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The sustainable development consequences of IMF debt vs. capital control: Comparing progress in GPI and GDP terms for Korea and Malaysia

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ABSTRACT

The panic wrought by the 1997 Asian financial crisis spurred different mitigative measures. Some states assented to IMF bailout and restructuring, while others enforced capital control. Since then, despite intense academic and regulatory scrutiny of the nuances of the recession, empiric focus on recovery trajectory of affected countries centred chiefly around traditional GDP metrics; an approach that disregards economic performance in a manner congruent with Sustainable Development Goals (SDG). In this paper, we adopt a broader SDG-compatible approach by tracking two affected countries' (Korea and Malaysia) recovery via operationalizing an alternative growth indicator GPI (Genuine Progress Indicator). First, we construct a 35-year long GPI index from 1980 to 2014 and employ the Solow Growth Model to measure the impact of the two remedial measures on GDP and GPI of both countries. Employing an ARDL approach, we find external debt to impact significantly the GDP and GPI of Korea. Meanwhile for Malaysia, the controversial capital control failed to register significant impact. Moreover, unemployment rates, trade openness, fixed capital formation and the history of previous crises are found to be influential determinants of GDP and GPI, with credit and exchange rate variables showing ambiguous results.

1. Introduction

In the mid-1990s, a collapse of Thai Baht precipitated a cascade of currency collapses, culminating in a full-blown economic crisis in the South-East and East Asian regions. Ever since, this crisis has remained significant for academics and policymakers owing to its sudden trigger, rapid percolation, and varied consequences. For economists concentrating on crises, the 1997 crisis also serves as an epicentre for tracking crisis management schemes and recovery trajectories. In this regard, two economies—Malaysia and Korea—stand out as candidates for deeper investigation due to disparate recovery paths undertaken. The former imposed hard capital controls, while the latter acceded to IMF bail-out and restructuring. Since then, both economies performed impressively. Measurements of recovery over these periods have largely centred around economic growth metrics—most specifically medium-term rates of GDP growth within a decade (Corden, 2007; Zumkehr and Andriesse, 2008). This traditional usage of GDP as the chief marker of economic growth and success has come under criticisms lately. Scholars concerned with Sustainable Development Goals (SDG) criticize the GDP approach arguing that a policy of targeting

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GDP-centred growth leads to degradation of the environment, broadens wealth inequality, and results in distorted social dynamics (Philipsen, 2015; Pintner et al., 2012; Van den Bergh, 2009). Attempts to redress this include experimenting with Genuine Savings (GS) indicator to check if economic growth is on a sustainable path. GS, however, also attracts criticism due to espousal of a weak conceptualization of sustainability and contentious underlying assumptions. Some have also pointed out the difficulties of operationalizing GS on technical grounds due to disagreements over the weights needed to assign over monetary aspects and social variables (Hanley et al., 2015). Later in the new millennium, Genuine Progress Indicator (GPI) was introduced and received with enthusiasm by development experts due to its inherent design benefits of underlining the trade-offs connected to traditional economic growth and ability to reveal the broader impact of economic benefits and costs of human welfare. Moreover, early trials of GPI estimation in several countries have shown its ability to better inform and guide policymakers. What's more, GPI factors in the costs and benefits of achieving purely economic growth and predicts the potential impact of policy changes on economic health of a country. Thus, a marked rise in demand from the intelligentsia worldwide is observed for a metric beyond the classical GDP as a means to express the well-being of an economy in accordance with the parameters of sustainable development goals (Talberth and Weisdorf, 2017).

The work of Talberth et al. (2007) is considered the seminal reference for designing a framework for GPI estimation. Unrestrained by rigid parameters of GDP, a country may adopt an existing GPI framework applied by another country and fine-tune it according to its economy-specific characteristics. Hence, GPI components are not universally applicable to all countries. So far, GPI is best explained as a measure that uses indistinguishable individual data on consumption from GDP. It, however, makes augmentations to represent the services rendered by durable products, general infrastructure, volunteering and domestic/social values. Additionally, deduction allowances are made for wealth disparity, the consequences of crime, damage to the environment, and losing out on leisurely activities. Thus, GPI diverges from GDP by incorporating variables omitted in GDP measurement, and these variables reflect welfare and sustainability performance.

Economies fraught with crises aim to undertake policies that not only learn from history but also target avoiding its recurrence. For such economies, prior studies on debt and growth nexus demonstrate that external debt affects growth positively up to a certain threshold. Beyond that point growth deteriorates. Conversely, studies on the causal relationship between capital control and growth find that controls positively contribute to future growth. Comparative studies report mixed perception on the success of external debt and capital controls. Some authors investigated the causal relationship between external debt and growth, and others conducted research on the effect of capital controls on growth as well as other determinants of growth. However, most of these papers employ data spanning approximately one or two decades after the 1997 Asian financial crisis. Among them are Corden (2007), Eberhardt and Presbitero (2013), Kasidi and Said (2013), Lane (2004), Nguyen et al. (2003), Presbitero (2005), Ratha and Kang (2014), S. N. Mohd Daud et al. (2013) and Vaggi and Prizzon (2014). Nonetheless, the experience of GPI as a sustainability measure is still in its infancy, particularly for Malaysia – there are calls for the development of GPI for Malaysia by Othman et al. (2014); Yatim (2014) – and Korea (Feeny et al., 2013). This paper employs a short to medium time frame within the post-Asian crisis setting.

In the corpus of literature connected to economic crises, a longstanding dominance of the neoclassical paradigm persists that relies heavily on GDP and its derivatives as a metric of economic performance. Cyclical episodes of crises in the recent decades demonstrate the vulnerability of countries to recurrence of recession. Consequently, devising economic policy now requires not only learning the lessons of past crises but also understanding how present (and future) policy decisions are likely to impact the growth trajectory of the country and if that growth is indeed sustainable. Therefore, if sufficient evidence can support the positive momentum gained from a particular policy, responding to a crisis might generate a favourable outcome on a nation's long-term development. Accordingly, the objective of this paper is to analyse the efficacy of the two specific macroeconomic policies undertaken by South Korea and Malaysia, and to evaluate which policy setting contributed most effectively to sustainable long-term recovery.

Our paper contributes to the disciplines of economic development and sustainability literature in the following ways. Firstly, the paper attempts to construct a GPI to measure the sustainability and well-being of Malaysia. There already exist constructions of other sustainability measures, such as Green Savings for Malaysia, but there is no attempt at calculating the GPI of the country to the best of authors' knowledge. Despite the omission of several GPI components, this is considered as an added value to the field of environmental economics in Malaysia. Secondly, in terms of evaluating the efficacy of external debt engagement and capital control implementation, this study offers a comparative viewpoint between the performance in growth of South Korea and Malaysia. Proximally located in the pacific basin, a comparative perspective is favourable in terms of learning from other nations, especially neighbouring countries. Finally, the current study employs a long-range empirical approach from 1980 to 2014. Research using the Asian financial crisis as its time setting frequently employs an empirical method for the short to medium term; for example, between one and two decades. Thus, by adopting a longer time frame, our attempt promises better insight.

The remainder of the paper is structured as follows: Section 2 comprises literature review forming the basis for the paper, introduces the frameworks used and the research hypotheses. Sections 3 and 4 explain the data and methodology employed as well as the findings and discussion of the results of the empirical study. Finally, Section 5 concludes with a recap of major findings and suggests avenues for extending this stream of research.

2. Relevant literature

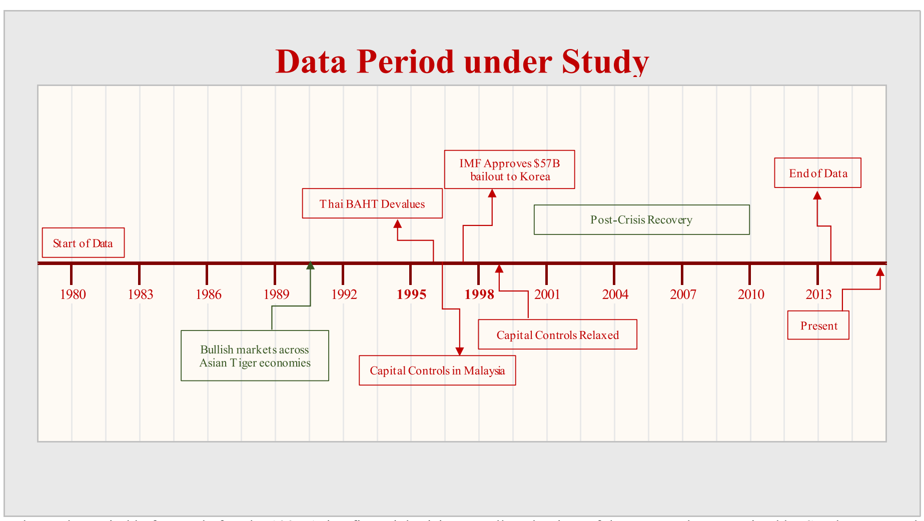
The Asian financial crisis episodes, which started with a prolonged investment boom in East Asian economies and ended with a 'hard landing', was set off by events in Thailand (Corden, 2007). Even after the 1997–98 experience, the recession effects continued in terms of significant drops in investment for Indonesia, Korea, Malaysia, and Thailand. This is confirmed by Ho and Yeh (2014), who study quantifying shifts in investment ratios as well as their determinants, finding that weak economic growth and banking systems result in downward shifts in the economy's investment. Additional to the general events of the Asian financial crisis, Zumkehr and Andriesse (2008) take into consideration the political, economic and social environment, as well as how particular pre-crisis issues might be useful for a satisfactory evaluation of the post-crisis phase. This is supported by a number of other studies, such as Corden (2007), Yoon (2005), Snodgrass (1995) and Yoshihara (2004). Table 1 below summarises the socio-economic indicators before the crisis, during the crisis and post-crisis. The timeline provided in Fig. 1 exhibits the pre, during and post-Asian financial crisis.

Among the distinctive characteristics for South Korea were poor

Table 1
Main socio-economic indicators of South Korea and Malaysia.

Year	1996		1997		1998		1999	
Country	Korea	Malaysia	Korea	Malaysia	Korea	Malaysia	Korea	Malaysia
Area (km^2) *	98,500	330,000						
Population (mil)	45.525	21.261	45.954	21.808	46.287	22.358	46.617	22.899
GDP ($ bil)	598.06	100.85	557.55	100.00	374.14	72.17	485.26	79.15
GDP per capita ($)	13,137.11	4744	12,132.83	4585	8083.13	3228	10,409.51	3456
GDP growth, % *	7.60	10.00	5.90	7.30	−5.50	−7.40	11.30	6.10
Gini coefficient **	0.291	0.456	0.283	0.459	0.316	0.459	0.321	0.443
E.Debt ($ bil) ***	144.835	39.673	161.620	47.228	151.556	42.409	139.812	41.976
FDI n.i ($ bil)	2.325	5.078	2.844	5.136	5.412	2.163	9.333	3.895
UnE rate, %	2.10	2.50	2.60	2.40	7.00	3.20	6.60	3.40
Trade bal. ($ bil)	−20,623	−254	−8452	−45	39,031	58,439	23,933	73,083
Structure of output (% of GDP) ##								
Agriculture	5.00%	11.68%	4.52%	11.10%	4.28%	13.31%	4.31%	10.84%
Industry	34.81%	40.94%	34.72%	41.83%	34.72%	40.63%	34.06%	43.26%
Service	50.45%	44.16%	50.78%	43.94%	52.26%	44.18%	51.73%	43.75%

Notes: This table shows the main socio-economic indicators of South Korea and Malaysia in 1996–1999. GDP indicators show v-shape trends where the lowest are in 1998 and the unemployment rate displays an inverted v-shape at a high of 7% and 3.4% in 1998 in South Korea and Malaysia, respectively. South Korean Gini coefficient starts to rise in 1998 signalling an increment in distributional inequality. However, the Malaysian Gini coefficient starts to rise in 1997 signalling an increment in distributional inequality, but is brought down in 1999. E. Debt denotes an external debt value. FDI n. i. denotes FDI net inflows which represent the financial openness that increases over time. UnE rate denotes unemployment rate. Trade balance (trade bal.) is negative when total exports exceed total imports and vice versa. Structure of output concentrating on the service sector shows a rising pattern. Sources: World Bank database except for; * IMF's WEO April 2016, ** Kang (2001) (South Korea) and Official Website of Economic Planning Unit (Malaysia), and *** IMF's WEO April 2016 and OECD External Debt Statistics (various editions), # Department of Statistics Malaysia, and ## Bank of Korea and Department of Statistics Malaysia.



Notes: This timeline shows the period before and after the 1997 Asian financial crisis, as well as the time of the IMF package received by South Korea and the period of capital controls of Malaysia.

Fig. 1. Timeline for period before and after crisis.
Notes: This timeline shows the period before and after the 1997 Asian financial crisis, as well as the time of the IMF package received by South Korea and the period of capital controls of Malaysia.

regulation of the financial system, weak supervision of the Chaebols (huge family-owned and controlled multinational enterprises), excessive non-performing loans (Zumkehr and Andriesse, 2008), financial markets unprepared for openness (Jin, 2006), additional aid by the IMF and the United States which Thailand and Indonesia did not have, and earlier revival than that of the other countries affected in the region (Corden, 2007). Conversely, the unique features of Malaysia are large current account deficits, excessive offshore traffic in the Malaysian Ringgit (Zumkehr and Andriesse, 2008), sufficient liquidity in foreign currency, relatively lower short-term debt ratio than other countries together with heavy local loans (Yoon, 2005). Malaysia had no currency mismatch problem of the kind that South Korea, Thailand and Indonesia had and the 1998 controls were enforced on 'short-term capital outflows, in particular on the repatriation of portfolio capital by non-residents, as well as on speculative positions against the currency' (Corden, 2007).

Another essential acknowledgement is that the crisis episodes in South Korea and Malaysia did not unfurl concurrently. The pressure on the Malaysian financial markets only peaked in August 1998, while by January 1998 pressure had already arrived at its peak in South Korea, preceding by about seven months. In addition, the timing of the Malaysian corrective measure of capital controls lagged behind South Korea, which had, by that time, obtained nine months of IMF treatment (Kaplan and Rodrik, 2002; Zumkehr and Andriesse, 2008).

With regards to the indicators of economic progress, the metric of GDP, ever since its development in the past century, has enjoyed a dominant position in determining economic growth and progress for economies around the world. This is evidenced through widespread adoption of this measure by policymakers, economists, mainstream media, and even non-experts. According to this metric, the economic performance of a country (within its geographical boundaries) is determined via the total market value of all final products and services in a 12-month period. This measure has both nominal and real variants and can be calculated in three main ways; namely, through expenditures, through income, and value addition. The expenditure approach is the most widely used one in academic and policy literature and is adopted in this paper. This is shown in equation (1) (Tran, 2011).

$$GDP_t = C_t + I_t + G_t + (X_t - M_t) \quad (1)$$

In equation (1), the indicators mean the following:

Variable	Economic Interpretation	Time
GDP_t	Gross domestic product within a 12-month period	t
C_t	Annual consumption by private households	t
I_t	Private investment	t
G_t	Government expenses	t
X_t	Export value	t
M_t	Import value	t

Despite consternations by sustainability advocates, GDP remains the *de facto* scorecard of a nation's economic health for decades. It is broadly exercised by legislators, economists, international agencies and the media, even though it is simply a gross count of products and services bought and sold, without accounting for those differences between transactions that boost well-being or shrink it. Researchers have made critical statements over GDP's role as a growth measure. Talberth et al. (2007) analogise a nation's GDP as a business entity which, “[lump] together income and expenses, assets and liabilities” to assess its financial situation. GDP is an insufficient, misinforming metric of national achievement and quality of life. According to Giannetti et al. (2015), GDP quantifies only partial economic activities. Hence, it is not intrinsically destructive or inaccurate, but applying it as a pointer of general well-being is vague and risky. The GDP paradox explored by Van den Bergh (2009), on the other hand, appraises the rationale behind social scientists' criticisms of GDP but disagrees with the relevance. Another crucial claim is made by England (1998), stating that “GDP is acknowledged to be a poor measure of social well-being”; he conducts a critical survey on quantitative metrics, which have been put forward as complementary or substitutes for GDP. Over-reliance on GDP obfuscates the decision-making shaping a nation's economy and a society spending more money would be presumed to also see their life conditions advancing too (Cha, 2013).

Following the limitations of GDP, measures relying upon the sustainability concept are becoming more well-known. These measures are generally referred to as green GDP measures, and GPI is one of them. The GPI framework which is based on Talberth et al.`s (2007) work is also published by the Redefining Progress[1].

But GPI also has been criticised on some accounts. Most of them are attended to during the development phase of GPI. The concerns regarding GPI are pointed at the theoretical foundations, components, and computation methods. Despite suggestions by Van den Bergh (2009), Costanza et al. (2014) and Kubiszewski et al. (2013) to leave GDP behind and the concerns about GPI, GPI is viewed as a favourable complimentary indicator to support GDP in charting policy strategy, rather than as a replacement (Bleys and Whitby, 2015). In addition, there is no sign that the world is ready to fully replace GDP by an alternative indicator (Van Den Bergh and Antal, 2014; England, 1998). According to Giannetti et al. (2015), an ideal indicator should be comprehensive and capable of undertaking environmental, social and economic issues independently and adequately. Hence, because no single indicator can cover the full gamut of perspectives, for the time being, the combination of different approaches should be preferable.

There are many studies on GPI and the components are based on the general framework with several country/region-specific adjustments, as listed by Bleys and Whitby (2015) and Posner and Costanza (2011). Feeny et al. (2013) develop the GPI for South Korea from 1970 to 2005. As for Malaysia, Othman et al. (2014) and Vaghefi et al. (2015) estimate sustainable economic measure using Genuine Savings and Green GDP, respectively. The necessity of adopting a sustainable growth indicator for Malaysia, particularly GPI, is highlighted by Othman (2015) and Yatim (2014). Table 2 below summarises the determinants of growth and literature that suggests these determinants. Debt and control policies are also included as determinants of growth. Different aspects on the effectiveness of debt and control policies are also listed to ease understanding of these policies.

3. Data and methodology

The study utilises secondary data mainly sourced from the World Bank, spanning 1980 to 2014, for all determinants except for GPI and external debt. A summary of the sources for data (except for GPI) is provided in Table 3 below.

3.1. GPI construction

The initial step in performing the analysis for this study is to construct a GPI for South Korea and Malaysia. The GPI was constructed using the following equation (2):

$$GPI_{it} = CON_{it} + HL_t + SCD_{it} + SHS_{it} - CC_{it} - CD_{it} - AIR_{it} - NAT_{it} + FD_{it} + CI_{it} \quad (2)$$

Where *GPIit* or Genuine Progress Indicator of country; *i* at certain period; *t* is the sum of Weighted Personal Consumption (*CON*), Household Labour (*HL*), Service from Consumer Durables (*SCD*), Service from Highways and Streets (*SHS*) and minus Cost of Crime (*CC*), Consumer Durables (*CD*), Cost of air pollution *(AIR)*, Natural resources depletion (*NAT*), Change in foreign debt (*FD*), and Change in net capital investment (*CI*).

The variables and methodology used in the calculation extend upon those utilised by Talberth and Bohara (2006) and Tran (2011), from a selection of sources. The results of the constructed GPI are provided in the findings section. Further details of each of the components of the GPI, data sources and how they are calculated are provided in Table 4. It is important to note that not all GPI components will be included in the current study. Some are omitted due to data and time constraints.

[1] Redefining Progress is a United States organisation that was formed in 1994 to expand and encourage ‘economically viable, socially equitable, and environmentally sustainable public policy’ (Tran, 2011). GPI (further refined from ISEW) is an extensively used term, mainly in the United States and Asia–Pacific region (Bleys and Whitby, 2015). Methodological refining of ISEW is done to harmonise with the Fisherian notion and the valuation methods employed. Concurrently, new terms for the ISEW emerged, such as the Genuine Progress Indicator, Measure of Domestic Progress (MDP) and National Welfare Index (NWI). At this moment, Redefining Progress is actively improving the efficacy of this measure to provide a true and fair indication of sustainability. For an overview and references on the efforts, development processes and components of GPI, see Talberth et al. (2007) as well as the other papers published in the *Journal of Ecological Economics*.

Table 2
Summary of literature on the determinants of growth.

Details	Aspects	Literature
IMF (External debt)	Debt threshold	Baum et al. (2013), Eberhardt & Presbitero (2013), Kasidi and Said (2013), Nguyen et al. (2003), Ouyang & Rajan (2014), Pattillo et al. (2011) & Presbitero (2005) & Mohd Daud et al. (2013)
	Ineffective	Sulimierska (2012)
	Debt service	Kasidi and Said (2013)
	Public investment	Nguyen et al. (2003)
	Emerging market	Lane (2004), Vaggi and Prizzon (2014), Kwack (1983, Alesina and Tabellini (1989)
Capital Control	Objectives are achieved	Abdelal and Alfaro (2003), Gross (2008), Kaplan and Rodrik (2002), Magud et al. (2011)
	Time	Kaplan and Rodrik (2002), Zumkehr and Andriesse (2008), Doraisami (2004)
	Not fully accomplished	Inoguchi (2009), Corden (2007)
	Momentarily	Jongwanich et al. (2011)
	Political connection	Jomo (1998), Tamirisa et al. (2007)
Different effect		Sundaram (2006), Tamirisa et al. (2007)
Crisis management		Kim and Rai (2001), Sundaram (2006)
Miscellany		Trade openness & unemployment rate: Talberth and Bohara (2006); FDI: Carstensen and Toubal (2004) and Mun et al. (2008); Domestic credit: Othman et al. (2014); Inflation: Jin (2006), and Reinhart and Rogoff (2010); Exchange rate: Ouyang & Rajan (2014), Ratha and Kang (2014), and Sulimierska (2012); Interest rate: Doraisami (2004) and Kwack (1983), Crisis: Reinhart and Rogoff (2011, 2014), and Tamirisa et al. (2007); Control: Doraisami (2004), Inoguchi (2009); Previous crisis: Reinhart and Rogoff (2014)

Notes: This table shows a summary of literature on the determinants of growth as explained in Determinants of growth.

Table 3
Summary of sources for data (except for GPI construction data).

Code	Variable	Source	Details	Freq	Period available
GDP	Gross Domestic Product	World Bank	GDP at purchaser's prices (current US$).	Annual	1980–2014
DEBT	External Debt	Collins and Park (1989), OECD External Debt Statistics (EDS; various editions), Sheng (2009), Bank of Korea, World Bank	All data are in current U.S. dollars. Data for Malaysian external debt is from the World Bank website, as for South Korea there are limitations due to obtaining from a single source, thus, this study employs combination of sources.	Annual	1980–2014
OPEN	Trade Openness	World Bank	Ratio of the value of trade (value of imports plus value of exports) to GDP.	Annual	1980–2014
FC	Fixed Capital	World Bank	Includes land improvements – such as boundary markers, channels, drains, etc. – purchase of plant, machinery, and equipment, and the construction of roads, railways, together with schools, offices, hospitals, private residential dwellings, and commercial and industrial builds. All data are in current U.S. dollars.	Annual	1980–2014
UNEMP	Unemployment Rate	IMF IFS and DOS Malaysia	For the years that are unavailable, data are interpolated.	Annual	KOR: 1980–2014; MYS: 1982–2014
INF	Inflation	World Bank	Measured by the consumer price index in the current U.S. dollar.	Annual	1980–2014
CREDIT	Domestic Credit provided by the financial sector	World Bank	Includes all gross claims to various segments except to the central government, which is in net amount, derived as percentage of GDP.	Annual	1980–2014
FDI	Foreign Direct Investment	World Bank	Net inflows of foreign direct investment are used to represent financial openness. All data are in current U.S. dollars.	Annual	1980–2014
EXC	Exchange Rate	World Bank	The exchange rate established by national authorities and defined as the price of one currency in terms of another.	Annual	1980–2015
I	Interest Rate	World Bank	Deposit interest rate is used to represent many interest rates coexisting in an economy and these rates differ by country.	Annual	1980–2014
CRID	Financial Crisis Dummy		Follow Reinhart & Rogoff (2011, 2014), and Tamirisa et al. (2007) to represent the 1997 Asian financial crisis. “1” is assigned to the years of crisis and “0” is assigned to the years without crisis.	Annual	1980–2014

Notes: This table shows a summary for sources of data for growth determinants (except for GPI construction from 1980 to 2014. Code refers to items in equation (3). Details describe the indicators name as found in the database and the adjustment made to reflect the nature of the variables. Years where values are absent are interpolated.

3.2. Model

Fundamentally, the model used follows on from the works by Othman et al. (2014) and Talberth and Bohara (2006), which utilize the Solow Growth Model, which proposes that GDP is a function of the nation's stocks of capital (K) and labour (L) as well as other determinants (O) and can be formulated as $GDP_t = f(K_t, L_t, O_t)$. In this study, stocks of capital (K) and labour (L) are represented by fixed capital investment (PFC) and unemployment rate, respectively. External debt (DEBT), trade openness ratio (OPEN) and crisis

Table 4
Data summary for GPI computation.

Code	Variable	Source	Details	Freq	Period available
HCON ($bill)	Household final consumption expenditure (billions of US$)	World Bank	Household final consumption expenditure (current US$)	Annual	1980–2014
DI	Distribution Index	KOR: Kang (2001) MYS: Official Website of Economic Planning Unit - Household Income & Poverty	Lowest Gini coefficient is set as base (2014) and index is calculated by finding difference between current year and base year figure. Unavailable input follows the preceding year input	Annual	KOR: 1980–2000, 2006-2014MYS: 1979, 1984, 1987, 1989, 1992, 1995, 1997, 1999, 2002, 2007, 2009, 2012, 2014
+ CON ($bill)	Weighted Personal Consumption (billions of US$)	NIL	HCON ($bill) divided by DI	Annual	1980–2014
+ HL ($bill)	Household labour (billions of US$)	Justlanded.com website, World Bank KOR: Minimum Wage Council Republic of Korea, ECOS Economic Statistics System, Bank of Korea; MYS: Minimum Wages Malaysia	Multiplication of annual working hours (52 weeks minus vacation week), hourly minimum wage, number of households (population divided by average person per household). Unavailable data for minimum wage are estimated at average ratio of available minimum wage to GDP per capita (South Korea: 24.14% and Malaysia: 26.40%).	Annual	KOR: 1988–2014; MYS: 2012–2014
+ SCD ($bill)	Service from consumer durables (billions of US$)	KOR: ECOS Economic Statistics System, Bank of Korea; MYS: UN data Report Database	Following Tran (2011), inputs are derived from adding previous ten years of consumer durables to arrive at stock of consumer durables, then multiplying by 0.1 (10%). Stock of consumer durables for 1980 until 1989 are computed by discounting at average 10 years ratio of the stocks to household final consumption expenditure of following years (KOR: 6%, MYS: 15%).	Annual	KOR: 1980–2014; MYS: 1983, 2000–2013
+ SHS ($bill)	Service from highways and streets (billions of US$)	World Bank	Adjusted savings: consumption of fixed capital (current US$)' times the total of 'Deposit interest rate (%)' and depreciation rate. Depreciation is assumed at 7.5% (Talberth (2007)).	Annual	1980–2014
- CC ($bill)	Cost of crime (billions of US$)	United Nations Crime Trends Surveys (United Nations Office on Drugs and Crime Database - UNODC), Korean National Police Agency (KNPA), Muhammad Amin et al., (2014), Keng (2006)	Number of recorded offences times costs of crime.	Annual	1980–2000, KOR: 2005–2014, MYS: 2004, 2007–2013
- CD ($bill)	Consumer Durables (billions of US$)	KOR: ECOS Economic Statistics System, Bank of Korea; MYS: UNdata Report Database	For Malaysia, only 'Furnishings, household equipment and routine maintenance of the house' assumed as durables.	Annual	KOR: 1980–2014; MYS: 1983, 2000–2013
- AIR ($bill)	Cost of air pollution (billions of US$)	The Cost of Air Pollution - Health Impacts of Road Transport (OECD)	Unavailable data being estimated at annual growth rate 0.25% and the cost is as percentage of total of final household consumption.	Annual	KOR: 2005, 2010
- NAT ($bill)	Natural resources depletion (billions of US$)	World Bank	Adjusted savings: natural resources depletion (% of GNI)' times 'GNI (current US$)'.	Annual	1980–2014
- FD ($bill)	Change in foreign debt position (billions of US$)	Collins and Park (1989), OECD External Debt Statistics (EDS; various editions), Sheng (2009), Bank of Korea, World Bank	Difference between External debt previous year and current year.	Annual	1980–2014
+CI ($bill)	Change in net capital investment (billions of US$)	World Bank	Amount of new capital (change in 'gross fixed capital formation' from previous year) minus capital requirement. capital requirement = changes in labour force participation rate times previous year's gross fixed capital formation.	Annual	1980–2014

Notes: This table shows data summary for the construction of GPI for South Korea and Malaysia from 1980 to 2014. Code refers to items in equation (2). Details describe the indicators name as found in the database and the adjustment made to reflect the nature of the variables. Years where values are absent are interpolated.

dummy (CRID) take place for other determinants (O). Data are analysed in a double-log equation as formulated in equation (3) below:

$$\ln Y_{i,t} = \beta_0 + \beta_1 \ln DEBT_{i,t} + \beta_2 \ln OPEN_{i,t} + \beta_3 \ln PFC_{i,t} + \beta_4 \ln UNEMP_{i,t} + \beta_5 CRID_{i,t} + u_{i,t} \quad (3)$$

Where the income of the country (Y_{it}); either GDP or GPI; is a function of the country's External debt (*DEBT*), Trade openness ratio (*OPEN*), Fixed capital investment (*PFC*), Unemployment rate (*UNEMP*), Crisis dummy (*CRID*) during a particular period, t. u_{it} represents the error term of country *i* at time *t*. All variables are in natural logs forms.

The present study uses Equation (3) to estimate the long-run relationship among the variables. The specification should be in an error-correction term, in order to include the short-run dynamics into Equation (3). Hence, following Pesaran et al. (2001), we substitute Equation (3) with Equation (4) and the error-correction form is as follows:

$$\begin{aligned}\Delta \ln Y_{i,t} = {} & \beta_0 + \sum_{k=1}^{n} a_k \Delta \ln Y_{i,t-k} + \sum_{k=0}^{n} b_k \Delta \ln DEBT_{i,t-k} \\ & + \sum_{k=0}^{n} c_k \Delta \ln OPEN_{i,t-k} + \sum_{k=0}^{n} d_k \Delta \ln PFC_{i,t-k} \\ & + \sum_{k=0}^{n} e_k \Delta \ln UNEMP_{i,t-k} + \beta_1 \ln Y_{i,t-1} + \beta_2 \ln DEBT_{i,t-1} \\ & + \beta_3 \ln OPEN_{i,t-1} + \beta_4 \ln PFC_{i,t-1} + \beta_5 \ln UNEMP_{i,t-1} \\ & + \beta_6 CRID_{i,t-1} + \omega_t \end{aligned} \quad (4)$$

3.3. Panel linear regression

Complementing the panel linear data regression on Equation (3) for OLS, random and fixed effects methods, Breusch-Pagan LM and Hausman tests are employed to determine whether the random effect variable is preferable to the OLS and whether the fixed effect variable is preferable to the random, respectively. Diagnostic tests are done to verify whether the series are free from autocorrelation, and heteroscedasticity issues. Hypotheses tested are:

Hypothesis A:

H0. There is autocorrelation between members of series of observations ordered in time.

H1. There is not autocorrelation between members of series of observations ordered in time.

Hypothesis B:

H0. There are constant variances for the residual term.

H1. There are no constant variances for the residual term.

3.4. Autoregressive distributed lag (ARDL)

The ARDL or Bounds Testing methodology of Pesaran et al. (2001) is used in the study. ARDL has advantages over other cointegration tests such as Vector Error Correction Model (VECM) because it can be used with a mixture of I(0) and I(1) variables. The ARDL method is also superior for small sample size and flexibility of assigning different lag-lengths to regressors. In accordance with Giles (2013), we first test variables for unit roots to avoid variables with I(2) or higher integration. We employ two of the most common unit root tests: the Augmented Dickey-Fuller (ADF) and the Phillips-Perron (PP) tests (Dimitrioss and Hall, 2011). Next, we formulate an unrestricted error-correction model (ECM) in equation (4). Then, appropriate lags are assigned following information criteria; more specifically, we opt for Akaike Information Criteria (AIC). After obtaining suitable lags, LM test is employed to satisfy the Pesaran et al. (2001) assumption of the errors in equation (4) are serially independent. Next, we engage in Bounds testing to identify evidence of a long-run relationship among the variables. Based on (4), F-test is performed, and the result is compared to the bounds critical values supplied by Narayan (2004) as the sample size for the current study is 35 years. At this stage, three possible conclusions can be drawn. First, the regressors are I(0), thus no cointegration; if the calculated F-statistic lies below the lower bound. Second, the regressors are I(1), hence cointegration exists; if the calculated F-statistic exceeds the upper bound. Third, the test is inconclusive, if the F-statistic falls between the bounds. If the Bounds test suggests that there is cointegration, the following step is to estimate the long run equilibrium and the restricted ECM. From this estimation, the short-run dynamic effects, and the long-run equilibrating relationship between the variables can be measured. We also perform several diagnostic tests to complement Bounds testing.

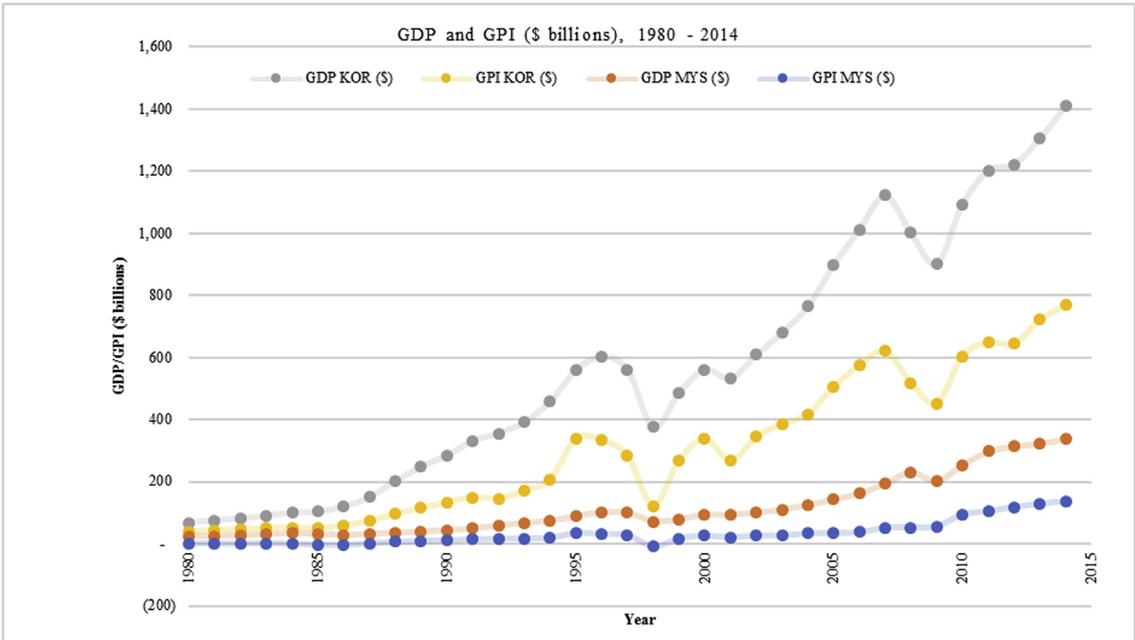
4. Result and discussion

4.1. GPI for South Korea and Malaysia

The initial step is to construct the GPI for both South Korea and Malaysia. Preferably, an all-inclusive set of components in the production of GPI would have been employed; however, due to data limitations certain variables are left out. These include the value of higher education, loss of leisure time, costs of underemployment, cost of commuting, cost of household pollution abatement, cost of automobile accidents, cost of water pollution, cost of noise pollution, loss of wetlands, loss of farmland, loss of primary forests, carbon dioxide emissions damage and cost of ozone depletion. If these components were included in GPI, it may have notably altered the outcome. The results are presented in Fig. 2 and Fig. 3 that follow.

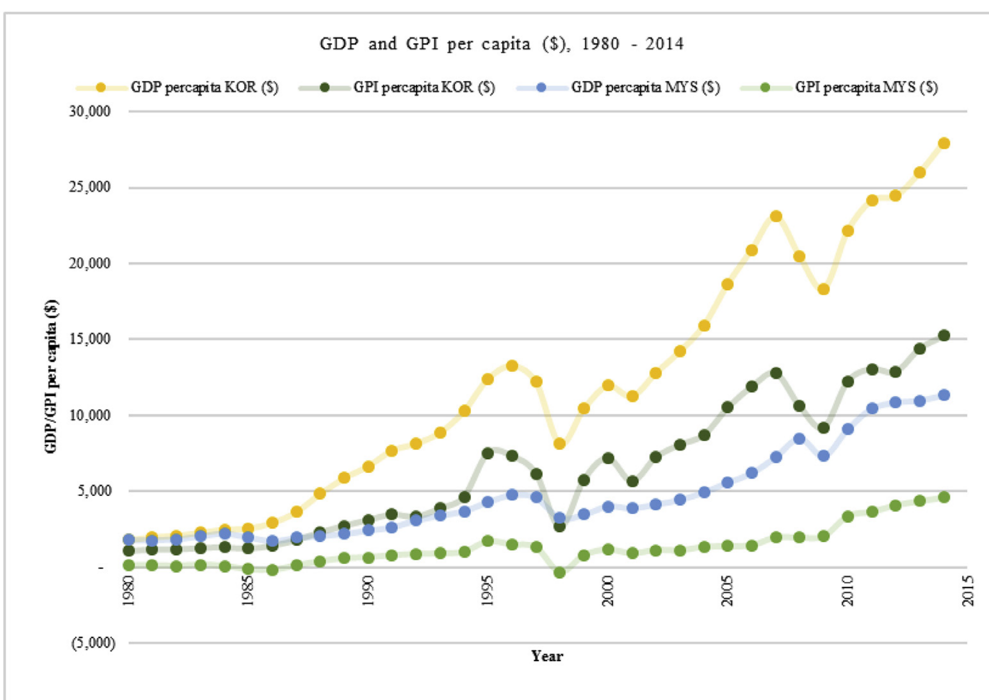
Comparing the GPI results for both countries, GPI forms a curve below GDP. This conforms to most findings in the literature; the performance when measured by GPI is not as high as the one that GDP portrays. During the period 1980–2014, South Korea's GPI increases from $1046 per South Korean capita to $15,236. This average rise is approximately 40% per annum or 1350% for the study period. This growth in sustainability is considered satisfying, particularly compared to the increase in South Korea's GDP per capita – an increase of almost 1500% over the study period or about 40% per annum. South Korea's GDP per capita was $1778 in 1980 and $27,970 in 2014. The difference between South Korea's GDP per capita and GPI per capita grows considerably from $732 to $12, 734 per South Korean during the study time frame (about 1600% increase in the discrepancy). South Korea's GPI per capita fluctuates over the duration of the study period. After a preliminary continuous rise, which varies minimally from year to year until 1996, per capita GPI slumps during the Asian crisis in 1998 to $2, 654 per South Korean. However, per capita GPI rises again and fluctuates considerably over the remaining years.

The divergence between the two indicators varies to an exceptionally small magnitude between 1980 and 1986. An alarming feature is that beyond 1986 per capita GPI did not appreciate in the same manner as per capita GDP. It is also interesting to note that despite the fact that both indicators rise positively, the difference in indicator growth has built an obvious gap between the two beyond



Notes: The graph shows trend lines of GDP and GPI in billions of U. S. dollars for South Korea and Malaysia in 1980 - 2014.

Fig. 2. GDP and GPI ($ billions), 1980–2014.
Notes: The graph shows trend lines of GDP and GPI in billions of U. S. dollars for South Korea and Malaysia in 1980–2014.



Notes: The graph shows trend lines of GDP and GPI per capita in U. S. dollars for South Korea and Malaysia in 1980 - 2014.

Fig. 3. GDP and GPI per capita ($), 1980–2014.
Notes: The graph shows trend lines of GDP and GPI per capita in U. S. dollars for South Korea and Malaysia in 1980–2014.

1986. South Korea's GDP and GPI per capita recede in 1998 and rise again after the Asian crisis. Both measures drop slightly in 2001 and continue to increase until 2007 yet maintaining the same gap. Around the time of the subprime mortgage crisis, the GPI per capita drops earlier in 2008 than the GDP per capita in 2009. Beyond 2009, GDP rises steadily and reaches its peak at $27, 970 per South

Korean, while GPI increases fairly at $15, 236 per South Korean in 2014.

Compared to South Korea, the disparity between Malaysia's GDP per capita and GPI per capita grows from $1677 to $6720 per Malaysian overall (an almost 300% rise in difference). During the period 1980 to 2014, Malaysia's GPI increases from $102 per Malaysian to $4586. This average rise is approximately 125% per annum or approximately 4400% for the study period. This growth in sustainability is major, relatively to the rise in Malaysia's GDP per capita − a positive change of about 540% over the study period or 15% per annum. Malaysia's GDP per capita was $1770 in 1980 and $11,307 in 2014. Malaysia's GPI per capita fluctuates over the study period.

Following a continuous increase since the opening of the study period until 1995, per capita GPI drops to negative in 1998 at $332 per Malaysian but rises again in 1998 and fluctuates moderately over the remaining years. On the contrary, GDP drops during the Asian crisis to $3228 per Malaysian and rises rapidly before it drops again during the subprime crisis. It is interesting to note that there was no clear relationship between the GDP and the GPI throughout this period, with one index experiencing continuous rise and the other fluctuating mildly until the end of the study period. Beyond 2009, GDP rises steadily and reaches its peak at $11,307 per Malaysian, while GPI increases moderately at $4586 per Malaysian in 2014.

Beyond 1986, the growth rate of both countries' GPI is incapable of keeping up with the rate of increase in their per capita GDP measure. This hints that, firstly: the rise in GDP per capita incurs an opportunity cost of escalating social and environmental sacrifices. Secondly, the speedy rise in per capita GDP overall does not transform efficiently into a rise in sustainable welfare. The volatility and patterns in per capita GPI are inferior compared to the rate of economic growth during the study time and can be explained by deconstructing the GPI compositions.[2]

4.2. Diagnostic and unit roots tests

A summary of descriptive statistics for variables used in the model is provided in supplementary files containing appendices (Appendix Table 9—in this case). All models with *lgdp* as dependent variable fail to reject null hypotheses of Hypotheses A and B (except *lgdp* model (5) which suffers from heteroscedasticity. Thus, the models other than (5) are devoid of autocorrelation and heteroscedasticity problems. On the other hand, all models with *lgpi* as dependent variable fail to reject null hypothesis of Hypothesis B only. Therefore, they are free from autocorrelation but suffer heteroscedasticity problems. Table 5 exhibits the Augmented Dickey-Fuller and Phillips-Perron tests results for the variables. The Augmented Dickey-Fuller and Phillips-Perron tests for stationary point out that the variables taken at level fail to reject that the null hypothesis regarding data for South Korea and Malaysia are non-stationary. However, both tests reject the null hypothesis at the 0.05 level when the variables are tested at first differences without trend as reported in Table 5.

4.3. Panel linear regression results

The estimation results of panel data for all the indicators, using the three methods (OLS method, random effects and fixed effects) as well as three additional models (to test for robustness of the base model), are tabulated in Table 6 and Table 7 shown below; although *lgpi* models are not homoscedastic. Overall estimation models for both *lgdp* and *lgpi* are seen fit based on the outcomes of R-squared at a minimum of 0.848 point and a maximum of 0.976 point. From Table 6 it becomes apparent from the p-values of the regressors that all but crisis and country dummy are largely significant at 5% level. A large discrepancy between the magnitudes of coefficients is observed for levels of debt, where random effect model demonstrates weaker dependence. As such, the fixed effect and pooled OLS models emphasize greater impact of debt levels vis-a-vis debt levels, while random effect model undermines such connection by nearly four times. In terms of coefficient signs, the models disagree with regards to crisis dummy, where random effect model ascribes significant and positive impact of crisis. This anomalous sign is reversed from the hypothesized one and appears counterintuitive. Nonetheless, the preference to fixed effect model imputed by Hausman test results means that this aberration has weaker explanatory power compared to other models which do not consider crisis to be of significance. Meanwhile, using GPI as the dependent variable, Table 7 demonstrates slightly different results whereby the models broadly agree in terms of signs of the coefficients but divergences in strength are observed. For instance, random effect model—like Table 6—reports weaker association for debt levels. The most striking difference is observed in fixed capital results, where most models report insignificance. The stronger significance of unemployment in the GPI model is consistent with assertions of Kubiszewski et al. (2013) and empirical results from Brazil reported by Andrade and Garcia (2015).

Using *lgdp* as dependent variable, the outcome suggests *ldebt*, *lpfc*, *lopen*, and *lunemp* to be significant at 0.01 and *pred* to be significant at 0.05 as per the pooled OLS and the random effects model (chosen by the Breusch-Pagan LM test and Hausman test). Further observed, the first two have a positive impact on *lgdp*, while the rest are negative and *ldebt* has the largest magnitude increase on *lgdp* at 1.027% for every 1% increase in *ldebt*. It is interesting to note that *cond* is insignificant to affect *lgdp*, but *pred* is contributing significantly to decrease the *lgdp* by 0.402%. To verify for robustness of the base model, three other models are employed by including variables of *lcpi*, *lcr* (robustness test 1), *lfdi*, *lexc* (robustness test 2) and *li* (robustness test 3).

In robustness test 1, *lcpi* and *lcr* are found to be insignificant at all levels. Concurrently, the model estimation brings the *lunemp* a level down to 0.05 significance level and *lpfc* score to be insignificant. In addition, the significant level of *pred* drops to 10%. Next, in robustness test 2, *lfdi* and *lexc* are found to be significant at 0.01 but at the same time, estimation of the model brings down the *lopen*, *lpfc* and *pred* score to be insignificant at all levels. Then, in robustness test 3, li is found to be significant at 0.01. The common findings in all robustness test models are: *ldebt* consistently shows a positive effect and 0.01 of significance level, *lunemp* consistently shows a negative effect and 0.01 of significance level (except for robustness test 1 at 0.05), crid and cond report no significant results in robustness models.

In summary, percentage changes of *ldebt* and *lunemp* are important determinants of percentage change in lgdp. There is a direct relationship between *lgdp* and *ldebt* as well as an indirect relationship between *lgdp* and *lunemp*. Other determinants that influence percentage change in *lgdp* are *lopen*, *lpfc*, *lfdi*, *lexc*, *li* and *pred*. *crid* and *cond* are found to have no major effect on percentage change of *lgpd*.

Repeating the procedure to lgpi as dependent variable, the outcome suggests the *ldebt*, and *lunemp* to be significant at 0.01 and *lopen* to be significant at 0.10 as per the fixed effects model (chosen

[2] Given the extensive coverage of methodologies of GPI adjustments that have appeared over a period of time, and with the focus of this paper being less on the GPI itself and more on the effects of external debt and capital control policies, a fuller description of the methodologies associated with these adjustments are omitted but available from the authors on request.

Table 5
Augmented Dickey-Fuller and Phillips-Perron tests for unit root results.

	Panel A: Korea							
	Augmented Dickey-Fuller (ADF) Test				Phillips-Perron (PP) Test			
	No trend		With trend		No trend		With trend	
	Level	First Difference	Level	First Difference	Level	First Difference	Level	First Difference
lgdp	−1.710	−4.689***	−1.52	−4.689***	−1.739	−4.633***	−1.56	−4.76***
lgpi	−1.164	−6.503***	−2.987	−6.439***	−1.12	−7.068***	−2.91	−7.062***
ldebt	−0.546	−3.461***	−1.81	−3.405**	−0.64	−3.423***	−2.36	−3.364*
lopen	−0.507	−5.520***	−1.96	−5.765***	−0.58	−5.523***	−1.92	−5.769***
lfc	−1.498	−4.397***	−1.35	−4.55***	−1.485	−4.317***	−1.46	−4.458***
lunemp	−2.656	−4.603***	−2.603	−4.554***	−2.711	−4.488***	−2.64	−4.428***
crid	−1.000	−5.745***	−1.97	−5.652***	−0.991	−5.747***	−2.1	−5.652***
	Panel B: Malaysia							
	Augmented Dickey-Fuller (ADF) Test				Phillips-Perron (PP) Test			
	No trend		With trend		No trend		With trend	
	Level	First Difference	Level	First Difference	Level	First Difference	Level	First Difference
lgdp	0.102	−5.141***	−2.36	−5.070***	0.157	−5.109***	−2.47	−5.027***
lgpi	−0.924	−7.091***	−2.159	−6.728***	−0.91	−7.731***	−2.51	−7.344***
ldebt	−0.763	−3.216**	−1.88	−3.167*	−0.84	−3.108**	−2.5	−3.0280
lopen	−1.252	−3.417***	0.422	−3.975***	−1.35	−3.321**	0.101	−3.825**
lfc	−0.489	−4.082***	−1.78	−4.038***	−0.661	−4.005***	−2.14	−3.950***
lunemp	−1.745	−4.790***	−2.143	−4.720***	−1.895	−4.745***	−2.39	−4.674***
crid	−1.000	−5.745***	−1.97	−5.652***	−0.991	−5.747***	−2.1	−5.652***

Notes: This table summarises the descriptive statistics, Levin-Lin-Chu and Im-Pesaran-Shin tests for unit root results. Standard errors in parentheses ***p < 0.01, **p < 0.05, *p < 0.1.

Table 6
Results of panel data analysis with GDP as dependent variable; (1) Base model, (2) Fixed effects model, (3) Random effects model, (4) Robustness test 1, (5) Robustness test 2, and (6) Robustness test 3.

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	lgdp	lgdp	lgdp	lgdp	lgdp	lgdp
Ldebt	1.027***	0.947***	0.280***	1.000***	0.734***	0.936***
	(0.0365)	(0.0479)	(0.0292)	(0.0572)	(0.0527)	(0.0481)
Lopen	−0.496***	−0.129	−0.184***	−0.570***	−0.197	−0.719***
	(0.0709)	(0.164)	(0.0311)	(0.137)	(0.126)	(0.106)
Lpfc	0.537***	0.480**	0.674***	0.393	0.0836	0.749***
	(0.199)	(0.193)	(0.0271)	(0.247)	(0.170)	(0.204)
Lunemp	−0.350***	−0.365***	−0.357***	−0.397**	−0.428***	−0.399***
	(0.128)	(0.123)	(0.041)	(0.155)	(0.0992)	(0.123)
Lcpi				0.0528		
				(0.0556)		
Lcr				0.131		
				(0.155)		
Crid	−0.115	−0.106	0.204***	−0.0619	−0.165	0.0678
	(0.138)	(0.133)	(0.033)	(0.152)	(0.107)	(0.147)
Cond	0.100	−0.00969	0.181	−0.0153	−0.0273	0.104
	(0.242)	(0.237)	(0.293)	(0.269)	(0.190)	(0.230)
Pred	−0.402**	−0.380**	−0.418**	−0.342*	−0.226	−0.369**
	(0.188)	(0.181)	(0.163)	(0.200)	(0.147)	(0.179)
Lfdi					0.141***	
					(0.0249)	
Lexc					0.118***	
					(0.0246)	
Li						−0.324***
						(0.118)
Constant	1.294	1.802	2.992	2.215	5.342***	4.493**
	(1.541)	(1.497)	(0.517)	(2.134)	(1.349)	(1.874)
Breusch-Pagan LM Test	1.0000					
	(0.0000)					
Hausman Test		6.08				
		(0.5303)				
Wooldridge	32.525			94.051	52.996	27.299
	(0.1105)			(0.0654)	(0.0869)	(0.1204)
Breusch-Pagan/Cook-Weisberg	6.08			5.89	27.47	6.03
	(0.5301)			(0.7506)	(0.0012)	(0.6444)
Observations	70	70	70	70	70	70
R-squared	0.959	0.931	0.993	0.959	0.976	0.963
Number of ctry		2	2			

Notes: Standard errors in parentheses ***p < 0.01, **p < 0.05, *p < 0.1 except for the Breusch-Pagan LM Test, Hausman Test, Breusch- Pagan/Cook-Weisberg Heteroscedasticity Test and Wooldridge Serial Correlation Test which are p-values.

Table 7
Results of panel data analysis with GPI as dependent variable; (1) Base model, (2) Fixed effects model, (3) Random effects model, (4) Robustness test 1, (5) Robustness test 2, and (6) Robustness test 3.

VARIABLES	(1)	(2)	(3)	(4)	(6)	(7)
	lgpi	lgpi	lgpi	lgpi	lgpi	lgpi
ldebt	1.380***	1.025***	0.536***	1.598***	0.859***	1.407***
	(0.0854)	(0.100)	(0.196)	(0.132)	(0.134)	(0.121)
lopen	−0.916***	0.692*	−0.462***	−0.344	0.574*	−0.848***
	(0.167)	(0.347)	(0.204)	(0.315)	(0.325)	(0.268)
lpfc	0.603	0.314	0.832***	1.052*	0.121	0.543
	(0.468)	(0.398)	(0.177)	(0.562)	(0.428)	(0.507)
lunemp	−0.756**	−0.927***	−0.380*	−0.368	−1.012***	−0.737**
	(0.310)	(0.263)	(0.168)	(0.354)	(0.260)	(0.318)
lcpi				0.0567		
				(0.131)		
lcr				−0.659*		
				(0.354)		
crid	−0.116	−0.0513	−0.066	−0.350	−0.120	−0.173
	(0.323)	(0.272)	(0.217)	(0.343)	(0.267)	(0.369)
cond	0.337	−0.229	0.295	0.704	−0.294	0.365
	(0.713)	(0.610)	(0.618)	(0.738)	(0.598)	(0.724)
pred	0.173	−0.147	−0.187	0.0533	0.0205	0.176
	(0.610)	(0.516)	(0.991)	(0.602)	(0.516)	(0.615)
lfdi					0.0886	
					(0.0631)	
lexc					0.352***	
					(0.0642)	
li						0.0976
						(0.301)
Constant	−6.370*	−3.761	−6.482*	−13.55***	−1.652	−7.359
	(3.617)	(3.082)	(3.359)	(4.886)	(3.392)	(4.752)
Breusch-Pagan LM Test	1.0000					
	(0.0000)					
Hausman Test		26.90				
		(0.0003) ***				
Wooldridge	39.480			33.266	9.493	108.441
	(0.1005)			(0.1093)	(0.1998)	(0.0609)
Breusch-Pagan/Cook-Weisberg	36.97			43.12	40.93	36.60
	(0.0000)			(0.0000)	(0.0000)	(0.0000)
Observations	67	67	67	67	67	67
R-squared	0.893	0.848	0.937	0.902	0.930	0.893
Number of ctry		2	2			

Notes: Standard errors in parentheses ***p < 0.01, **p < 0.05, *p < 0.1 except for Breusch-Pagan LM Test, Hausman Test, Breusch- Pagan/Cook-Weisberg Heteroscedasticity Test and Wooldridge Serial Correlation Test which are p-values.

by the Hausman test). We observe further that *ldebt*, and *lopen* have positive effect on lgpi, while the lunemp are negative and ldebt has the largest magnitude increase on lgpi at 1.025% for every 1% increase in *ldebt*. Note that all dummy variables are insignificant to affect lgpi. To verify for robustness of the base model, three other models are employed by including variables of *lcpi*, *lcr* (robustness test 1), *lfdi*, *lexc* (robustness test 2) and *li* (robustness test 3). An interesting finding on *lopen* is the sign change from positive impact (in the base model) to negative impact in robustness test 1 and 3.

In robustness test 1, lcr is significant at 0.10; the model estimation brings down the *lopen* and *lunemp* score to be insignificant as well. In addition, *lpfc* becomes significant at 10%. Next, in robustness test 2, *lexc* is found to be significant at 0.01 and *lfdi* has no major impact on lgpi. Nevertheless, at the same time, estimation of the model brings down the lopen score to be significant at 10%. Then, in robustness test 3, *li* is found to be insignificant at all levels and *lunemp* is significant at 5%. The common findings in all robustness test models are: *ldebt* consistently shows positive effect and 0.01 of significance level, *lunemp* consistently shows negative effect and 0.01 of significance level (except for robustness test 3 at 0.05), and all dummies report no significant results in robustness models.

Summing up in Table 8, percentage changes of *ldebt* and *lunemp* are important determinants of percentage change in *lgpi*. There is a direct relationship between *lgpi* and *ldebt* as well as an indirect relationship between *lgpi* and *lunemp*. Other determinants that influence percentage change in *lgpi* are *lopen*, *lpfc*, and *lexc*. *lfdi*, *li*, *crid*, *cond* and *pred* are found to have no major effect on percentage change of *lgpi*.

4.4. Autoregressive distributed lag (ARDL) results

Since the unit roots testing indicate integration of different orders among the variables, ARDL approach to cointegration is appropriate to investigate the long-run association between the variables. The error correction term in ARDL investigation denotes the rate at which adjustment occurs to re-establish equilibrium. It is ideally expected to be both statistically significant and possess a negative sign. As per earlier literature, the high significance of error correction term confirms existence of a stable long-term relationship between the series. For our paper this is applicable for GDP but not GPI for both countries. For Malaysia, the coefficient of error correction term (−0.642) indicates that in the long run a deviation by one unit is corrected by 64.2% for the following year. Meanwhile, for Korea the amount is 57.2%.

Furthermore, long and short run dynamics for Korea indicate significant results only for fixed capital in the GDP model. In this regard, the short run effect model is more prominent compared to long run. In the latter case, fixed capital values are significant at lag length 1. At the same time, for the GPI model, difference in

Table 8
ARDL short-run and long-run results.

Country	South Korea						Malaysia					
Ardl Model	Gdp Model (1 2 1 2 3 1)			GPI MODEL (1 2 1 2 3 1)			Gdp Model (1 2 2 2 2 1)			Gpi Model (2 2 2 2 2 1)		
Variables	ECT $^{t-1}$	LR	SR	ECT $^{t-1}$	LR	SR	ECT $^{t-1}$	LR	SR	ECT $^{t-1}$	LR	SR
D.ldebt			−0.0931			0.0736			0.0267			−0.406
			(0.111)			(0.168)			(0.141)			(0.741)
LD.ldebt			−0.0156			0.0364			0.00641			−0.532
			(0.101)			(0.168)			(0.135)			(0.709)
D.lopen			0.0544			0.165			−0.241			−0.568
			(0.155)			(0.257)			(0.291)			(1.299)
D.lunemp			0.0471			−0.251*			−0.139			−1.325*
			(0.0734)			(0.125)			(0.150)			(0.600)
LD.lunemp			−0.00496			−0.277			−0.0344			−1.841**
			(0.0998)			(0.161)			(0.115)			(0.640)
D.lfc			0.517**			1.227***			0.235			−0.103
			(0.204)			(0.260)			(0.173)			(1.409)
LD.lfc			−0.0389			−0.710**			−0.0497			−1.428
			(0.130)			(0.281)			(0.104)			(0.938)
L2D.lfc			0.105			0.169						
			(0.0932)			(0.154)						
D.crid			−0.0462			0.240			−0.217*			−0.145
			(0.106)			(0.183)			(0.112)			(0.779)
ldebt		0.237			0.111			0.272			0.493	
		(0.185)			(0.596)			(0.203)			(2.361)	
lopen		−0.125			0.0589			0.240			3.059	
		(0.279)			(0.863)			(0.210)			(2.624)	
lunemp		0.0241			1.252			0.425			4.212*	
		(0.298)			(1.550)			(0.288)			(2.256)	
lfc		0.759***			1.236			0.698***			2.168	
		(0.131)			(0.725)			(0.227)			(2.080)	
crid		0.0632			−0.577			0.319			−0.546	
		(0.178)			(0.994)			(0.190)			(2.232)	
L.lgdp	−0.572*						−0.642**					
	(0.274)						(0.293)					
L.lgpi				−0.323						−0.481		
				(0.263)						(0.360)		
LD.lopen									−0.0885			−1.016
									(0.333)			(1.431)
LD.lgpi												−0.180
												(0.308)
Constant			1.009			−3.197			−0.0466			−29.09**
			(1.727)			(2.755)			(1.242)			(11.58)
Observations	32	32	32	32	32	32	33	33	33	26	26	26
R-squared	0.960	0.960	0.960	0.972	0.972	0.972	0.853	0.853	0.853	0.853	0.853	0.853

Note: The table shows results for auto regressive distributed models for South Korean GDP and GPI, as well as Malaysian GDP and GPI. ECT^{t-1} denotes error correction terms, while SR and LR represent short-run and long-run coefficient estimates, respectively. The D. prefix before a variable denotes the first difference operator. Standard errors are shown in parentheses (***p < 0.01, **p < 0.05, *p < 0.1) The number of optimal lags is decided based on AIC and are supplemented in the lag selection criteria tables in the appendix.

unemployment shows slight negative association. Again, in this model—like GDP—fixed capital displays comparable significance, although reverts to negative sign in the short run model beyond the first lag. Conversely, for Malaysia, fixed capital too scores significantly in the GDP model in the long run. In the short run, the crisis dummy is significant only in GDP model. Strikingly, this sign is negative with a weak significance at 10%. This suggests that GDP based indication of economy's health suffers considerably (and understandably) during years when the economy is in depression. However, the same is not observed when measured in GPI paradigm. For the Malaysian GPI model, meanwhile, unemployment appears significant in both long and short run. In the long run it shows positive association with GPI with a very high coefficient value (4.212). Interestingly, the effect is negative across first and second lag length. This phenomenon is puzzling since an initial sacrifice in unemployment level can be tolerated in an emergent economy in the short run. Instead, a short-run benefit is observed in Malaysia, which is eventually not sustainable. Comparing with Korea, persisting with GPI-oriented growth in the long run appears to yield no long run benefit either. Instead, the effect is felt much more modestly in the short run.

5. Conclusion

This paper examines the impact of the taking of IMF debt and imposition of capital controls by South Korea and Malaysia, respectively, over 35 years from 1980 to 2014. We employ panel regression with GDP and GPI as dependent variables. Initially, we hand-construct GPI for the two countries. The investigations indicate that the curves for GPI appear to be of lesser magnitude than GDP. However, given omissions in GPI components, its underestimation cannot be ruled out. The results from panel-based regressions indicate that the long run association between GDP and GPI is significant. Yet, the impact of capital controls in both GDP and GPI models fail to yield statistical significance. Additionally, lack of employment, open trade policy, formation of fixed capital, and prior episodes of financial crisis do emerge as significant determinants of GDP and GPI models. Meanwhile, the results for exchange rates and credit were inconclusive. We furnish explanations to our findings in a three-pronged analysis.

First, we discuss which factors contribute the most to a sustainability oriented metric of well-being: GPI. The determinants of GPI are different from GDP even though both start with personal consumption. We make multiple adjustments to GPI to reflect the welfare and sustainability qualities of the country's performance. These adjustments are not subject to a specific standard framework suit for ubiquitous application. For instance, consumer durables data for South Korea is available, while none is available for Malaysia. Future researchers may choose to exclude the variable or include it with a certain level of assumptions involved. However, for comparison between these two nations, we do include the variable and make assumptions for parsimony. This choice is in line with existing practice in GPI studies. Even though variables included in the computation of GPI are different from GDP, these variables provide crucial information not captured by GDP: namely, value of household works, cost of crimes, cost of natural resource depletion, and distribution index. All these variables show different trends, which—incidentally—are not parallel to personal consumption trend. Additionally, we compare the GDP and GPI regressions together for explanation purposes. The two indices provide different points of view on how to define growth: GDP as a comparable economic growth measure between nations due to its standardised and worldwide usage, with GPI as a measure for welfare and sustainability performance.

Our second and third analyses entail efficacy of external debt and capital control in boosting long-term economic growth—denominated in GDP and GPI metrics. Our regression results suggest that external debt implementation contributes significantly to growth as indicated by both measures. In addition, the magnitude of debt-growth consistently shows higher positive values compared to other independent variables in all tests. On the other hand, capital controls dummy shows an insignificant result regarding the effect on the growth of both GDP and GPI. This result suggests that in the long run, in a 35-year time frame, external debt contributes positively to growth performance either measured by GDP or GPI. On the other hand, the capital control imposition does not contribute to growth, neither measured by GDP and GPI in the long run. Nonetheless, we stay shy of drawing definitive conclusions about contributions of these two policies in the short run in light of low statistical power. Given that there is literature supporting a temporary effect of capital controls on growth, the role of capital control in the short run cannot be denied or confirmed (Jongwanich et al., 2011). These findings should enable policymakers to chart a judicious strategy for handling future crises from economic well-being and sustainable development viewpoints.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jclepro.2019.06.144.

Appendix

Table 9
Descriptive statistics of panel linear data

Var	lgdp	lgpi	ldebt	lopen	lpfc	lunemp	lcpi	1cr	crid	cond	pred	lfdi	lexc	li
N	70	67	70	70	70	70	70	70	70	70	70	70	70	70
μ	25.935	24.900	24.916	4.635	3.372	1.288	1.126	4.551	0.086	0.029	0.029	21.483	3.962	1.736
X	25.902	24.781	24.696	4.672	3.391	1.253	1.154	4.772	0.000	0.000	0.000	21.935	3.888	1.775
σ	1.188	1.719	1.018	0.481	0.182	0.289	0.784	0.476	0.282	0.168	0.168	1.566	2.902	0.524
Min	23.921	20.738	22.612	3.885	3.024	0.742	−1.238	3.711	0.000	0.000	0.000	15.607	0.779	0.732
Max	27.975	27.367	26.774	5.395	3.775	2.001	3.357	5.096	1.000	1.000	1.000	23.439	7245	2.970
S	0.023	−0.670	0.078	0.053	0.061	0.698	−0.351	−0.606	2.960	5.659	5.659	−1.199	0.003	0.042
K	1.872	2.975	2.267	1.596	2.513	3.357	4.644	1.720	9.760	33.029	33.029	4.637	1.020	1.936

Notes: This table summarises the descriptive statistics of panel linear data. Var denotes Variables, *N* denotes number of observations, μ denotes mean, X denotes median, σ denotes standard deviation, Min denotes minimum point, Max denotes maximum point, S denotes skewness and K denotes kurtosis.

Table 10
ARDL ECM (Error Correction Model) Results

COUNTRY	SOUTH KOREA		MALAYSIA	
ECM	GDP MODEL (1 2 1 2 3 1)	GPI MODEL (1 2 1 2 3 1)	GDP MODEL (1 2 2 2 2 1)	GPI MODEL (2 2 2 2 2 1)
VARIABLES	D.lgdp	D.lgpi	D.lgdp	D.lgpi
L.lgdp	−0.572*		−0.642**	
	(0.274)		(0.293)	
ldebt	0.136	0.0359	0.175	0.237
	(0.119)	(0.207)	(0.142)	(1.023)
lopen	−0.0718	0.0190	0.154	1.470*
	(0.161)	(0.274)	(0.134)	(0.662)
lunemp	0.0138	0.404	0.273	2.025
	(0.169)	(0.288)	(0.252)	(1.172)
lfc	0.435*	0.399**	0.448	1.042
	(0.219)	(0.175)	(0.275)	(1.549)
crid	0.0362	−0.186	0.205	−0.262
	(0.107)	(0.205)	(0.170)	(0.943)
D.ldebt	−0.0931	0.0736	0.0267	−0.406
	(0.111)	(0.168)	(0.141)	(0.741)
LD.ldebt	−0.0156	0.0364	0.00641	−0.532
	(0.101)	(0.168)	(0.135)	(0.709)

(continued on next page)

Table 10 (*continued*)

COUNTRY	SOUTH KOREA		MALAYSIA	
ECM	GDP MODEL (1 2 1 2 3 1)	GPI MODEL (1 2 1 2 3 1)	GDP MODEL (1 2 2 2 2 1)	GPI MODEL (2 2 2 2 2 1)
VARIABLES	D.lgdp	D.lgpi	D.lgdp	D.lgpi
D.lopen	0.0544	0.165	−0.241	−0.568
	(0.155)	(0.257)	(0.291)	(1.299)
D.lunemp	0.0471	−0.251*	−0.139	−1.325*
	(0.0734)	(0.125)	(0.150)	(0.600)
LD.lunemp	−0.00496	−0.277	−0.0344	−1.841**
	(0.0998)	(0.161)	(0.115)	(0.640)
D.lfc	0.517**	1.227***	0.235	−0.103
	(0.204)	(0.260)	(0.173)	(1.409)
LD.lfc	−0.0389	−0.710**	−0.0497	−1.428
	(0.130)	(0.281)	(0.104)	(0.938)
L2D.lfc	0.105	0.169		
	(0.0932)	(0.154)		
D.crid	−0.0462	0.240	−0.217*	−0.145
	(0.106)	(0.183)	(0.112)	(0.779)
L.lgpi		−0.323		−0.481
		(0.263)		(0.360)
LD.lopen			−0.0885	−1.016
			(0.333)	(1.431)
LD.lgpi				−0.180
				(0.308)
Constant	1.009	−3.197	−0.0466	−29.09**
	(1.727)	(2.755)	(1.242)	(11.58)
Observations	32	32	33	26
R-squared	0.960	0.972	0.853	0.853

Notes: This table shows results for error correction models for South Korean GDP and GPI, as well as Malaysian GDP and GPI. Standard errors are shown in parentheses (***p < 0.01, **p < 0.05, *p < 0.1).

Table 11
Summary of results.since the

Variables		GDP			GPI	
		Hypothesis	Significance	Relationship	Significance	Relationship
ldebt	External debt	+/−	YES	+	YES	+
lopen	Trade openness	+/−	YES	−	YES	+/−
lpfc	Fixed capital	+	YES	+	YES	+
lunemp	Unemployment rate	−	YES	−	YES	−
lcpi	Inflation	+/−	NO	+	NO	+
lcr	Credit	+	NO	+	YES	−
crid	Asian crisis dummies	−	NO	−	NO	−
cond	Capital controls dummy	+	NO	+/−	NO	+/−
pred	Previous crisis dummies	−	YES	−	NO	−
lfdi	Foreign direct investment	+	YES	+	NO	+
lexc	Exchange rate		YES	+	YES	+
li	Interest rate	−	YES	−	NO	+

Notes: This table presents the summary of results of the empirical tests. Hypotheses shown are based on the literature review. GDP and GPI results are from the findings section.

Table 12
Lag selection-order criteria tests for both South Korea and Malaysia.

Variable: ldebt; Sample: 1984–2014; *N*: 31								
Lag	LL	LR	dF	p	FPE	AIC	HQIC	SBIC
0	−36.2573				.659193	2.42112	2.4362	2.46737
1	20.4851	114.02	1	0	.017769	−1.19259	−1.16243	−1.10007
2	24.0514	7.1325*	1	.008	.015064*	−1.35815*	−1.31292*	−1.21938*
3	24.3726	.64244	1	.0423	.15752	−1.31436	−1.25405	−1.12933
4	24.4761	.20704	1	.649	.016713	−1.25652	−1.18113	−1.02524
Variable: lgdp; Sample: 1984–2014; *N*: 31								
Lag	LL	LR	dF	p	FPE	AIC	HQIC	SBIC
0	−35.1175				0.601883	2.33016	2.34512	2.37462
1	21.1224	112.48*	1	0	.017054*	−1.2337*	−1.20354*	−1.14119*
2	21.3553	0.46593	1	0.495	0.017926	−1.18421	−1.13898	−1.04544
3	22.3475	1.9844	1	0.159	0.01795	−1.18371	−1.1234	−0.998682
4	22.3843	0.07342	1	0.786	0.019128	−1.12157	−1.04617	−0.890277

Table 12 (*continued*)

Variable: ldebt; Sample: 1984–2014; *N*: 31								
Lag	LL	LR	dF	p	FPE	AIC	HQIC	SBIC
Variable: lgpi; Sample: 1984–2014; *N*: 31								
Lag	LL	LR	dF	p	FPE	AIC	HQIC	SBIC
0	−37.5948				.706193	2.48999	2.50507	2.53625
1	-.808627	73.572*	1	0	.070194	.181202*	.211359*	.273717*
2	-.494777	.6277	1	.428	.073402	.225469	.270706	.364242
3	1.09578	3.1811	1	.074	.070718	.187369	.247684	.3724
4	1.79969	1.4078	1	.235	.072182	.206472	.281866	.43776
Variable: lopen; Sample: 1984–2014; *N*: 31								
Lag	LL	LR	dF	p	FPE	AIC	HQIC	SBIC
0	.071459				.062166	.059906	.074985	.106164
1	32.3692	64.595*	1	0	.008254*	−1.9593*	−1.92914*	−1.86679*
2	32.3718	.00531	1	0.942	.008807	−1.89496	−1.84972	−1.75618
3	32.3847	.02585	1	0.872	.009394	−1.83127	−1.77096	−1.64624
4	32.9964	1.2234	1	0.269	.009646	−1.80622	−1.73083	−1.57493
Variable: lpfc; Sample: 1984–2014; *N*: 31								
Lag	LL	LR	dF	p	FPE	AIC	HQIC	SBIC
0	33.1607				.007352	−2.07488	−2.05981	−2.02863
1	48.4766	30.632	1	0	.00292	−2.99849	−2.96833	−2.90597
2	50.7475	4.5419*	1	.033	.002691	−3.08048	−3.03525	−2.94171*
3	52.1366	2.7781	1	.096	.002627	−3.10558	−3.04527	−2.92055
4	53.6996	3.126	1	.077	.002537*	−3.14191*	−3.06651*	−2.91062
Variable: lunemp; Sample: 1984–2014; *N*: 31								
Lag	LL	LR	dF	p	FPE	AIC	HQIC	SBIC
0	−3.34554				.077498	.280357	.295436	.326615
1	6.11248	18.916	1	0	.044913	-.265321	-.235164	-.172806
2	8.93762	5.6503*	1	.017	.039941*	-.383072*	-.337836*	-.2443*
3	9.05883	.24242	1	.0622	.042307	-.326376	-.266061	-.141346
4	9.06934	.02102	1	.885	.045158	-.262538	-.187411	-.03215
Variable: crid; Sample: 1984–2014; *N*: 31								
Lag	LL	LR	dF	p	FPE	AIC	HQIC	SBIC
0	−6.21115				.0923536	.465236	.480314	.511493
1	1.65766	15.738*	1	0	.059868	.022086	.052244*	.116402*
2	2.47232	1.6293	1	.202	.06014	.034044	.07928	.172817
3	3.85817	2.7717	1	.096	.59174	.099151	.069644	.194181
4	5.25725	2.7892	1	.095	.057767*	-.016307*	.059088	.214928

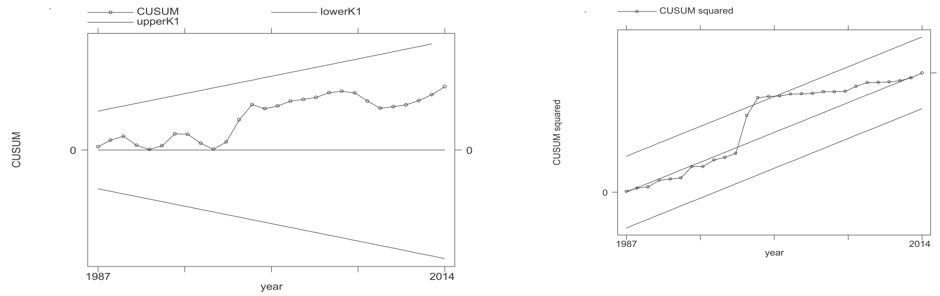
	lgdp	lgpi	ldebt	lopen	lfc	lunemp	crid	cond	pred
S KOREA									
AIC	1	1	2	1	2	3	1		
BIC	1	1	2	1	2	3	1		
MALAYSIA									
AIC	1	2	2	2	2	2	4	2	0
BIC	1	2	2	2	2	2	1	2	0

Note: The above tables denote results of various lag selection criteria. The chosen lags for Korea and Malaysia are tabulated in a summarized form in the last table.

Table 13
Summary of bound tests results

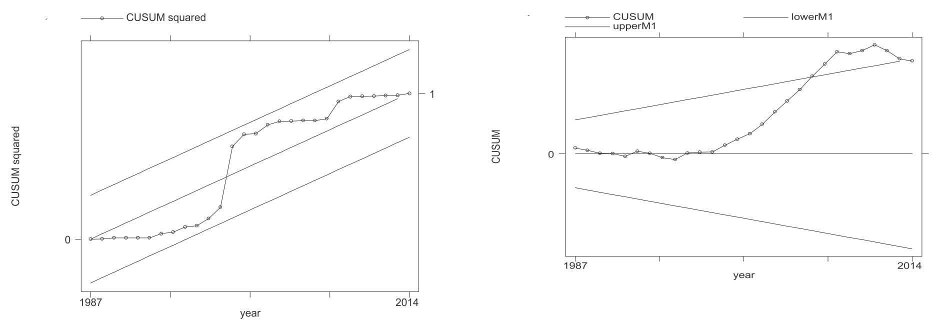
Country	Case	F-Stat	t-value	Critical Value	Reject Null?
Korea	GDP	8.090	−4.152	I(0): 2.96 I(1): 4.18	Yes
Korea	GPI	1.184	−0.820	I(0): 2.96 I(1): 4.18	No
Malaysia	GDP	0.724	−1.674	I(0): 2.96 I(1): 4.18	No
Malaysia	GPI	2.394	−2.992	I(0): 2.96 I(1): 4.18	No

Note: This table provides summary of bounds test results based on Pesaran et al. (2001)



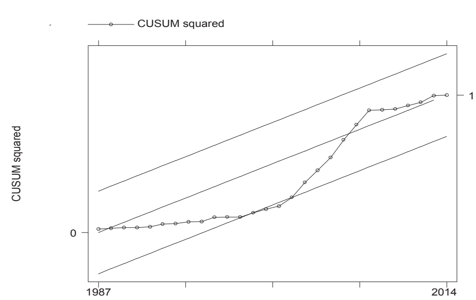
Notes: This figure shows CUSUM and CUSUMSQ graphs for Korea GDP to check the stability of the coefficients.

Fig. 4. CUSUM and CUSUMSQ graphs for Korea GDP.
Notes: This figure shows CUSUM and CUSUMSQ graphs for Korea GDP to check the stability of the coefficients.



Notes: This figure shows CUSUM and CUSUMSQ graphs for Korea GPI to check the stability of the coefficients.

Fig. 5. CUSUM and CUSUMSQ graphs for Korea GPI.
Notes: This figure shows CUSUM and CUSUMSQ graphs for Korea GPI to check the stability of the coefficients.



Notes: This figure shows CUSUM and CUSUMSQ graphs for Malaysia GDP to check the stability of the coefficients.

Fig. 6. CUSUMSQ graph for Malaysia GDP
Notes: This figure shows CUSUM and CUSUMSQ graphs for Malaysia GDP to check the stability of the coefficients.

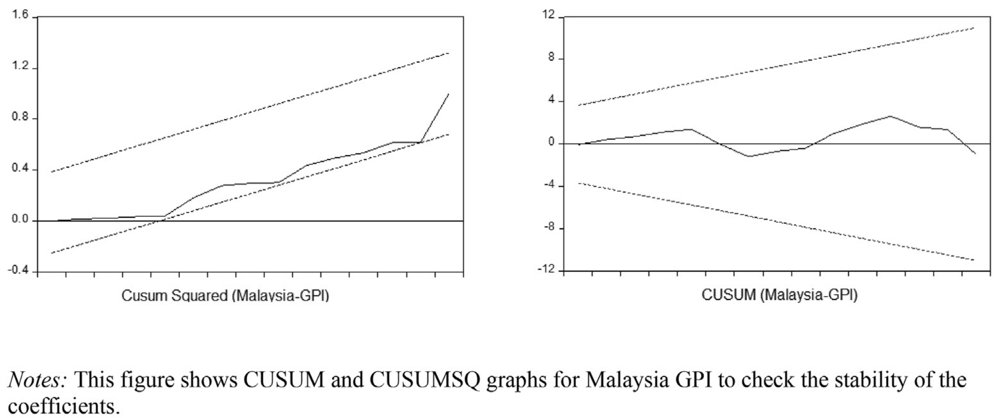


Fig. 7. CUSUM and CUSUMSQ graphs for Malaysia GPI.
Notes: This figure shows CUSUM and CUSUMSQ graphs for Malaysia GPI to check the stability of the coefficients.

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