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The Determinants of Economic Growth Versus Genuine Progress in South Korea

Simon Feeny · Heather Mitchell · Christine Tran · Matthew Clarke

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Abstract This paper examines whether the drivers of economic growth are the same as those for genuine progress in the case of South Korea. Using data covering the period 1970–2005, the paper first constructs a Genuine Progress Indicator (GPI). An empirical model is then specified and estimated using growth in GDP per capita and growth in the GPI per capita as dependent variables. Results indicate that while physical capital, research and development, exports, and inflation are all important in determining growth in GDP per capita, only physical capital is a driver of genuine progress. These findings highlight the need for policymakers to identify and target other determinants of genuine progress to improve the well-being of South Koreans, rather than focus attention on traditional sources of economic growth.

Keywords Well-being · Genuine progress indicator · Economic growth · South Korea

1 Introduction

Recently, there has been a renewed and strong interest in moving beyond the reliance on using Gross Domestic Product (GDP) per capita as a measure of progress. The 2009 Report of the Commission on the Measurement of Economic Performance and Social Progress, led by Nobel Prize winner Joseph Stiglitz, highlighted the limitations of GDP per capita as an indicator of economic performance and social progress. The report argued that the conventional measurement system of economic activity needs to shift away from measuring economic production and focus instead on measuring human well-being. Moreover, President of France, Nicolas Sarkozy, argued that, "For years statistics have registered an increasingly strong economic growth as a victory over shortage, until it emerged that this growth was destroying more than it was creating. The [2008 global financial] crisis doesn't

S. Feeny · H. Mitchell · C. Tran
School of Economics, Finance and Marketing, RMIT University, Melbourne, Australia

M. Clarke (✉)
School of Humanities and Social Sciences, Deakin University, Geelong, Melbourne, Australia
e-mail: mclarke@deakin.edu.au

only make us free to imagine other models, another future, another world. It obliges us to do so" (The Guardian 2009).[1]

A number of alternative measures of progress have been devised, including the Measure of Economic Welfare (MEW) (Nordhaus and Tobin 1973), the Index of Sustainable Economic Welfare (ISEW)[2] (Daly and Cobb 1990), and the Genuine Progress Indicator (Lawn 2003). All of these progress indices are designed to better reflect the economic welfare that is associated with economic activity, and incorporate sustainability components to account for resource depletion and pollution costs.

Despite the existence of these alternatives, GDP per capita remains the dominant measure of living standards. For example, the Commission on Growth and Development stressed the importance of economic growth as a means to achieve poverty reduction (World Bank 2008). Further, the Seoul Development Consensus emanating from the 2010 G20-Seoul Summit argues for countries to be economic growth-oriented to assist with progress towards the United Nations Millennium Development Goals (MDGs), although growth should be strong, sustainable and balanced (G20 2010).

Debates over the most appropriate measures of progress continue. What is important in this debate is whether the determinants (and, therefore, government policies and reforms) differ across progress measures. For example, are the policies that spur economic growth also effective at spurring genuine progress? Genuine progress can be considered 'good change' (Kingsbury et al. 2008). Such good change brings about positive improvements in all spheres of people's livs and is not simply limited to increased income. The intrinsic goal of genuine progress is to advance human dignity, freedom, social equity and self-determination. A lack of genuine progress is characterized by social exclusion, poverty, ill-health, powerlessness, and shortened life expectancy. Genuine progress outcomes are best achieved when communities have ownership of the goals and processes of development and where there are participatory representation, transparency and accountability mechanisms. Genuine progress outcomes must also explicitly consider the importance of gender and diversity. This requires processes that appreciate existing endogenous strengths and (often) exogenous interventions and finally it requires critical analysis, mutual learning, and acceptance of its paradoxes and dilemmas.

If economic growth and genuine progress have similar impacts, then debates over the most appropriate measure of progress are nullified. Yet the determinants of these alternative measures of progress have not been examined previously and this is the main objective of this paper. It starts by calculating a Genuine Progress Indicator (GPI) for South Korea and proceeds by estimating empirical models to examine whether the determinants of changes in GDP per capita are the same as those for changes in genuine progress (per capita). According to Lawn and Clarke (2006, p.17), the GPI is:

> 'a recently established indicator specifically designed to ascertain the impact of a growing economy on sustainable well-being. Usually comprised of around twenty individual benefit and cost items, the GPI integrates the wide-ranging impacts of economic growth into a single monetary-based index. As such, the GPI includes

[1] The shortcomings of GDP per capita as a measure of progress have long been known (Kuznets 1941; Abramovitz 1961). For example, GDP per capita ignores non-market production and fails to account for the social and environmental costs of production. It also fails to capture the distribution of income and excludes the value of leisure and illegal activities.

[2] Like the GPI, the MEW was an adjusted GDP to take into account certain aspects of welfare that the GDP faled to properly consider. The ISEW was also an adjusted GDP but was more comprehensive in the adjustments made than the MEW. The ISEW is the basis of the GPI.

benefits and costs of the social and environmental kind as well as those of the standard economic variety. Whilst the GPI embraces some of the national accounting values used in the computation of GDP, its calculation accounts for a number of benefits and costs that normally escape market valuation'.

South Korea is a nation that has experienced extraordinary economic growth during the last few decades. Labelled as one of the 'Asian Tigers', South Korea experienced consistently high economic growth that averaged 8.7 % per year from 1963 to 1996 (Kwon 2005). During this time, social indicators also improved markedly. Since 1960, South Korea—along with other top-performing countries such as Japan, Hong Kong, Singapore, Taiwan, Indonesia, Malaysia and Thailand, recorded economic growth more than twice as high as the rest of East Asia, triple the growth in Latin America and South Asia, and five times as much as sub-Saharan Africa. Despite growth falling sharply following the 1997 Asian economic crisis, it quickly recovered to average around 5 % for the first half of the 2000s.

The academic literature concerning South Korea, however, demonstrates a noted lack of engagement with the social and environmental aspects of the nation's growth. Davis and Gonzalez (2003) show that between 1986 and 2001, of the 1,171 *Journal of Economic Literature* articles based on South Korea, 30.6 % were papers on economic growth, compared to just 0.8 % of studies examining issues of health, education and welfare. This provides further motivation for the current study.

The remainder of the paper is structured as follows: Sect. 2 provides a review of the relevant literature about economic growth in South Korea. The strengths and weaknesses of the GPI as a measure of progress are examined in Sect. 3 and the calculation of the GPI for South Korea is provided in Sect. 4. The data and empirical approach to examining the determinants of GDP and GPI per capita are provided in Sect. 5. Section 6 presents and discusses the results and Sect. 7 concludes.

2 Economic Growth in South Korea: A Critical Review of the Literature

An extensive literature has empirically examined the determinants of South Korea's impressive economic growth record. Studies have typically used the econometric analysis of historical times-series data, cointegration techniques and error correction models.

There are a number of consistent findings within this literature. Most studies from the mid-1990s conclude that human capital plays a central role in achieving economic growth in South Korea (Sengupta and Espana 1994; Piazolo 1995; Kang 2006; Harvie and Pahlavani 2007). Methods of measuring human capital vary between studies, with one way being levels of educational attainment, represented by the number of South Koreans who have completed secondary school education (Lee et al. 1994). Other studies use the number of secondary school and university students as a percentage of the total population (Piazolo 1995), or calculating the average years of schooling of South Korea's labour force (Kwack and Lee 2006). Regardless of how it is measured, though, human capital is usually found to be an important determinant of growth.

While Lee et al. (1994) find evidence to support human capital as a determinant of economic growth, they also argue that physical capital accumulation and export expansion are more important. Yuhn and Kwon (2000) confirm the importance of investment and capital accumulation for South Korea's economic growth. Other prominent drivers of South Korea's economic growth are financial liberalisation and export expansion. Kwack

and Lee (2006) used a financial liberalisation index (as constructed by Chun 2003) while Piazolo (1995) employed dummy variables to capture the various trade policies adopted by South Korea during relevant time periods. The importance of exports for growth is confirmed by Lee et al. (1994), Sengupta and Espana (1994), Piazolo (1995) and Harvie and Pahlavani (2007). In addition to these positive drivers of growth, Piazolo (1995) finds that inflation and government consumption have negative impacts.

Other important factors in explaining South Korea's GDP per capita growth include the country's capacity to quickly adapt to rapidly evolving technology, as well its ability to explore new opportunities (Kwack and Lee 2006); the capacity of entrepreneurs and policy makers to adjust rapidly and flexibly to external shocks; and the maintenance of relatively equitable income distribution (Harvie and Lee 2003).

Recent studies have emerged, however, that indicate South Korea's rapid growth has come at a cost,—in the form of reduced welfare and environmental degradation. Park and Shin (2005) find that a large number of South Koreans experienced a decline in their living conditions in recent years. Further, while Yang (2003) finds evidence of greater quality in family life, Kwon (2005) documents South Korea's divorce rate, indicating that it increased from 1.1 divorces for every 1,000 people in 1990 to 3.5 divorces for every 1,000 people in 2003. This represents one of the highest rates in the world. Joo (2003) determines that the crime rate (defined as the total number of crimes that take place per 100,000 people) in South Korea increased 3.6 times from 1,035 in 1970 to 3,697 in 1999, while Chul-Kyoo (2004) finds a steep decline in the country's environmental resources. Moreover, despite an overall increase in income in South Korea, there has been evidence of a rise in the inequality of income distribution, particularly after the 1997 financial crisis (Cheong 2001). These developments point to the pressing need to move beyond GDP to measure the country's progress.

3 The GPI: Strengths and Limitations

The intent of the GPI (and its antecedents: the MEW and ISEW) was to provide an alternative measure of human well-being to that of the GDP per capita (see Sametz 1968; Nordhaus and Tobin 1973; Daly and Cobb 1990). This alternative measure included the costs, as well as the benefits associated with economic expansion.

As with the GDP though, the GPI is not without its limitations. The GPI is a constructed number; that is, the GPI is calculated through a series of adjustments starting with personal consumption. These adjustments are based on value judgments, but while these value judgments are explicit (and more explicit than the value judgments that underpin standard national accounts, such as GDP), the final GPI estimate is dependent on a range of criteria: the analyst's arbitrary values, choices and preferences for the methodologies, as well as what costs and benefits are included or excluded from the GPI (Clarke and Islam 2004). While the list of adjustments are becoming increasingly common across GPI studies (starting with Nordhaus and Tobin 1973; and Daly and Cobb 1990), most studies have slight variations (cf. Daly and Cobb 1990; Diefenbacher 1994; Hamilton 1998; Jackson and Marks 1994; Lawn and Sanders 1999; Rosenberg and Oegema 1995; Stockhammer et al. 1997). Neumayer (1999) and Dietz and Neumayer (2006) argue that, without a standard set of adjustments and common methodology for the estimation of these adjustments, the construction of the GPI is subjective and lacks scientific rigour.

However, it is possible to identify a standard list of GPI indicators and consider the question of the 'ownership' of the costs and benefits associated with economic growth. Table 1 lists the most common adjustments made within a GPI.

Table 1 Standard GPI adjustments

Item	Welfare contribution
Consumption (private and public) expenditure	+
Defensive and rehabilitative expenditures	−
Expenditure on consumer durables	−
Service from consumer durables	+
Distribution Index	±
Welfare generated by publicly-provided infrastructure	+
Value of non-paid household labour	+
Value of volunteer labour	+
Cost of unemployment and underemployment	−
Cost of crime	−
Cost of family breakdown	−
Change in foreign debt position	±
Cost of non-renewable resource depletion	−
Cost of lost agricultural land	−
Cost of timber depletion	−
Cost of air pollution	−
Cost of waste-water pollution	−
Cost of long-term environmental damage	−

4 Calculating a GPI for South Korea: Data and Methodology

The variables and methodology used in calculating a GPI for South Korea were largely based on that employed by Lawn and Clarke (2006). Data are from a variety of sources including the World Bank, the International Monetary Fund (IMF), the Korean Statistical Information System (KOSIS), the Korean National Statistical Office, the OECD, the Bank of Korea, the Republic of Korea Ministry of Environment, the United Nations, the Australian Institute of Criminology, as well as work conducted by Tsuya et al. (2000). Any gaps in the data were imputed using forecasting methods. As is common within GPI studies (see Lawn and Clarke 2008), the final estimation of the GPI was partially a result of data availability.

The basis of the South Korean GPI is private consumption expenditure. This is reasonable as people's basic needs include food, water, shelter and clothing. However, not all personal consumption items are included in the GPI, as much consumption is wasteful, conspicuous or non-welfare-enhancing. Therefore, certain items of private consumption expenditure are excluded from the GPI calculations, this includes, spending on tobacco because of its health risks, but also spending on health and education (private and public), costs of vehicle accidents and insurance services (private consumption), defence, environmental protection, and public order and security (public consumption) as all this is rehabilitative or defensive expenditure. Private consumption expenditure on durable items is also excluded. Within GDP, it is assumed that all the benefits of these purchases flow immediately and in total at the time of purchase. However, it is more likely that the benefits (or services) of these consumer durables continue over a period of time (and well outside the time limits of a normal GDP reporting period of a single year).

To overcome this, expenditure on consumer durables is excluded from the GPI calculated but services from accrued consumer durables (normally accumulated expenditure on consumer durables for the last 10 years) are added back in. An index assessing changes in income distribution is then applied to this adjusted personal consumption figure. The next two adjustments explicitly acknowledge that well-being can be enhanced beyond simple increases in personal consumption. Public infrastructure and non-paid household labour that enhance well-being are therefore added to the GPI. Unlike national accounts, explicit costs are associated with an expanding economy and subsequently subtracted from the GPI. Estimates of the costs of crime are made and removed as it is considered that an expanding economy can cause social pressures that exacerbate these social costs. It is assumed that less foreign debt enhances well-being, therefore changes in foreign debt are reflected as either additions or subtractions from the GPI. Environmental costs considered are limited to air pollution. The South Korean GPI is therefore a constructed index of these adjustments.[3]

Adjustments and the methodology undertaken in the South Korea GPI are listed in Table 2. The values of the GPI components are provided in Table 8 of the "Appendix".

5 Determinants of GDP and theGPI Per Capita: Data and Methodology

5.1 Data

After establishing the Korean GPI, the study now examines the determinants of GDP for South Korea then tests to see if the same variables which drive GDP also impact on the country's GPI. Annual data for the period 1970–2005 are employed. As this provides a relatively small number of data points, only a small number of explanatory variables are considered. The variables are selected based on theory and those found to be important in the literature review provided in Sect. 2. The variables considered are:

- Physical capital expenditure per capita;
- Export expenditure per capita;
- Research and development expenditure per capita;
- Inflation (percentage change in the consumer price index); and
- Human capital (defined as the number of South Koreans aged 15 years and over who had completed post-secondary education as a proportion of the population aged 15 years and over).[4]

Per capita variables were used to adjust for the population increase of 25 % over the study period and all are measured in constant (2000) prices. Where the data were incomplete, values were imputed assuming a constant growth rate estimated from the data. Sources are given below in Table 3.

[3] Given the extensive coverage of methodologies of GPI adjustments that have appeared over a period of time within *Ecological Economics,* and with the focus of this paper being less on the GPI itself and more on the drivers of GPI and GDP within South Korea, a fuller description of the methodologies associated with these adjustments are omitted but available from the authors on request.

[4] Other measures of human capital were considered, including the number of university students as a percentage of the population; the number of secondary school students; and the number of secondary students as a percentage of the population. These measures either had less available data than the chosen proxy, or did not give significantly different results.

Table 2 GPI data sources

Variable	Source	Details	Frequency	Time period available
Private consumption expenditure	World Bank (2008)	'Household final consumption expenditure (constant billion won)'	Annual	1970–2005
Public consumption expenditure	World Bank (2008)	'General government final consumption expenditure (constant billion won)'	Annual	1970–2005
Expenditure on consumer durables (ECD)	KOSIS (2010)	'Expenditure of consumer durables (constant billion won)'	Annual	1970–2005
Service from consumer durables (SCD)	Derived	Derived from adding previous 10 years of expenditure on consumer durables to arrive at stock of consumer durables, and then multiplying by 0.1 (10 %)	Annual	1970–2005 Values for 1970–1979 were calculated using backcasting of average growth rates
Distribution index (DI)	OECD (2008a)	Data comprised of two types: GMF1 (both sexes): gross monthly earnings (including overtime and one twelfth of annual bonuses) of full-time South Korean workers GMF1 data was available from 1975 to 2000 (mean values from 1975 to 2000, median values from 1984 to 2000) GMF0 (both sexes): gross monthly earnings (excluding overtime and one twelfth of annual bonuses) of full-time South Korean workers GMF0 data was available from 2000 to 2005 (median values)	Annual	1970–2005 A number of steps were involved in calculating a time series of real gross annual income and therefore the distribution index (refer to Sect. 5.1 for further detail).
Welfare from publicly-provided service capital (WPPSC)	Derived	Assumed to be equal to 75 % of the public sector consumption of fixed capital	Annual	1970–2005

Table 2 continued

Variable	Source	Details	Frequency	Time period available
Value of non-paid household labour (HL)	Tsuya et al. (2000) OECD (2008b).	Hours of household labour based on study by Tsuya et al. (2000) minimum wage rate obtained from OECD (2008) The annual value of household labour per household multiplied by number of households	Annual	1970–2005 Data for number of household labour hours available for 1994. The number of hours for other years is reduced by 1 % each year due to labour-reducing technologies based on assumption by Lawn and Clarke (2006).
Change in foreign debt position (FORDEBT)	IMF (2007)	To calculate South Korea's net foreign debt, the nation's foreign assets were deducted from its foreign liabilities	Annual	1970–2005
Cost of crime (CR)	United Nations Crime Surveys (2010) Australian Institute of Criminology (Mayhew 2003)	The number of different categories of crime obtained from United Nations Crime Surveys and then multiplied by crime costs as calculated by the Australian Institute of Criminology	Annual	1970–2005 There were missing data for all categories of crime, so these values were interpolated.
Cost of air pollution (AIR)	Republic of Korea Ministry of Environment (2006)	To calculate the cost of air pollution, three assumptions are made (following Lawn and Clarke 2006): 1. Air pollution is closely related to the level of production within an economy, and therefore is positively correlated with the nation's GDP; 2. Air pollution abatement technology improves at the rate of 1 % per annum, constantly reducing the impact of a per unit of production on air quality; and 3. Air pollution damage cost is assumed to be ten times control cost	Annual	1970–2005 The cost of controlling air pollution was available for 2003. Values for other years were based on the assumption that air pollution is closely related to the level of economic growth

Table 3 Determinants of GDP: variables and sources

Variable	Source	Details	Frequency	Time period available
Real GDP per capita (value level)	World Bank (2008)	'GDP per capita (constant billion Won)'	Annual	1970–2005
Physical capital expenditure per capita (value level)	World Bank (2008)	'Gross fixed capital formation (constant billion Won)' divided by 'Population, total'	Annual	1970–2005
Export expenditure per capita (value level)	World Bank (2008)	'Exports of goods and services (constant billion Won)' divided by 'Population, total'	Annual	1970–2005
Inflation (growth rate)	World Bank (2008)	'Inflation, consumer prices (annual %)'	Annual	1970–2005
Research and development expenditure per capita (value level)	South Korean Ministry of Education, Science & Technology (2008)	'Total R&D expenditure (constant billion Won' divided by World Bank, 'Population, total'	Every 5 years between 1970 and 1995 and then every year from 1996 to 2005	1970–2005
Human capital (%)	Barro and Lee (2000)	Number of South Koreans who have completed post-secondary education as a proportion of the population aged 15 and over	Every 5 years between 1970 and 2000	1970–2005
Population	World Bank (2008)	Used in calculation of other variables	Annual	1970–2005

Table 4 presents summary statistics for each of the variables used in the model. Over the 36-year study period, the median GDP per capita was 6.3 million won ($US5,544); however, by the end of the study period in 2005, it had reached a value of 14.9 million won ($US13,210). Over the same time period, the median GPI per capita exhibited a slightly lower result of 4.3 million won, but, like GDP per capita, reached its highest value at the end of the study period (10.7 million won), albeit approximately 4 million won lower than GDP per capita.

As with GDP per capita growth, exports per capita in South Korea have grown steadily over the study period, with a median value of 1.2 million won per year. Growth in research and development per capita has been relatively steady, with an annual median value of 100,000 won. Although physical capital per capita was growing at a relatively strong pace for the first 25 years of the study period, it experienced a large drop around the time of the Asian financial crisis, declining by almost 25 % from 1997 to 1998. It continued to grow after the Asian financial crisis, but at a slower pace than before.

Inflation in South Korea has been fairly volatile over the study period, particularly in the first decade. In 1980, South Korea's annual inflation rate was a staggering 28.7 %, triple its mean inflation rate of 8.7 %, thus requiring the use of constant prices in the analysis.

The number of South Koreans who have completed tertiary education as a proportion of the population aged 15 years and over has been on a steady rise since the 1970s, apart from

Table 4 Summary statistics: GDP and GPI variables

	GDP per cap (million won)	GPI per cap (million won)	Exports per cap (million won)	R&D per cap (million won)	Physical cap per cap (million won)	Inflation (%)	Human capital (%)
Mean	7.167	5.698	2.043	0.142	2.178	8.683	7.439
Median	6.270	4.324	1.225	0.098	1.775	5.980	6.300
Maximum	14.900	10.723	8.070	0.446	4.330	28.700	14.000
Minimum	2.163	2.133	0.097	0.008	0.323	0.810	2.600
SD	4.079	3.052	2.199	0.134	1.469	7.333	3.533
Skewness	0.424	0.366	1.333	0.691	0.183	1.271	0.461
Kurtosis	1.790	1.527	3.718	2.216	1.412	3.611	1.860
Jarque–Bera	3.274	4.056	11.435	3.790	3.982	10.249	3.228
Probability	0.1946	0.1316	0.0033	0.1503	0.1366	0.0060	0.199
Obs.	36	36	36	36	36	36	36
Aug. D-F stat (p value)							
Level (Trend & Intercept, Lags = 3)	0.7738	0.5803	1.000	0.9847	0.2964	0.0196	Phillips–Perron trend stationary
1st Difference (Trend & Intercept, Lags = 3)	0.0001	0.0008	0.0025	0.0025	0.0025	–	
Stationarity	I(1)	I(1)	I(1)	I(1)	I(1)	I(0)	

The human capital variable is proxied by the number of South Koreans who have completed post-secondary education as a percentage of the population aged 15 years and over

a dip at the end of the 1980s. As at 2005, 14 % of the South Korean labour force had completed tertiary education, compared with only 2.6 % of the labour force at the beginning of the study period in 1970.

Only inflation and exports are found to be non-normal. In both cases, this is caused by positive skewness resulting from a large positive outlier. Stationarity is tested for each of the variables, using the Augmented Dickey–Fuller test. Inflation was the only variable that was stationary. The human capital variable exhibited a distinct structural break resulting from a change in government policy, which caused tertiary education enrolments in South Korea to soar by 2.5 times between 1980 and 1990 (Kim 2002). To allow for this break, the Phillips–Perron test was applied, which found the series to be trend stationary. All remaining variables are integrated at order one.

Figure 1 indicates that, over the 36-year study period from 1970 to 2005, the value of South Korea's GDP per capita has been consistently above its corresponding GPI per capita. From 1970 to 1973, South Korea's GDP per capita and GPI per capita were virtually the same, until the two values diverged in 1974 (this is a similar pattern to that experienced by neighbouring Thailand—see Clarke and Islam 2004). This is a reflection of the trend of the weighted adjusted consumption expenditure, the decline of which can be attributed to a rise in the income distribution index during the same period. The increase in the distribution index is indicative of an expanding gap between the incomes of the wealthy and the poor, resulting in a dip in the GPI per capita.

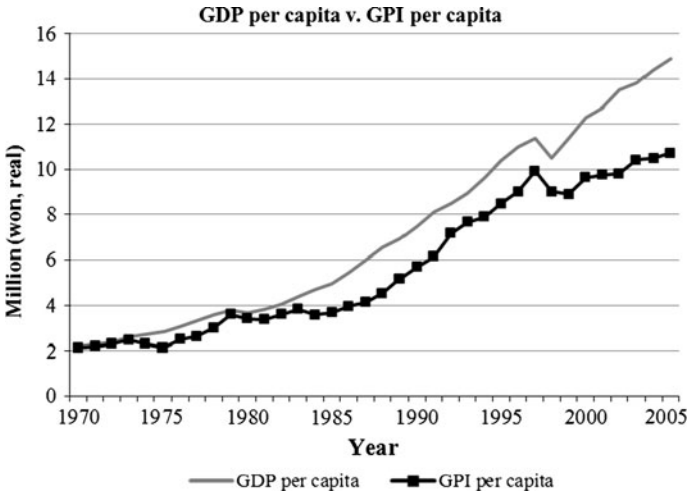

Fig. 1 South Korea's GDP versus GPI

In 1976, the GPI per capita increased until it reached a peak in 1979, and again in 1983. The peak in 1979 is the closest it would come to the level of GDP per capita within the study period since 1974. Again, a clear driver of the growth of GPI per capita in 1979 was the distribution index, which was only 89.9 during that year (the lowest level recorded during the entire period of interest). During the first half of the 1980s, although growth was sluggish for both GDP per capita and GPI per capita, growth in GPI per capita was still lower. This was consistent with the distribution index, which began to increase during this period, indicating a rise in income inequality.

From the mid-1980s till the Asian financial crisis in 1997–1998, the graph clearly displays an acceleration in both GDP per capita and GPI per capita, with both lines virtually parallel and a gap of approximately 2 million won ($US2,000). This suggests that the drivers of GDP per capita during this period are also influencing the GPI per capita at the same rate. This is reflected in South Korea's GDP growth where, prior to 1998, the average rate was 7.8 % while the GPI growth rate was slightly lower at 7.5 %. According to the OECD (2003), South Korea's increase in the ratio of persons of working age (15–64 years of age) to the total population in the 1990s was a key factor for the nation's rise in GDP per capita. During this time, most components of the GPI per capita also increased, namely weighted adjusted consumption expenditure, welfare capital and household labour. Combined with a decline in foreign debt, this led to rises in the GPI per capita.

In 1997, both measures contract as a result of the Asian financial crisis, then rise again, with the GPI at a slower rate than GDP. After the Asian financial crisis, GDP and GPI growth rates started to diverge significantly, with GDP growth averaging 5.8 % and GPI growth only averaging 3.3 %. This could be due to a number of factors: a steady increase in income inequality, stagnation in welfare capital, and the massive foreign debt incurred as a result of the IMF bailout in 1998. GPI per capita growth appears to taper off towards the end of the study period, while GDP per capita is observed to be growing at a solid rate. The increasing divergence between the two measures reveals that, despite GDP per capita indicating an ongoing expansion in economic activity, South Korea's citizens are not as

well off as this might suggest if taking into consideration social and environmental factors. Therefore, GDP may well overstate the nation's true level of well-being.

5.2 Methodology

To investigate determinants of South Korea's growth and genuine progress, a model is estimated that incorporates all variables considered to be drivers of GDP per capita as discussed above. The variables have all been made stationary. Inflation needs no adjustment, but human capital is de-trended and all the remaining variables are differenced once. The model is specified as:

$$\Delta y_t = \beta_o + \Delta\beta_1 X_t + \Delta\beta_2 RD_t + \Delta\beta_3 K_t + DETREND\beta_4 HC_t + \beta_5 INF_t + \varepsilon_t \quad (1)$$

where: Δy_t = Change in value of South Korea's GDP per capita at time t or change in value of South Korea's GPI per capita at time t, as applicable; ΔX_t = Change in value of South Korea's exports per capita at time t; ΔRD_t = Change in value of South Korea's research and development per capita at time t; ΔK_t = Change in value of South Korea's investment in physical capita at time t; $DETRENDHC_t$ = Number of South Koreans who have completed post-secondary education as a percentage of the population aged 15 years and over after detrending, at time t; and INF_t = South Korea's annual inflation rate at time t.

To check the model specification, a second model incorporates an inflation squared variable to test for a non-linear impact and as there was a noticeable drop in GDP in 1998 due to the Asian financial crisis, a dummy variable was included in a third model to account for this effect. These models omit the human capital variable as it was found to be insignificant.

Cointegration is tested for using the Johansen test, with both the Trace and Maximum Eigenvalue forms of the test considered. An error correction form of the final model is then estimated. In the first stage, the long-run or equilibrium equation is estimated using only the levels of the difference stationary variables as shown in equation (2).

$$y_t = \alpha_o + \alpha_1 X_t + \alpha_2 RD_t + \alpha_3 K_t + u_t \quad (2)$$

The lagged residuals from this equation (ECV), which measure how far y_t was from its long-run value in the previous period, are then used as an explanatory variable in an equation based on (1) to measure the return to equilibrium as shown in equation (3) below.

$$\Delta y_t = \beta_o + \Delta\beta_1 X_t + \Delta\beta_2 RD_t + \Delta\beta_3 K_t + \beta_5 INF_t - \lambda ECV_{t-1} + \varepsilon_t \quad (3)$$

6 Results and Discussion

6.1 GDP Per Capita Model

This section provides the results from the estimation of the empirical models. Table 5 presents results using GDP per capita as the dependent variable. The t statistics are adjusted for heteroskedasticity and correlation using the Newey–West adjustment.

The coefficients in the base model all have the expected sign, but the coefficient on the human capital variable is not significant at conventional levels of significance, so is omitted from remaining models. Neither the inclusion of the non-linear inflation term or the 1998 dummy variable significantly improve the model. The final specification includes exports, R&D, physical capital and inflation (with inflation having the expected negative

Table 5 GDP model results for South Korea

	Base model Coefficient	Inflation squared Coefficient	Dummy = 1998 Coefficient	Final model Coefficient
Intercept	0.2259	0.2933	0.2710	0.2220
	(0.0001)***	(0.0003)***	(0.0001)***	(0.0001)***
Exports	0.1519	0.1435	0.2013	0.1619
	(0.1382)	(0.1212)	(0.0405)**	(0.0822)*
Research	5.5484	5.0517	3.9316	5.5961
	(0.0219)**	(0.0329)**	(0.1346)	(0.0186)**
Physical capital	0.8761	0.8854	0.7526	0.8669
	(0.000)***	(0.000)***	(0.000)***	(0.000)***
Inflation	−0.0077	−0.0229	−0.0093	−0.0075
	(0.0315)**	(0.0639)*	(0.0125)**	(0.0283)**
Human capital	0.0086			
	(0.8019)			
Inflation squared		0.0005		
		(0.1893)		
Dummy = 1998			−0.302272	
			(0.1977)	
R squared	0.8821	0.8888	0.8885	0.8818
Adjusted *R* squared	0.8618	0.8696	0.8693	0.8661
SE of regression	0.1214	0.1180	0.1181	0.1195
F statistic	43.390	46.340	46.223	55.967
p value (*F* statistic)	(0.000)***	(0.000)***	(0.000)***	(0.000)***
Akaike info criterion	−1.2239	−1.2821	−1.2799	−1.2788
Schwarz criterion	−0.9572	−1.0155	−1.0132	−1.0566
Hannan-Quinn criter	−1.1318	−1.1901	−1.1878	−1.2021
Durbin–Watson stat	2.2109	2.3193	1.8780	2.2154
Heteroskedasticity test (white)				
F statistic	4.336	5.104	4.033	5.475
p value (*F* statistic)	0.0046***	0.0018***	0.0067***	0.0020***
Autocorrelation test (Q statistics)				
1 lag (*p* value)	0.4910	0.3010	0.7370	0.4850
2 lags (*p* value)	0.7720	0.5460	0.9160	0.7670
3 lags (*p* value)	0.9140	0.7460	0.9800	0.9120
4 lags (*p* value)	0.3210	0.3640	0.6010	0.3170
Normality test (Jarque–Bera)				
Statistic	5.627	2.010	4.8270	7.292
p value	0.0600*	0.3660	0.0895*	0.0261**

Values are in millions (won)

Values in brackets are *p* values: * denotes statistical significance at the 10 % level; ** denotes statistical significance at the 5 % level; and *** denotes statistical significance at the 1 % level

The human capital variable is detrended and is proxied by the number of South Koreans who have completed post-secondary education as a percentage of the population aged 15 years and over

To correct the t-statistics for heteroskedasticity in each of the models, the Newey-West adjustment was applied

association with GDP per capita and all other variables a positive association). The coefficient on exports is only significant at the 10 % level, but other coefficients are significant at the 5 % level.

The variables in the final model were then tested for cointegration using the Johansen test. The p values of the two unrestricted cointegration rank tests were 0.0006 and 0.0031 for the Trace and Maximum Eigenvalue tests, respectively. Therefore, the null hypothesis of no cointegrating relationship was rejected against the alternative hypothesis of at least one cointegrating relationship using a level of significance equal to 5 %. When the error correction model was fitted, the coefficient of the error correction term was estimated to be –0.0058, with a p value of 0.9507. As this coefficient was insignificant and showed an excessively slow return to equilibrium (over 100 years), the model was not considered appropriate.

6.2 GPI Per Capita Model

Table 6 presents the results of the four GPI models using the same methodology as the GDP per capita models. Similar to the GDP per capita results, there is no significant impact from the 1998 dummy variable.

Although the model including the quadratic inflation terms appears to be superior based on the statistical measures, the response function is not reasonable. It shows GPI increasing with inflation, peaking at a level of 13.7 %; inflation does not have a negative impact until it exceeds 27.5 %. Therefore, this model was rejected.

For comparison, the same final model was fitted as for GDP per capita. This proved to have superior performance to all but the rejected quadratic inflation model based on the consistent model selection criteria of Schwartz and Hannan-Quinn. This model shows that only physical capital has a statistically significant impact on GPI. The coefficients on the inflation and R&D variables have the expected signs but are not significant.

The variables from this final model were tested for cointegration, again using the Johansen test. Similarly to the GDP per capita case, the null hypothesis of no cointegrating relationship was rejected but not the null hypothesis of at most one cointegrating relationship using a level of significance of 5 %.

Table 7 presents the results of the GPI error correction model. Consistent with the GDP per capita long-run error correction model, physical capital per capita is again found to be statistically significant at the 1 % level, indicating a strong long term relationship with GPI per capita growth. Although exports and research per capita exhibit positive coefficients, they are not statistically significant.

When the short-run equation of the error correction model is estimated, the coefficient of the error correction variable had the correct coefficient sign, and was found to be statistically significant at the 5 % level, showing a rapid return to the long-run relationship. Despite positive coefficients for the exports and R&D variables, these were not found to be statistically significant, unlike physical capital. The error correction model indicates that there is a stable long-run relationship between physical capital and the GPI per capita, but none of the other variables commonly found to impact GDP per capita affect the GPI per capita.

These results indicate that while physical capital, research and development, exports, and inflation are all important in determining South Korea's GDP per capita, only physical capital is found to have a significant positive effect on genuine progress once social and environmental aspects of economic growth are considered. The drivers of GDP per capita clearly differ vis-à-vis the GPI per capita.

Table 6 GPI model results for South Korea

	Base model Coefficient	Inflation squared Coefficient	Dummy = 1998 Coefficient	GPI final model Coefficient
Intercept	0.0798	−0.2020	0.2285	0.1325
	(0.5648)	(0.2333)	(0.2268)	(0.3066)
Exports	0.0624	0.1275	0.0038	−0.0733
	(0.7144)	(0.5002)	(0.9858)	(0.7232)
Research	8.6817	10.8172	4.7738	8.0360
	(0.1791)	(0.0961)*	(0.3467)	(0.1945)
Physical capital	0.4289	0.3627	0.3291	0.5532
	(0.2219)	(0.2865)	(0.4758)	(0.0825)*
Inflation	−0.0009	0.0604	−0.0075	−0.0039
	(0.9053)	(0.0045)***	(0.423)	(0.608)
Human capital	−0.1163	−0.1091		
	(0.0805)*	(0.0321)**		
Inflation squared		−0.0022		
		(0.0003)***		
Dummy = 1998			−0.5924	
			(0.262)	
R squared	0.4333	0.5193	0.4159	0.3960
Adjusted *R* squared	0.3356	0.4163	0.3152	0.3154
SE of regression	0.3019	0.2829	0.3065	0.3064
F statistic	4.434	5.041	4.130	4.917
p value (*F* statistic)	(0.0040)***	(0.0013)***	(0.0059)***	(0.0036)***
Akaike info criterion	0.5972	0.4897	0.6273	0.6038
Schwarz criterion	0.8638	0.8008	0.8939	0.8260
Hannan-Quinn criter	0.6892	0.5971	0.7193	0.6805
Durbin–Watson stat	2.0659	2.3444	1.7950	1.9691
Heteroskedasticity test (white)				
F statistic	0.535	0.588	0.624	0.449
p value (*F* statistic)	0.7482	0.7367	0.6823	0.7722
Autocorrelation test (Q statistics)				
1 lag (*p* value)	0.821	0.2770	0.5520	0.950
2 lags (*p* value)	0.186	0.0350**	0.6450	0.306
3 lags (*p* value)	0.124	0.0210**	0.1860	0.181
4 lags (*p* value)	0.217	0.0450**	0.2750	0.283
Normality test (Jarque–Bera)				
Statistic	5.906	6.755	4.192	2.853
p value	0.0522*	0.0341**	0.1229	0.2402

Values are in millions (won)

The human capital variable is detrended and is proxied by the number of Koreans who had completed tertiary education as a percentage of the labour force

Values in brackets are *p* values: * denotes statistical significance at the 10 % level; ** denotes statistical significance at the 5 % level; and *** denotes statistical significance at the 1 % level

Table 7 GPI error correction model

Long-run equation		Short-run equation	
	Coefficient		Coefficient
Intercept	1.6043	Intercept	0.1674
	(0.000)***		(0.1033)
Exports	0.2552	Exports	0.0842
	(0.2446)		(0.6583)
Research	3.6515	Research	4.6650
	(0.5661)		(0.3270)
Physical capital	1.4028	Physical capital	0.4966
	(0.000)***		(0.0429)**
		Inflation	−0.0055
			(0.4204)
		ECV	−0.5204
			(0.0002)***
R squared	0.9855	*R* squared	0.6261
Adjusted *R* squared	0.9842	Adjusted *R* squared	0.5616
SE of regression	0.3842	SE of regression	0.2452
F statistic	726.640	*F* statistic	9.7125
p value (*F* statistic)	0.000***	*p* value (*F* statistic)	0.000***
Akaike info criterion	1.0293	Akaike info criterion	0.1812
Schwarz criterion	1.2052	Schwarz criterion	0.4479
Hannan-Quinn criter	1.0907	Hannan-Quinn criter	0.2733
Durbin–Watson stat	0.8363	Durbin–Watson stat	1.6818

Values are in millions (won)

ECV error correction variable

Values in brackets are *p* values: * denotes statistical significance at the 10 % level; ** denotes statistical significance at the 5 % level; and *** denotes statistical significance at the 1 % level

7 Conclusion

The 2008 global financial crisis served as a timely reminder of the risk associated with the relentless pursuit of material growth. Utilising indicators that provide a more holistic evaluation of a nation's progress broadens understandings of how actions within an economy influence its other parts. This paper calculated a GPI for South Korea and analysis was conducted to determine if the drivers of economic growth in South Korea are the same ones that drive growth in the GPI. While the GPI and GDP did track in tandem for the first 15 years of the study period, an increasing divergence occurred following the 1997 Asian Financial Crisis. The increasing divergence between the two measures reveal that South Korea's citizens are not as well off as GDP per capita suggests once social and environmental aspects of economic growth are considered. GDP may therefore overstate a nation's true progress.

To explore the difference between GDP and GPI per capita further, several empirical models developed by the study were estimated. The results of the study find that the variables that drive growth in GDP per capita in South Korea are different to those that drive growth in GPI per capita. While physical capital, research and development, exports,

and inflation are all important in determining South Korea's GDP per capita, once social and environmental aspects of economic growth are taken into account, only physical capital is found to have a significant positive effect on genuine progress. Public policy that preferences physical capital over other drivers will therefore have greater impact on enhancing genuine progress.

The difference in the drivers of GDP per capita and GPI per capita suggests that policy makers should not rely solely on GDP per capita as an indication of the well-being of a nation. Before making decisions, policy makers should seek additional social and environmental data that will provide a more comprehensive perspective of a nation's status. There is value, therefore, in considering the drivers of genuine progress in other countries (including developed countries) to determine if these elements are largely standard across economies or differ on a country-to-country basis. Over time, as this practice becomes more common and measures such as the GPI are utilised, the use of genuine progress indicators will become more mainstream and be adopted more willingly. To facilitate this it would be valuable to greater consistency of datasets for the construction of GPIs between countries. This consistency would also allow provide greater opportunities to consider policy implications across countries and regions.

Appendix

See Table 8.

Table 8 GPI component values for South Korea

Years	Adj. cons. (weighted) (billion won) +	Welf cap (billion won) +	Household labour (billion won) +	Foreign debt (billion won) −	Crime (billion won) −	Air pollution (billion won) −	GPI (billion won)	GPI per capita (million won)
1970	61,431.033	50.683	6,590.738	18.212	0.079	0.001	68,054.163	2.132
1971	64,334.861	60.625	6,984.684	51.854	0.060	0.001	71,328.256	2.188
1972	68,588.320	72.518	7,519.655	−84.619	0.050	0.002	76,265.060	2.293
1973	74,948.115	86.745	8,758.700	−61.183	0.038	0.002	83,854.703	2.471
1974	71,160.896	103.761	8,471.461	81.348	0.038	0.003	79,654.729	2.302
1975	67,056.507	124.117	8,127.321	−0.760	0.050	0.004	75,308.651	2.135
1976	78,719.822	155.698	10,017.650	40.830	0.056	0.005	88,852.279	2.479
1977	83,669.395	207.339	11,279.743	−277.630	0.119	0.007	95,433.981	2.621
1978	97,661.048	256.886	13,674.166	331.560	0.083	0.009	111,260.448	3.010
1979	117,988.579	349.623	16,764.800	684.300	0.182	0.011	134,418.509	3.581
1980	114,123.817	449.600	15,879.904	827.610	0.100	0.014	129,625.597	3.400
1981	114,303.059	630.541	16,318.900	1,264.400	0.115	0.017	129,987.968	3.357
1982	124,413.431	840.561	18,283.254	2,401.930	0.125	0.019	141,135.171	3.589
1983	131,335.917	952.065	20,109.463	311.470	0.157	0.022	152,085.796	3.811
1984	124,556.054	1,149.273	19,657.745	1,258.370	0.142	0.025	144,104.534	3.566
1985	129,660.869	1,391.304	20,857.621	2,107.200	0.200	0.028	149,802.365	3.671
1986	136,825.321	1,389.112	23,072.096	−1,392.490	0.190	0.032	162,678.796	3.950
1987	141,358.191	1,507.752	25,030.732	−3,615.550	0.175	0.038	171,512.013	4.125

Table 8 continued

Years	Adj. cons. (weighted) (billion won) +	Welf cap (billion won) +	Household labour (billion won) +	Foreign debt (billion won) −	Crime (billion won) −	Air pollution (billion won) −	GPI (billion won)	GPI per capita (million won)
1988	156,771.898	1,755.916	28,715.320	−2,791.740	0.182	0.044	190,034.649	4.527
1989	184,225.460	1,841.076	33,401.664	62.370	0.240	0.049	219,405.541	5.177
1990	203,890.938	2,054.302	37,213.533	−782.890	0.242	0.059	243,941.361	5.690
1991	223,487.646	2,514.310	41,638.628	1,885.300	0.326	0.071	265,754.887	6.142
1992	260,118.567	3,193.717	48,573.344	−972.300	0.467	0.080	312,857.382	7.165
1993	278,736.679	3,926.203	52,488.833	−2,521.500	0.785	0.089	337,672.341	7.665
1994	291,937.098	4,277.052	55,939.735	1,326.900	0.864	0.103	350,826.017	7.892
1995	318,750.930	5,077.237	61,449.342	2,636.200	1.110	0.120	382,640.079	8.486
1996	342,708.586	6,607.411	65,847.018	5,007.800	1.091	0.134	410,153.990	9.009
1997	361,762.191	8,726.757	70,194.751	−15,918.200	0.971	0.145	456,600.784	9.936
1998	340,234.865	13,196.182	66,534.814	2,246.400	0.711	0.141	417,718.609	9.025
1999	332,510.795	13,272.917	66,194.096	−2,351.000	0.821	0.153	414,327.834	8.888
2000	362,270.990	13,382.980	73,801.640	−4,142.800	0.873	0.166	453,597.372	9.649
2001	374,665.223	15,347.379	75,699.217	3,410.800	1.063	0.176	462,299.780	9.762
2002	394,885.083	14,432.913	79,895.300	21,773.400	0.942	0.192	467,438.762	9.816
2003	400,792.188	16,828.600	83,047.292	2,378.500	0.746	0.201	498,288.633	10.412
2004	397,863.475	17,854.385	86,037.491	−3,610.000	0.746	0.214	505,364.391	10.520
2005	413,797.894	19,391.288	90,635.845	5,911.900	0.795	0.219	517,912.113	10.759

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