An Empirical Study on Determinants of Sustainable Development of Sudan: A VECM Approach of Short-Term and Long-Term Relationships

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Abstract

This paper assesses several factors that might have effect on sustainable development, as proxies by Adjusted Savings (ADJS) rate in Sudan. The annual data used for time-serial analysis in this study is selected from 1992 to 2015. Inflation Rate (INF), Unemployment Rate (U) and Per Capita Income (Q) are the selected independent variables that were hypothesized to have effects on adjusted savings. Unit-root testing, optimum lag selection, Johansen Test of Co integration and VECM were conducted in this study to develop the short-run and long-run relationship among the selected variables. The result findings showed the existence of a short run and long run relationship between the independent variables with Adjusted Savings. Diagnostic checking on the models has further indicated that there is no serial correlation, heteroscedasticity and the data were normally distributed.

Keywords: Adjusted Savings, Sustainable Development, VECM, Sudan

1. Introduction

The road to sustainable broad-based development in Sudan has been hampered by a number of country-specific challenges that render Sudan's experience unique from other post conflict countries in the region. Since its independence in 1956, Sudan has been mired in several conflicts, with the exception of 1972-1983; the period after the Addis Ababa Peace Agreement was signed. These conflicts have led to huge loss of life and have severely debilitated the country's capacity for development. Development projects in areas affected by armed conflict were often undermined by insecurity and weak and disintegrating socio-economic fabric of communities. Exodus or influx of Internal Displaced Persons (IDPs) created environments not conducive for meaningful development initiatives. International isolation, the Darfur conflict, and the tenuous North-South relationship diverted attention from the development agenda and its impact on bringing peace and security. In recent years, most of the civil conflicts, including the rebellion in Southern Sudan have been resolved. But armed conflict continues in Darfur, with risks of conflict emerging in some other areas. These past and ongoing conflicts pose challenges for governance, human development, and poverty reduction in Sudan (IMF Country Report No. 13/318-2013). During the last decade, we have observed a remarkable upsurge of concern about the sustainability of economic development over the long run. As a result, considerable effort has been invested in the design of an analytical framework that can be used to think about policies that promote sustainable growth. This task has implied several methodological challenges, ranging from trying to define what is meant by sustainable development, to operationalizing the definition and designing indicators that can be used to monitor it. It is safe to state that there is not a single, commonly accepted concept of sustainable development, how to measure it, or even less on how it should be promoted. There are, in my opinion, two major views on the subject. On one hand, we have the ecologists' view that associates sustainability

with the preservation of the status and function of ecological systems. On the other hand, we have economists that consider that sustainability is about the maintenance and improvement of human living standards. In the words of Robert Solow "if sustainability is anything more than a slogan or expression of emotion, it must amount to an injunction to preserve productive capacity for the indefinite future" Solow (1999). Sustainable development (SD) is development that "meets the needs of the present without compromising the ability of future generations to meet their own needs". The definition also includes two facets: First one is about the concept of 'needs', in particular the essential needs of the world's poor, to which overriding priority should be given; and second one is the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs. Initially, SD was emphasized only the environmental issues; however, the reality of development, this concept should also encompass the social development perspectives and other key indicators such as natural, cultural and economic issues. At the 1992 'Rio Earth symposium' in Brazil, sustainable development issue was the main topic of discussion. Rio Earth Summit in Brazil was attended by 152 world leaders from around the world. The symposium's main focus was to highlight the importance of sustainability, included in agenda 21, a plan of action, and a recommendation that all countries should produce national sustainable development strategy Hatthachan (2014). Measuring sustainability has become an important issue since traditional concept of Gross Domestic Product (GDP) as indicator for measuring growth is no longer adequate to reflect sustainable development path of an economy. G Saving (GS) rate has been introduced by the World Bank during 1990s as an alternative indicator to measure sustainable development. GS measures true rate of saving in a nation by making some adjustments from GDP and net national saving, by including public expenditure on education with deducting minerals depletion and environmental degradation. It is normally expressed as a fraction from Gross National Income (GNI).

2. Empirical Studies

Following the first conception of sustainable development theory, there were numbers of publications that has defined and redefine the meaning. These literatures can be distinguished from the background of the authors, whether they're from environmental, economic, or social sciences analysts. Academic economist suggested that the concept of sustainable economic development is applied to the Third World. It is therefore directly concerned with increasing the material standard of living of the poor at the 'grassroots' level, which can be quantitatively measured by means of increased food, real income, educational services, health-care, sanitation, and water supply, emergency stocks of food and cash, etc., and only indirectly concerned, with economic growth at the aggregate. In general terms, the primary objective is reducing the absolute poverty of the world's poor through providing lasting and secure livelihoods that minimize resource depletion, environmental degradation, cultural disruption, and social instability Hamilton (1999). A recent paper by Boos (2011) has investigated the impact of resource-dependence and governance on sustainable development. The study examined the relationship between resource extraction, institutional quality, armed violence and sustainable development; using a panel data of 108 developing countries for the period of 24 years. The result finding highlights a negative relationship between resource extractions and ANS per capita, a different approach from previous authors. The findings showed that armed conflict have negative impact on ANS rate per capita. Armed conflict, as measured by homicide rate; negatively impacted ANS. Another important variable, which is the population growth tend to

have negative correlation with ANS rate per capita. It is indeed a consistent conclusion by most authors in this field that growing population would eventually decreases the level of saving in ANS, thus reducing potentiality of sustaining development.
Ploeg (2010) somehow empirically tested the impact of depletion in renewable resources on ANS rather than most studies that focused on exhaustible resources. The study suggested that some major modifications on ANS calculation should be made to consider the renewable resources. It is also understood that countries with low level of renewable resources do not necessarily will be facing a gloomy future, only if the renewability is guaranteed with no irreversible effect.

Study presented by Yamaguchi (2011) has analyzed the determinants of ANS rate with regards to its relationship with resource curse (RC) variables. Using a sample of countries from 1970 to 2008, the study showed that the curse of natural resources could have negative impact not only to economic growth, but also to capital stock in average. By using ANS rate as the proxy for sustainability, with its components (human, physical, and natural capitals) as the dependent variables, the study conclusively showed a more appropriate approach to explain Resource Curse hypothesis rather than single regressions on gross domestic product.

Gilles et al. (2011) discussed that it has often been argued that oil, gas and minerals may have a negative impact on development as measured by income per capita. Yet this assertion does not say much about sustainability, which is critical for developing countries whose economic growth derives primarily from the exploitation of exhaustible resources. The results highlight a negative relationship between natural resource extraction and ANS but indicate that this is not inevitable. The results further confirm that armed conflict and armed violence as measured by homicide rate have a negative impact on ANS.

Aidt (2010) studied the relationship between corruption and sustainable development in a sample of 110 countries between 1996 and 2007. Sustainability is measured by growth in genuine wealth per capita. The empirical analysis consistently found that cross-national measures of perceived and experienced corruption reduce growth in genuine wealth per capita. In contrast to the evidence on the relationship between corruption and growth in GDP per capita, the negative correlation between a wide range of different corruption indices and growth in genuine wealth per capita is very robust and is of economic as well as of statistical significance.

3. Theoretical Background

3.1 From Growth to Sustainable Development

Sustainable development involves the development of three realms ensuring fair living conditions. They include: natural capital, material and financial capital, as well as social and human capital. To pursue this type of development is to ensure a durable improvement of life quality through integrating and determining adequate proportions among the three types of capital in question. Sustainable development being defined in this way, the above mentioned fields of development have been assigned three mutually integrating domains, i.e. environmental, economic and the social one. It is necessary to highlight that we did not use the strict definition of the sustainable development. It was rather a theoretical construct that was made only for a purpose of this research. Sustainable development implies the fulfillment of several conditions: preserving the overall balance, respect for the environment, and preventing the exhaustion of natural resources. Reduced production of waste and the rationalization of production and energy

consumption must also be implemented. Sustainable development is presented as a more or less clean break from other modes of development, which have led and are still leading to worrying social and ecological damage on both a worldwide and a local scale. In order to be sustainable, development must combine three main elements: fairness, protection of the environment, and economic efficiency. A sustainable development project must be based on a better-developed mode of consultation between the community and the members it comprises. The success of such a policy also depends on consumers accepting certain constraints and citizens observing certain requirements with regard to transparency and participation. Robert (2005) discussed that the Brundtland Commission's brief definition of sustainable development as the "ability to make development sustainable—to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs" is surely the standard definition when judged by its widespread use and frequency of citation. The use of this definition has led many to see sustainable development as having a major focus on intergenerational equity. Although the brief definition does not explicitly mention the environment or development, the subsequent paragraphs, while rarely quoted, are clear. On development, the report states that human needs are basic and essential; that economic growth-but also equity to share resources with the pooris required to sustain them; and that equity is encouraged by effective citizen participation.

3.2 The Concept of Sustainable Development

The term 'sustainability' is originally developed from the concept of 'conservation' which was mentioned in IUCN's report on World Conservation Strategy. Sustainable utilization is a means that species and ecosystems should be utilized at levels and renewable for all practical purposes indefinitely. A society's dependence on resources would rise importance to ensure sustainable utilization of the ecosystem and species. The greater the diversity and flexibility of an economy, the less need for it to utilize certain resources sustainably. Therefore, sustainable development means a development that likely to achieve lasting satisfaction of human needs and improvement of the quality of human life. The report's definition of conservation relating to sustainability has received notable critics from social scientists, due to neglecting address on the social science aspect of conservation; especially in the aspect of economics. The Brundtland Report, prepared by the committee of World Commission on Environment and Development (United Nations) in 1987 corrected the term by signifying social science input into the definition of sustainable development. The report suggested that new development path is required, which sustained human progress not just in a few places for a few years, but for the entire planet into the distant future Faridah et al (2015). In the extensive discussion and use of the concept since then, there has generally been recognition of three aspects of sustainable development Holmberg (1992):

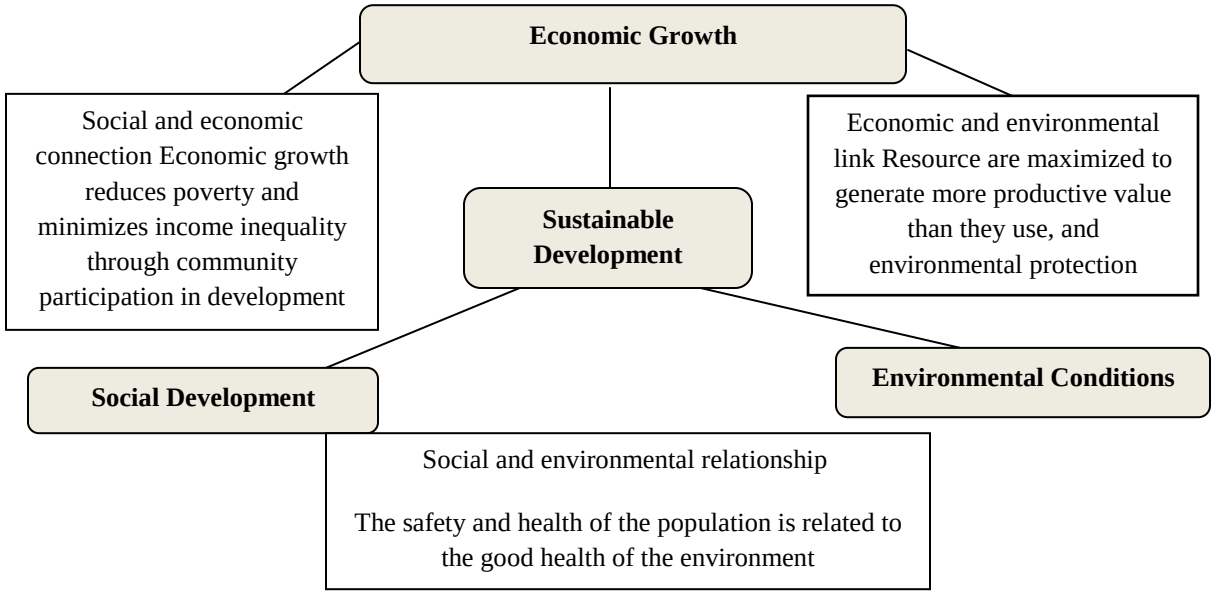
Economic: An economically sustainable system must be able to produce goods and services on a continuing basis, to maintain manageable levels of government and external debt, and to avoid extreme sectoral imbalances which damage agricultural or industrial production.

Environmental: An environmentally sustainable system must maintain a stable resource base, avoiding over-exploitation of renewable resource systems or environmental sink functions, and depleting non-renewable resources only to the extent that investment is made in adequate substitutes. This includes maintenance of biodiversity, atmospheric stability, and other ecosystem functions not ordinarily classed as economic resources.

Social: A socially sustainable system must achieve distributional equity, adequate provision of social services including health and education, gender equity, and political accountability and

participation. Clearly, these three elements of sustainability introduce many potential complications to the original simple definition. The goals expressed or implied are multidimensional, raising the issue of how to balance objectives and how to judge success or failure. For example, what if provision of adequate food and water supplies appears to require changes in land use which will decrease biodiversity? What if non-polluting energy sources are more expensive, thus increasing the burden on the poor, for whom they represent a larger proportion of daily expenditure? Which goal will take precedence? Globally, most countries have made significant advances both in GDP and in Human Development Index measures. But overall, the record of development on a world scale is open to two major criticisms: The benefits of development have been distributed unevenly, with income inequalities remaining persistent and sometimes increasing over time, The global numbers of extremely poor and malnourished people have remained high, and in some areas have increased, even as a global middle class has achieved relative affluence, There have been major negative impacts of development on the environment and on existing social structures. Many traditional societies have been devastated by development of forests, water systems, and intensive fisheries. Urban areas in developing countries commonly suffer from extreme pollution and inadequate transportation, water, and sewer infrastructure. Environmental damage, if unchecked, may undermine the achievements of development and even lead to collapse of essential ecosystems, The analysis of sustainable development is important in innovative environmental theory, because it suggests how society itself should be organized, not simply how environmental protection should be adapted or how well it can be improved. The road map of sustainable development is proposed in Figure 1 and would be a very useful framework for the current and future development of Sudan.

Figure 1: Proposed Road Map for Sustainable Development in Sudan



Source: Author's own proposal

4. Methodology

This paper attempts to determine the importance of sustainable development and aims to propose some determinants and tools that would be used to facilitate a transition towards sustainability. It uses macro data. Sample data spans over the period 1992 to 2015. The start period showed establishment of the Central Bank of Sudan, and the end period showed the secession of South Sudan**.**

4.1 Model Specification

Saving has been studied intensively using domestic and national saving as dependent variable. The main analytical tools were correlation, OLS, autoregressive distributed lag, vector autoregressive, Granger causality, and GARCH models. This section is to discuss the development of research framework from the theoretical model in earlier studies using Vector Error Correction Model (VECM). The fundamental theory is based from the extended version of economic growth model. Economic Growth Model From the basic Cobb-Douglas production function, level of national output for a country can be written as follows:

4.2 The Model

$$ADJS = C(1,1) * ADJ - S(-1) + C(1,2) * Q(-1) + C(1,3) * INF(-1) + C(1,4) * U(-1)$$

$$Q = C(2,1) * ADJ - S(-1) + C(2,2) * Q(-1) + C(2,3) * INF(-1) + C(2,4) * U(-1)$$

$$INF = C(3,1) * ADJ - S(-1) + C(3,2) * Q(-1) + C(3,3) * INF(-1) + C(3,4) * U(-1)$$

$$U = C(4,1) * ADJ - S(-1) + C(4,2) * Q(-1) + C(4,3) * INF(-1) + C(4,4) * U(-1)$$

Where:

$ADJS$: is Adjusted Savings Ratio

Q : Per Capita Rate

INF : implies the Inflation Rate

U :implies Unemployment Rate

4.3 Data Description

Annual time series data on gross savings and per capita income used as a measure of sustainable development in Sudan. The data used for investigating the determinants of sustainable development in the Sudan economy during the period 1992 – 2015 are taken from different sources. Data symbols, description and sources are depicted in table (1) below:

Table 1: Variables included, their description and sources 1992-2015

Variable	Symbol	Description	Source
Adjusted Savings	ADJS	Ratio to GNI	World Bank Estimates
Inflation Rate	INF	Million SDG	Central Bureau of Statistics
Unemployment Rate	U	Million SDG	Central Bureau of Statistics
Per Capita Income	Q	Million SDG	Central Bureau of Statistics

*** Central Bureau of Statistics & World Bank**

**** SDG means Sudanese Pound**

5. Empirical Evidence

5.1 Descriptive Statistics

The growth rates of consumer prices, money supply, and nominal exchange rate were low in 1960s then increased over the decades 1970s to 1990s, decreased in 2000s an increased again in the last five years. Nominal effective exchange rate appreciated in 1960s, followed by depreciation over 1970s to 1990s, appreciated in 2000s before depreciating in the last five year

Table (1). It is obvious that model variables tend to move together up and down. Excess money has the largest standard deviation, followed by NEER, real GDP and CPI. There is significant negative correlation coefficient of -0.61 between CPI and NEER, and very high positive correlation between CPI and real GDP. Negative correlation between CPI and excess money has been rejected. Pairwise Granger Causality test indicates that consumer price index on one hand and effective exchange rate, real GDP, and excess money on the other hand Granger cause each other. Import prices increase more rapidly than general level of prices and to a lesser extent so does the export prices.

5.2 Unit Root Results

Economic time-series data were often to be containing unit root (i.e. non-stationary) when they were observed at levels' order of integration. Regression on the data which are not stationary at levels might resulting in 'spurious' regression' and thus, is not favorable. Therefore, it is an essential exercise to conduct a unit root test on each variable before proceeding to estimation of the co-integration models. The result of unit root test is depicted in Table. The study found that only ADJS and U have unit root (non-stationary) and INF and Q doesn't have unit root at their level order of integration (stationary). All the variables ADJS, INF, U and Q can be concluded as stationary at their first difference and second difference, I (1).

5.3 Johansen Co-Integration Results

Having achieved stationary, accordingly, as Johansen co integration indicates, there should be a co-integration test. The existence of co-integration between the variables is an indication that there is a long run relationship between the variables. The co-integration test is performed using Johansen co integration two-step residual based test for the entire test statistics used. Except in the case of ADJS and U where it is found that they are co-integrated at 5% level of significance. Therefore, when Granger causality is run on these two variables (ADJS and U) in their levels, the results may be unreliable and misleading. The Johansen co integration test in appendix 1 result in presented with the variables in their first differences and second one. The result of the co integration means that there is no long run relationship between adjusted savings and unemployment, inflation and per capita income. In view of the absence of co integration between the variables, we estimate the granger causality using VECM model. However, we have to first estimate the VECM lag order selection criterion to enable us to know the extent of the lag length that we should use in estimating the VECM model.

5.4 Vector Error Correction Results

Since the existence of co integration are found among the variables of interest, the study proceed to estimate the long-run relationship between ADJS and its determinants - INF, U and Q. VECM (Vector Error Correction) is run to estimate the long-run and short run relationship model of adjusted savings in Sudan. The first VECM C (1) is negative -0.013478 and P value is 0.9289 not significant, meaning there is no long run causality run form INF, U and Q independent variables to ADJS dependent variable. Then after running Wald test the P value 0.8284 which is not significant and more than 5%, meaning we cannot reject null hypothesis, that is there is no short run causality running from Independents variables INF, Q and U to dependent variable ADJS. The second VECM C (1) is negative -0.267464 and P value is 0.0000 which is significant. Also after running Wald test the P value 0.0012 which is significant and less than 5%, meaning we can reject null hypothesis and accept alternative hypothesis, that is there is a short run causality running from Independents variables INF, Q and U to dependent variable ADJS. Concluding that there exist short and long run causality run form INf, U and Q independent variables to ADJS

dependent variable. In sum, the speed adjustment is -0.267464 as annual data that is the whole system is getting back to long run to equilibrium at the speed up of -0.267464 annually.

6. Discussion

This study investigated the various determinants of Adjusted Savings rate in Sudan. A VECM approach of long-run and short-run model of relationship between inflation rate, per capita income and unemployment and adjusted savings rate (ADJS) have been estimated and established. The variable of interest employed in this study, ADJS rate is perceived as the proxy for sustainable development. ADJS rate have been proposed by the World Bank since 1990s as an economic indicator to measure sustainable development. In the short run, it is found that the 1-lagged values of ADJS rate, per capita income, financial development and inflation rate have significant impact on sustainable development, as proxies by ADJS rate. However in the long-run, all of the variables including minerals depletion tend to have a strong impact on sustainability in Sudan. The findings from this study have provided some insight to the researcher in terms of more in depth knowledge of saving and income theory. It can be generally concluded that firmed macroeconomic policy should be carefully designed by policymaker in order to ensure a sustainable development progress in both economic and environmental aspects, especially for a country like Sudan.

There are two basic results linking levels of saving (defined as the change in real wealth, excluding capital gains) and development prospects.

First, if adjusted net savings are positive at a point in time, then the present value of social welfare along the development path is increasing. This implies, of course, that a development path where net saving is everywhere positive is also one where the present value of social welfare is always increasing. To answer the question of whether prospects for social welfare are improving, therefore, it is sufficient to measure net saving. Second, if adjusted net saving is negative at a point in time, then not only is the present value of social welfare declining, but the level of social welfare over some interval in the future along the development path must actually be lower than current social welfare. This is equivalent to saying that the economy is on an unsustainable path. Negative net saving is therefore an indicator of un sustainability.

7. Conclusion

Finally, there exists a strong necessity to obtain much more detailed statistical data regarding environmental issues. Moreover, it can be difficult to make a research on sustainable development without finding a statistical method, which will enable us to recognize a real character of environmental phenomena. Furthermore, in the future, quantitative research concerning sustainable development, it should be considered weighting of each variable and, consequently, of each component in order to minimize the prevalence of socioeconomic domains over environmental ones, which results from the different access to statistical data. The major policy implication from our findings indicate that the unemployment crisis is related or linked to the endogenous and exogenous causes explained above, therefore reducing unemployment and enhancement of employment creation are most probably related or linked to several important factors and so policies intervention should deal with these endogenous and exogenous reasons or causes. The solution to the unemployment problem in Sudan not only includes the role of the government and public sector, but also essential roles for the private sector and nongovernmental organizations as well as civil society. Therefore, solving political problems and achieving political stabilization; ensuring equity and fairness in the labor market; attracting foreign capital

for the creation of new employment opportunities for domestic and local workers and upgrading skill levels; creating more job opportunities for the poor by enhancing small and medium scale enterprises and provide unemployment insurance; enhancing small and family projects; implementing balanced development strategies and improving work conditions and availability of infrastructure and offering incentives to encourage work in the remote states; and finally use of oil revenues to create more and new employment opportunities for domestic workers in Sudan. It is important to realize that the unemployment crisis cannot be managed in a sustainable way through increased employment in an already inflated public sector; productive employment must be generated mostly in the private sector. Dealing with the unemployment crisis and meeting the poverty alleviation challenge requires action in wide-ranging areas of structural reforms to improve the business environment, sector investment, stimulate productivity growth and enhance efficiency. The implementation of plans simultaneously targeting reducing unemployment and poverty, for instance, provision of more employment opportunities and poverty alleviation, are related to improving infrastructure and facilities of value to the whole society, using labor-intensive methods or schemes to generate employment for large numbers of poor people as well as mobilizing small, informal enterprises where many of the poorest workers are concentrated. These strategies are expected to also lead to sustainable job creation and therefore poverty alleviation.

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Appendices

Appendix 1: Co integration Test

Date: 02/16/17 Time: 19:36
Sample (adjusted): 1994 2014
Included observations: 21 after adjustments
Trend assumption: Linear deterministic trend
Series: ADJ_S INF U Q
Lags interval (in first differences): 1 to 1
Unrestricted Co integration Rank Test (Trace)

Hypothesized		Trace	0.05	
No. of CE(s)	Eigen value	Statistic	Critical Value	Prob.**
None	0.764272	47.31919	47.85613	0.0561
At most 1	0.37677	16.97254	29.79707	0.6421
At most 2	0.262152	7.042905	15.49471	0.5726
At most 3	0.030873	0.658543	3.841466	0.4171

Trace test indicates no co integration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Appendix 2: Vector Error Correction Estimates

Vector Error Correction Estimates
Date: 02/16/17 Time: 19:33
Sample (adjusted): 1995 2014
Included observations: 20 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1			
ADJ_S(-1)	1			
INF(-1)	0.077893			
	-0.00324			
	[24.0641]			
U(-1)	-0.21127			
	-0.09139			

	[-2.31161]			
Q(-1)	-0.00114			
	-0.00015			
	[-7.58485]			
92	0.676771			
C	-12.3227			
Error Correction:	D(ADJ_S)	D(INF)	D(U)	D(Q)
CointEq1	-0.66125	-15.1371	0.366601	433.0737
	-0.50466	-5.9735	-0.39186	-541.363
	[-1.31030]	[-2.53404]	[0.93554]	[0.79997]
D(ADJ_S(-1))	0.398715	13.03457	-0.0175	-137.887
	-0.47495	-5.62189	-0.36879	-509.497
	[0.83948]	[2.31854]	[-0.04745]	[-0.27063]
D(ADJ_S(-2))	0.208358	6.472748	0.583466	-87.2372
	-0.35796	-4.23703	-0.27795	-383.991
	[0.58208]	[1.52766]	[2.09920]	[-0.22719]
D(INF(-1))	0.035875	0.624902	0.008306	-27.5639
	-0.03527	-0.41752	-0.02739	-37.8389
	[1.01707]	[1.49670]	[0.30324]	[-0.72846]
D(INF(-2))	0.02221	0.222588	0.007944	-8.93828
	-0.01912	-0.22629	-0.01484	-20.5077
	[1.16176]	[0.98366]	[0.53518]	[-0.43585]
D(U(-1))	-0.11129	2.133892	-0.34897	-134.713
	-0.22063	-2.6115	-0.17131	-236.673
	[-0.50444]	[0.81711]	[-2.03706]	[-0.56919]
D(U(-2))	0.154964	9.367979	0.121769	-110.427
	-0.23909	-2.83002	-0.18565	-256.477
	[0.64815]	[3.31022]	[0.65592]	[-0.43055]
D(Q(-1))	-0.0002	-0.00947	0.000259	-0.39378
	-0.00045	-0.00535	-0.00035	-0.48466
	[-0.44329]	[-1.77074]	[0.73859]	[-0.81247]
D(Q(-2))	0.000553	-0.00195	0.00044	-0.21358
	-0.00031	-0.00361	-0.00024	-0.32722
	[1.81143]	[-0.53920]	[1.85691]	[-0.65272]
C	1.242037	-30.0753	-0.40887	-78.8171
	-1.06388	-12.5929	-0.82609	-1141.26
	[1.16746]	[-2.38827]	[-0.49495]	[-0.06906]
92	-0.08175	2.635601	0.061413	-2.90406
	-0.07926	-0.9382	-0.06155	-85.027
	[-1.03140]	[2.80920]	[0.99784]	[-0.03415]

R-squared	0.638576	0.810185	0.800329	0.437244
Adj. R-squared	0.236994	0.59928	0.578473	-0.18804
Sum sq. resids	20.65502	2893.948	12.45347	23768952
S.E. equation	1.514927	17.93181	1.176316	1625.114
F-statistic	1.590151	3.841461	3.607417	0.699273
Log likelihood	-28.701	-78.1252	-23.6414	-168.26
Akaike AIC	3.970103	8.912522	3.464144	17.92604
Schwarz SC	4.517756	9.460175	4.011797	18.47369
Mean dependent	-0.1943	-3.5539	0.05	19.715
S.D. dependent	1.734314	28.32718	1.811803	1490.968
Determinant resid covariance (dof adj.)		2.33E+08		
Determinant resid covariance		9550353		
Log likelihood		-274.236		
Akaike information criterion		32.2236		
Schwarz criterion		34.61335		

Vector Error Correction Estimates
Date: 02/16/17 Time: 19:29
Sample (adjusted): 1995 2015
Included observations: 21 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Co integrating Eq:	CointEq1			
GS_GDP(-1)	1			
INF(-1)	0.359112			
	-0.06233			
	[5.76153]			
U(-1)	5.699316			
	-1.45903			
	[3.90624]			
Q(-1)	-0.00557			
	-0.00399			
	[-1.39640]			
C	-116.868			
	-24.6292			
	[-4.74511]			
Error Correction:	D(GS_GDP)	D(INF)	D(U)	D(Q)
CointEq1	-0.17421	-0.86378	-0.04791	0.210872
	-0.26253	-0.47557	-0.03925	-34.9926
	[-0.66360]	[-1.81629]	[-1.22081]	[0.00603]
D(GS_GDP(-1))	-0.15964	-0.06807	-0.00076	-19.4539
	-0.31232	-0.56577	-0.04669	-41.6293
	[-0.51113]	[-0.12032]	[-0.01620]	[-0.46731]

D(GS_GDP(-2))	-0.12483	0.059053	0.016951	4.164416
	-0.37764	-0.6841	-0.05646	-50.3366
	[-0.33054]	[0.08632]	[0.30024]	[0.08273]
D(INF(-1))	0.129731	0.039786	0.024749	-0.90526
	-0.14008	-0.25375	-0.02094	-18.671
	[0.92614]	[0.15679]	[1.18183]	[-0.04848]
D(INF(-2))	-0.0202	0.100744	0.025902	1.267246
	-0.10827	-0.19613	-0.01619	-14.4314
	[-0.18660]	[0.51366]	[1.60026]	[0.08781]
D(U(-1))	1.726858	-0.62487	-0.08887	-42.7408
	-1.63138	-2.95524	-0.24389	-217.447
	[1.05853]	[-0.21144]	[-0.36438]	[-0.19656]
D(U(-2))	2.468178	5.600637	0.1339	-38.9367
	-1.56847	-2.84128	-0.23448	-209.063
	[1.57362]	[1.97116]	[0.57104]	[-0.18624]
D(Q(-1))	-4.43E-05	-0.00535	-2.45E-05	-0.67348
	-0.00248	-0.0045	-0.00037	-0.3312
	[-0.01782]	[-1.18792]	[-0.06603]	[-2.03348]
D(Q(-2))	0.001239	-0.00251	0.000197	-0.33746
	-0.00228	-0.00413	-0.00034	-0.30373
	[0.54351]	[-0.60750]	[0.57826]	[-1.11104]
R-squared	0.343329	0.672803	0.455402	0.36051
Adj. R-squared	-0.09445	0.454671	0.092336	-0.06582
Sum sq. resids	1520.277	4988.846	33.97826	27009947
S.E. equation	11.25566	20.38963	1.682713	1500.276
F-statistic	0.78425	3.084392	1.254324	0.845621
Log likelihood	-74.76	-87.2373	-34.8503	-177.503
Akaike AIC	7.977146	9.165457	4.176218	17.76221
Schwarz SC	8.424798	9.61311	4.623871	18.20987
Mean dependent	0.004952	-3.50371	0.057143	19.69048
S.D. dependent	10.75902	27.61088	1.766231	1453.216
Determinant resid covariance (dof adj.)		9.94E+10		
Determinant resid covariance		1.06E+10		
Log likelihood		-361.575		
Akaike information criterion		38.34045		
Schwarz criterion		40.37976		

Appendix 3: Vector Error Correction Estimates

Vector Error Correction Estimates
Date: 02/16/17 Time: 19:31
Sample (adjusted): 1994 2015
Included observations: 22 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Co integrating Eq:	CointEq1			
GS_GNI(-1)	1.000000			
INF(-1)	1.587369			
	(0.49885)			
	[3.18205]			
U(-1)	-40.60009			
	(10.2905)			
	[-3.94539]			
Q(-1)	0.068600			
	(0.02027)			
	[3.38451]			
@TREND(92)	11.48012			
C	443.6791			
Error Correction:	D(GS_GNI)	D(INF)	D(U)	D(Q)
CointEq1	-0.043074	0.026138	0.020140	-5.230931
	(0.04571)	(0.06153)	(0.00412)	(3.99080)
	[-0.94242]	[0.42480]	[4.89020]	[-1.31075]
D(GS_GNI(-1))	-0.291388	-0.342068	-0.020272	-10.67890
	(0.23919)	(0.32200)	(0.02155)	(20.8850)
	[-1.21822]	[-1.06234]	[-0.94056]	[-0.51132]
D(INF(-1))	0.114744	-0.457357	-0.018474	8.483076
	(0.15030)	(0.20233)	(0.01354)	(13.1236)
	[0.76342]	[-2.26040]	[-1.36408]	[0.64640]
D(U(-1))	-0.758747	-4.660658	-0.183247	-118.3442
	(1.63701)	(2.20370)	(0.14750)	(142.934)
	[-0.46350]	[-2.11492]	[-1.24232]	[-0.82796]
D(Q(-1))	0.001630	-0.001819	-0.000796	-0.310036
	(0.00298)	(0.00402)	(0.00027)	(0.26042)
	[0.54651]	[-0.45298]	[-2.96181]	[-1.19051]
C	4.040012	-22.71289	0.793227	287.2453
	(7.89212)	(10.6242)	(0.71112)	(689.095)
	[0.51190]	[-2.13784]	[1.11545]	[0.41684]
@TREND(92)	-0.295476	1.557174	-0.032893	-16.85641
	(0.55451)	(0.74647)	(0.04996)	(48.4170)
	[-0.53286]	[2.08604]	[-0.65832]	[-0.34815]
R-squared	0.155752	0.575541	0.740358	0.342783
Adj. R-squared	-0.181947	0.405757	0.636501	0.079896
Sum sq. resids	3641.124	6598.423	29.56236	27759157
S.E. equation	15.58017	20.97367	1.403860	1360.371
F-statistic	0.461216	3.389846	7.128646	1.303919
Log likelihood	-87.41571	-93.95563	-34.46670	-185.7450
Mean dependent	-0.210273	-2.700227	0.390909	18.45000
S.D. dependent	14.33089	27.20774	2.328480	1418.205
Log likelihood		-400.7902		