paper.

In this paper, we will comparatively evaluate the impact of two factors – market reforms and human capital – along with their complementary effects on economic growth in India and South Korea in the post-reform period during the second half of the twentieth century. Our choice of countries is justified by the fact that India and South Korea are the two largest economies in Asia. They were at a somewhat similar economic level in per capita GDP terms when the reforms were initiated. And yet, the impact of reforms has differed significantly between these two economies.

In particular, we have the following objectives for this paper. We perform a comparative analysis of the economic reforms and the movement of major economic variables before and after the reform implementation in India and South Korea. As no explicit data are available for market reforms and human capital, we develop a new methodology for determination and construction of two composite indexes – a reform index and a human capital index – to measure these variables implicitly. We use a multi-variable time series model to test the hypotheses of the impact of economic reforms and human capital on economic growth in India and South Korea in the long run. Our model is based on a modified production function, which along with conventional factors of production, incorporates composite reform and human capital indexes. We perform a cointegration analysis of the potential long-run growth functions of each

country. By finding elasticities of countries' GDP to economic reforms and human capital augmented labor, we trace the effects of different reforms and human capital accumulation on balanced growth path of each economy. Based on the conclusions of our empirical analysis, we discuss policy implications and assess the soundness of economic reform policies.

The rest of the paper is structured as follows. Section 2 reviews the literature. Section 3 develops a simple model to quantify empirically the impact of economic reforms and human capital accumulation on economic growth. Section 4 briefly introduces readers to the recent economic developments in India and South Korea with an assessment of market reforms outcomes, describes data, and performs empirical analysis based on a multi-variable time series model. Section 5 provides policy recommendations, explores avenues for further research, and offers conclusions.

2. LITERATURE REVIEW

What is the key to the economic success of South Korea? Among professional economists, the view is that the East Asian miracle could be attributed to market-oriented policies and the reduced role of government intervention.[1] In particular, Krueger (1993) argues that in contrast to the overcontrolled, overregulated, and highly distorted other East Asian economies, the Korean economy has been characterized by diminishing intervention in most spheres of economic activity, and much smaller degree of distortion. Rodrik (1996) also confirms that the success of South Korea and Taiwan at the end of the twentieth century could actually be explained by an extensive set of reforms during the late 1950s and early 1960s.

Harvie and Pahlavani (2006) examine the major determinants of GDP growth in South Korea during 1980-2005, allowing for the presence of potential structural breaks, which coincide in time with the effects of the Asian crisis on the Korean economy. The authors argue that there is a cointegration relationship among the Korean GDP growth, investment, trade, and human capital. Employing an error correction procedure, Harvie and Pahlavani (2006) conclude that, in the long run, policies aimed at promoting various types of physical and human capital, and trade openness improved Korea's economic growth in 1980-2005. The impact of total imports is found to be insignificant, primarily due to capital vs consumer goods compositional changes. These are in line with Ahmed (2008) and Zhuang and Koo (2008). Ahmed (2008) claims that South Korean growth is input driven. Promotion of FDI helped the manufacturing sector to become the engine of economic growth, and as a result companies such as Daewoo, Samsung and LG were to compete globally. Zhuang and Koo (2008) empirically prove that the prospective U.S. free trade agreement with South Korea would increase the Korean GDP by about 0.79-1.73%.

[1] For additional discussion, see Ranis and Mahmood (1992).

However, studies about Indian growth are controversial with regard to reforms. Rodrik and Subramanian (2004) explore the causes of India's productivity surge since 1980, more than a decade before serious economic reforms were initiated. They find that traditional reforms – trade liberalization, expansionary demand, a favorable external environment, and improved agricultural performance – did not play a role. Instead, they attribute the growth to earlier pre-reform environment that played an important role in determining which state took advantage of further policy changes. In another study on Indian growth, Hausmann *et al*. (2005) argue that growth tends to be correlated with increases in investment, trade, and real exchange rate depreciation. However, as all these growth accelerations are highly unpredictable, they conclude that in most instances economic reforms in India do not necessarily produce growth. Acharyya (2009) finds a statistically significant long run positive impact of FDI inflow on GDP growth in India during 1980-2003. On the other hand, according to Acharyya (2009), this is also associated with a large negative impact on environment, via increased emission of CO_2. In contrast, Zhang and Fan (2004) uses generalized method of moments to illustrate that regardless of the declining investment trend in rural areas, infrastructure reform in India turned out to be productive. Other studies on Indian growth also report ambiguous success of reforms, allowing Virmani (2009) to claim that India's growth is an example of economic Sudoku.

Both studies – of Indian and South Korean development – have some shortcomings. For example, Harvie and Pahlavani (2006) explain the growth of Korean GDP employing an unusual specification of production function,[2] which makes the results questionable. Investigation of the Indian growth in contrary overlooks the labor and human capital component of development, with the exception of Venkataramani *et al*. (2010) that analyzes how improvements in health impact economic performance in agricultural sector. In this paper, we will address this gap in the literature and comparatively evaluate the impact of two factors – combined market reforms measures and human capital – along with their complementary effects on each other, on economic growth in India and South Korea in the post-reform period based on a cointegration analysis.

3. THE MODEL

In this section, we develop an empirical model to ascertain the impact of three major types of market reforms and human capital development on economic growth in India and South Korea in the post-reform periods. The three major market reforms considered

[2] i.e., in Harvie and Pahlavani (2006) framework, the Cobb-Douglas production function incorporates along with traditional determinants – physical and human capital – two additional factors (exports and imports) that come from expenditure approach to measurement of GDP rather than production process.

are trade liberalization, financial reform, and enterprise restructuring. We make a conventional assumption that economic reforms, if properly implemented, boost total factor productivity (TFP). Institutional changes that occur in the process are considered exogenous.

We assume a continuous time infinite horizon economy with identical, rational agents. At each time *t*, production of a single homogenous good is represented by:

$$Q = A(R,O)F(K,hL), \tag{1}$$

where Q is the quantity of output produced per period of time, A is the total factor productivity, R is the reform measure, O is a catch-all factor for all other effects not explained by R, F is a general constant elasticity of substitution production function, K is a capital stock, L is the number of workers, h is the measure of human capital per worker, and hL is the total labor input in the economy.

According to Weil (2004), productivity A can be determined by two factors: technology, that represents the knowledge about how factors of production are combined to produce output, and efficiency, that measures how effectively given technology and factors of production are employed. The positive impact of reform measures such as trade liberalization, financial reform, and enterprise restructuring on both technology and efficiency components of the total factor productivity A is well supported by Edwards (1992). To this end, we establish the following property of a productivity term in our model $A_R > 0$. A shock to the economy from market reforms will have a positive effect on total factor productivity A. Moreover, a higher productivity will accelerate economic growth, and total production Q will reach a new higher level at the end of transition process.

The effects of trade liberalization, openness to foreign investments, and enterprise restructuring on economic growth are easily justified. Liberalization of trade, with reduction of tariffs, subsidies, and quotas on imports and exports increases competition in the domestic market. In order to compete with imported products, domestic producers would have to increase their productivity. Similarly, exporters would need to increase quality and productivity of their output in order to compete in the world market. Thus, by engendering efficiency, trade liberalization will boost economic growth and overall production in the economy.

When the economy reduces restrictions on foreign investment, the level of capital inflows into the economy is likely to increase. In the absence of distortions, and with a rational maximizers' behavior, the hitherto inefficient economy should become more efficient.[3] Increased investment and enterprise restructuring will boost production directly by increasing the capital level, and indirectly by improving efficiencies in the

[3] However, if trade distortions are present in the economy, foreign investments may further increase production of a "wrong" good and make the economy even more inefficient.

production processes. New technologies and more efficient production methods associated with foreign investment will speed up the economic growth.

In a similar way, the effect of human capital on economic growth can be assessed. Improvement in human capital will make labor more efficient. According to Equation (1), this will have a direct positive impact on the country's production.

We specify the production function similar to Kushnirsky (2001), and use this production function as a benchmark function in our estimations:

$$Q = OK^{\alpha}(hL)^{\beta}R^{\gamma}, \tag{2}$$

where a constant term *O* and all the exponents α, β, and γ are independent of a country choice. The function above will be estimated with cointegration approach to evaluate how different paths of economic reforms and human capital accumulation affect the growth of a country.

4. EMPIRICAL STUDY

The main objective of this section is to comparatively evaluate economic reforms in India and South Korea, and to explore the long-run relationship among economic reforms, human capital accumulation, and economic growth in these two countries in the post-reform period by employing a cointegration approach.

4.1. Data Description

For empirical study, we confine our dataset to the periods when the major economic reforms were implemented in both countries. Arguably, the defining initial year of a major economic reform in South Korea is 1965, with a second wave of changes initiated in the late 1970s. As for India, Rodrik and Subramanyam (2004) point out that even though the first hesitant market-oriented reform took place in the mid-1980s, the more decisive reform occurred only in 1991. Driven by a relatively shorter post-reform period in India, we consider a twelve-year post-reform period. To maintain symmetry in data, we confine our dataset to 1966-1977 in case of South Korea, and to 1992-2003 in case of India.[4]

The variables in our empirical analysis for both India and Korea are as follows:

GDP (Q): GDP in 2000 constant US dollars comes from the World Development

[4]Even though we recognize that twelve years timeframe is a relatively short period for cointegration analysis, we focus on this interval in order to discuss an immediate impact of reform measures implementation in each country.

Indicators (WDI) 2005. The World Bank defines this as the sum of gross value added of all resident producers in the economy adjusted for taxes and subsidies.

Labor (L): Total labor force comes from the WDI 2005. The World Bank uses International Labor Organization (ILO) definition of economically active population to determine total labor force. It includes both employed and unemployed, but excludes homemakers, other unpaid caregivers, and workers in the informal sector. Taking into account a thriving informal sector in India,[5] and a relatively undeveloped data collection procedures in Korea in the 1960s, we acknowledge that labor force data in both countries might be biased and should be treated with caution.

Capital Stock (K): As no explicit data available for the capital stock, we convert Larson *et al*. (2000) 1967-1992 capital stock database in 1990 US dollars to 2000 constant US dollars. We further extend the dataset to the remaining years of the 1960-2003 period. Specifically, we use the Larson *et al*. (2000) fixed capital deflator to convert total capital stock in 1990 constant US dollars to current US dollars. We then employ the GDP deflator from the WDI 2005 to convert the total capital stock in current US dollars to constant 2000 US dollars. We expand the capital stock data over the 1960-2003 period by applying a perpetual inventory method (PIM):

$$K_t = K_{t-1} + I_t - D_t , \tag{3}$$

where K_t is a capital stock at time *t*, K_{t-1} is a capital stock at time (*t*-1), I_t is investment at time *t*, and D_t is a depreciation at time *t*. We use gross capital formation data from WDI 2005 as a proxy for investment (*I*) and assume that the depreciation rate is 5 percent, which according to the recent economic literature is close to reality.

Reform Index (R): We construct a composite reform index R in the style of De Melo *et al*. (1996).[6] Taking into account the specifics of economic reforms in India and South Korea, our index is an average of three reform indicators − trade reform, financial reform, and enterprise restructuring.

Trade Reform: We define trade reform as a political process that employs various tools to enhance country's opportunities and increase the volume of international trade. As both India and South Korea followed an import-substitution development policy prior to reform implementation, liberalization of trade did not play a significant role in their economies. In order to increase competitiveness of exports, India implemented a major exchange rate reform in the early 1990s. Imports were also liberalized by removing quantitative restrictions and by gradually decreasing tariff rates. Yet, tariff

[5] For detailed estimations of the informal sector in India- refer to Chakrabarti and Kundu (2009).

[6] The De Melo *et al.* (1996) reform index is a weighted average of three reform indicators: 1) price liberalization and competition, 2) trade and foreign exchange regime, and 3) privatization and banking reform.

rates in India were relatively high compared to other East Asian countries until 2002. One of the notable features of Indian exports dynamics was a sharp increase in its service exports. A less repressive regulation and an inflow of foreign investment were the two key factors that stood behind the success of service sector in India. In contrast, the Korean government implemented a major exchange rate reform much earlier, in the mid-1960s. Reforms in the Korean imports focused mainly on the removal of quantitative barriers rather than decreasing tariffs. A trade reform in South Korea was characterized by a consistent government support in expanding export market and broad incentives in the form of tax reduction for export income. As a result, in South Korea, the share of the manufacturing sector in GDP increased significantly in the post-reform period.

To measure trade reform**,** we use the volume of trade, or sum of imports and exports as a percentage of GDP in 2000 constant US dollars. Figure 1 shows this index for India and South Korea in the period of interest.

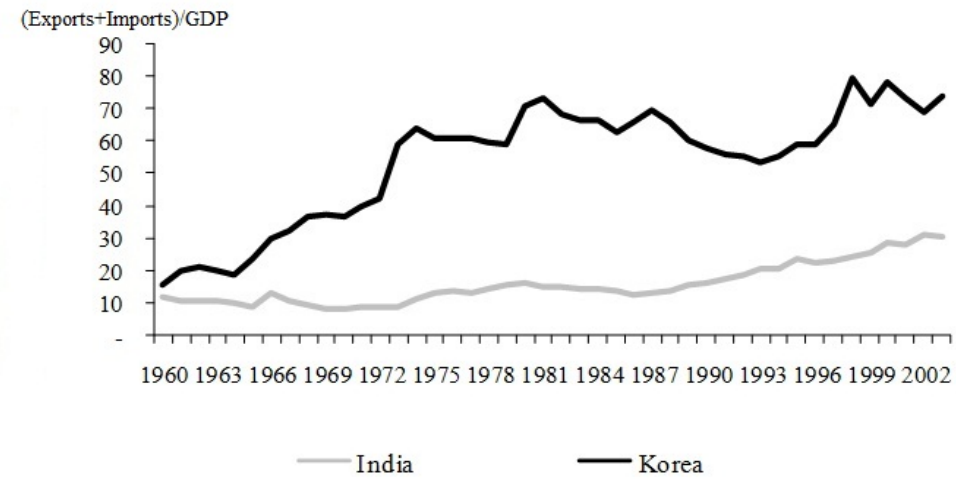

Figure 1. Volume of Trade as a Percentage of GDP in India and South Korea, 1960-2003

The volume of trade as a percentage of GDP in 2000 constant US dollars is available from the WDI 2005. Assuming that changes in this index are driven by policy changes, we use outcome-based measures to evaluate effectiveness of trade reforms. Specifically, the effectiveness of trade reforms is judged meaningfully by an increase in the trade volume it generates.[7]

[7] Following Edwards (1992), we also performed evaluation of the Structure Adjusted Trade Intensity (SATI) to control for country's size, GDP, transport cost and other relevant variables. This alternative measure of trade reform effectiveness produced no significant results that might have changed our choice.

Financial Reform: We look at the financial reform in India and South Korea as a broad set of policy measures that leads to the further sector development, liberalization, and deregulation, with particular focus on allocating credit to market forces via assigning greater flexibility in determining interest rates. India implemented a wide range of financial reform measures in early 1990s. These reforms included interest rate deregulation, opening up the banking sector to private and foreign banks, and reduction of government interventions in credit allocation. Prudential regulations following Basel Committee recommendations significantly improved bank supervision. New rules were enacted to manage the securities market. Similarly, South Korea introduced the first step of financial sector reforms by deregulating interest rates. Control over bank credits was reduced, and the banking sector was partially opened to foreign and private banks in the late 1960s - early 1970s.

Similar to trade reform measure, we justify variables measuring financial reform effectiveness by the outcome-based approach. Our financial reform index consists of the following two variables, with equal weights: 1) a ratio of broad money to GDP (M2/GDP) that measures a level of financial expansion in the economy:[8] 2) a ratio of domestic credit to private sector to GDP that approximates a reduction of government intervention in bank lending. All variables employed in the construction of this index come from the WDI 2005. Figure 2 shows dynamics of the financial reform indices in India and South Korea in 1960-2003.

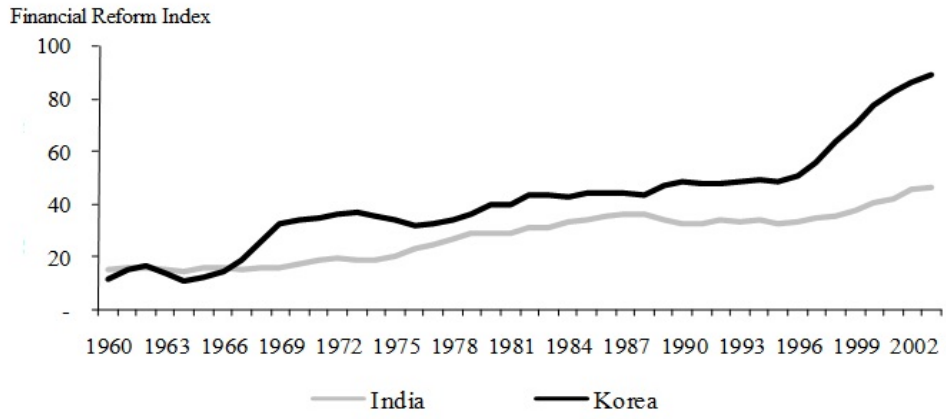

Figure 2. Financial Reform Index in India and South Korea, 1960-2003

Enterprise Restructuring: Under enterprise restructuring reform we look at the national government pursues to restructure enterprises from public to private ownership, by enacting new laws that encourage private sector participation in various economic

[8] M2/GDP is assumed to move upward with reforms in financial sector.

activities, and an increase in the private sector share of value added and employment.

Since independence, India's economy was dominated by huge public sector enterprises. In the 1990s, the government removed subsidies and preferential access to bank loans for these enterprises. A sharp reduction in the number of areas reserved for the public sector enterprises improved incentives for private participation and foreign direct investment (FDI). Reduced government regulation and bureaucratic red tape along with a larger amount of FDI contributed to a surprising growth of the Indian service sector. Unlike India, the South Korean economy was not dominated by public sector enterprises at the beginning of economic reforms. The Korean government restructured the public sector in the late 1960s to the early 1970s by mainly selling unprofitable public enterprises, and reorganizing other enterprises geared towards economic development. Important steps were taken in order to remove favorable treatment of large conglomerates and to enact legislation regulating monopolies.

Considering data availability, we employ two variables that capture enterprise restructuring effect on the economy: 1) private sector share of total employment (in India), and 2) private sector share of value added (in South Korea). The private sector share of employment data were obtained from the Reserve Bank of India; the data on private sector share of total value added in South Korea come from Kang (1989) and the Bank of Korea.

We construct an overall reform index as an average of the three reform measures – trade reform index, financial reform index, and enterprise restructuring index.[9] Figure 3 depicts dynamics of composite reform index in India and South Korea in 1960-2003.

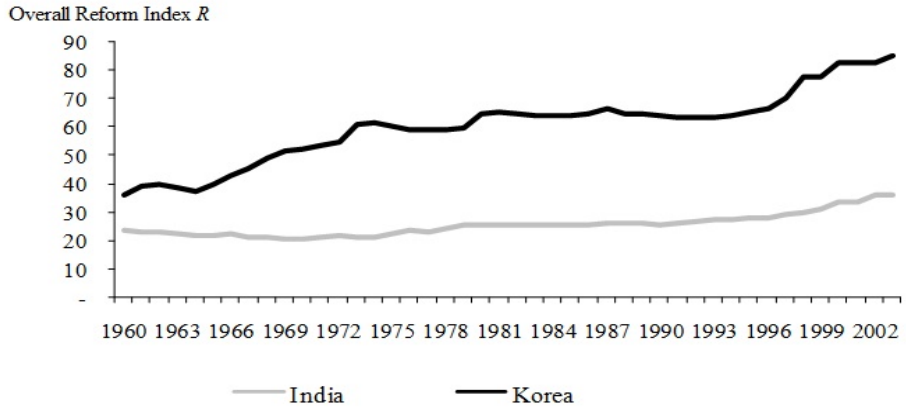

Figure 3. Overall Reform Index *R* in India and South Korea, 1960-2003

[9] In our cointegration analysis, we follow a benchmark model of Rabbani and Maksymenko (2011) to assign equal weights to three reform measures. Within the sensitivity check in the panel data analysis, Rabbani and Maksymenko (2011) also show that assigning different weights to reform measures does not effectively change the results.

Human Capital (h): It has been established in economic theory that human capital is one of the most significant sources of economic growth. Nevertheless, the empirical research has not yet produced convincing results to ascertain the importance of it for economic growth. The main problem lies in the construction of a human capital variable, which is not directly measurable.

In order to proxy a human capital for the Asian region, most empirical studies (Harvie and Pahlavani, 2006; Song, 1990; Guesan, 2004) rely more on data availability rather than on a theoretical definition. The variables commonly used as a proxy for human capital are investment in education, secondary or total school enrollment ratio, literacy rate, and average years of schooling. However, all these ratios have several disadvantages.[10] In addition, the above mentioned studies omit health component of the human capital variable. In contrast, Venkataramani *et al*. (2010) focus on health (proxied by district infant mortality rate) only.

In our judgment, a plausible variable for human capital should take into account returns on all types of investments that human beings undertake in order to increase their future well-being and production potential. Therefore, using conceptual foundations of the term, we construct a composite human capital index, which captures both major components of human capital −education and health. The composite human capital variable is created as a weighted average of the two indices− average years of schooling and life expectancy at birth - based on a principal component analysis.

Data on the years of formal schooling received, on average, by adults over age 15, defined as average years of schooling, are available from Barro and Lee (2000) for 1960-2000. We use a linear interpolation method to estimate missing observations. Data on life expectancy at birth, or the number of years a newborn infant would expect to live if prevailing patterns of mortality at the time of her birth were to stay the same throughout her life, come from the WDI 2005. To address the issue of comparability of indices, we set India's average years of schooling and life expectancy at birth in 1960 to unity, and normalize the rest of schooling and life expectancy data respectively. Figure 4 depicts the dynamics of human capital indices in two countries in 1960-2003.

[10] See Barro (1991), Nehru *et al.* (1995), Gemmel (1996), Hanushek and Kimko (2000), and Wobmann (2003).

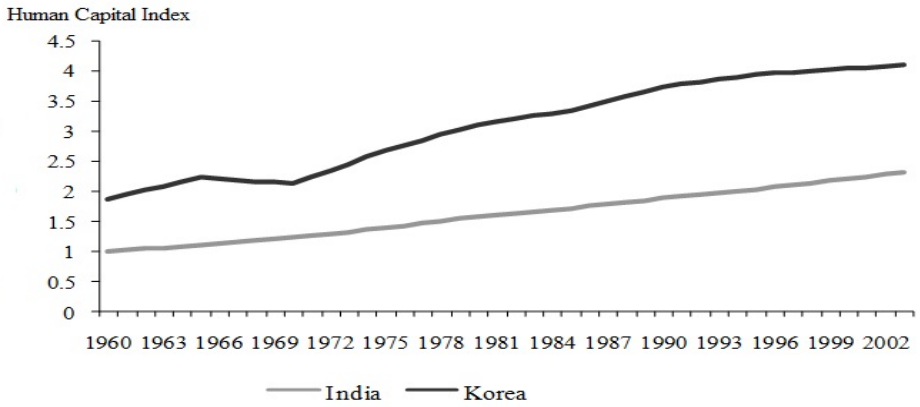

Figure 4. Human Capital Index in India and South Korea, 1960-2003

Table 1 provides a summary of definitions and sources of variables used in this study.

Table 1. Variables for the Empirical Analysis and Index Composition

Variable	Definition	Source
Q	Gross Domestic Product, in constant 2000 US dollars	World Development Indicators 2005
hL	Human capital augmented labor	Authors calculation
L	Total labor force, or economically active population	World Development Indicators 2005
h	Human capital index, assigns weights based on PCA to: a) average years of schooling b) life expectancy at birth	a) Barro and Lee (2000) b) World Development Indicators 2005
K	Physical capital, in constant 2000 US dollars	World Development Indicators 2005 and Larson *et al.* (2000)
R	Reform index, assigns equal weights to trade reform index, financial reform index, and enterprise restructuring index	Authors calculations
Trade Reform Index	(Exports +Imports)/GDP	World Development Indicators 2005
Financial Reform Index	Assigns equal weights to the M2/GDP, and the ratio of domestic credit to private sector to GDP	World Development Indicators 2005
Enterprise Restructuring Index	a) Private sector share of total employment (India) and b) private sector share of value added (South Korea)	a) Handbook of Indian Economy by the Reserve Bank of India b) Bank of Korea, National Accounts 1970-1987; Kang (1989)

4.2. Methodology

When different sets of economic reforms are imposed on two economies with similar initial conditions, economic forces might drive these economies towards different long run equilibrium conditions. As discussed earlier, South Korea and India implemented economic reforms in a different way: the Korean reform program was much more profound compared to the gradual Indian reform program. To explore the long-run relationship between economic growth and various economic reforms, we propose to use a cointegration analysis. It will enable us to examine the long-run equilibrium conditions for a growth path in each economy, and to trace the effects of different types of reforms on this balanced growth path over time.

The basic idea behind cointegration is that each of the components of a $(p \times 1)$ vector time series Z_t may follow a non-stationary unit root I(1) process, yet there may exist some linear combination of $\beta^T Z_t$, which ties the individual components together and is stationary (without a unit root).[11] This linear combination can be interpreted in economic terms as a long-run equilibrium relationship among variables of a vector Z_t.

We will use a multivariate maximum likelihood cointegration procedure proposed by Johansen (1988), that allows for the estimation and testing for a number of cointegrating relationships in the system.[12] All the hypothesis tests may be conducted in this case to using standard asymptotic chi-square tests.

4.3. Applications to India and South Korea

In this section, we conduct a cointegration analysis of the variables in the growth model for India and South Korea. Specifically, the functional relationship in growth Equation (2) $Q_t = F(K_t, hL_t, R_t)$ will be analyzed. Every variable in the equation is measured in logarithms. The cointegration analysis for both countries is conducted for post-reform periods of 12 years, namely, 1992-2003 for India and 1966-1977 for South Korea.

To apply Johansen's method for cointegration analysis, every variable should be non-stationary, i.e., integrated of some order greater than zero. We perform the augmented Dickey-Fuller (ADF) test to determine the integration properties of each variable series. The ADF test constructs a parametric correction for higher-order correlation by adding *p* lagged difference terms of dependent variable *z* to the right-hand side of the test regression under assumption that *z* series follow an *AR*(*p*) process:

[11] If this is a case, β is called a cointegrating vector.

[12] Phillips (1991) showed that the most preferred approach to the estimation of cointegrated systems is the Johansen's method, as the coefficient estimates obtained through this procedure are symmetrically distributed, median unbiased, and asymptotically efficient.

$$\Delta z_t = \alpha z_{t-1} + \delta x_t + \beta_1 \Delta z_{t-1} + ... + \beta_p \Delta z_{t-p} + \varepsilon_t , \quad (4)$$

where z_t is a non-stationary series whose variance increases with time and approaches infinity, x_t are exogenous regressors, which may contain a constant, or a constant and a trend, α and β are parameters to be estimated, and ε_t is a white noise. The null and alternative hypotheses are as below:

$$\begin{aligned} H_0 &: \quad \alpha = 0, \\ H_1 &: \quad \alpha < 0. \end{aligned} \quad (5)$$

The above hypotheses are tested using a conventional *t*-ratio for α:

$$t_\alpha = \frac{\hat{\alpha}}{se(\hat{\alpha})} . \quad (6)$$

As indicated, we conduct the ADF test for the 12-year post-reform period for both India and South Korea. The initial results of ADF statistics for ln(*Q*), ln(*hL*), ln(*K*), and ln(*R*) are given in Table 2.

Table 2. ADF Unit Root Test for Level Data

	India		South Korea	
Variables	ADF Test Statistics	P Value	ADF Test Statistics	P Value
ln (*Q*)	-1.499	0.743	-0.383	0.881
ln (*hL*)	-0.863	0.743	-0.152	0.917
ln (*K*)	0.438	0.995	0.008	0.939
ln (*R*)	1.756	0.998	-0.941	0.909

Note: The *p*-values for the ADF test in the table above are based on McKinnon (1996).

At 10% level of significance, all four variables are non-stationary for India and South Korea. In order to determine the order of integration, we run the ADF test for the series in first differences. The results in Table 3 show that all differenced variables are stationary at least at the 8 percent level.

Table 3. ADF Unit Root Test for First-Differenced Data

	India		South Korea	
Variables	ADF Test Statistics	*P* Value	ADF Test Statistics	*P* Value
D(ln (*Q*))	-4.394	0.044	-3.345	0.041
D(ln (*hL*))	-3.079	0.069	-10.087	0.001
D(ln (*K*))	-7.743	0.001	-2.926	0.077
D(ln (*R*))	-4.473	0.008	-7.356	0.005

Notes: The *p*-values for the ADF test in the table above are based on McKinnon (1996). D( ) refers to the first-differenced variable.

Knowing that all the variables are I(1) in the post-reform period, we proceed with cointegration analysis. The initial step in cointegration analysis is to determine the number of lags needed in the VAR(*p*) model. We use Sims' (1980) modified lag test to determine the appropriate number of lags. We begin with the maximum number of lags *m* and test the hypothesis that coefficients of lag *m* are jointly equal to zero by employing the likelihood ratio (LHR) test:

$$LHR = (T - C)(\ln|\Omega_{m-1}| - \ln|\Omega_m|), \tag{7}$$

where T is the number of observations, C is the number of parameters estimated in each equation, Ω_m is the variance/covariance matrix of the residuals from the VAR(p) system. The above LHR statistic has an asymptotic chi-square distribution with degrees of freedom equal to the number of restrictions in the system. In order to choose the appropriate lag length for the system, we sequentially test the significance of lags by comparing the LHR statistic to the 5 percent critical value starting from the maximum lag and decreasing one lag at a time until we first get a rejection. The LHR statistic indicates that one lag would be appropriate to capture the dynamics in the post-reform period for both India and Korea.

Table 4 presents the results of Johansen's cointegration test that determines the cointegrating rank of the model. Both the trace and the maximum eigenvalue test statistics indicate a cointegrating rank of one for India and South Korea.

The estimated normalized cointegrating vectors β of $Z_t = (Q_t, K_t, hL_t, R_t)$ are reported in Table 5. Adjustments coefficients α usually interpreted as the average speed of adjustment towards the estimated long run equilibriums state. The adjustment coefficients derived for India and Korea are all significant at the 5% level. These significant adjustment coefficients imply that all variables are converging towards the long run equilibrium.

Table 4. Johansen Cointegration Test Result for Cointegration Rank

	India's Statistics		South Korea's Statistics	
Rank	Trace	Maximum Eigenvalue	Trace	Maximum Eigenvalue
None	105.693*	72.134*	70.563*	50.395*
At most 1	33.559	19.294	20.168	15.136
At most 2	14.264	11.613	5.032	3.217
At most 3	2.652	2.652	1.815	1.815

Note: * denotes rejection of the hypothesis at the 5% level.

Table 5. Cointegrated Vectors from Johansen's Cointegration Test

	Unrestricted		Normalized	
Variable	India	South Korea	India	South Korea
ln(*Q*)	-1.999	0.923	1	1
ln(*K*)	0.489	-0.357	-0.245	-0.387
ln(*hL*)	3.436	-0.472	-1.719	-0.511
ln(*R*)	-1.014	-1.738	0.507	-1.882

Note: all unrestricted correlation coefficient are statistically significant at the 5% level.

By rearranging the cointegrating relationship $\beta^T Z_t$ to capture the long-run equilibrium conditions, we obtain the following equations:

India:

$$\ln(Q_t) = 0.245\ln(K_t) + 1.719\ln(hL_t) - 0.507\ln(R_t), \quad (8)$$

South Korea:

$$\ln(Q_t) = 0.387\ln(K_t) + 0.511\ln(hL_t) + 1.882\ln(R_t). \quad (9)$$

In the economic sense, we can interpret Equations (8)-(9) as potential long-run growth functions. Several very important results can be observed. Firstly, the positive elasticity of GDP with respect to human capital augmented labor in Equations (8)-(9) confirms that in both countries – India and South Korea – human capital accumulation played an important role in the post-reform growth, in compliance with Nehru *et al*. (1995), Rodrik (1996), Venkataramani *et al*. (2008) and Rabbani and Maksymenko (2011). The impact of human capital augmented labor on Indian growth is found to be much larger in magnitude compared to its South Korean equation counterparts. Not surprisingly, being a labor-abundant economy with relatively low levels of schooling and life expectancy at the beginning of reform implementation, India experienced a much stronger input to its development process from the accumulation of human capital rather than from its scarce factor of production-capital.

Secondly, long-run equilibrium growth functions indicate that the impact of the reform measures is heterogeneous across countries. Namely, the elasticity of GDP with respect to economic reform in South Korea is positive, whereas it is negative in India. This result is suggestive of a different degree of efficiency in reform measures implementation in two countries. Equation (9) implies that economic reforms as measured by a composite reform index were much more sizable and significant in the South Korean post-reform growth relative to India. In the case of South Korea, our findings agree with the empirical literature, i.e., Harvie and Pahlavani (2006), on the impact of reform measures.

The negative long-run effect of the reform factor on economic growth in India, found by employing a cointegration technique, might be surprising at the first sight. Yet, there are several factors that may explain our results. Firstly, an initial hesitant approach to reform implementation in India might partly explain India's less effective reform outcomes during the first twelve years. Secondly, it can be justified by unfavourable time − invariant country − specific factors (such as initial state of the economy, income distribution, demographic transition, legal system, democracy, culture and traditions etc.), as well as persistent short-term complications in reform measures implementation in India. Traditional correlation analysis is not able to capture these factors. Thirdly, the economic literature suggests that having appropriate human capital is important for advancing the opportunities opened by reforms. A higher level of human capital in South Korea at the beginning of its reform implementation to a certain extent explains Korea's economic success. Rabbani and Maksymenko (2011) confirm a positive interaction between economic reforms and human capital augmented labor in South Korea. Yet, in India, where the human capital dividend was at a relatively lower level prior to reform implementation, we do not observe this interaction. To this end, the negative sign of the reform measures on growth in India can be partly explained by inability of the Indian labor to accommodate the pace of reforms. This leaves a broad avenue for the policy makers to address the issues of human capital, by expanding economic reforms to labor markets, education, and healthcare. While India is unique in having a very successful tertiary education system, its primary education is in a poor state, which is evidenced by a low literacy rate. Therefore, primary education system is vital for the Indian effort to improve human capital. More funding, adequate teacher training, and improved infrastructure should lead towards this goal. Vocational education can be provided to people who do not intend to pursue higher education. Finally, the inefficient enterprise-restructuring and corrupt pattern of privatization may also have contributed to the negative coefficient by Reform Index *R*. Prices for many nationalized companies were fixed during the privatization process, and the methods of privatization favoured wealthy strata. Privatization procedures and prices in many cases were not determined by the market, but rather by the hierarchal allocation process. This contributed to inefficiency of reform implementation as measured by enterprise restructuring index, and in turn affected the sign of cointegration coefficient in our growth analysis. With all these in mind, we can expect that beyond the twelve-year

horizon, when the economy moves further towards the market, the negative impact of reform measures implementation in India would fade, and slowly change towards the positive effect. We will leave this topic for the further studies.

5. CONCLUSIONS

In this paper, we analyzed the impact of economic reforms and human capital on the economic growth of India and South Korea in the post-reform period. We constructed a modified production function which along with a conventional factor of production – physical capital – incorporates a composite reform index and augmented labor in order show the effect of various reform measures and human capital accumulation on economic growth. By constructing two unique indices – a composite economic reform index and a human capital index – we explored the transitional dynamics of a growth in total factor productivity generated by trade reform, financial reform, enterprise restructuring, schooling, and improvements in life expectancy. We employed a cointegration analysis based on a modification of our baseline production function to assess the effects of economic reforms on the economic growth in India and South Korea.

Our analysis suggests that economic reforms and human capital accumulation produce a significant long-run effect on economic growth in the countries under consideration. The significant positive effect of human capital augmented labor is revealed both in India and South Korea in the twelve-year post-reform period. The impact of market reforms is found to be heterogeneous across these economies. The effect is positive, significant, and sizable in South Korea, while it is negative and small in India. This result is suggestive of different degree of efficacy of reform measures implementation in two countries. The negative long-run effect of the reform factor on economic growth in India is justified by several factors, including an original hesitant approach to reform implementation, unfavourable time – invariant country – specific factors (such as initial state of the economy, income distribution, demographic transition, legal system, democracy, culture and traditions etc), and the absence of a complementary effect of human capital augmented labor to market reforms.

In conclusion, our study opens a broad avenue for further research. We recognize that economic reforms and human capital accumulation are important factors for explaining growth in India and South Korea. As such, it will be interesting to employ a multivariate maximum likelihood cointegration technique in order to explore the long-run interaction between economic growth, reform measures, and human capital development in a broader range of Asian countries that recently implemented market reforms and significantly improved their human capital.

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