Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 19 February 2018 doi:10.20944/preprints201802.0124.v1

Peer-reviewed version available at *Sustainability* **2018**, *10*, 909; doi:10.3390/su10040909

Article

Does Sustainability Matter for Corporate Performance and Economic Development? Based on the Asia Pacific and North America

Kyungbok Kim [1] , Sang-Myung Lee [2*],

[1] Department of Economics, Auburn University, Auburn, Alabama, 36849, USA; kzk0056@auburn.edu
[2] School of Business, Hanyang University, Seoul, 04763, South Korea
[*] Correspondence: sanglee@hanyang.ac.kr; Tel.: +82-2-2220-2594

Abstract: This paper explores how the sustainable investment impacts financial returns and economic development in of Asia Pacific and North America, utilizing real data empirically. In academia and industrial field, it is polemical that indeed, the sustainable behavior has economic returns. In order to clarify that, we tested hypotheses with an analysis of seven stock markets, accounting of rates such as ROI, ROIC, and ROA in eleven companies, and GDP/GNI per capita. The results indicate that both financial return and economic development are positively germane to the sustainable investment. Besides, the variance of sustainability to economic development exists, depending on GDP per capita between two regions. We conclude, concerning the sustainability, by corroborating micro perspective for corporate level and macro perspective of economic development in the private and public sector. This research consequence will be interested in both practitioners and researchers in the measurement of sustainability performance.

Keywords: sustainable investment, corporate performance, economic development, VAR, and VECM

1. Introduction

An issue of sustainability has emerged from several decades. The sustainable management matters because companies want to get competitive advantages over the future, using their resources efficiently in the saturated or competitive markets. A big reason why it was caused is due to the climate change. We trace back to why it became as an important agenda before we discuss concerning sustainable management. According to EPA(Environmental Protection Agency) 2016 report, it denotes that three cardinal factors, both natural and human, can cause the climate changes in earth's energy balance including; 1) variations in the sun's energy reaching earth; 2) changes in the reflectivity of earth's atmosphere and surface; 3) changes in the greenhouse effect, which affects the amount of heat, retained by earth's atmosphere. These three are authentic evidence from scientists. IPCC (2013) reports that they have pieced together a record of earth's climate, dating back hundreds of thousands of years and in some cases, millions or hundreds of million years, by analyzing a number of indirect measures of climate such as ice cores tree rings, glacier lengths, pollen remains, and ocean sediments, and by studying changes in earth's orbit around the sun.

© 2018 by the author(s). Distributed under a Creative Commons CC BY license.

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 19 February 2018 doi:10.20944/preprints201802.0124.v1

Peer-reviewed version available at Sustainability 2018, 10, 909; doi:10.3390/su10040909

Being following that everything is changing because of the climate change including technological development, everyone knows and recognizes that industrial revolution has destroyed the environment, even though our lives have been comfortable. UNEP FI [79] report says that the activities of the world's 3,000 biggest companies estimate on third of profits would be lost if firms were forced to pay for use, loss, and damage to the environment as well as world's top firms cause $2.15 trillion of environmental damage. As mentioned above, if many companies do not protect the environmental issues in which climate change, water scarcity, food security and deforestation have emerged, they are not able to obtain sustainable competitive advantages such as getting various scenarios for future. The corporate sustainability is becoming significant as mainstream for now and future's growth engine. In the theoretical and empirical research papers, it demonstrated that why companies do need the sustainable strategy because there was positive relationship between sustainable management and financial returns as evidence by [16,39,48,49,75].

Previously on literature review, measuring sustainability was like a conundrum because it has two characteristics. Firstly, the sustainability has a long term figure [16]. Measuring performance about sustainable activities needs many times with the precise data. It means previous works have not been timely and infelicitous. Sustainable performance is analogous to build up for enterprise strategies, forecasting multiple scenarios in the long-term period. For here, it is opaque that long-term cannot be calculated precisely. In the stock market, similarly, there is a calculation method for sustainable growth rates of companies using accounting of rates such as financial statements. Through various measuring tools like financial or predictive modeling based on demand forecast, we can figure it out. To differentiate the former works, this research analyzes the financial data and stock price of companies in comparison with sustainability index by time series method. Secondly, according to European Commission's report [22], it is murky that almost all sustainable assessment studies end up comparing different alternative scenarios with the evaluation trying to individuate which alternative way leads to a more sustainable development. It is very obscure to evaluate how much certain products, policy or institution can contribute to its fulfillment. Therefore, this paper shows empirical evidence, surmounting two characteristics as noted above. In order to do that, we explore the empirical data from a historical and authentic institution with industry issues. Plus, we reckon the analyses on as-is and future of the sustainability are crucial to overcoming its uncertainty by portraying prediction model.

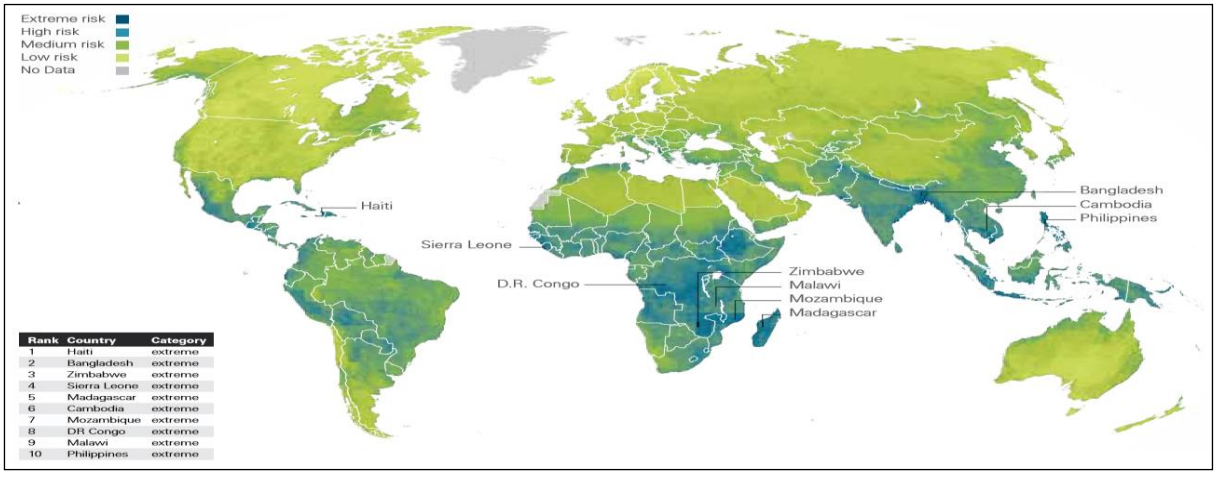


Figure 1. Climate change vulnerability index

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 19 February 2018 doi:10.20944/preprints201802.0124.v1

Peer-reviewed version available at Sustainability 2018, 10, 909; doi:10.3390/su10040909

Sources: KPMG US(2012) and Maplecroft(2012), The Climate Change and Environmental Risk Atlas. Available at http://maplecroft.com - Restructured

Figure 1 indicates vulnerability of climate change throughout the world. As elucidated about climate change, it is the global mega forces that impact all others such as water scarcity, energy and fuel, deforestation and ecosystem decline directly. Our paper focuses on North America and Asia Pacific region. There are two reasons why we picked. The first one is a deficiency of data for Africa where climate change is highly susceptible. The second one is that Asia Pacific is the second vulnerable region in climate change of sustainability. So this region will be compared by well-performed region such North America.

Our salient research question is how well companies operate sustainable management by climate change and why companies need the competitive advantage from it. Here we examine the empirical analysis that the relationship between investment in sustainability and economic and financial is inevitable regarding utilizing stock indices and DJSI, which is based on an analysis of corporate economic, environmental and social performance, assessing issues such as corporate governance, risk management, climate change mitigation, supply chain standards and labor practices by utilizing theories of investment, and development economics. The contribution of this paper is why many companies need the sustainable management like managerial implications by analyzing empirical data. We also show academic implications that the firm's capacity, having the sustainability and corporate performance, has the competitive advantages against no evidence between economic returns and sustainability.

2. A theoretical framework for the hypothesis

2.1. Definitions of Sustainability in previous literatures

With respect to the sustainability, people tend to think that sustainable management is an environmentalism. It, however, is the wrong assumption. Traditionally, it is not only the managerial influence on balance including economic, environmental and social issues but also the management technique with financial and non-financial performance such as total sales, net profit, and ethnic, environmental and social problems. That is what people call corporate social responsibility, ethnic or stakeholder management. In the former works about sustainable management, it has been denoted as eclectic definitions. For example, Dyllick and Hockerts [19] have declined corporate sustainability as: "meeting the needs of the firm's direct and indirect stakeholders(such as shareholders, employees, clients, pressure groups, communities, etc.,.) without compromising its ability to meet future stakeholders needs as well". Marrwijk [45] explained that corporate sustainability refers to "demonstrating the inclusion of social and environmental concerns in business operations and interactions with stakeholders". Like many others, these definitions build on stakeholder theory, which is one of the most widely applied theoretical frameworks for research on corporate sustainability written by [60].

Gray [26] states that sustainability is as the systems based conceptualize it as anything below planetary and species level. A simple assessment of the relationship between a single organization and planetary sustainability is virtually impossible [4]. Bradbury [8] defines that sustainability, the creation of "organizations that can sustain financial, human-social and environmental resources over the long-term" is becoming a critical area that warrants systematic investigation. Crowther and Aras [13] argue that

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 19 February 2018 doi:10.20944/preprints201802.0124.v1

Peer-reviewed version available at Sustainability 2018, 10, 909; doi:10.3390/su10040909

sustainability is based upon efficiency in the transformation process and equity in the distributive effects. The World Commission on Environment and Development have manifested the sustainability as the ability to "meet the needs of the present without compromising the ability of future generations to respond to their needs." In fact, being sustainable is now becoming a source of competitive advantage and a matter of corporate survival rather than a costly inconvenience. A process of sustainability facilitates to create a vibrant economy and a better quality of life while respecting the need to sustain natural resources and protect the environment. It can express as the principle that future generations should live in a world that the present generation has enjoyed but not diminished. To sum up, most of proposed definitions state that corporate sustainability subsumes the variety of aspects that need to be considered simultaneously and is often clustered into three main sub-groups; Environmental (E), Social (S), and Governance (G), like systematic concept, associating with the continuity of economic, social, institutional and environmental perspectives of human society [79]. Hence, in this paper, we define as the ESG that is a catch-all term for measuring corporate sustainability.

2.2. The Sustainability and Corporate Performance on Investment Theory

It is controversial that the relationship between financial or economic returns and sustainable behavior is positive or negative. There are several kinds of literature having no correlation between them. Margolis and Walsh [42], found no evidence that embracing sustainability increases profitability. The work of Palmer and Siebert suggested that as the environment and natural resources are the main production factors, imposing limitations on them will increase costs and limit the firm's ability to grow written by [69,74]. Hansen et al. [30] indicated that the relationship between a comprehensive set of social and environmental indicators and financial performance over the previous two years for 1,100 CEOs had no correlation between them. Neoclassical economists often base their arguments on the shareholder theory, stating that the only social responsibility of business is to increase profits and that doing otherwise, such as investing resources in costly sustainability initiatives, will necessarily reduce shareholder value by Friedman [23].

The most important thing is that people who are making the policies recognize sustainable management like environmentally utilizing resources is the nugatory investment since they think it is only for future, not in the present as well as not physical consequences immediately. There is the evidence that the Boston Consulting Group [10] had surveyed to 1,500 corporate executives and managers from companies individually throughout the world. It came up with the results that more than 70 percent of survey respondents showed their company had not developed a clear business case for sustainability and self-identified experts in sustainability believed more strongly in the importance of engaging with suppliers across the value chain. In addition to that, sixty-two percent of these respondents considered it necessary to hold providers to specific sustainability criteria. Of course, only this research does not mean why the sustainable management is significant in whole industries.

Albeit recent papers suggest that these kinds of sustainability investments can augment beneficial performance such as financial returns, other work continues to find a correlation between financial returns and investments in sustainability by Rebecca [55]. The management of sustainability performance requires a sound management framework which firstly links environmental and social management with the business, competitive strategy and management and, secondly, that integrates environmental and social information with economic business information and sustainability reporting written by Schaltegger and Wagner [61]. Galema, Plantinga, and Scholtens [24] corroborated a theory that socially responsible

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 19 February 2018 doi:10.20944/preprints201802.0124.v1

Peer-reviewed version available at Sustainability 2018, 10, 909; doi:10.3390/su10040909

investing influences on stock returns by lowering the book to market ratio and not by generating positive alphas. Research on corporate sustainability has shown deference to business orthodoxy as scholars strive to prove the business case for sustainability, and in doing so fit it into the dominant beliefs embedded within business literature by [2,32,46,59].

Fundamentally, we reckon that corporate performance comes from many and various factors. Among them, the overarching cause can be as the investments for accretion of firms through institutional investors. According to U.S. Securities and Exchange Commission, the growth in the proportion of assets managed by institutional investors has been accompanied by a dramatic increase in the market capitalization of U.S. listed companies. For example, in 1950, the combined market value of all stocks listed on the New York Stock Exchange (NYSE) was about $94 billion. By 2012, however, the domestic market capitalization of the NYSE was more than $14 trillion, an increase of nearly 1,500 %. This growth is even more impressive if you add the $4.5 trillion in market capitalization on the NASDAQ market, which did not exist until 1971. As mentioned for institutional investors above, why do they invest a lot of money to company's stock? The answer to a question is indubitable that they want to get money back as much as they invested and to obtain savings. Plus, in another aspect, many companies need the investments from them as well due to a reason why in general, the business expansion for the future accrues the competitive advantages of their own eventually. In the investment theory, there are two motivations for the investment. Goetzmann [27] addressed that motivation of the investment is the desire to increase wealth (i.e. make money grow). Another one is the desire to pass money from the present into the future. People and organizations anticipate future cash needs and expect that their earnings in the future will not meet those needs.

In order to prove the relation between sustainability investments and financial performance, we utilize ROI(Return On Investment), ROIC(Return On Invested Capital), and ROA(Return On Asset). These financial statements are the overarching factors to evaluate company's financial performance measures and investment returns. There is evidence that firms have begun to monitor and track some of these measures through internal cost-benefit analyses and activity-based costing [47,66]. Basically, ROI shows how companies invest efficiently, and the value of ROIC subsumes not only the firm earns the cost of capital but also how much they invest. ROA denotes how efficiently firm yields the income using its assets. We reckon that the firms, are with accounting rates of return such as ROA, ROI, and ROIC, have better performance than the firms that are not doing sustainability. In the previous work of accounting rates and sustainability, Robert et al. [56] corroborated that the performance between high sustainability companies and low sustainability companies was different in long-term by comparing samples of 180 US firms. The results showed that high sustainability companies were significantly outperformed over the long-term, using variables such as ROE, ROA, stakeholder engagement, the disclosure of nonfinancial information, and governance. In this work we concentrate on ROI, ROIC, and ROA, differentiating former works because they are reasonable when evaluating revenues based on an amount invested not a sales account. This point can reduce the distortion that an index like total sales has extensive benefit rates including ROA, ROE. In other words, if we use the ROIC in a company, we will see purely benefit rates based on how much we invest.

In this regard, becoming that the environmental investment is significant, this sector requires a lot of money because we are not able to ameliorate better environment developing economic status without it. According to World Bank report [80], it turned out that the total projected energy sector investment requirements for the region over the next 20–25 years are enormous. They amount to about $3.3 trillion (in 2008 dollars), some 3 percent of accumulated GDP during that period. As mentioned above, previous

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 19 February 2018 doi:10.20944/preprints201802.0124.v1

Peer-reviewed version available at Sustainability 2018, 10, 909; doi:10.3390/su10040909

research for the relation between financial returns and the sustainability has been corroborated positively although there was an argument in which several types of research showed no evidence and findings. What we are going to underline is to find their causality, but not a correlation between them. Corporate investment in the sustainability is to determine valuable values for the future's competitive advantages as well as by augmenting the present value of a company such as economic benefits; financial performance will be increased. Accordingly, we hypothesize the positive causality between stock investment and sustainability:

Hypothesis 1: The causality between the sustainability and financial returns will be positively associated with firm's present and future values.

Hypothesis 1-1: Major capital flows of a stock market in both North America and Asia Pacific area will have a positive relationship with sustainable investment.

Hypothesis 1-2: Firm's stock prices, which are on sustainable management in both North America and Asia Pacific area will be positively associated with the sustainable investment.

Hypothesis 1-3: Firm's accounting of rates with ROI, ROIC, and ROA will be positively associated with sustainability investments.

2.3. Regional Differences of Sustainability Performance on Economic Development Theory

The prominent norm of the sustainability performance among countries depends on two situations at which we focused on our paper, even though there are many standards to appraise the sustainability performance. The first one is how much the money has been invested in the industries of its country. Another one is how well the countries have been burgeoned economically, purporting that ESG (Environment, Social, and Governance) is embraced. Asia is not only to be faced with the environmental problems of air pollution, water management, and land degradation but also to have wicked problems meaning there are many brittle nature circumstances. In the last decades, East Asia-Pacific such as China has been burgeoned even though there have been precarious situations economically. Coxhead [14] verified the analysis on the features of the relationship between economic growth and environmental resources in different parts of the region. Zhang [77] contemplated environmental degradation due to burgeoning energy demand across Asia and recommended several policies to address the increasing prominence of this issue as economic expansion continues. There is the other research concerning the relevance of the regional economy and environmental issues.

Bawa et al. [7] explored the competitive use of resources by India and the PRC, the need for inter-state cooperation over environmental issues, and the impact of these major players in the broader region. In figure 2, what they have in common is that the each rate of greenhouse gases, water abstraction, and pollutants in Asia takes possession that is the most substantial proportion in these charts. Especially East-Asia has been in high economic growth rate throughout the world from 2006 to now as well as a lot of environmental capital is flowing in. There is evidence that in 2014 notably, buyout-backed exists in Asia-Pacific markets shot up to nearly $53 billion, a 120% increase by [6].

In all, Asia-Pacific exits topped $105 billion meaning that this percentage is the largest figure compared by North America (34%) and Europe (50%). Figure 2 shows us that in environmental problems such as

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 19 February 2018 doi:10.20944/preprints201802.0124.v1

Peer-reviewed version available at Sustainability 2018, 10, 909; doi:10.3390/su10040909

greenhouse gas, water abstraction, and pollutants, both Asia and North America have huge proportion. Why do two regions have environmentally maladies? Estimating differences in economic growth rates, population, and GDP indicates that how well each nation experiences the economic development. This paper concentrates on the role of sustainability, generating that regional disparity exists in economic development.

What is the development? There are a lot of definition about it, but we make it simple using Sumner and Tribe's [72] words. They defined as three categories; 1) short to medium term outcome of attractive targets, 2) long-term process of structural societal transformation, 3) a dominant discourse of western modernity. The development we referred to the literature review above looks analogous with the sustainability as we discussed in the previous section. Yes, this point we assume is the final goal for our research which means the sustainability has the tremendous importance of economic development. To do that, we need to look for its attributes like what factors are germane to causality between them. Albeit there is a difference depending on the subject of pioneering researchers such as Smith, Marx, Schumpeter, Lewis, and Rostow in many former types of research for the economic development, we found the properties approaching the theory of economic development in Table 1. Our research, however, underscores whole theories regardless of that each time in development economics has leading models. What it means that even if we utilize the prevailing theory in advanced sequences, new growth theories have been failed with the method of coordination such as government intervention and underdevelopment.

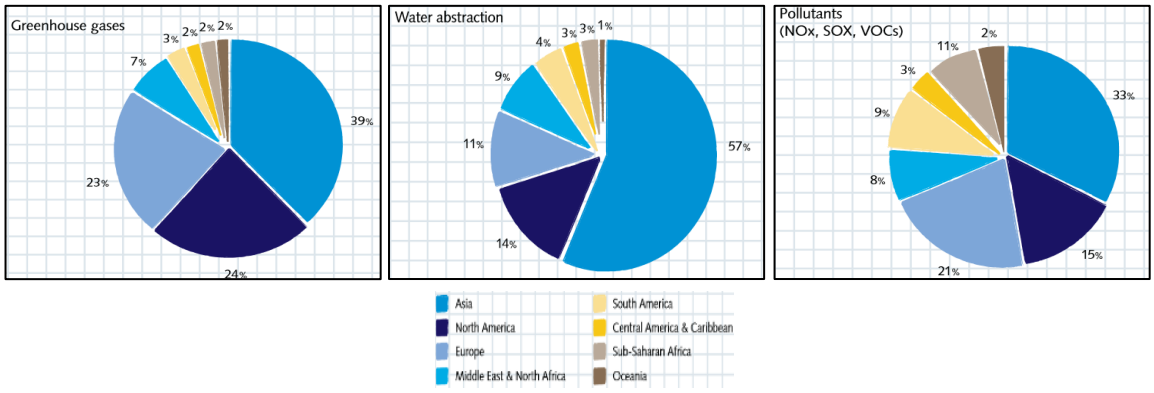


Figure 2. Regional Rate of Environmental Issues
Sources: ISSP Insight (2013)

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 19 February 2018 doi:10.20944/preprints201802.0124.v1

Peer-reviewed version available at Sustainability 2018, 10, 909; doi:10.3390/su10040909

Table1. The evolution of development economics

By time	Main Key Words and Models(Theories)	Researchers
Early Views	▪ Capitalism; free trade, private property and competition	Smith [71]
	▪ Communism; social or public ownership of property, and independence of foreign capital and goods	Marx [43]
	▪ Technology; business cycles, innovation, socialism	Schumpeter [70]
Classical Theories	▪ Linear Stage Growth Model	Rostow [58], Harrod [29], Domar [18]
	▪ Structural Change Model	Lewis [50], Chenery [12]
	▪ International Dependence Model	Singer [65], Baran [9]
	▪ Neoclassical Counter Revolution Model	Stiglitz [68]
Contemporary Theories	▪ New Growth Model; knowledge, role of public sector and investment	Aghion [3], Sen [63]

The goal of economic development in its simplest form is to improve the quality of life and to be sustainable development as well as the most significant thing is to bring about the growth such as gross income per capita. Before the 1970s, rapid economic growth has been considered a good proxy for other attributes of development [76]. There are many ways to evaluate the economic development. In our paper, we concentrate on GNP and GDP which have properties to elucidate the importance of sustainability and economic development empirically. Giang and Sui [25] demonstrated that financial performance is measured by an annual increase in gross national product (GNP) and World Bank estimates it as GNI per capita. Also, Caroll and Stanfiled [11] utilized the factor like stock price and GDP substantiating that regional development design generates sustainable economic development. In comparison with previous research, there was no multi-faceted sustainability performance regionally and empirically while what we distinguish is by two instructions using both stock prices into local investment and GNP/GDP. In summary, regional difference and the link between sustainability and economic development leads directly to our second hypothesis:

Hypothesis 2: The sustainability will exist the regional differences of economic development between Asia-Pacific and North America.

Hypothesis 2-1: The gross national income (GNI) and gross domestic product (GDP) that are overarching factors for economic development will be positively associated with sustainability investment in each region.

Hypothesis 2-2: Each region between Asia-Pacific and North America will have the different level of variance for sustainability's index.

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 19 February 2018 doi:10.20944/preprints201802.0124.v1

Peer-reviewed version available at Sustainability 2018, 10, 909; doi:10.3390/su10040909

3. METHODS

VAR Properties. Our goal is to figure out for the causality among the sustainability performance, financial returns, and economic development. To do this, we require using VAR (Vector Autoregressive), model. In the former researches, it has been utilized for analyses such as financial data, stock prices/returns, and money supply by [40,51,52,]. The VAR model in economics has made popular by Sims [64]. Especially it is proven to be useful for describing the dynamic behaviors of economics and financial time series and for forecasting as well as it has been known as the model from univariate autoregressive to multivariate autoregressive frequently using for projection and efficiency analysis by the change of endogenous variables. Zivot and Wang [78] indicated that the VAR model is used for structural inference and policy analysis. In structural analysis, certain assumptions about the causal structure of the data under investigation are imposed, and the resulting causal impacts of unexpected shocks or innovations to specified variables on the variables in the model are summarized. Utilizing VAR model that a change of any one variable can be determined by an endogenous variable in the dynamic response, our goal concentrates on the causality, not a correlation between investing sustainability and financial returns.

Table 2. How to operate time series model

Div.	***Univariate***	***Multivariate***
Stationary	ARMA Model	VAR Model (Vector Autoregressive)
Non-Stationary	Unit Root Test	VECM (Vector Error Correction Model)

There is a difference about between time-series and cross-sectional data. Based on the stationarity of variable, time series analysis satisfies its assumption and has the efficiency. When their variables have non-stationarity, they have to be eradicated for detrending before estimating a specific VAR model. The first thing we do is to employ the Augmented Dickey-Fuller (ADF) and Phillips-Person (PP) unit root tests for the multivariate approach of Johansen and Juselius [35]. After ADF test, if the variable is non-stationary, we have to treat the first difference of variable indicating that non-stationary variable modifies into being stationary. Then, given nature of results, we can make a decision selecting the lag length. As denoted in Table 2, our paper is embraced in ‘multivariate’ analyzing our hypotheses by VAR and VECM. Why we choose this VAR model is that first, it is lucid the impulse response analysis attests a change of one variable in endogenous variable influencing dynamic effects. Secondly, through the variance decomposition, we can analyze the size of the contribution of these variables to the total variation in each endogenous variation. What it means is that VAR does not settle on the hypothesis by economic theory but analyzes real economy using given economic time series. In other words, it makes systematic outputs utilizing parallax variable like an explanatory variable to all variables.

Table 3. Independent Variables for Hypothesis

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 19 February 2018 doi:10.20944/preprints201802.0124.v1

Peer-reviewed version available at *Sustainability* **2018**, *10*, 909; doi:10.3390/su10040909

Part	Region	Independent Variables	
Hypothesis 1	Asia Pacific	▪ Nikkei 225 (NK) ▪ KOSPI (KP) ▪ Hong Kong Hangsen (HKH)	▪ Shanghai Shenzhen (SS) ▪ AUS 200 (AUS)
	North America	▪ NASDAQ (ND)	▪ S&P 500 Total Revenue (SP)
	Asia Pacific (Each company's Stock Price, ROI, ROE, and ROIC)	▪ Samsung Electronics (SE) ▪ Seven and Holdings (SH) ▪ Toyota Motors (TM)	▪ NTT Docomo (NTD) ▪ West Banking (WB) ▪ Astellas Pharma (AP)
	North America (Each company's Stock Price, ROI, ROE, and ROIC)	▪ Apple Inc. (AI) ▪ Exxon Mobil (EM) ▪ Johnson and Johnson (JJ)	▪ Pepsi Co. Inc. (PCI) ▪ Verizon (VZ)
Hypothesis 2	Asia Pacific and North America	▪ Gross National Income per capita ▪ Gross Domestic Product per capita	
Dummy Variables		▪ Great Recession (2008 and 2009) ▪ Population by each region	

* Sources: World Bank, APEC, Federal Reserve Bank of St. Louis, Each company's stock by searching
* Period: Hypothesis 1 (2010-01-04 through 2015-12-07),
Hypothesis 2 (1998-01-04 through 2016 of GDP (Quarterly) and GNI (Quarterly/Annually) by each region)
* Dependent Variables: Dow Jones Sustainability Index by each region

Modeling and Data. In order to clarify the relationship between sustainability performance, financial returns, and economic development, we have garnered the variables such as the data of stock market regionally, each firm's stock price, macro economy factors. Many types of research have demonstrated the relation among stock market, stock returns, and specific economic variables by [5,17,31,38,41,73]. This paper has difference contributions in comparison with them. First, it extends regional stock markets in Asia-Pacific and North America including a particular topic, the sustainability performance empirically. The only conceptual 'buildup' was operated a lot because it is demanding to gather real data as well as the hardship exists to measure quantitatively. Hence, we settle on a variable of sustainability performance by DJSI (Dow Jones Sustainability Index) which is factual data. Its conceptual definition is analogous to what we define in Section 2.1.

In comparison with previous works, which is based on empirical methodology, our work differentiates approaching macro and micro perspectives by using representative stock indices in Asia and North America as well as individual firm's stock prices. How we proceed 'the step by step' for hypothesis 1 is through two approaches; 1) selecting capital flows of major stock markets such as Nikkei 225, Shanghai-Shenzhen, KOSPI, AUS 200, and Hong Kong Hansen of Asia-Pacific and NASDAQ, S&P 500 of North America

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 19 February 2018 doi:10.20944/preprints201802.0124.v1

Peer-reviewed version available at *Sustainability* **2018**, *10*, 909; doi:10.3390/su10040909

respectively. These are all responsible for handling and organizing the investment in each region; 2) constituting stock prices of top 5 sustainability companies of DJSI regionally; 3) using the variables of accounting of rates such as ROI, ROIC, and ROA from a financial corporation, 'Five Tree.' Hypothesis 2 portrays the causality between sustainability performance and economic development by GDP per capita and GNI per capita. To avert the multicollinearity, it requires other variables because depending on the population, especially the values of GDP and GNI can be a discrepancy in which two predictors in multiple regression models are highly correlated indicating that one variable may be linearly predicted from the others with an equivalent degree of accuracy. We focus on GNI and GDP as mentioned in theory building of the last section, albeit macro economy has many indicators like money supply, CPI, and un/employment. The time setting for hypothesis 2 is from 1998 to 2016 because economic development is not 'fleeting innovation,' while hypothesis 1 which is germane to the sustainability settles on 2010 through 2016. Plus, all variables were modified to logarithms to set up the normal distribution at which regression equation is stable.

When the time series variables have stationarity, the first model of time series we can consider is the ARIMA. However, that has the limited option in which they utilize only the information related to their past. In order generally to observe the relationship between each variable, ARIMA model has some limitations that do not consider with additional information such as factors. Therefore, we need to add the other variables influencing on the dependent variable. By adding vectors, AR model treats scalar variable, while VAR model deals with a vector which means dependent and explanatory variable. Hypothesis 1 construes the causality between sustainability performance and economic value, especially financial returns. To do so, we use the VAR basic model in (1) as below,

$$Y_t = \phi_1 y_{t-1} + \phi_2 y_{t-2} + \ldots + \phi_p y_{t-p} + e_t, \quad e_t \sim \text{i.i.d. } (0, \Omega) \tag{1}$$

$$\text{Only, } Y_t = \begin{bmatrix} Y_{1,t} \\ Y_{2,t} \end{bmatrix}, \quad \phi_1 = \begin{bmatrix} \phi_{11} & \phi_{12} \\ \phi_{21} & \phi_{22} \end{bmatrix}, \quad e_t = \begin{bmatrix} e_{1t} \\ e_{2t} \end{bmatrix}$$

For here, $Y_t = (Y_{1t}. .Y_{2t}. .Y_{kt})$ constitutes the vector, some "k" endogenous variable of analysis target. If we use VAR model, it is possible to consider how other variables affect our objective variable, Y_t. All time series variables should accord with stationarity so then they forestall the significance of endogenous variables to diverge. If our variables have unsated stationary time series, we modify to VECM (Vector Error Correction Model), in (1) following that to estimate co-integration relationship, the stationarity satisfies to add lagged variables, Z_{t-1}.

$$Y_t = \gamma z_{t-1} + \phi_1 y_{t-1} + \phi_2 y_{t-2} + \ldots + \phi_p y_{t-p} + e_t, \quad e_t \sim \text{i.i.d. } (0, \Omega) \tag{2}$$

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 19 February 2018 doi:10.20944/preprints201802.0124.v1

Peer-reviewed version available at Sustainability 2018, 10, 909; doi:10.3390/su10040909

$$\text{Only, } Y_t = \begin{bmatrix} Y_{1,t} \\ Y_{2,t} \end{bmatrix}, \quad \phi_1 = \begin{bmatrix} \phi_{11} & \phi_{12} \\ \phi_{21} & \phi_{22} \end{bmatrix}, \quad e_t = \begin{bmatrix} e_{1t} \\ e_{2t} \end{bmatrix},$$

$$\gamma = \begin{bmatrix} \gamma_1 \\ \gamma_2 \end{bmatrix}, \quad Z_{t-1} = Y_{1,t} - \alpha Y_{2,t}$$

It is possible that VAR analysis can be applied for dummy variables [54]. We define the dummy variable as zero and one (0, 1). When the GNI and GDP have the over value compared to an average value in each time, the value is one, 1. Otherwise, zero, 0. As mentioned in Figure 4, we set another dummy variable such as GR (Great Recession) from 2008 to 2009 as their variables need to get the shock mitigation not influencing on the other variables.

Preliminary Analysis: ADF and KPSS Test. In order to verify the stationarity of VAR model, we employ the ADF and KPSS analysis of unit root test individually. The estimation of ADF test is in (3), and a null hypothesis is H_0 : π =0. We assume that if a null hypothesis cannot reject, the unit root exists.

$$Y_t = \beta_1 + \beta_2 t + \pi y_{t-1} + \sum_{j=1}^{K} \gamma_j y_{t-j} + e_t \quad (3)$$

Showing the consequences of ADF and KPSS test in Figure 6, we reject a null hypothesis meaning that unit root exists. However, after first difference in KPSS test, all variables have the stationarity. In this regard, Eagle and Granger [21] substantiated that even if there is the change of trend in individual economic time series to abnormal set (or unstable) and if the linear combination having stationary time series in the long term exists, the linear combination becomes stationary time series variable. In other words, these time series variables are in a co-integrating relationship. However, it has the deficiency when the co-integrating vector is two more or over. So Johansen [36] found that when variables are non-stationary, it is possible to modify the alternatives such as vector error correction model (VECM) after performing the co-integration test. As we settle on not only a standard of time series analysis in Figure 4, but also literature review as mentioned above, the remainder of variables is operated by vector error correction model (VECM) except for log(ND), log(NTD), and log(AP_GDP). To lay the groundwork for VECM, we operate the co-integration test such as Johansen test before (See Appendix).

Table 4. Values of ADF and KPSS Test

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 19 February 2018 doi:10.20944/preprints201802.0124.v1

Peer-reviewed version available at *Sustainability* **2018**, *10*, 909; doi:10.3390/su10040909

Variables (Log values)	Lag	ADF Test (Asymptotic p-value)	KPSS Test (After first difference)
DJSI_APTR	3	0.2663	0.0494***
SP	6	0.3586	0.0432***
DJSI_NATR	6	0.1252	0.0350***
ND	6	**0.0966***	0.0338***
AUS	9	0.5919	0.0838***
HKH	3	0.1626	0.0311***
NK	5	0.3870	0.1812***
SS	5	0.7615	0.1820***
KP	8	0.1152	0.0678***
AI	3	0.6133	0.1854***
AI ROA	2	0.7854	0.11451**
AI ROI	2	0.7706	0.11873**
AI ROIC	2	0.9916	0.1919
JJ	3	0.5118	0.1097***
JJ ROA	2	0.5263	0.1013**
JJ ROI	2	0.474	0.09113*
JJ ROIC	2	0.1413	0.1890***
EM	6	0.8878	0.1602***
EM ROA	2	0.9938	0.3328
EM ROI	2	0.9945	0.3225
EM ROIC	2	0.9454	0.2564***
PCI	6	0.2567	0.0381***
PCI ROA	2	0.6134	0.18212***
PCI ROI	2	0.947	0.25858***
PCI ROIC	2	0.7627	0.0936***
VZ	3	0.8888	0.1000***
VZ ROA	2	0.7322	0.138304***
VZ ROI	2	0.9056	0.1712***
VZ ROIC	2	0.8623	0.13447***
SE	3	0.7589	0.1226***
SE ROA	2	**0.02****	0.08427*
SE ROI	2	0.1636	0.0761*
SE ROIC	2	0.639	0.10265
TM	3	0.9647	0.3699*
TM ROA	2	0.789	0.090*
TM ROI	2	0.6846	0.0941
TM ROIC	2	0.7539	0.09741*
NTD	2	**0.1000***	0.2121***
NTD ROA	2	**0.04274****	0.0861*
NTD ROI	2	**0.03814****	0.0875*
NTD ROIC	2	0.1558	0.07932*
AP	3	0.1404	0.1549***
AP ROA	2	0.3804	0.08343
AP ROI	2	0.3528	0.0713*
AP ROIC	2	0.669	0.103959
SH	3	0.9455	0.1719***
SH ROA	2	0.2475	0.06941*
SH ROI	2	0.3069	0.0845*
SH ROIC	2	0.543	0.06347*
WB	6	0.7358	0.0794***
WB ROA	2	**0.06568***	0.0970*
WB ROI	2	0.07466*	0.0971*

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 19 February 2018 doi:10.20944/preprints201802.0124.v1

Peer-reviewed version available at Sustainability 2018, 10, 909; doi:10.3390/su10040909

WB ROIC	1	0.443	0.07282*
AP_GDP	7	**0.0044*** **	0.0451***
AP_GNI	1	N/A	0.3200***
NA_GDP	3	0.3293	0.3134*
NA_GNI	2	0.3371	0.2382***

※ KPSS Test: Critical Values: *p < 10%, **p < 5%, and ***p < 1%, depending on how much variables have the samples

4. Results

According to the result of hypothesis 1-1, using VECM in daily data from 2010 to 2015, the sustainability performance in Asia Pacific is positively associated with Asia major stock markets such as AUS (<0.00001), SS (0.07), KP (0.007) in Table 5. The rest, NK, and HKH, however, are not significant with sustainability total returns. A determinant of variable stationarity, eigenvectors are 0.05, 0.03, 0.02, 0.01, 0.008, and 0.005 indicating that they are stationary, less than one, '1'(See the Appendix). In North America, the consequences of VECM show that ND and SP have highly strong relation with sustainability performance. Albeit many companies are registered in ND and SP respectively, they are pertinent to the investment and financial returns like economic values. That is a crucial reason why this research determines vector autoregressive analysis instead of correlation between them. Their eigenvectors are stationary. In other words, this VECM is stable.

Table 5. Results of Hypothesis 1-1 in Asia Pacific

Equation: DJSI_AP__TR

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	-0.25828	0.0501213	-5.1531	<0.00001	***
d_DJSI_AP__TR_1	-0.376414	0.0878289	-4.2858	0.00002	***
d_DJSI_AP__TR_2	-0.279773	0.10485	-2.6683	0.00771	***
AUS	0.0425609	0.00946702	4.4957	<0.00001	***
HKH	-0.00243169	0.00564701	-0.4306	0.66681	
NK	6.69217e-05	0.00252908	0.0265	0.97889	
SS	-0.00166616	0.000929865	-1.7918	0.07336	*
KP	0.0173326	0.00646122	2.6826	0.00739	***

*p < 10%, **p < 5%, and ***p < 1%

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 19 February 2018 doi:10.20944/preprints201802.0124.v1

Peer-reviewed version available at Sustainability 2018, 10, 909; doi:10.3390/su10040909

Table 6. Results of Hypothesis 1-1 in North America

Equation : NASDAQ

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	0.102927	0.0309391	3.3267	0.00090	***
d_NASDAQ_1	-0.00147645	0.0891948	-0.0166	0.98680	
d_NASDAQ_2	-0.000152853	0.0891785	-0.0017	0.99863	
d_NASDAQ_3	-0.19826	0.089072	-2.2258	0.02618	**
DJSI_NA__TR	0.091003	0.0286718	3.1740	0.00153	***
EC1	-0.0259547	0.00911177	-2.8485	0.00445	***

Equation : S_P_500__Net_TR_

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	0.0943388	0.0277548	3.3990	0.00069	***
d_NASDAQ_1	0.0152236	0.0800145	0.1903	0.84913	
d_NASDAQ_2	0.0212452	0.0799999	0.2656	0.79061	
DJSI_NA__TR	0.0830494	0.0257208	3.2289	0.00127	***
EC1	-0.022194	0.00817395	-2.7152	0.00670	***

*p < 10%, **p < 5%, and ***p < 1%

In order to verify the relation between sustainability performance and financial returns, we estimate the causality with specific variables for hypothesis 1-2. Table 7 and 8 present that the most of top 5 companies, which have the efflorescence on sustainability in each region, are germane to financial returns. Of course, statistically several companies such as SE, TM, SH, and WB in Asia Pacific, also for AI, JJ, and VZ in North America, are not significant but as seen in Table 9, AP, TM, SH, and WB are all significant with sustainability total returns after individual VECM analysis by putting them to endogenous variables. That is because, in one of the properties in VAR, it is not necessary to worry which variable is the endogenous variable and which is the exogenous variable [37]. The remainders of independent variables, AI, JJ, and VZ do not have the significance against sustainability total returns after even analyzing individual VECM. For here, there is an implication that we need to categorize by industry and then to figure out for why these companies have the significance through an in-depth case study.

Causalities among the variables are shown in Table 10. The hypothesis 1-3 is substantiated. In North America and Asia Pacific area, the financial earns of investment are germane to sustainable management in their firms. All p-values in ROI, ROIC, and ROA are significant. Besides, adjusted R-squared values meaning explanatory power between variables are high in Asia Pacific area especially. As mentioned for using ROI and ROIC, these results indicate that there are causalities

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 19 February 2018 doi:10.20944/preprints201802.0124.v1

Peer-reviewed version available at Sustainability 2018, 10, 909; doi:10.3390/su10040909

between the efficiency of investment and sustainable management. It assumes carefully that high sustainable management will be outperformed in comparison with not doing sustainable management. We accentuate that sustainable management encompasses all of the corporate processes. To preserve the environment, the firms have not only to develop technologies using their core competencies but also to take the contribution to society; they try to solve the poverty as volunteers, donating one part of their revenues. Plus, by taking organizational governance, the firms let investors know that a company uses accurate and transparent accounting methodologies, and also they help them to see that common stockholders are allowed to vote on significant issues.

Table 7. Results of Hypothesis 1-2 in Asia Pacific

Equation : DJSI_AP__TR

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	0.0276998	0.0343111	0.8073	0.41964	
d_DJSI_AP__TR_1	-0.250126	0.0302913	-8.2574	<0.00001	***
d_DJSI_AP__TR_2	-0.132501	0.0305765	-4.3334	0.00002	***
d_DJSI_AP__TR_3	-0.0682469	0.0297634	-2.2930	0.02202	**
SE	-0.00121541	0.00260241	-0.4670	0.64056	
TM	0.000247451	0.0031117	0.0795	0.93663	
NTD	-0.00590851	0.00271244	-2.1783	0.02957	**
AP	0.00485957	0.00272154	1.7856	0.07441	*
SH	-0.00150992	0.00397724	-0.3796	0.70428	
WB	-0.00364771	0.00490616	-0.7435	0.45732	
EC1	-0.0208552	0.00873587	-2.3873	0.01712	**

*p < 10%, **p < 5%, and ***p < 1%

Table 8. VECM Results of Hypothesis 1-2 in North America

Equation: DJSI_NA__TR

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	0.0439565	0.0225431	1.9499	0.05138	*
d_DJSI_NA__TR_1	-0.372026	0.0745782	-4.9884	<0.00001	***
d_DJSI_NA__TR_2	-0.365586	0.0923568	-3.9584	0.00008	***
d_DJSI_NA__TR_3	-0.372294	0.0961928	-3.8703	0.00011	***
d_DJSI_NA__TR_4	-0.312382	0.0917764	-3.4037	0.00068	***

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 19 February 2018 doi:10.20944/preprints201802.0124.v1

Peer-reviewed version available at Sustainability 2018, 10, 909; doi:10.3390/su10040909

d_DJSI_NA__TR_5	-0.23167	0.0740189	-3.1299	0.00178	***
AI	-0.00078442	0.000748456	-1.0481	0.29479	
JJ	0.00493479	0.00543489	0.9080	0.36403	
EM	0.0136437	0.00481917	2.8311	0.00470	***
PCI	0.0149709	0.00827384	1.8094	0.07059	*
VZ	-0.00567402	0.00517378	-1.0967	0.27296	
EC1	-0.102535	0.0184821	-5.5478	<0.00001	***

*p < 10%, **p < 5%, and ***p < 1%

Table 9. Results of Hypothesis 1-2 in Asia Pacific

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
AP and DJSI_AP__TR_3	0.275416	0.123704	2.226	0.0262	**
TM and DJSI_AP__TR_3	0.318044	0.184161	1.727	0.0844	*
DJSI_AP__TR_4	0.327980	0.154622	2.121	0.0341	**
SH and DJSI_AP__TR_2	-0.314653	0.178842	-1.759	0.0788	*
WB and DJSI_AP__TR_1	-0.204422	0.119337	-1.713	0.0870	*
DJSI_AP__TR_3	-0.299495	0.135512	-2.210	0.0273	**
DJSI_AP__TR_4	-0.200700	0.113776	-1.764	0.0780	*

*p < 10%, **p < 5%, and ***p < 1%

Table 10. Results of Hypothesis 1-3 in North America and Asia Pacific

	Accounting of Rates	*Adjusted R-squared*	*F-value*	*Sum squared resid*	*p-value(F)*	
North America	ROI	0.436652	2.660931	0.421648	0.09	*
	ROIC	0.400598	2.432132	0.448633	0.1	*
	ROA	0.477294	2.956687	0.391229	0.07	*
Asia Pacific	ROI	0.832195	10.29866	0.065429	0.002	***
	ROIC	0.764873	7.099418	0.091679	0.008	***
	ROA	0.843936	11.13932	0.060851	0.002	***

*p < 10%, **p < 5%, and ***p < 1%

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 19 February 2018 doi:10.20944/preprints201802.0124.v1

Peer-reviewed version available at Sustainability 2018, 10, 909; doi:10.3390/su10040909

As a long literature has suggested for the relation between macro-economy variables and economic growth, our paper has the characteristics analyzing real and authentic data of sustainability, firm's accounting of rates, and macro- economy variable like GDP per capita and GNI per capita. As a result, Table 11 shows that it is manifest that GDP(0.05915) and GNI (0.03319) are significant with the sustainability total returns in Asia Pacific as well as eigenvalues are stationary, less than '1'(See Appendix). North America's consequences of GDP and GNI against the sustainability are 0.00088 and 0.0285 respectively.

To test hypothesis 2-2, we use forecast error variance decomposition. The difference between regions exists precisely. Asia Pacific, for example, has the proportion that after the 15th quarters, sustainability variance explains 65.59%. Meanwhile, GDP and the population of variance contribute to sustainability with 9.86% and 24.55% respectively while in North America, sustainability variance expounds on 51.03% and the rest variances account for GDP 24.68% and population 2.56%. Table 13 denotes these results. Depending on that the quarters, we know how the values of indicators like sustainability and GDP can be predicted. The findings for hypothesis 2-2, then provide, not vague explanations, support for an idea that why the sustainability in Asia Pacific area has the importance for future because it would be the overarching factor for near future. In summary, the results are consistent with the hypotheses developed above. We know the ramification that how the impact of the sustainability to financial returns and economic development influences on several industries.

Table 11. Results of Hypothesis 2-1, GDP and GNI per capita in Asia Pacific

VECM

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	0.106917	0.133464	0.8011	0.42680	
Population_log__1	0.054724	0.0266501	2.0534	0.04518	**
Population_log__2	0.0501459	0.0266954	1.8784	0.06604	*
AP_Sustainability_7	-0.226886	0.132538	-1.7119	0.09300	*
AP_GDP_	0.034562	0.017906	1.9302	0.05915	*
EC1	-0.0334078	0.0264163	-1.2647	0.21174	

*p < 10%, **p < 5%, and ***p < 1%

ARIMA

	Coefficient	*Std. Error*	*z*	*p-value*	
Const	18.5077	5.19202	3.5646	0.00036	***
phi_1	-0.11305	0.251165	-0.4501	0.65264	
theta_1	1	0.309313	3.2330	0.00123	***
AP_Sustainability	2.29636	1.07819	2.1298	0.03319	**

*p < 10%, **p < 5%, and ***p < 1%

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 19 February 2018 doi:10.20944/preprints201802.0124.v1

Peer-reviewed version available at Sustainability 2018, 10, 909; doi:10.3390/su10040909

Table 12. Results of Hypothesis 2-1, GDP and GNI per capita in North America

Equation : GDP

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
Const	0.00708408	0.00173884	4.0740	0.00015	***
NA GNI	0.379953	0.139819	2.7175	0.00878	***
NA Sustainability	0.0275953	0.0078443	3.5179	0.00088	***
Population	-0.0024001	0.00136396	-1.7597	0.08403	*
GR	-0.00782993	0.00291081	-2.6900	0.00944	***

Equation : GNI

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
Const	0.00431492	0.00212025	2.0351	0.04667	**
NA GDP	0.377127	0.187582	2.0105	0.04930	**
NA Sustainability	0.0227566	0.00956496	2.3792	0.02085	**
Population	-0.00100094	0.00166315	-0.6018	0.54976	
GR	-0.00450185	0.0035493	-1.2684	0.21001	

*p < 10%, **p < 5%, and ***p < 1%

Table 13. Results of Forecast Error Variance Decomposition for Hypothesis 2-2

	Sustainability	***GDP***	***Population***
Asia Pacific	0.6559 (65.59%)	**0.0986 (9.86%)**	0.2455 (24.55%)
North America	0.5103 (51.03%)	**0.2468 (24.68%)**	0.0256 (2.56%)

5. Discussion

5.1 Contributions

As discussed in the previous section, the literature has argued that the sustainability benefit is relevant to financial returns and economic values of firms, depending on time such as short and long run, against the opponents who think that it has no guarantee for now and future. While there are many conceptual and theoretical papers in this field, the fact is that there are not many empirical studies. Moreover, as seen in BCG report [10], the recognitions for why sustainability is being crucial have not been changed by thinking of that it is not only an environmental strategy but also future plan. Sustainability conforms to the cardinal natures in which environment, society, and governance

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 19 February 2018 doi:10.20944/preprints201802.0124.v1

Peer-reviewed version available at Sustainability 2018, 10, 909; doi:10.3390/su10040909

interact with each different speed. Besides, its quantification model takes many times and variables. Doing sustainable management helps firms or institutions to get innovative processes, to reduce waste, and to gain insight into possible growth areas as evidence by [33]. Therefore, the sustainability is not an environmentally oriented strategy, but the multifaceted solutions that subsume environment, society, and governance in public and private sectors.

Showing the relationship between financial performance and economic development regarding the sustainability of Asia Pacific and North America is meaningful. We have two contributions in micro perspective and macro perspective respectively through this study. Firstly, in micro view, using the real and authentic data, we found a strong relationship between financial returns and sustainability, analyzing capital flows in stock markets and firm's share prices and financial statement. If many companies recognize this implication, they will invest actively in the assets such as making amenities and facilities, adopting new technologies including upright entrepreneurship. In general, this is because they want to get many investments from institutional investors. Through the results of hypothesis 1, their relation was significant for now and future, not talking about a tedious story that investments are highly pertinent to financial returns.

Secondly, macro perspective gives us the significance that sustainability is positively germane to not only to financial performance but also to economic growth by classifying two regions like Asia Pacific and North America. Among macro-economy variables, especially concerning economic growth, the most commonly used variables are GDP and GNI, adding their per capita individually. This implication is imprinted on policymakers because a cardinal principle of sustainability, like ESG, can apply for all countries, even though each nation depends on different history, economy, society, and political circumstances. Following that economic growth has importance for the overall quality of life and education level, this paper demonstrated clearly that two regions, Asia Pacific and North America have a different sustainability and GDP values in forecast error variance decomposition. There is one more contribution that the firms in this paper were considered by several industries such as beverage, oil, telecommunications, electronics, automotive, pharmaceutical, and banking industries, although each company does not mean an industry representative.

5.2 Limitations and Future research

VAR model has a bit of limitation; having less preliminary information like being atheoretical; using nonstationary variables [15]; showing different values in time length, which means critical values can be changed. Despite these drawbacks, what we did ameliorate was to run ADF test to get stationary variables individually and to determine the reasonable time length, which was operated by the test of lag selection. Depending on each variable's stationarity, we have run different sort of time series analysis such as VECM, and ARIMA. Even though VAR model is a-theoretical, this study made rational equations of sustainability to supplement defect, which has less prior information. We, however, have still a limit due to lack of one data, Asia Pacific GNI per capita. This point is what we have to make up for future research. Plus, to prove the economic development, it has to do add up with many macro-economy variables such as private and public consumption, price level, money supply, and un/employment rate, even though both GNI and GDP are the important factors as an evaluating economic index.

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 19 February 2018 doi:10.20944/preprints201802.0124.v1

Peer-reviewed version available at *Sustainability* **2018**, *10*, 909; doi:10.3390/su10040909

Appendix A.

A.1 Cointegration Test

A.1.1 Asia Pacific: Sustainability Performance and Major Stock Prices

Johansen test: Major Stocks
Log-likelihood = 36625.4 (including constant term: 32379.9)

Rank	Eigenvalue	Trace test	p-value	Lmax test	p-value
0	0.050072	199.42	[0.0000]	76.849	[0.0000]
1	0.038212	122.57	[0.0001]	58.286	[0.0000]
2	0.019208	64.283	[0.1266]	29.015	[0.1740]
3	0.0098990	35.267	[0.4388]	14.883	[0.7571]
4	0.0084091	20.385	[0.4080]	12.633	[0.5004]
5	0.0051664	7.7515	[0.4995]	7.7490	[0.4135]

Corrected for sample size (df = 1446)

Rank	Trace test	p-value
0	199.42	[0.0000]
1	122.57	[0.0002]
2	64.283	[0.1288]
3	35.267	[0.4413]
4	20.385	[0.4050]
5	7.7515	[0.5001]

eigenvalue	0.050072	0.038212	0.019208	0.0098990	0.0084091	0.0051664

A.1.2 Asia Pacific: Sustainability Performance and Top 5% companies

Johansen test:
Log-likelihood = 32248.3 (including constant term: 28712.3)

Rank	Eigenvalue	Trace test	p-value	Lmax test	p-value
0	0.039577	152.05	[0.1180]	50.315	[0.0769]
1	0.026453	101.73	[0.5494]	33.405	[0.5783]
2	0.018399	68.328	[0.7749]	23.138	[0.8635]
3	0.015579	45.190	[0.8225]	19.565	[0.7845]
4	0.0093995	25.625	[0.8973]	11.767	[0.9307]
5	0.0076591	13.858	[0.8482]	9.5800	[0.7832]
6	0.0024337	4.2781	[0.8746]	3.0361	[0.9340]
7	0.00099626	1.2420	[0.2651]	1.2420	[0.2651]

Corrected for sample size (df = 1205)

Rank	Trace test	p-value
0	152.05	[0.1242]
1	101.73	[0.5583]
2	68.328	[0.7798]
3	45.190	[0.8254]
4	25.625	[0.8986]
5	13.858	[0.8469]
6	4.2781	[0.8749]
7	1.2420	[0.2653]

eigenvalue	0.039577	0.026453	0.018399	0.015579	0.0093995	0.0076591	0.0024337	0.00099626

A1.2 North America: Sustainability Performance and Major Stock Prices

Johansen test:

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 19 February 2018 doi:10.20944/preprints201802.0124.v1

Peer-reviewed version available at *Sustainability* **2018**, *10*, 909; doi:10.3390/su10040909

Log-likelihood = 47944.3 (including constant term: 43698.9)

Rank	Eigenvalue	Trace test	p-value	Lmax test	p-value
0	0.13755	456.63	[0.0000]	221.37	[0.0000]
1	0.096270	235.26	[0.0000]	151.43	[0.0000]
2	0.042962	83.830	[0.0000]	65.692	[0.0000]
3	0.0088450	18.138	[0.5659]	13.291	[0.4402]
4	0.0031934	4.8466	[0.8223]	4.7849	[0.7675]

Corrected for sample size (df = 1453)

Rank	Trace test	p-value
0	456.63	[0.0000]
1	235.26	[0.0000]
2	83.830	[0.0000]
3	18.138	[0.5631]
4	4.8466	[0.8226]

eigenvalue	0.13755	0.096270	0.042962	0.0088450	0.0031934

A.1.3 North America: Sustainability Performance and Top 5% companies

Johansen test:
Exogenous regressor(s): DJSI_AP__PR and DJSI_AP__TR
Log-likelihood = 37901.8 (including constant term: 33656.3)
Cointegration tests, ignoring exogenous variables

Rank	Eigenvalue	Trace test	p-value	Lmax test	p-value
0	0.038790	155.17	[0.0002]	59.185	[0.0005]
1	0.021245	95.983	[0.0463]	32.125	[0.3075]
2	0.016086	63.858	[0.1354]	24.261	[0.4497]
3	0.011977	39.597	[0.2397]	18.025	[0.5048]
4	0.0070393	21.571	[0.3330]	10.568	[0.6962]
5	0.0060669	11.003	[0.2147]	9.1038	[0.2841]
6	0.0012690	1.8996	[0.1681]	1.8996	[0.1681]

Corrected for sample size (df = 1444)

Rank	Trace test	p-value
0	155.17	[0.0002]
1	95.983	[0.0478]
2	63.858	[0.1376]
3	39.597	[0.2418]
4	21.571	[0.3302]
5	11.003	[0.2152]
6	1.8996	[0.1681]

eigenvalue	0.038790	0.021245	0.016086	0.011977	0.0070393	0.0060669	0.0012690

A.1.4 Asia Pacific: GDP per capita, and Sustainability Performance

Johansen test:
Log-likelihood = 386.628 (including constant term: 182.301)

Rank	Eigenvalue	Trace test	p-value	Lmax test	p-value
0	0.27892	30.767	[0.0382]	23.544	[0.0202]
1	0.070398	7.2221	[0.5585]	5.2559	[0.7113]
2	0.026938	1.9661	[0.1609]	1.9661	[0.1609]

Corrected for sample size (df = 41)

Rank	Trace test	p-value
0	30.767	[0.0535]
1	7.2221	[0.5805]
2	1.9661	[0.1747]

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 19 February 2018 doi:10.20944/preprints201802.0124.v1

Peer-reviewed version available at Sustainability 2018, 10, 909; doi:10.3390/su10040909

eigenvalue 0.27892 0.070398 0.026938

A.1.5 Asia Pacific: GNI per capita, and Sustainability Performance

Johansen test:
Log-likelihood = 52.6431 (including constant term: 7.23707)

Rank	Eigenvalue	Trace test	p-value	Lmax test	p-value
0	0.46962	16.290	[0.6983]	10.147	[0.7344]
1	0.26172	6.1430	[0.6823]	4.8548	[0.7594]
2	0.077354	1.2882	[0.2564]	1.2882	[0.2564]

Corrected for sample size (df = 12)

Rank	Trace test	p-value
0	16.290	[0.8501]
1	6.1430	[0.7491]
2	1.2882	[0.3114]

eigenvalue 0.46962 0.26172 0.077354

A.1.6 North America: GDP, GNI per capita, and Sustainability Performance (Dummy Variables: Great Recession, Population)

Johansen test:
Log-likelihood = 995.443 (including constant term: 799.63)

Rank	Eigenvalue	Trace test	p-value	Lmax test	p-value
0	0.35476	77.317	[0.0099]	30.231	[0.1289]
1	0.27113	47.086	[0.0574]	21.822	[0.2370]
2	0.22630	25.264	[0.1568]	17.703	[0.1456]
3	0.10288	7.5603	[0.5205]	7.4913	[0.4416]
4	0.00099986	0.069025	[0.7928]	0.069025	[0.7928]

Corrected for sample size (df = 38)

Rank	Trace test	p-value
0	77.317	[0.0377]
1	47.086	[0.1062]
2	25.264	[0.1986]
3	7.5603	[0.5451]
4	0.069025	[0.7999]

eigenvalue 0.35476 0.27113 0.22630 0.10288 0.00099986

Appendix B.

B.1 Hypothesis 1 Results

B.1.1 Hypothesis 1-1. VECM: Sustainability Performance and Asia Major Stocks in Asia Pacific

Equation: d_DJSI_AP__TR

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	-0.25828	0.0501213	-5.1531	<0.00001	***
d_DJSI_AP__TR_1	-0.376414	0.0878289	-4.2858	0.00002	***

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 19 February 2018 doi:10.20944/preprints201802.0124.v1

Peer-reviewed version available at *Sustainability* **2018**, *10*, 909; doi:10.3390/su10040909

d_DJSI_AP__TR_2	-0.279773	0.10485	-2.6683	0.00771	***
AUS200	0.0425609	0.00946702	4.4957	<0.00001	***
Hongkong_Hangsen	-0.00243169	0.00564701	-0.4306	0.66681	
Nikkei_225	6.69217e-05	0.00252908	0.0265	0.97889	
Shanghai_Shenzhen	-0.00166616	0.000929865	-1.7918	0.07336	*
Kospi	0.0173326	0.00646122	2.6826	0.00739	***

Mean dependent var	0.000119	S.D. dependent var	0.010974
Sum squared resid	0.170889	S.E. of regression	0.010735
R-squared	0.052169	Adjusted R-squared	0.043221
rho	-0.002731	Durbin-Watson	2.004587

B.1.2 Hypothesis 1-2. VECM: Sustainability Performance and Top 5% Companies in Asia Pacific

Equation : d_DJSI_AP__TR

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	0.0276998	0.0343111	0.8073	0.41964	
d_DJSI_AP__TR_1	-0.250126	0.0302913	-8.2574	<0.00001	***
d_DJSI_AP__TR_2	-0.132501	0.0305765	-4.3334	0.00002	***
d_DJSI_AP__TR_3	-0.0682469	0.0297634	-2.2930	0.02202	**
Samsung_Electronics	-0.00121541	0.00260241	-0.4670	0.64056	
Toyota_Motor	0.000247451	0.0031117	0.0795	0.93663	
NTT_Docomo	-0.00590851	0.00271244	-2.1783	0.02957	**
Astellas_Phama	0.00485957	0.00272154	1.7856	0.07441	*
Seven_and_Holdings	-0.00150992	0.00397724	-0.3796	0.70428	
West_Banking_GR	-0.00364771	0.00490616	-0.7435	0.45732	
EC1	-0.0208552	0.00873587	-2.3873	0.01712	**

Mean dependent var	0.000166	S.D. dependent var	0.011146
Sum squared resid	0.116320	S.E. of regression	0.009725
R-squared	0.247944	Adjusted R-squared	0.238773
rho	-0.004115	Durbin-Watson	2.004091

B.1.3 Hypothesis 1-1. VECM: Sustainability Performance and Major Stocks in North America

Equation : d_NASDAQ

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	0.102927	0.0309391	3.3267	0.00090	***
d_NASDAQ_1	-0.00147645	0.0891948	-0.0166	0.98680	
d_NASDAQ_2	-0.000152853	0.0891785	-0.0017	0.99863	
d_NASDAQ_3	-0.19826	0.089072	-2.2258	0.02618	**
DJSI_NA__PR	-0.0790962	0.0294078	-2.6896	0.00723	***
DJSI_NA__TR	0.091003	0.0286718	3.1740	0.00153	***
EC1	-0.0259547	0.00911177	-2.8485	0.00445	***

Mean dependent var	0.000511	S.D. dependent var	0.011189
Sum squared resid	0.182365	S.E. of regression	0.011123

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 19 February 2018 doi:10.20944/preprints201802.0124.v1

Peer-reviewed version available at *Sustainability* **2018**, *10*, 909; doi:10.3390/su10040909

R-squared	0.024288	Adjusted R-squared	0.011711
rho	0.001068	Durbin-Watson	1.996174

Equation : d_S_P_500__Net_TR_

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	0.0943388	0.0277548	3.3990	0.00069	***
d_NASDAQ_1	0.0152236	0.0800145	0.1903	0.84913	
d_NASDAQ_2	0.0212452	0.0799999	0.2656	0.79061	
DJSI_NA__PR	-0.074483	0.0263811	-2.8234	0.00482	***
DJSI_NA__TR	0.0830494	0.0257208	3.2289	0.00127	***
EC1	-0.022194	0.00817395	-2.7152	0.00670	***

Mean dependent var	0.000437	S.D. dependent var	0.010057
Sum squared resid	0.146758	S.E. of regression	0.009978
R-squared	0.028226	Adjusted R-squared	0.015700
rho	-0.000390	Durbin-Watson	1.999360

Equation: DJSI_NA__TR

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	-0.128415	0.0171057	-7.5071	<0.00001	***
d_DJSI_NA__TR_1	-0.231994	0.0716583	-3.2375	0.00123	***
d_DJSI_NA__TR_2	-0.200256	0.0860118	-2.3282	0.02003	**
d_DJSI_NA__TR_3	-0.200014	0.0858076	-2.3310	0.01989	**
d_DJSI_NA__TR_4	-0.119864	0.0719811	-1.6652	0.09608	*
S_P_500__Net_TR_	0.0471296	0.0122462	3.8485	0.00012	***
NASDAQ	0.0112437	0.0105518	1.0656	0.28679	
EC1	0.00226497	0.00027094	8.3597	<0.00001	***

Mean dependent var	0.000402	S.D. dependent var	0.009909
Sum squared resid	0.137147	S.E. of regression	0.009607
R-squared	0.067005	Adjusted R-squared	0.060099
rho	-0.007581	Durbin-Watson	2.014257

B.1.4 Hypothesis 1-2 – VECM: Sustainability Performance and Top 5% companies in North America

Equation: d_DJSI_NA__PR

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	0.0472015	0.0228456	2.0661	0.03899	**
d_DJSI_NA__PR_1	-0.464005	0.0751827	-6.1717	<0.00001	***
d_DJSI_NA__PR_2	-0.194565	0.0931189	-2.0894	0.03684	**
d_DJSI_NA__PR_3	-0.182082	0.0971522	-1.8742	0.06110	*
d_DJSI_NA__TR_1	0.432012	0.075579	5.7160	<0.00001	***
d_DJSI_NA__TR_2	0.247207	0.0935961	2.6412	0.00835	***
Exxon_Mobile	0.0139425	0.00488384	2.8548	0.00437	***
Pepsi_Co_Inc	0.0155388	0.00838486	1.8532	0.06405	*
Verizon_Inc	-0.00602455	0.0052432	-1.1490	0.25073	

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 19 February 2018 doi:10.20944/preprints201802.0124.v1

Peer-reviewed version available at *Sustainability* **2018**, *10*, 909; doi:10.3390/su10040909

EC1	-0.108264	0.0187302	-5.7802	<0.00001	***

Mean dependent var	0.000305	S.D. dependent var	0.010185
Sum squared resid	0.143277	S.E. of regression	0.009839
R-squared	0.076687	Adjusted R-squared	0.066705
rho	0.001011	Durbin-Watson	1.996198

Equation : DJSI_NA__TR

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	0.0439565	0.0225431	1.9499	0.05138	*
d_DJSI_NA__TR_1	-0.372026	0.0745782	-4.9884	<0.00001	***
d_DJSI_NA__TR_2	-0.365586	0.0923568	-3.9584	0.00008	***
d_DJSI_NA__TR_3	-0.372294	0.0961928	-3.8703	0.00011	***
d_DJSI_NA__TR_4	-0.312382	0.0917764	-3.4037	0.00068	***
d_DJSI_NA__TR_5	-0.23167	0.0740189	-3.1299	0.00178	***
Apple_Inc	-0.00078442	0.000748456	-1.0481	0.29479	
Johnson_and_Johnson	0.00493479	0.00543489	0.9080	0.36403	
Exxon_Mobile	0.0136437	0.00481917	2.8311	0.00470	***
Pepsi_Co_Inc	0.0149709	0.00827384	1.8094	0.07059	*
Verizon_Inc	-0.00567402	0.00517378	-1.0967	0.27296	
EC1	-0.102535	0.0184821	-5.5478	<0.00001	***

Mean dependent var	0.000402	S.D. dependent var	0.009913
Sum squared resid	0.139507	S.E. of regression	0.009709
R-squared	0.050948	Adjusted R-squared	0.040688
rho	-0.001484	Durbin-Watson	2.001728

B.1.5 Hypothesis 1-3-VAR: Sustainability Performance and ROI, ROIC, and ROA of Top 5% companies in North America and Asia Pacific

B.1.5.1 ROI_North America

Equation 1: North_America_Sustainability_Log

Mean dependent var	4.934266	S.D. dependent var	0.305873
Sum squared resid	0.198641	S.E. of regression	0.157576
R-squared	0.858455	Adjusted R-squared	0.734602
F(7, 8)	6.931285	P-value(F)	0.006982
rho	-0.291912	Durbin-Watson	2.583113

F-tests of zero restrictions:

All lags of North_America_Sustainability_LoF(1, 8) = 0.39677 [0.5463]

B.1.5.2 ROIC_North America

Equation 1: North_America_Sustainability_Log

Mean dependent var	4.934266	S.D. dependent var	0.305873
Sum squared resid	0.255915	S.E. of regression	0.178856
R-squared	0.817643	Adjusted R-squared	0.658081
F(7, 8)	5.124295	P-value(F)	0.017531
rho	-0.207474	Durbin-Watson	2.367653

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 19 February 2018 doi:10.20944/preprints201802.0124.v1

Peer-reviewed version available at Sustainability 2018, 10, 909; doi:10.3390/su10040909

F-tests of zero restrictions:
All lags of North_America_Sustainability_LoF(1, 8) = 0.7962 [0.3983]

B.1.5.3 ROA_North America

Equation 1: North_America_Sustainability_Log

Mean dependent var	4.934266	S.D. dependent var	0.305873
Sum squared resid	0.206214	S.E. of regression	0.160551
R-squared	0.853059	Adjusted R-squared	0.724485
F(7, 8)	6.634786	P-value(F)	0.008012
rho	-0.263801	Durbin-Watson	2.521545

F-tests of zero restrictions:
All lags of North_America_Sustainability_LoF(1, 8) = 0.37232 [0.5587]

B.1.5.4 Asia Pacific

Equation 1: Asia_Pacific_Sustainability_Log

Mean dependent var	4.932797	S.D. dependent var	0.236012
Sum squared resid	0.045000	S.E. of regression	0.080178
R-squared	0.946142	Adjusted R-squared	0.884590
F(8, 7)	15.37147	P-value(F)	0.000855
rho	-0.141623	Durbin-Watson	2.254296

F-tests of zero restrictions:
All lags of Asia_Pacific_Sustainability_LogF(1, 7) = 47.395 [0.0002]

B.1.5.5 Asia Pacific

Equation 1: Asia_Pacific_Sustainability_Log

Mean dependent var	4.932797	S.D. dependent var	0.236012
Sum squared resid	0.092135	S.E. of regression	0.114727
R-squared	0.889728	Adjusted R-squared	0.763702
F(8, 7)	7.059894	P-value(F)	0.009136
rho	-0.015106	Durbin-Watson	2.009564

F-tests of zero restrictions:
All lags of Asia_Pacific_Sustainability_LogF(1, 7) = 1.3504 [0.2833]

B.1.5.6 Asia Pacific

Equation 1: Asia_Pacific_Sustainability_Log

Mean dependent var	4.932797	S.D. dependent var	0.236012
Sum squared resid	0.063539	S.E. of regression	0.095273
R-squared	0.923954	Adjusted R-squared	0.837044
F(8, 7)	10.63116	P-value(F)	0.002710
rho	0.030502	Durbin-Watson	1.936730

F-tests of zero restrictions:
All lags of Asia_Pacific_Sustainability_LogF(1, 7) = 23.657 [0.0018]

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 19 February 2018 doi:10.20944/preprints201802.0124.v1

Peer-reviewed version available at *Sustainability* **2018**, *10*, 909; doi:10.3390/su10040909

B.2.1 Hypothesis 2 Results

B.2.1.1 Hypothesis 2-1 - VECM: Sustainability Performance and GDP per capita in Asia Pacific

Equation : d_Asia_Pacific_Sustainability_l

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	0.106917	0.133464	0.8011	0.42680	
d_Population_log__1	0.054724	0.0266501	2.0534	0.04518	**
d_Population_log__2	0.0501459	0.0266954	1.8784	0.06604	*
d_Asia_Pacific_Sustainability_7	-0.226886	0.132538	-1.7119	0.09300	*
Asia_Pacific_GDP_log_	0.034562	0.017906	1.9302	0.05915	*
EC1	-0.0334078	0.0264163	-1.2647	0.21174	

Mean dependent var	0.003749	S.D. dependent var	0.042871
Sum squared resid	0.097840	S.E. of regression	0.043800
R-squared	0.250211	Adjusted R-squared	-0.043824
rho	0.013043	Durbin-Watson	1.946557

B.2.1.2 Hypothesis 2-1 - ARIMA: Sustainability Performance and GNI per capita in Asia Pacific

Dependent variable: Asia_Pacific_GNI_Per_capita_Log
Standard errors based on Hessian

	Coefficient	*Std. Error*	*z*	*p-value*	
const	18.5077	5.19202	3.5646	0.00036	***
phi_1	-0.11305	0.251165	-0.4501	0.65264	
theta_1	1	0.309313	3.2330	0.00123	***
Asia_Pacific_Sustainability_Log	2.29636	1.07819	2.1298	0.03319	**

Mean dependent var	29.95311	S.D. dependent var	1.043681
Mean of innovations	-0.019966	S.D. of innovations	0.501897
Log-likelihood	-13.74151	Akaike criterion	39.48303
Schwarz criterion	44.48231	Hannan-Quinn	39.97997

B.2.1.3 Hypothesis 2-1 - VAR: Sustainability Performance, GNI and GDP per capita in North America

Equation : d_GDP_log_

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
Const	0.00708408	0.00173884	4.0740	0.00015	***
d_GDP_log__1	-0.219931	0.153838	-1.4296	0.15848	
d_GNI_log__1	0.379953	0.139819	2.7175	0.00878	***
d_Sustainability_log_	0.0275953	0.0078443	3.5179	0.00088	***
Population	-0.0024001	0.00136396	-1.7597	0.08403	*
GR	-0.00782993	0.00291081	-2.6900	0.00944	***

Mean dependent var	0.004859	S.D. dependent var	0.006336

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 19 February 2018 doi:10.20944/preprints201802.0124.v1

Peer-reviewed version available at *Sustainability* **2018**, *10*, 909; doi:10.3390/su10040909

Sum squared resid	0.001267	S.E. of regression	0.004799
R-squared	0.535942	Adjusted R-squared	0.426256
F(13, 55)	4.886135	P-value(F)	0.000014
Rho	-0.132906	Durbin-Watson	2.241414

Equation : d_GNI_log_

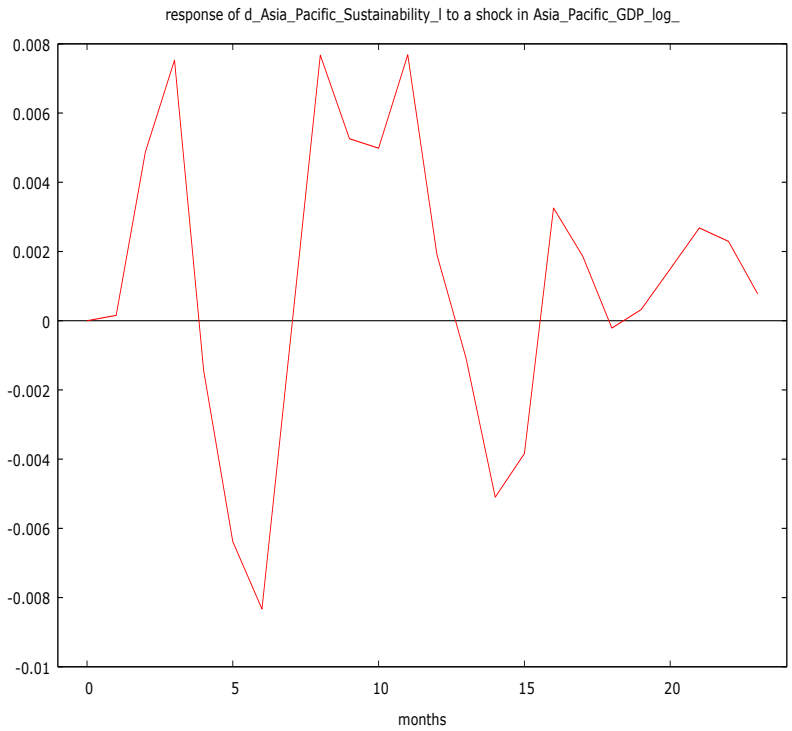
	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
Const	0.00431492	0.00212025	2.0351	0.04667	**
d_GDP_log__1	0.377127	0.187582	2.0105	0.04930	**
d_Sustainability_log_	0.0227566	0.00956496	2.3792	0.02085	**
Population	-0.00100094	0.00166315	-0.6018	0.54976	
GR	-0.00450185	0.0035493	-1.2684	0.21001	

Mean dependent var	0.005107	S.D. dependent var	0.006976
Sum squared resid	0.001884	S.E. of regression	0.005852
R-squared	0.430749	Adjusted R-squared	0.296198
F(13, 55)	3.201396	P-value(F)	0.001256
Rho	-0.070876	Durbin-Watson	2.123085

Appendix C.

C.1 Impulse Response Function

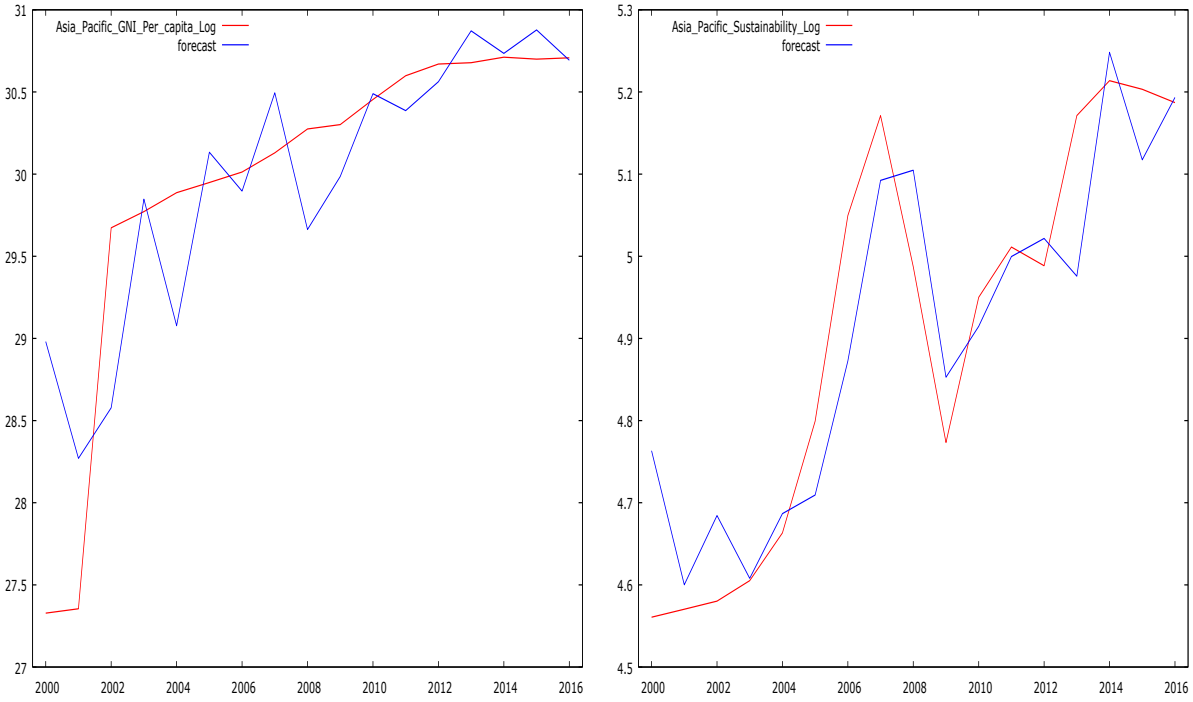
C.1.1 Hypothesis 2-2 ; The response of sustainability to shock in GDP in Asia Pacific



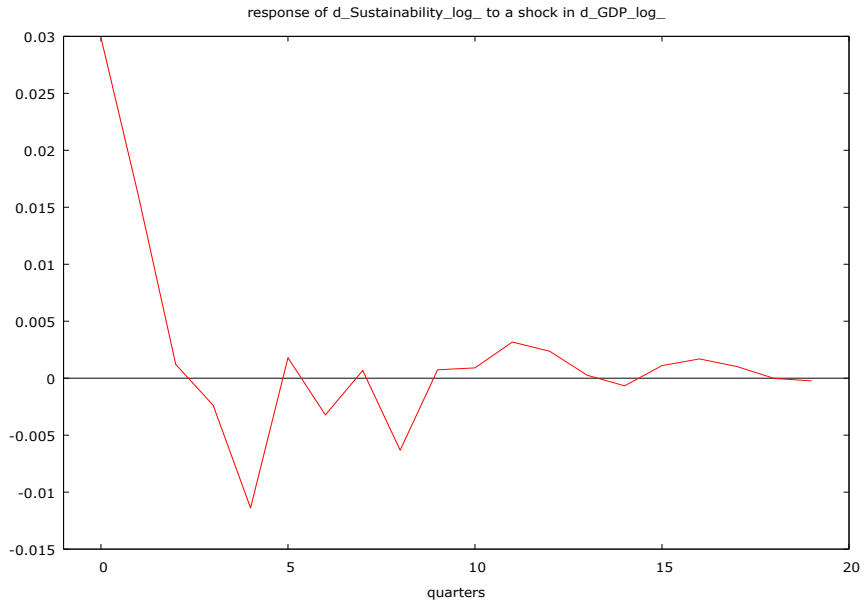
Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 19 February 2018 doi:10.20944/preprints201802.0124.v1

Peer-reviewed version available at *Sustainability* **2018**, *10*, 909; doi:10.3390/su10040909

C.1.2 Hypothesis 2-2; Forecast in GNI in Asia Pacific



C.1.3 Hypothesis 2-2 ; The response of sustainability to shock in GDP in North America

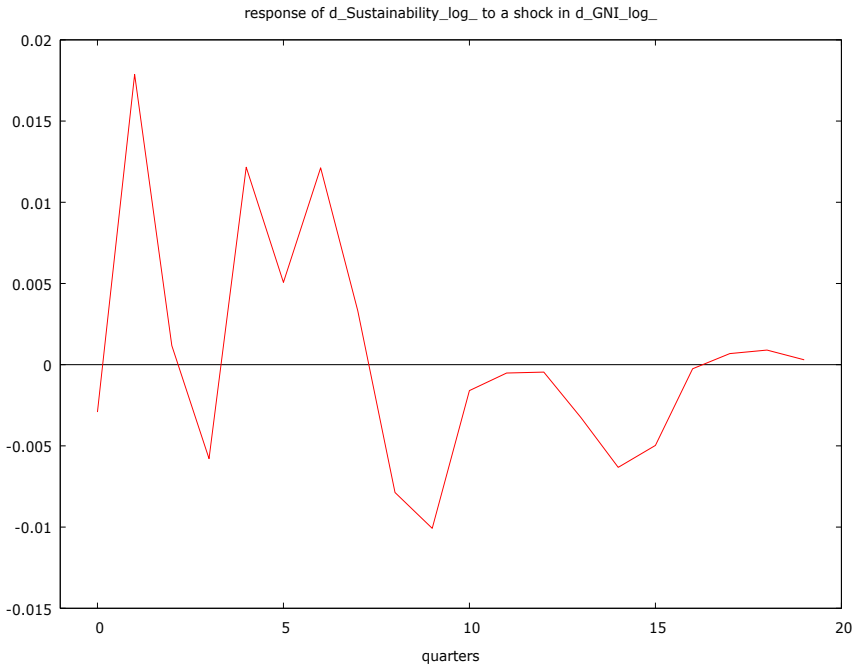


Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 19 February 2018 doi:10.20944/preprints201802.0124.v1

Peer-reviewed version available at *Sustainability* **2018**, *10*, 909; doi:10.3390/su10040909

C.1.4 Hypothesis 2-2; The response of sustainability to shock in GNI in North America

C.2.1 Forecast Error Variance Decomposition



C.2.2 Hypothesis 2-2: Decomposition of variance for d_Sustainability_log in Asia Pacific

period	std. error	Population_	Asia_Pacific_GDP_log_	Asia_Pacific_Sustainability_log
1	0.031344	4.4980	0.0181	95.4839
2	0.0408924	5.0785	0.0162	94.9053
3	0.0482745	3.9116	0.8387	95.2497
4	0.0561424	2.9478	5.1939	91.8583
5	0.0610802	3.9986	7.2307	88.7707
6	0.0665939	5.4413	6.3676	88.1910
7	0.072398	6.8692	6.0194	87.1115
8	0.0761064	9.3982	6.0303	84.5715
9	0.0793286	11.1161	5.5827	83.3012
10	0.0836756	14.4344	5.4888	80.0768
11	0.0895513	16.7985	5.9387	77.2628
12	0.096616	18.7281	7.7999	73.4720
13	0.104097	21.3809	9.3266	69.2924
14	0.111016	23.3920	10.1504	66.4576
15	0.116867	24.5528	9.8586	65.5887

C.2.3 Hypothesis 2-2: Decomposition of variance for d_Sustainability_log in North America

period	std. error	d_GDP_log_	d_Sustainability_log_	GR	Population
1	0.0653108	27.7679	72.2321	0.0000	0.0000
2	0.0676831	30.5592	68.8086	0.4747	0.1575
3	0.0700152	28.5584	64.5224	6.3748	0.5443
4	0.0763279	24.1659	54.7630	20.2524	0.8188

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 19 February 2018 doi:10.20944/preprints201802.0124.v1

Peer-reviewed version available at Sustainability 2018, 10, 909; doi:10.3390/su10040909

5	0.0780887	24.2839	54.1782	19.3546	2.1832
6	0.0788093	24.7153	53.3903	19.7451	2.1492
7	0.079447	24.3450	53.5594	19.9796	2.1160
8	0.0801673	24.0698	52.6189	20.9777	2.3335
9	0.0808326	25.0554	51.9043	20.6416	2.3988
10	0.0810394	25.1232	51.7520	20.5603	2.5645
11	0.081348	25.0899	51.5956	20.7695	2.5450
12	0.0818684	24.8019	51.2687	21.4096	2.5198
13	0.0820088	24.7435	51.1407	21.5927	2.5231
14	0.0821009	24.6881	51.0304	21.7291	2.5525
15	0.0821133	24.6841	51.0329	21.7225	2.5605

References

1. ADB Institute, Asia's Wicked Environmental Problem', Asia Development Bank Institute, **2012**
2. Albertini, E., Does environmental management improve financial performance? A meta-analytical review. *Organization & Environment*, **2013**, 26, 431-457.
3. Aghion, P., & Howitt, P., A model of growth through creative destruction. *Econometrica*, **1992**, 60(2), 323–351.
4. Ameer R and Othman. R, Sustainability Practices and Corporate Financial Performance: A Study Based on the Top Global Corporations, *Journal of Business Ethics*, **2012**, Vol. 108, No. 1, pp. 61-79.
5. Ayadi. O. Felix, THE EFFICIENCY OF PRICE DISCOVERY IN THE STOCK MARKET AND MACROECONOMIC VARIABLES: AN EMPIRICAL INVESTIGATION, *African Review of Money Finance and Banking,* **1994,** No. 1/2, pp. 33-55.
6. Bain & Company, GLOBAL PRIVATE EQUITY REPORT 2015, Bain & Company, Inc., 2015
7. Bawa, K. S., Koh, L. P., Lee, T. M., Liu, J., Ramakrishnan, P. S., Yu, D. W., Zhang, Y. and P. Raven, China, India, and the Environment. *Science* **2010**, 327: 1457–8.
8. Bradbury, H., Sustaining inner and outer worlds: A whole systems approach to developing sustainable business practices in management, *Journal of Management Education*, **2003**, 27(2),172–186.
9. Baran, P., The Political Economy of Growth. Monthly Review Press, **1957.**
10. Boston Consulting Group, The Business of Sustainability; imperatives, advantages, and actions, BCG Report., 2009
11. Caroll. C. M. and Stanfield. R. J., Sustainable Regional Economic Development, *Journal of Economic Issues*, **2001**, Vol. 35, No. 2, pp. 469-476.
12. Chenery, H. B, Patterns of industrial growth. *The American Economic Review*, **1960**, 50(4), 624–654.
13. Crowther D. and Aras, G., Evaluating sustainability: Need for standards, *Issues in Social and Environmental Accounting*, **2008**, 2(1), 19–35.
14. Coxhead, I., Development and the Environment in Asia, *Asian-Pacific Economic Literature,* **2003**, 17(1): 22–54.
15. Cuthberton, K., Quantitative Financial Economics: Stock, Bonds, and Foreign Exchange, John Wiley and Son, New York, **2002**, p.436.
16. Danciu V., The sustainable company: new challenges and strategies for more sustainability, Theoretical and Applied Economics, **2013**, No. 9(586), pp.7-26

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 19 February 2018 doi:10.20944/preprints201802.0124.v1

Peer-reviewed version available at Sustainability 2018, 10, 909; doi:10.3390/su10040909

17. D'Amico. Stefania, Farka. Mira, The Fed and the Stock Market: An Identification Based on Intraday Futures Data, *Journal of Business & Economic Statistics*, **2011**, Vol. 29, No. 1, pp. 126-137.

18. Domar, Evsey D., Expansion and Employment, The American Economic Review, **1947**, Vol. 37, No. 1

19. Dyllick Thomas and Hockerts Kai, Beyond the business for corporate sustainability, *Business Strategy and the Environment*, **2002**, 11, 130-141.

20. Dina Spector, 10 More Reasons Companies Should Care About Sustainability, Business Insiders-Stategy, 2012

21. Engle, R.F. and C.W.J. Granger, Co-integration and error correction: representation, estimation and testing, *Econometrica*, **1987**, 55, 251-276.

22. European Union, Dealing with uncertainty in sustainability assessment, 2012

23. Friedman, M., The Social Responsibility of Business is to Increase its Profits, *New York Times Magazine*., 1962

24. Galema. R., Plantinga. A. and Scholtens. B., The stocks at stake: Return and risk in socially responsible investment, *Journal of Banking & Finance*, **2008**, Vol. 32, Issue 12, Dec. 2008, pp. 2646-2654

25. Giang. D and Sui. P., Infrastructure investments in developing economies, *Springer Singapore*, chapter 2 (Theory of Economic Development), **2015**, p11-26.

26. Gray, R., Is accounting for sustainability actually accounting for sustainability and how would we know? An exploration of narratives of organizations and the planet, *Accounting, Organizations and Society*, **2010**, 35, 47–62.

27. Goetzmann. William N., An Introduction To Investment Theory, published by Yale School of Management., 1996

28. Haigh. N and Hoffman A. J, The New Heretics: Hybrid Organizations and the Challenges They Present to Corporate Sustainability, *Organization & Environment*, **2014**, Vol. 27(3) 223–241.

29. Harrod R. F., The Fall In Consumption, Oxford Bulletin of Economics and Statistics, **1948**

30. Hansen, M. C., Potapov, P. V., Moore, R., et al., High-resolution global maps of 21st-century forest cover change. Science, 2013, 342:850-853.

31. Harvey. Campbell R., Forecasts of Economic Growth from the Bond and Stock Markets, *Financial Analysts Journal*, **1989**, Vol. 45, No. 5 (Sep. - Oct., 1989), pp. 38-45.

32. Horváthová, E., Does environmental performance affect financial performance? A meta-analysis. *Ecological Economics*, **2010**, 70, 52-59.

33. Hull C. E. and Rothenberg S., Firm Performance: The Interactions of Corporate Social Performance with Innovation and Industry Differentiation, *Strategic Management Journal*, **2008**, Volume 29, Issue 7, pp. 781–789.

34. IPCC, Climate Change: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA., 2013

35. Johansen. S. and Juselius. K., "Maximum Likelihood Estimation and Inference on Cointegration with applications to the demand for money" *Oxford Bulletin of Economics and Statistics*, **1990**, Vol 52, Issue 2, p169-210.

36. Johansen, S., "Estimation and hypothesis testing of cointegration vectors in Gaussian vector autoregressive models", *Econometrica*, **1991**, 59, 1551-1580.

37. Kinal. T. and Ratner. J.B., Regional Forecasting Model with Vector Autoregression: The case of New York State

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 19 February 2018 doi:10.20944/preprints201802.0124.v1

Peer-reviewed version available at Sustainability 2018, 10, 909; doi:10.3390/su10040909

Discussion Paper #155, Department of Economics, State University of New York at Albany, 1982

38. Levine Ross and Zervos. Sara, Stock Market Development and Long-Run Growth, *The World Bank Economic Review*, **1996**, Vol. 10, No. 2, A Symposium Issue on Stock Markets and Economic Development, pp. 323-339.

39. Lourenço. I.C., Branco M.C., Curto J.D., and Eugénio T., How Does the Market Value Corporate Sustainability Performance? , *Journal of Business Ethics*, **2012**, Vol. 108, No. 4, pp. 417-428.

40. Ibrahim, Mansor H., MONETARY SHOCKS AND STOCK RETURNS IN AN EMERGING MARKET: A VAR ANALYSIS, *Savings and Development*, **2001,** Vol. 25, No. 4, pp. 439-456.

41. Ibrahim, Mansor H., STOCK MARKET AND PRIVATE CONSUMPTION IN MALAYSIA, *Savings and Development*, **2009,** Vol. 33, No. 4, pp. 359-376.

42. Margolis, J.D. and J.P. Walsh, Misery loves companies: Rethinking social initiatives by business, Administrative Science Quarterly, **2003**, 48, 268-305.

43. Marx, Karl, The Philosophy of Art of Karl Marx, Pluto Press Limited, **1993**

44. Mayr. J. and Ulbricht. D., Log versus level in VAR forecasting: 42 million empirical answers – Expect the unexpected, *Economics Letter*, **2015,** Vol. 126, p40-52.

45. Marrewijk. Van Marcel., Concepts and Definitions of CSR Corporate Sustainability Between Communication and Agency, **2003**, Vol. 44, pp95-105.

46. Menguc, B., & Ozanne, L. K., Challenges of the green imperative: A natural resource-based approach to the environmental orientation—business performance relationship. *Journal of Business Research*, **2005**, 58, 430-438.

47. Moozakis, C., Services Calculate Net ROI, InternetWeek, **2000,** 827, Aug. 28, 2000, p. 62.

48. Melville. Nigel P., Information Systems Innovation for Environmental Sustainability, MIS Quarterly, **2013**, Vol. 34, No. 1 (March 2010), pp. 1-21.

49. Lackmann, Jürgen Ernstberger, Michael Stich, Market Reactions to Increased Reliability of Sustainability Information Julia, *Journal of Business Ethics*, **2012,** Vol. 107, No. 2, pp. 111-128.

50. Lewis. W. Arthur, Economic Development with Unlimited Supplies of Labour, The Manchester School, **1954**,

51. Mishkin, F. S., The Economics of Money, Banking, and Financial Markets, 5th Edition, Addison-Wesley, **1998**

52. Park, K. and R. A. Ratti, Real activity, inflation, stock returns and monetary policy, *The Financial Review*, **2000,** 35, 59-78.

53. Praveen. K. Parboteeah, Addae. M. Helena, Cullen. B. John, Propensity to Support Sustainability Initiatives: A Cross-National Model, *Journal of Business Ethics*, **2012**, Vol. 105, No. 3, pp. 403-413.

54. Ramey, V.A., and M.D. Shapiro, Costly Capital Reallocation and the Effects of Government Spending. *Carnegie-Rochester Conference Series on Public Policy* **1998**, 48 (June): 145-194.

55. Rebecca Henderson, Making the business case for sustainability, Harvard Business Review, Working paper series, **2015,** No. 15-068.

56. Robert G. Eccles, Ioannis Ioannou & George Serafeim, The Impact of Corporate Sustainability on Organizational Process and Performance", Harvard Business School Working Paper Series, **2012,** No. 12-035.

57. Robertson, James. The New Economics of Sustainable Development: A Briefing for Policy Makers. New York: St. Martin's Press, **1999**.

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 19 February 2018 doi:10.20944/preprints201802.0124.v1

Peer-reviewed version available at Sustainability 2018, 10, 909; doi:10.3390/su10040909

58. Rostow, W. W., The Stages of Economic Growth. A non-communist manifesto, Cambridge University Press, New York, **1960.**

59. Russo, M. V., & Fouts, P. A., A resource-based perspective on corporate environmental performance and profitability. *Academy of Management Journal*, **1997,** 40, 534-559.

60. Searcy Cory, Corporate Sustainability Performance Measurement Systems: A Review and Research Agenda, *Journal of Business Ethics*, Vol. 107, No. 3, **2012**, pp. 239-253.

61. Schaltegger, S., & Wagner, M., Integrative management of sustainable performance, measurement and reporting. *International Journal of Accounting*. Auditing and Performance Evaluation, **2006,** 3, 1–19.

62. Schaltegger, T and Synnestvedt, T., The link between "green" and economic success: Environmental management as the crucial trigger between environmental and economic performance. *Journal of Environmental Management,* **2002**, 65(4): 339-346.

63. Sen, A., Development as freedom. Oxford: Oxford University Press, **1999.**

64. Sims, C.A., Macroeconomics and Reality, *Econometrica*, **1980,** 48, 1-48.

65. Singer, H.W.,The Distribution of Gains Between Investing and Borrowing Countries. *American Economic Review,* **1950**, 40(2), 473–85.

66. Slater, D., "Go Figure," WebMaster Magazine, A. http://www.cio.com/archive/webbusiness/040197_roi.html

67. Steger, U., Building business case for corporate sustainability in emerging markets. *Greener Management International*. , **2006,** 44(4): 17-32.

68. Stiglitz. Joseph, Distribution of Income and Wealth among Individuals, *Econometrica*, **1969**, vol. 37, issue 3, 382-97.

69. Horst Siebert, Jürgen Eichberger, Ralf Gronych, and Rüdiger Pethig, Trade and Environment. A Theoretical Inquiry, Elsevier, Amsterdam, Oxford, New York, 1980

70. Schumpeter J., Theory of Economic Development: An Inquiry into Profits, Capital, Credit, Interest, and the Business Cycle. Harvard University Press, Cambridge, MA., 1934

71. Smith Adam, An Inquiry into the Nature and Causes of the Wealth of Nations, W. Strahan and T. Cadell, London, **1776**

72. Sumner. A. and Tribe. M., Development studies and Cross-disciplinarity : Research at the social science-Physical science interface, *Journal of International Development*, **2008,** Dev. 20, 751–767.

73. Su. Ender and Knowles. Thomas W., Asian Pacific Stock Market Volatility Modeling and Value at Risk Analysis, *Emerging Markets Finance & Trade*, **2006**, Vol. 42, No. 2, pp. 18-62.

74. Palmer Karen, Wallace E. Oates and Paul R. Portney, Tightening Environmental Standards: The Benefit-Cost or the No-Cost Paradigm?, *he Journal of Economic Perspectives,* **1995**, Vol. 9, No. 4 (Autumn, 1995), pp. 119-132

75. Peloza. John, Moritz Loock, James Cerruti, and Michael Muyot, Sustainability: How Stakeholder Perceptions Differ from Corporate Reality, California Management Review, **2012,** Vol. 55, No. 1, pp. 74-97.

76. Todaro, M., & Smith, S., Economic development (10th ed.). Boston: Addison Wesley. 2008

77. Zhang, Z. X., Asian energy and environmental policy: Promoting growth whilst preserving the environment. *Energy Policy* , **2008,** 36: 3905–24.

78. Zivot Eric and Wang Jiahui, Financial Modeling Time Series with S-Plus, Springer NerYork, p385-429, 2006

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 19 February 2018 doi:10.20944/preprints201802.0124.v1

Peer-reviewed version available at Sustainability 2018, 10, 909; doi:10.3390/su10040909

79. UNEP FI, Why environmental externalities matter to institutional investors, 2010

80. World Bank Group Report, Energy Strategy Approach Paper Sustainable Development Network, 2009

Websites

1. 2016 2. 23 https://www3.epa.gov/climatechange/science/causes.html

2. 2012. 5. 1 http://www.businessinsider.com/the-top-10-benefits-of-convincing-your-company-to-care-about-sustainability-2012-3

3. 2013. 4. 19 https://www.sec.gov/News/Speech/Detail/Speech/1365171515808

4. 2017. 1. 3 https://fred.stlouisfed.org/search?st=gross+national+income+for+asia