Ghana Petroleum Fund Experiment

´Can a Petroleum Fund help Ghana manage its petroleum revenue (wealth)? An Experimental Inquiry´

By

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Abstract

Ghana starts petroleum production and export business in the third quarter of 2010. The management of the petroleum tax revenue is seen as timely fiscal policy decisions by the government and its partners. These policy decisions could either lead to a "blessing**"**; managing the revenue well or a "curse"; mismanaging the revenue, if right decisions are not taken. Studies also show that people commonly misperceive the dynamics of a system when making decisions, resulting to poor outcomes of their decisions.

The following hypotheses were made: first, policy makers in Ghana will mismanage its petroleum tax revenue through a Fund- 'curse'. Second, policy makers will misperceive the dynamics of a petroleum economy while making spending decisions. Third, misperceptions lead to a cyclical development of the total capacity utilisation.

A system dynamics model-based experiment was carried out in Ghana to test these hypotheses. The model behind the experiment captured a simple macroeconomic dynamics of a petroleum economy, which shares some essential features of Ghana's economy. The experiment was supported with administering of questionnaire, interviews and field data. Selected policy makers from the Bank of Ghana, Ministry of Finance and Economic Planning and the Parliamentary Committee on Finance formed the subjects of the experiments.

The experimental output indicates a potential for policy makers in Ghana managing its petroleum tax revenue well through a Petroleum Fund. Most policy makers seemed to have based their spending decisions on the Fund inflows, leading to misperceptions of the dynamics of the petroleum economy. This created a cyclical development of the total capacity utilisation and other economic indicators. It is recommended that, a Petroleum Fund is established in Ghana with a strong fiscal policy and a discipline commitment attached to its management.

Key words: Ghana Petroleum Fund, Petroleum Tax Revenue, System Dynamics, Public Spending, Total Capacity Utilisation, Misperceptions

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1. Introduction

Countries endowed with natural resource are faced with resource revenue management problems. These problems are so universal to the extent of having a whole vocabulary developed to describe it. Terms like the "resource curse,'' the "paradox of plenty," "Dutch disease," "economic indigestion," "the devil excrement," and even the "banyan tree problem" have all been used to describe these problems, Tsalik (2003). This is because, in recent years countries endowed with the resource blessings have continuously underperformed the natural resource-poor countries on most indicators of progress; human development index, economic growth, good governance and political stability. This is also supported by Sachs and Warner (2001). Gylfason (2001) named countries like Nigeria, Iran and Kuwait as examples of countries facing the curse with its gross domestic product (GDP) remaining the same or growing slowly after decades of discovering oil. He also argues that rich countries seem to escape this curse, citing Norway for example. The resource curse is discussed into details by Corden and Neary, (1982); Corden, (1984); Steven, (2003) through the "Dutch Disease syndrome"[1].

In order to avoid this curse or syndrome, countries like Norway, Chile, the State of Alaska, Venezuela, Kuwait and Oman has established a Fund with an aim of saving the excess revenue made in the oil boom periods for bad periods or future generations or different purposes, Ugo (2000). He points out that, out of the above mentioned countries, only Norway and Chile have managed their Funds well while Venezuela did run its Fund into deficits in 1999. He attributes this to both the fiscal policies and discipline attached to the Fund management by governments. In addition, the loopholes in the Funds'

[1] According to Corden and Neary, (1982), the resource curse (Dutch Disease) occurs when the growth of the traditional export sector (manufacturing sector) of an economy is hindered by the operations of the booming sector (resource producing sector). This hindrance is attributed to both the spending and resource movement effects. They divide the boom economy into three sectors such as the booming sector (resource producing sector) and lagging sector (manufacturing or traditional export sector), which are the traded goods sectors. The third is the non traded sector, which supplies the domestic needs (retail trade, services and construction. etc).

revenue allocation mechanisms, the attached legislation and the various political manipulations affect its management (Econ. Devt. and Pros., 2005; Eifert et al., 2002; Gelb and Grasmann, 2008). Despite these challenges, the Petroleum Fund is recommended as the way forward in minimising the resource curse (dutch disease), when there is a high degree of transparency, strong institutions and fiscal policy discipline attached to its management. This attests to why Norway has so far managed its Funds to minimise the resource curse and ensure economic growth (Gelb and Grasmann, 2008 and Ugo, 2000).

In light of the above mentioned challenges faced by natural resource countries in the revenue management, we attempted to investigate the following problematic issues of concern to Ghana's petroleum revenue management: First, we ask: will Ghana face these challenges in the natural resource revenue management? We hypothesised that policy makers in Ghana will mismanage its petroleum tax revenue through a Fund. This implies that Ghana will join the unsuccessful stories of the Fund management by these countries; Venezuela and Oman (Ugo, 2000). The research focused much on the rationales behind the outcomes[2]. In adding up to the existing literature on the revenue management challenges faced by natural resource economies led to the next research questions:

Will policy makers[3] misperceive the dynamics of natural resource economies (petroleum economy) when making spending decisions[4]? If yes, will it create a cyclical development of the total capacity utilisation (total CU)? We hypothesised that policy makers will misperceive the dynamics of a petroleum economy when making spending decisions. In addition, misperceptions of the dynamics of the petroleum economy lead to a cyclical in the total CU. The word 'misperceptions' implies the tendency of experiment subjects to base their decisions on too simple mental models. Thus, deciding on annual budget deficit payments based on the Fund inflows (petroleum tax revenue) and also failing to recognise the dynamics of the economy. These dynamics includes: first, the influence of the multiplier effect (ME) on the economy. Second, the delay time between the domestic

[2] Outcomes are the results of experiment or the observed subjects' behaviours.
[3] Policy Makers refer to the subjects of the experiments.
[4] Public Spending Decisions are the decided budget deficits payment decisions made by the subjects of the experiments. Other spending decisions are internally made by the model.

market demands (DMDs)[5] and production capacity (PC). Third, the feedback effects of subjects` decisions on the development of total capacity utilisation (TCU) and other indicators.

The two hypotheses on misperceptions surrounding spending decisions and leading to cyclical development of TCU were motivated by these studies (Moxnes and Jensen, 2009; Moxnes, 2004, 1998b, Rouwette et. al., 2004; and Sterman, 1989). It is explained that people commonly based decisions on too simple mental models. By doing so, they fail to recognise the dynamics and the feedback structures of the systems that their decisions affect. In an experiment conducted by Moxnes (1998b) explained the role of misperceptions of bioeconomics thus, how subjects' decisions based on static mental models led to the overexploitation of renewable resources. In addition, Sterman (1989) attributed the poor performance of subjects in an inventory management experiment 'Beer Distribution Game' to the misperception of feedback. Thus, subjects' insensitivity to the feedback from their decisions to the environment in which, they operate. From these experimental outcomes and the challenges faced by natural resources countries, to investigate the tendency for policy makers in Ghana to misperceive the dynamics of a petroleum economy and its possible implications is worth pursuing.

In addressing the research questions, a simple macroeconomic model-based computer experiment was carried out in Ghana. This involved selected policy makers from these bodies; the Bank of Ghana, the Parliament, and Ministry of Finance and Economic Planning. They acted as government appointees in charge of managing Ghana's petroleum tax revenue through a Fund. This implies making annual budget deficit payment decisions (public spending decisions) strictly to be financed from the Fund. A questionnaire was also designed to assist in finding out the rationales behind subjects' decisions (appendix II). The model captures some features of a petroleum economy, which are similar to some aspects of Ghana's economy. Ghana was selected as the experiment based country because it joins the petroleum exporting countries in the third

[5] Domestic Market Demands (DMDs) are the total market demands for the modeled economy. DMDs can be seen as national demands including both public and private sectors for any given time.

quarter of 2010. In addition, the issues mentioned above are of a major concern to the government of Ghana and its development partners. Besides, none of the literature on Ghana's oil discoveries (Gary, 2009; Breisinger et al; Osei et al and World Bank 2009), have made attempt to address the problems of misperceptions surrounding spending decisions as done in this paper. Moreover, this is the first experiment to involve real policy makers of these categories.

The next chapter gives a detail description of the underlying model behind the experiment. Chapter three explains the experiment design and hypotheses. Chapter four presents the experiment results, which indicates the potentials for policy makers in Ghana managing its petroleum tax revenue well through a Fund. In addition, subjects' spending patterns followed the public expenditure patterns of most petroleum producing countries in relation to revenue inflows. There was also a great ideal of misperceptions surrounding public spending decisions, which resulted in a cyclical development of the total capacity utilisation. Chapter five discusses the research outcomes, the responses to questionnaire and policy suggestions from the policy makers, who were involved in the experiment. Lastly, the paper is concluded with the main findings of the research work and some policy suggestions from the policy makers involved in experiment, for a supposed proper management of Ghana's petroleum tax revenue.

2. Research Method and Model Description

2.1. Research Method

System dynamics (SD) is a research method, which enhances learning in complex systems (Sterman, 2000). Thus its application is in studying and understanding the dynamics and the complexities of systems; business, economic, health and others. The SD method has been applied in several studies to facilitate the learning of feedback and delay structures of systems as well as the misperceptions of systems (Moxnes and Jensen, 2009; Moxnes, 2004, 1998b; Rouwette et. al., 2004 and Sterman, 2000, 1989, Wheat Jr., 2007). This explains why SD method of researching was applied in this study; to break

the myth of misperceptions surrounding public spending decisions making and petroleum Fund management.

Moreover, SD method provided us with the modeling tools for developing the mimic macroeconomic model behind the experiment. Through the interactive learning environment component of the SD method, a computer-based experiment was developed. This created a platform for the subjects (policy makers) to interact with the developed model and also facilitated the learning aspect of the experiment. In addition, SD method has been used by Moxnes (1982) on designing governmental policies for oil production rates and oil income spending for Norway. He explains why he opted for SD models but not the existing MSG model, which was not useful to his work focus. Our work shares some similarities with his work with reference to the complexity of petroleum tax revenue spending and its impacts on the macroeconomic developments.

Other research techniques used were; interviews and questionnaires. Other issues relating to the experiment design will be explained in detail in the next chapter.

The concept of stocks and flows commonly used in the field of system dynamics was applied in explaining the structural interactions of the model. This concept is well explained by Sterman (2000) and also used in addressing issues of misperceptions (Moxnes and Jensen, 2009; Moxnes, 2004, 1998b and Sterman, 1989).

2.2 Model Description

After explaining why SD method of researching was adopted. We proceed by explaining the mimic macroeconomic model behind the experiment and the assumptions used in its building. As mentioned earlier, the model shares some features of a national economy similar to Ghana, our country of study. First, an overview of the model is given. This is followed by a detail model structural description. The model is structured as follows: the multiplier effect structure, the total capacity utilisation and domestic cost level structure and the Fund structure. The section is concluded with an explanation on why some features of the economy excluded from the model.

2.2.1 Model Overview

A general structural overview of the macroeconomic model (the assumed petroleum economy) has been illustrated in **Fig.2.1**. As captured in the diagram, subjects` spending decisions (decided budget deficit payments) and grants annually add to spending (TNS)[6] for the economy. Spending is then divided into savings/capital investments and consumption. Both add up to domestic market demands (DMDs), which is transferred into the gross domestic product (GDP) through production capacity and capacity utilisation. The total output of the economy (GDP) is increased at the end of the economic activity as a multiply change in the initial total spending. This is described as the consumption multiplier or spending effect or multiplier effect (Blinder, 2008). In short, while spending increases, so does consumption and investments. This tends to increase total output (GDP), which feeds back into the economy to increase the next spending figure in a closed economy.

In the contrast, **fig. 2.1** shows an opening economy, which is exposed to other competing economies. Thus, the domestic market demands share for production sector of the economy is decreased by imports and increased by exports. Both exports and imports are influenced by the domestic cost level (DCL) in relation to the prices of the foreign substitutes. The DCL is subjected to the development of the total capacity utilisation (TCU), thus an increase in TCU corresponds to an increase in DCL. In the long run, the net balance of imports and exports (trade deficits or surplus) affects the Fund balance instead of the decided budget deficit payment. The Fund balance is increased by the petroleum tax revenue, interest on Fund (if positive balance), trade balance (if surplus) and grants. It is decreased by the trade balance (if deficits) as mentioned.

The next section focuses on the assumptions and key equations applied in the model structure building.

[6] Spending refers to all forms of all spending from both public and private sectors of the economy. Other forms of spending decisions are internally calculated by the model except the subjects' spending decisions (decided budget deficit payment).

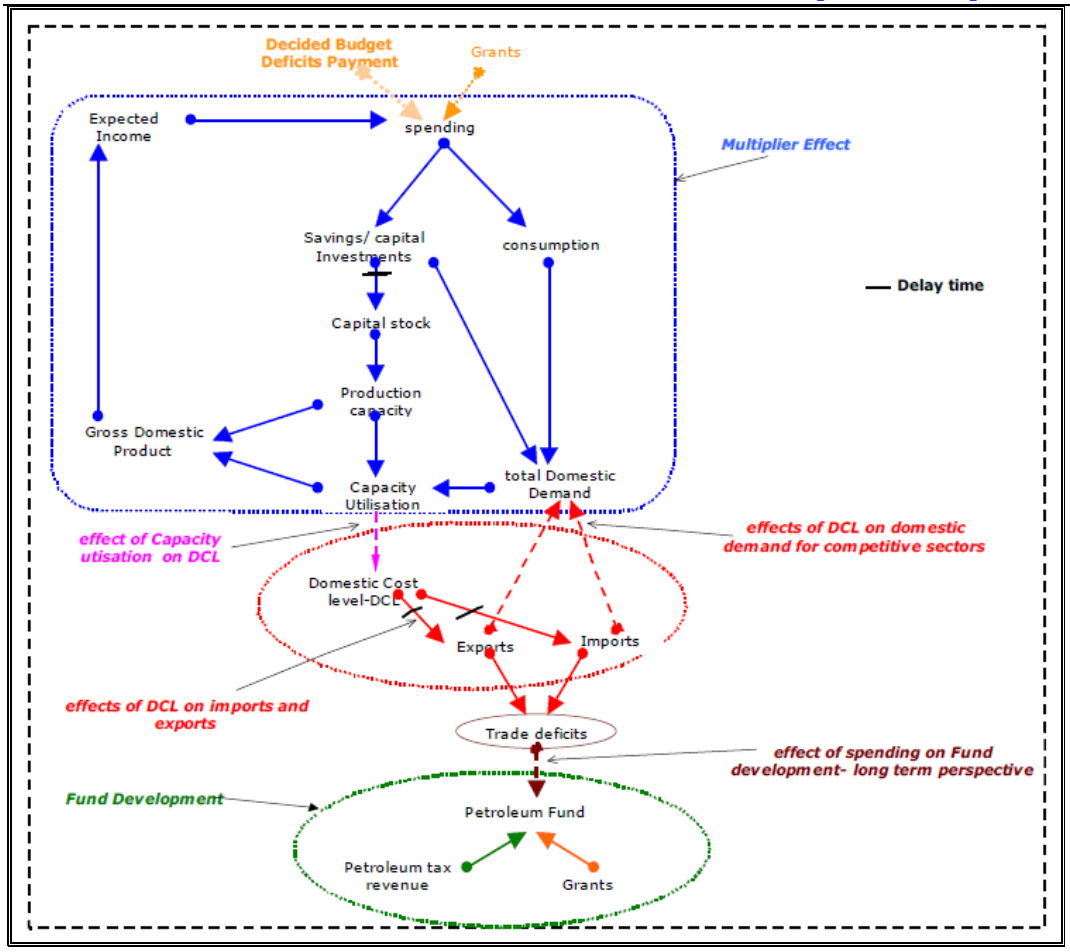


Fig.2.1 Mimic Macroeconomic and Petroleum Fund Structure

2.2.2 Model Structures

The model is explained under the three main structures to boost readers' understanding of the unique dynamics within each structure and its relevance to the paper. The structural linkages are identified and explained along. The section is summed up with an explanation on the macroeconomic variables that were not included in the model. Note, most of the formulas and assumptions used in the model building were derived mainly from these literature (Ghana Budget Statement, 2009; Moxnes, 1982; Sterman 2000; T 21 model and others)

2.2.2.1 The Multiplier Effect Structure

From the Keynesian model of economic activity, multiplier effect occurs when output increases by a multiple of the original change in spending that caused it (Blinder, 2008). In order to test if policy makers misperceive the dynamics of a petroleum economy when making annual spending decisions, we modelled the economic dynamics of multiplier effect and the inherent time delays within such dynamics as seen in **fig. 2.2**. The multiplier effect (**fig.2.2)** starts with the yearly subjects' decisions (decided budget deficit payment) in billion Ghana cedi (billion GHS)[7]. In reality, decided budget deficit payment (DBDP) takes more than half a year to be effected. To capture this reality, the transfer from DBDP to spending is delayed by half a year through a variable called budgeted government revenue from Fund. Spending is the internally generated revenue of the economy (both public and private) in addition to the subjects' DBDP and constant grants of 0.898 billion GHS.

Spending (total spending for the economy)

=Spending domestic income[8] *+ Budgeted Government revenue from Fund + Grants*

Spending is then divided into normal savings (saving/capital investments) and total consumption. First, normal savings are transferred into capital investments depending on the expected capacity cost index (Expected CCI). Expected CCI regulates the assumed constant saving rate of twenty five percent (25%) and CCI. It also ensures a balance relationship between total capital investments and normal savings with a time delay of one year captured by the variable, change in expected CCI.

Normal savings= spending saving rate*

[7] Ghana Cedi (GHC) is the currency used in Ghana, our case study country.
[8] Spending domestic income (internally generated revenue) represents the domestic revenue for both public (domestic revenue or other government incomes) and private (the household disposable income) sectors. This also is the part of the GDP to be spent for the next economic activity.

*Where, saving rate=0.25*expected CCI*

$$\textit{Expected CCI (t)} = \int_{t0}^{t} [\text{Change in Expected CCI (s)}]\, ds + \textit{Expected CCI } (t_0)$$

Where, change in expected CCI= CCI-Expected CCI / change time. The change time is one year.

Capacity Cost Index (CCI)

$$= \textit{Expected CCI}*[\alpha*(\textit{Normal savings /total capital investments-1})]$$

Where, α= (1-0.2) representing the probability of change of CCI and its long term effect on expected CCI, which affects normal savings share of spending through the saving rate.

The capital investments (CI) of the two production sectors of the economy formed the total capital investments (TCI). These sectors are named as; the protected sector (p) - without foreign market competition and competitive sector (c) - facing foreign market competition. The CI adds up to the capital stock for both sectors and then transfer to production capacity with an assumed constant technology improvement rate of 0.005% in an exponential growth. The equations below apply to both sectors (p & c):

Capital Stock CS (t)

$$= \int_{t0}^{t} [\text{CI(s)} - \text{D(s)}]\, ds + \textit{CS } (t_0)$$

*Where, CS (t_0) = the initial capital value of 0.5*51.6(billion GHS). Depreciation D(s) = CS* Capital lifetime. A capital lifetime of 15 years (straight line depreciation method) was assumed.*

Capital Investments (CI)

$$= \textit{DELAYINF [MAX (C, (CU * CS /CCI} - \textit{CS)/ n +D)}, \lambda, \infty, \textit{Initial D]}$$

Where, DELAYINF is the time delay function indicating the time for capital investments to convert into capital stock for production. MAX function prevents a scenario of negative investments with letter C representing the zero limits of investments (Billion in GHS). Letter ***n*** *denotes investments to capital conversion time of two years. CU- Capacity Utilisation, CCI- Capacity Cost Index, CS- Capital Stock. D is the depreciation and Initial D is the initial depreciation of 2.300 Billion GHS. The symbols;* λ *and* ∞ *denote the investment delay time of one year and the third order delay, respectively. The equation; (CU * CS /CCI – CS)/ n +D) of CI represents the needed capital investments at any given time.*

Production Capacity PC (s)

$$= Exp\ (e*(TIME-STARTTIME))*(CS_{(s)} / CS_{(0)})*(PC_0)$$

Where, Exp is the exponential growth function indicating the assumed economic growth fraction. The letter ***e*** *is the technology improvement rate of 0.005 per year to slow down the growth rate of the entire economy. This is because the model does not capture all aspects of an economy. The equation (TIME-STARTTIME) ensures that the model produces different* ***e*** *at any given time. CS (s) is the capital stock for any given time and CS (o) is the initial capital stock.* PC_0 *is the initial production capacity of 17.216 Billion GHS (for both sectors). We assumed that the initial GDP is the same initial PC.*

The production capacity for each sector (p or c) is multiplied with its respective capacity utilisation (CU) to form the production (output- p and c), which add up to the GDP. With the applied exponent growth function in *PC* multiplies the *GDP* to increase the expected income. The expected income then decreases the GDP transferred into the Unused Income[9] stock through the spending domestic income. This adds up to grants and the

[9] Unused income is an assumed portion of the expected income not to be spent immediately. This is different from the normal savings. It also captures the fact that in reality is not all of the GDP is transferred back into the economy immediately or not.

decided budget deficit payment (DBDP) by subjects to form the spending figure for another economy activity (multiplier effect).

Equations as follows:

Expected Income EI (t)

$$= \int_{t0}^{t} [\text{change in EI(s)}]\ ds + EI\ (t_0)$$

Where, Change in EI is the change in expected income at any given time.

Change in EI(s) = (GDP-EI)/expectation formation time). Where, the expectation formation time is assumed as one and half years. This indicates the length of time for the GDP to be transferred into an expected income for spending. EI_0 is expected income for the previous time.

After explaining the first component of spending- normal saving and the multiplier effect, next section focuses on the second component- the total consumption (TC) and the multiplier effect. The TC in addition to the total capital investments (TCI-capital inventory) from savings formed the domestic market demands (DMDs). The DMDs is shared between the two sectors as; domestic demand p (protected sector) and domestic demand c (competitive sector). Each sector's demand share is then divided by its respective production capacity (PC) to form demand supply ratio, which determines the indicated capacity utilisation ICU (see **fig. 2.7**). It takes a constant time delay of 0.4 year for the ICU to be recognised as capacity utilisation CU (actual). This is an assumed time interval for producers to be informed about market demand changes in relation to production capacity as exist in reality. The CU is multiplied with its respective PC to form production (p and c), which sums up to the GDP as a multiply change for spending in the next economic activity, thus the consumption multiplier. Some keys equations:

Domestic Demand p (demands p)

*= T C *consumption fraction p +TCI* Investment fraction p*

Domestic Demand c (demands c)

*= DMDs c *(1-Import fraction) + Exports*

Demand Supply Ratio DSR (p and c)

= demand / production capacity

*Where, DMDs c= (T C *(1-consumption fraction p) + TCI*(1- Investment fraction c))/ Price Index c. The assumed constant fractions of consumption and investments for sector p were 50% and 20% respectively indicating a large initial share of DMDs for sector but the same initial values for both CI c and p. The DMDs c is influenced by the price index and also the net balance from imports and exports. This explains how the multiplier effect structure is influenced by other competing economies. This is well discussed in the next section 2.2.2.2.*

In summary, subjects' decisions add to spending- savings/investments and total consumption, which leads to production (GDP). GDP is transferred as a multiplier change in spending for another economic activity (multiplier effect). As stated earlier, the multiplier effect is influenced by the market pressures from other competing economies because of the features of an opening economy modelled, through the demand c. Thus, the decrease and increase in demand c by the net balance of imports and exports. This effect is transferred to production c and its contribution to GDP and spending in the long run. Again, the multiplier effect structure is also affected by the price index c through domestic market demands c. These variables; exports, imports and price index c are determined by the domestic cost level (DCL), which is influenced by the total CU (national). The total CU is determined by these variables; the demand supply ratio and the production capacity for both sectors (p and c) of the multiplier effect structure. This indicates the influence of the multiplier effect on variables (imports, exports and PIc) of the other structure (**fig.2.3**) and their feedbacks to the multiplier. These interesting dynamics are further explained in the next section.

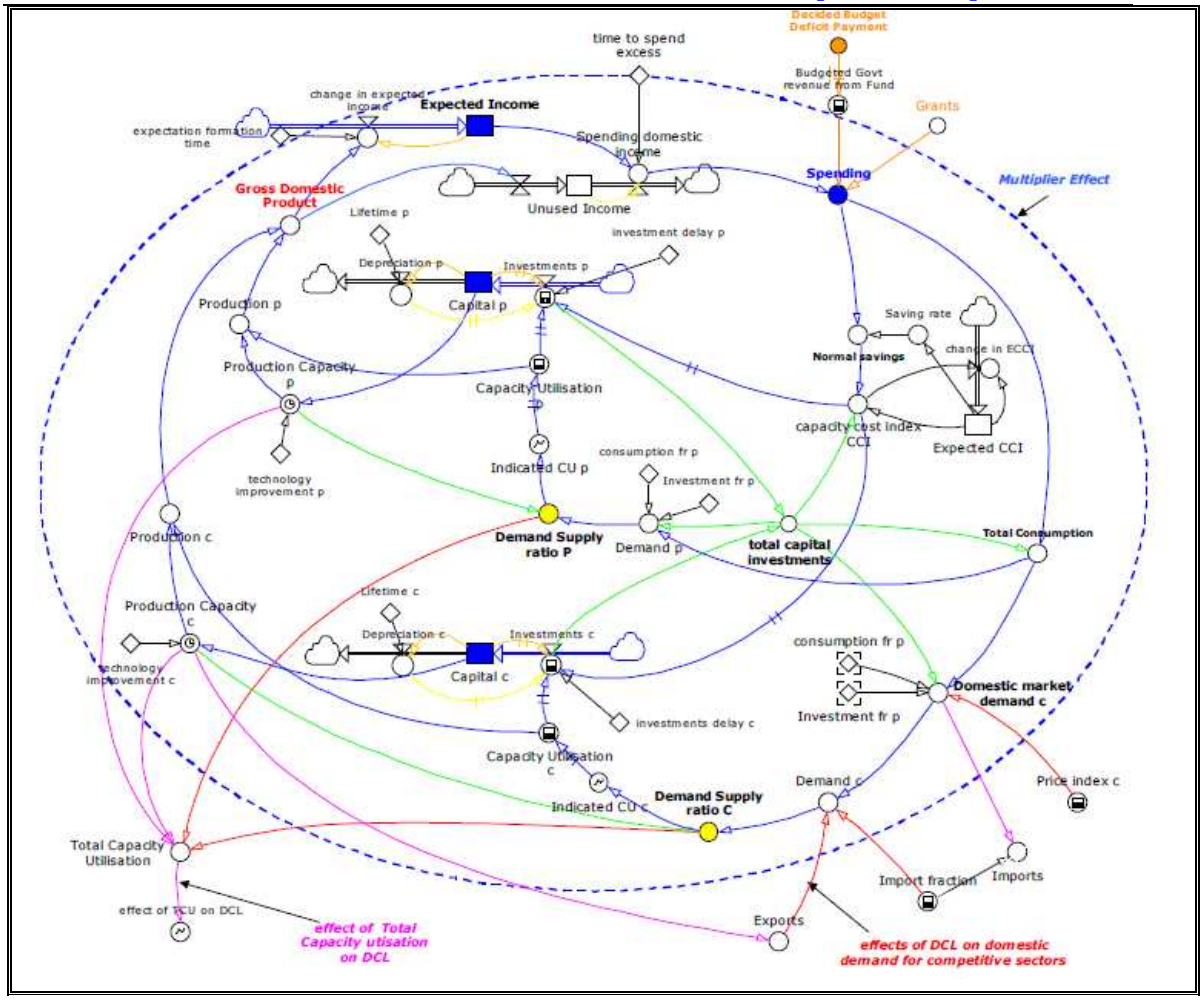


Fig.2.2. Multiplier Effect Model Structure

Note: The blue lines represent the multiplier effect loop. Start from spending to trace the link. The red lines from demand supply ratio to total CU and pink lines from PC p and C to total CU show the influence of multiplier effect on total CU and DCL structure. The red lines from exports, imports and price index c are the variables that influence loop.

2.2.2.2: The Total Capacity Utilisation (TCU) and the Domestic Cost Level (DCL) Structure

The interactions among the variables of the second model structure and how the structure is influenced or influences others structures of the model; multiplier effect (**fig.2.2**) and Fund- (**fig.2.4**) are shown in **Fig.2.3**. As mentioned earlier, the demand supply ratio (DSR) and production capacity of both sectors under the multiplier effect structure

(**fig.2.2**) adjust to form the TCU[10], which influences DCL without a time delay. This indicates the rapid effect of total capacity utilisation on DCL[11]. The DCL is divided by an assumed constant foreign substitutes cost level of one (US dollar) to form the relative value of domestic product (RVDP). The RVDP then determines the effect of DCL on exports and imports fractions (see time series; **fig.2.9** and **2.10** respectively). These fractions influence the yearly imports and exports figures. In addition, exports figure is restricted by production capacity c. The RVDP or the DCL also determines the price index c (PI c). These variable PI c, imports and exports determine the domestic demands c, indicating the influence of this structure on the multiplier effect as mentioned earlier (feedback). Key equations applied in **fig. 3**:

Total Capacity Utilisation (TCU)

$$= (DSRp*PCp+DSRc*PCc) / (PCp+PCc)$$

*Where, the desired PC is (DSRp*PCp+DSRc*PCc) and the actual PC is (PCp+PCc). For a quick recall, DSR p and DSR c- the demand supply ratio whiles PC p and PC c -the production capacity from the multiplier effect structure above.*

Domestic Cost Level (DCL)

$$= effect\ of\ TCU\ on\ DCL * Expected\ DCL$$

*Where, TCU is a time series (**fig.8**) and Expect DCL slows down the effects of DCL on exports, imports and PI c with an adjustment time of four years (change time).*

Expect DCL(t)

$$= \int_{t0}^{t} [\text{Change in Expected DCL(s)}]\, ds + Expected\ DCL\ (t_0)$$

[10] Total Capacity Utilisation (TCU) refers to the national production capacity utilisation level for both sectors (p and c). It can be used to measure the unemployment level of the modeled economy.
[11] Domestic Cost level (cost of production) used in this model refers to all forms of cost incurred in producing a product (goods or services). It can also be termed as national cost level. For example; labour cost (wages).

Where, Change in Expected DCL= (DCL-Expected DCL)/change time.

Export Fraction

= DELAYINF [effect of DCL on export fraction, λ, ∞, I]

Import fraction

= DELAYINF [effect of DCL on import fraction, λ, ∞, I]

For the effect of DCL on both exports and imports fractions, see the time series graphs, ***fig.2.9*** *and* ***2.10****. The* ***λ*** *symbol is the delay time for exports and imports as four and two years respectively. This implies that imports response to the changes in DCL more quickly than the exports. The same first order delay (∞****)*** *was used for both. The initial fractions (I) for exports and imports were 0.5 and 0.6228 respectively. These fractions were estimated based on the initial values of exports and imports as 4.3 and 7.1 Billion GHS. This indicates an initial trade deficit of 2.8 Billion GHS. These assumed figures were estimated based on the recorded imports and exports figures of Ghana for the 2008 (The Budget Statement and Economic Policy for 2009).*

Price Index c (PIc)

= DELAYINF= [(1-Import fraction) + Import fraction/Relative value of domestic product, λ, ∞, I]

Where, the delay time ***(λ)*** *is of one year with a first order delay (∞) and an initial price index c (I) of one.*

The net balance of the imports and exports (trade surplus or deficit) affects the Petroleum Fund balance instead of the subjects` decided budget deficit payment. This leads us to the next section 2.2.2.3, the Fund structure**.**

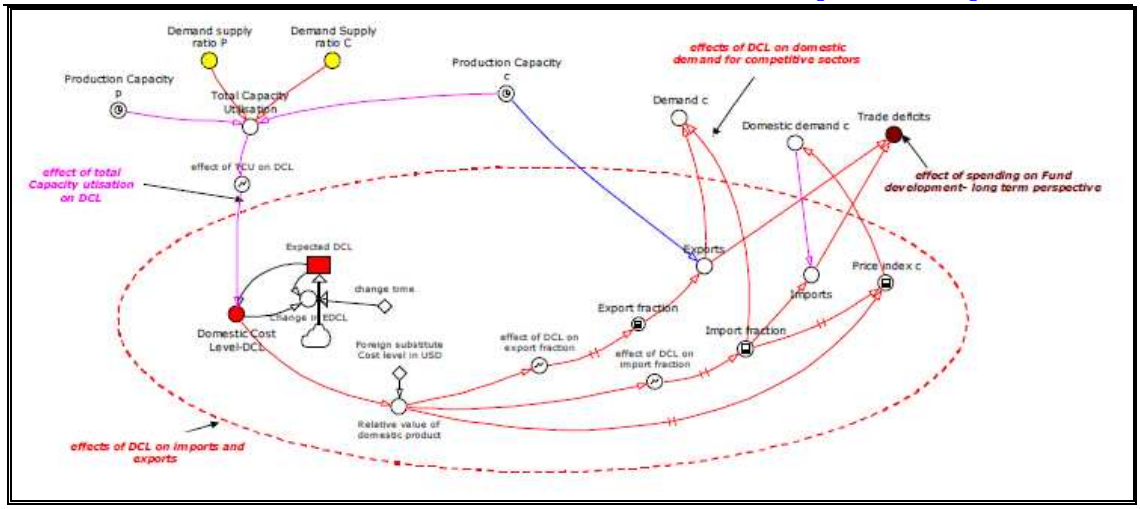


Fig.2.3. TCU and DCL Structure

2.2.2.3. The Fund Structure

As mentioned earlier, the Fund is increased by the yearly Fund inflows, which consist of the petroleum tax revenue, a positive interest on Fund, grants and the trade surplus. It should be noted that a negative interest on Fund decreases the Fund inflows. The Fund is decreased by the yearly trade deficit[12]. This tested the subjects` ability to recognise the long term economic effect (trade deficit or surplus) of their spending decisions on the developments of the Fund. The Fund started with a negative balance of 8.2 Billion GHS, approximately the public debt of Ghana for the end of 2008 (The Budget Statement and Economic Policy for 2009).

The Fund is modelled without any restriction on spending or purpose. This allowed subjects to manage the Fund based on their own set of purposes and spending strategies. In reality, the Natural Resources Funds (NRFs) are normally established to serve as Stabilisation Funds or Savings Funds or for both purposes (Ugo, 2000 and Tsalik, 2003). In Tsalik (2003), Stabilisation Funds aim at smoothening out government spending by transferring excess revenue to the Fund when resource prices are high-booming periods.

[12] Trade deficit is when imports exceeds exports, which are determined the macroeconomic dynamics captured in the model. Thus, spending influencing total capacity utilisation and domestic cost level, which determine imports and exports leading to the trade deficit, which decreases the Fund.

The transferred revenue is used to support budget spending at times of low prices. This ensures stability in public spending as against the unpredicted nature of the natural resources commodity prices (see **fig.2.5**). On the other hand, the Saving Funds are described as a ``rainy day`` Fund, storing up wealth for the future generation or oil down turn era (Tsalik, 2003). This, he attributes to the depleting nature of natural resources and that the saved earnings are invested to generate exact wealth. Other Funds described as hybrid type combines both purposes: ensuring stability in spending and also saving for the future generation.

Besides the above mentioned purposes, NRFs can prevent the Dutch disease if the assets are invested abroad. Investing abroad smoothen the real exchange rate developments to minimise its impacts on the non-oil tradable sector (Tsalik, 2003). This is modelled as the economic effects of subjects` spending decisions on the development of the total CU and domestic cost level, which affects the Fund balance in the long term as discussed earlier. In addition, the NRFs assist countries to ensure that the resource revenue are spent at the right time and purpose. In Tsalik (2003), the ``valued-added`` advantage of the Natural Resource Funds is that they serve as a compact between government and citizens by avoiding misappropriation and misallocation of natural resource revenue.

For effective function of NRFs, there must be transparency (through the public involvement) and a strong fiscal discipline attached to the Fund management (Tsalik, 2003 and Ugo, 2000). Examples of NRFs are; Alaska Permanent Fund, Alberta (Canada) Heritage Savings Fund, Venezuela's Stabilisation Investment Fund, Chilean Copper Fund, Norwegian Government Pension Fund and others. The operations and structures of these Funds are well discussed by Tsalik (2003).
Key equations applied in the Fund structure are:

Fund USD (t)

$$= \int_{t0}^{t} [\mathrm{FI(s)} - \mathrm{FO(s)}]\, ds + FB\,(t_0)$$

Where, FI (s) is the Fund inflows at a given anytime. FB (0) is the Fund balance at the previous time. FO (s) is the Fund outflows- the trade deficit measured in US dollars, which is the trade deficit in GHS multiplied by an assumed constant exchange rate of 1(USD /GHS).

Petroleum Tax Revenue

$$= Oil\ Revenue * Petroleum\ Tax\ Rate$$

*Where, oil revenue is the oil production per year multiplied by an assumed oil price, which fluctuates over time to represent the unpredicted nature of the oil prices in reality. For the oil production profile (see **fig.2.11)** and oil price profile (see **fig.2.12**). The petroleum tax rate is assumed as forty six percent of the oil revenue. This captures all forms of petroleum revenue entitled to the country, from royalties to corporate tax. The petroleum tax revenue inflows stop at year 2035.*

Interest on Fund

$$= FB(s) * Interest\ rate$$

Where, FB(s) is the Fund balance at any given time and measured in billion USD. A negative balance leads to interest on Fund payment while positive balance leads to interest on Fund (receipt). A constant four percent (0.04% p. a) annual interest rate was assumed. The investments options or management strategies attached to the Fund were not modelled. This gave subjects the opportunity to apply their own Fund management strategies.

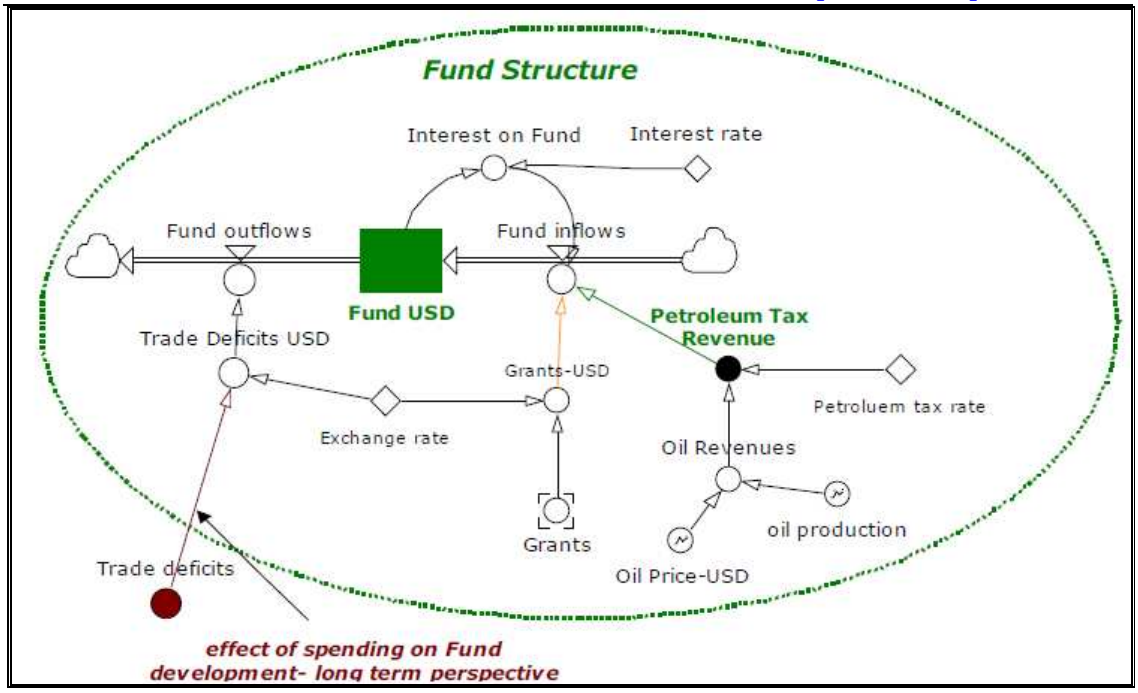


Fig.2.4. Fund Structure

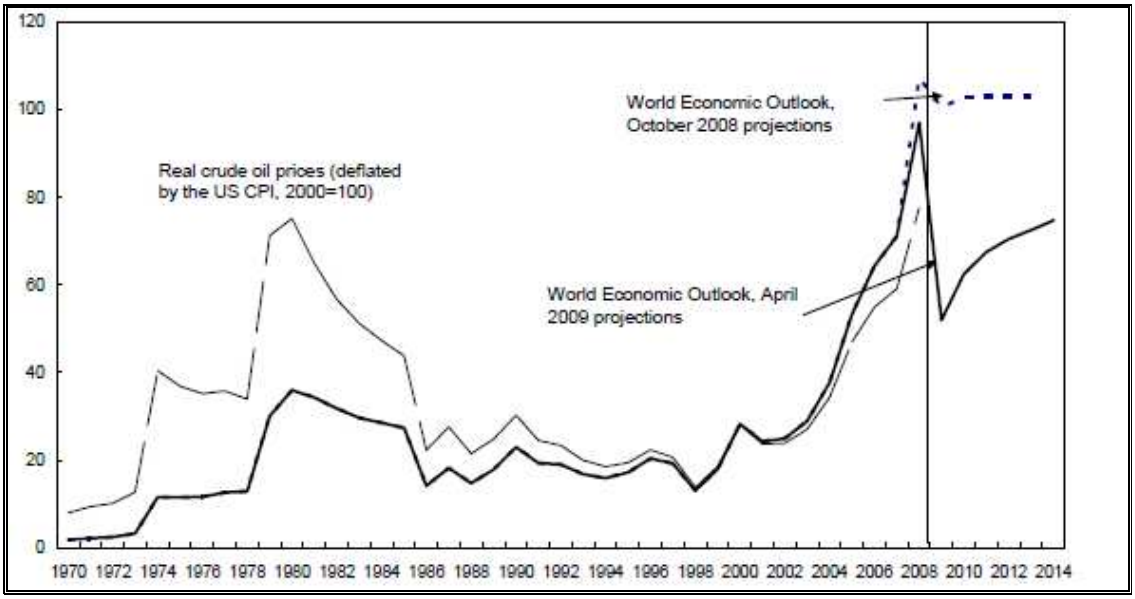


Fig.2.5. Nominal and Real Crude Oil (Spot) Prices, 1970-2014 (US Dollars)[13]

Source: IMF, World Economic Outlook 2008 and April 2009 but sited in York and Zhan (2009).

[13] The crude oil price is defined as the average of West Texas Intermediate, Brent, and Dubai Fateh crude oil (York and Zhan, 2009)

The chapter concludes with **fig.2.6**, which gives a full view of the underlying mimic macroeconomic model and the linkages among the three main structures explained above. In modelling the macroeconomic dynamics of spending, the following economic indicators were not modelled or assumed to be constant; first, the real exchange rate was assumed as constant. Second, the national interest rate and inflation were not modelled. The exclusion of these variables and others was to minimise the complexity of the model, which facilitated the learning nature of the experiment. In reality, these indicators play a critical role in shaping public spending decisions. Other things being, the assumptions used in the model do capture reality to some extent with reference to the modelled country, which shares some similarities with Ghana as explained above. Note: the model should not be used for economic policy analysis or prediction for Ghana. It is highly recommended that model is understood in the context of the experiment and also use for learning purposes.

Note: Powersim studio 8 modelling software was used in developing both the model and the experiment simulator in the form of computer game. The model was run at a simulation setting of 0.31625.

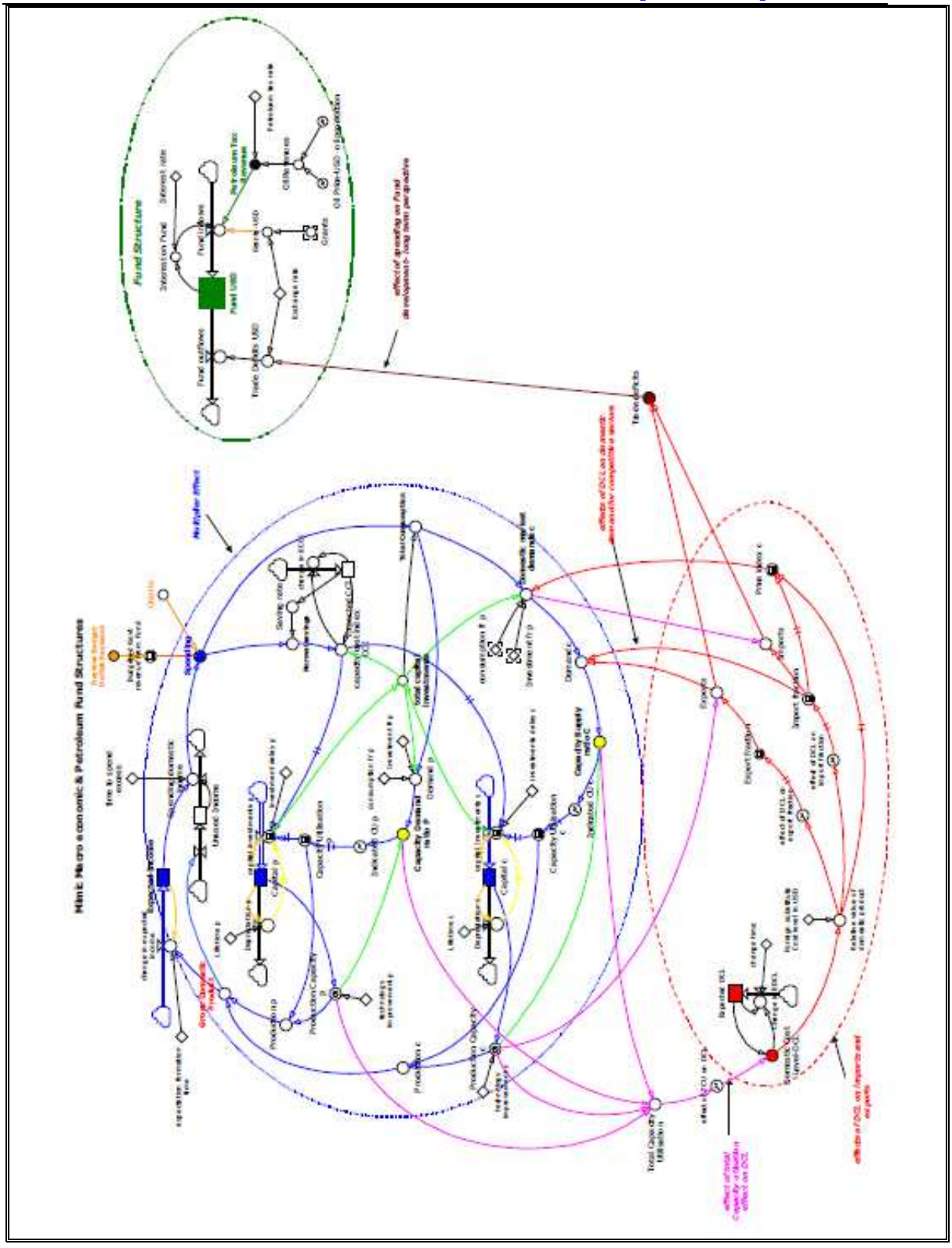


Fig.2.6. The mimic macroeconomic model (full view)

2.3. Time series used in the model

After explaining the assumptions applied in model building, the following times series graphs were used in the model. The graphical data were assumed to capture the relationship between the indicated variables.

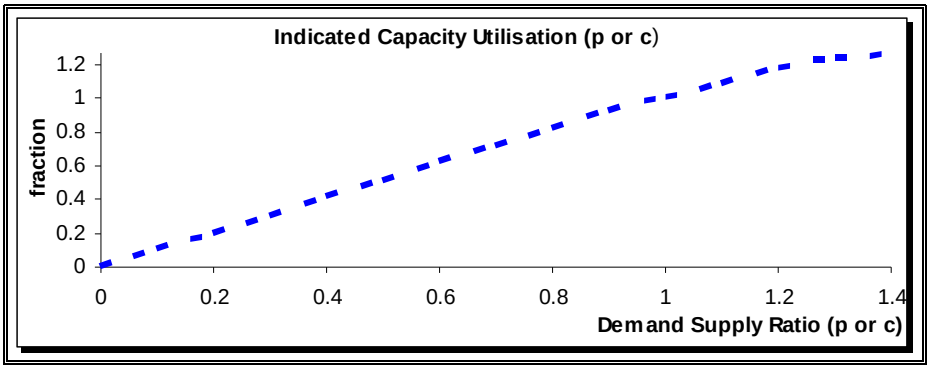


Fig.2.7. Indicated Capacity Utilisation (p or c)

This is unitless and applied to both sectors. The upper limit of indicated CU was assumed as 1.26. This limits production capacity even when demands require more. In estimating the indicated CU, Sterman (2000, page 559) was referred to.

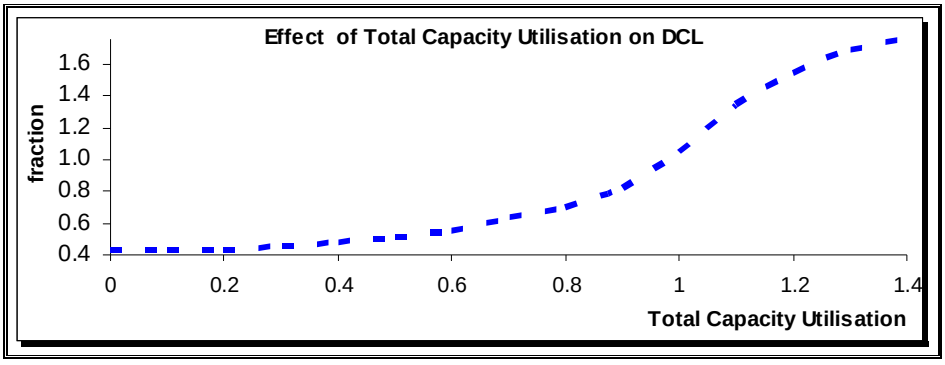


Fig.2.8. Effect of Total Capacity Utilisation on Domestic Cost Level (DCL)

Upper and lower limits of DCL: 1.71 and 0.37 (unitless). It denotes the level at which, DCL adjusts to TCU. The lower limit of 0.37 indicates the cost incurred even in the absence of production.

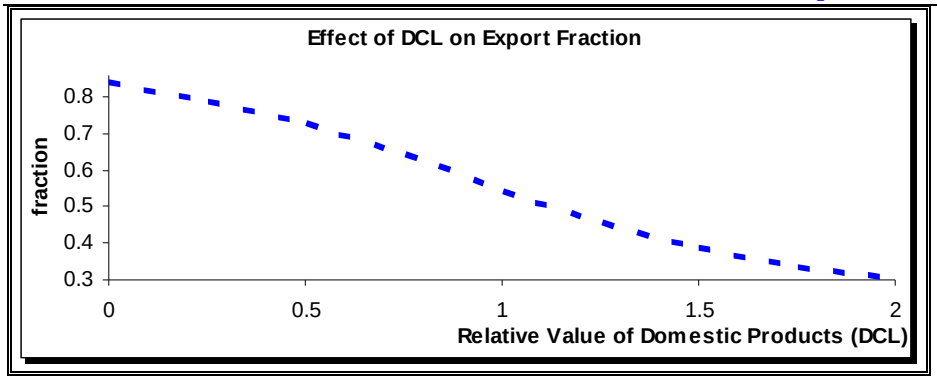


Fig.2.9. Effect of Domestic Cost Level on Export Fraction

Upper and lower limits: 0.8 and 0.26 (unitless). This implies that exports can not be increased more than 0.8 of PC even at the lowest DCL.

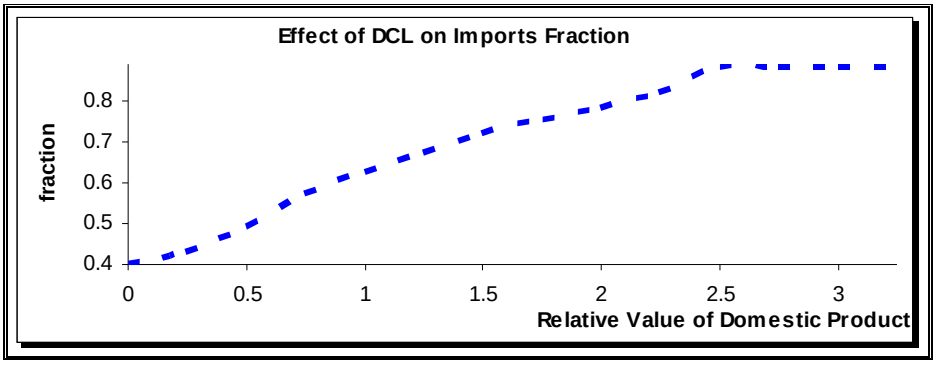


Fig.2.10. Effect of DCL on Imports Fraction

Upper and lower limits: 0.88 and 0.4 (unitless).

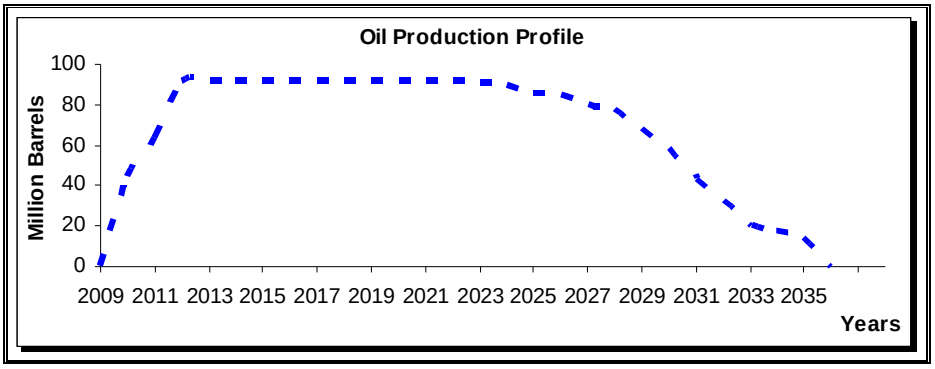


Fig.2.11. Oil Production Profile

(Source: estimated from Osei and Domte, 2008)

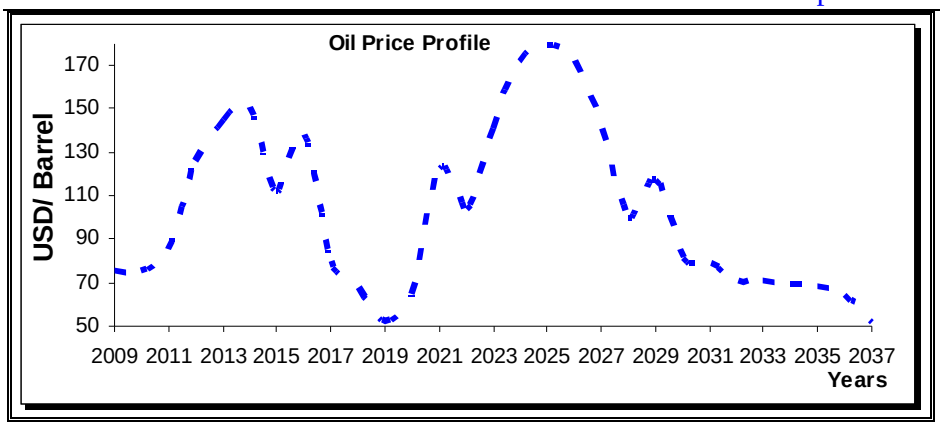


Fig.2.12. Oil Price Profile

These prices were assumed to capture the fluctuations in the oil prices in reality, see **fig.2.5**.

After discussing the model structure, the next chapter focuses on the experimental design and the hypotheses (paper focus). The hypotheses are further explained through the use of the casual diagrams.

3. Experimental Design

3.1. The Task

As the experiment attempted to find out the tendency for policy makers to misperceive the dynamics of a petroleum economy when making public spending decisions, a simulator was developed (**fig.3.2**). The simulator (computer game form) was based on the underlying macroeconomic model explained in chapter two. This allowed subjects of the experiment to interact with the model for the learning purposes. Subjects played the role of deciding on the annual budget deficit payments over a period of forty years (2010-2050). Specifically, they acted as petroleum revenue managers appointed by the Government of Ghana to manage its petroleum revenue through a Fund.

A document on the introduction to the simulator (appendix I) was given to the subjects to read before the experiment. After that, a power point presentation was made to address subjects' issues of misunderstanding and the basic assumptions applied in the model

behind the experiment. Again, subjects were updated annually on the following useful information on the simulator interface (**fig.3.2**) for a better understanding of the system, which their decisions affect.

1. Fund Information: oil and gas revenue (petroleum tax revenue) and interest on Fund, which could be negative (interest payments) or positive (interest receipts). Third, both total inflow and outflow to the Fund and subjects' decisions were shown on the same graph. Information on the Fund balance was also shown.

2. Economic indicators: Per capita GDP (GHS/person). This is GDP divided by the total population with an assumed low exponential growth rate of one percent (1% p. a) capturing deaths. Second, GDP growth rate (%/year). Third, GDP debt ratio (per year). This is the Fund balance divided by the GDP. Negative and positive ratios indicate debt and surplus, respectively. Per capita consumption (GHS/Person/year) that is the total consumption divided by the total population. See **fig.3.3** for the model structure for these variables. Fourth, the GDP, total investments, total consumption and total spending figures were shown. Lastly, graphical information was given on domestic cost level and the capacity utilisaton for both sectors (CU p and c).

3. Other information: subjects were asked to enter their annual decisions in the box named *Spending Decision (Billion GHS)*. After entering the decisions, they proceeded to the next year by clicking on the play bottom. They were not allowed to change decisions after clicking on the bottom. This is because in reality budget decisions made and implemented for the previous years cannot be changed. Lastly, the simulator time check was shown to guide the subjects on the periods within which they were making decisions. This was important because the petroleum tax revenue inflows ended at year 2035 whilst the simulator kept on running until 2050. This helped in addressing the question: will policy makers in Ghana mismanage its petroleum revenue through a Fund? Thus, subjects running their Fund balance into negatives at the end of the simulator.

There were no ethnical issues to be addressed. Subjects' profile was not recorded because it was not necessary to the purpose of the experiment. After the introduction to the simulator, the welcome page (**fig.3.1**) will appear on the PC screen to subjects. They then clicked on the bottom "start simulator" and proceeded to the decisions making interface, **fig.3.2**.

3.2 Experiment Payoff (Rewards for Subjects)

Subjects were rewarded at the end of the simulator. The reward was based on their ability to maximise welfare. Welfare was defined as an aggregated present value of the total consumption and the Fund balance. The criterion was based on an assumption that an increase in one of the variables leads to a decrease of the other. Thus, for subjects to increase total consumption demands an increase in spending decisions, which may affects the economy negatively if care is not taken. This tends to decrease the Fund balance in the long run through the trade deficit as explained earlier. This helped in testing, if policy makers will misperceive these economic dynamics as explained more in the chapter two or the causal diagram loop section. Subjects were rewarded between 40 to 60 GHS. The reward was only shown at the end of the simulator. **Fig.3.4** shows the modelled structure for the experiment payoff (criterion) and the applied key equations:

Payoff

$$= IF[TIME<N,0, MAX(45,MIN(60,45+0.3*(Criterion-K_1)/K_0))]$$

Where, N is year 2050. K_1 is 500 GHS and K_0 is one. The MAX and MIN functions regulate the payoff amount to fall within 45 to 60GHS. Whilst, the IF function ensures that zero is shown on the screen until year 2050 (end of simulator).

Criterion

$$=PV\ Consumption + PV\ Fund\ USD$$

Where; PV consumption=

$$\int_s^t [\text{Total Consumption} * \text{EXP}(-\text{Discount rate} * (\text{TIME} - \text{STARTTIME}))]$$

$$\textit{PV Fund USD} = [(\text{Fund USD} * \text{EXP}(-\text{Discount rate} * (\text{TIME} - \text{STARTTIME}))/\text{exchange rate}]$$

These above equations were applied in the model to aggregate both the total consumption and the Fund balance to derive the payoff figure. Note, the payoff was not used as a performance evaluation of the subjects.

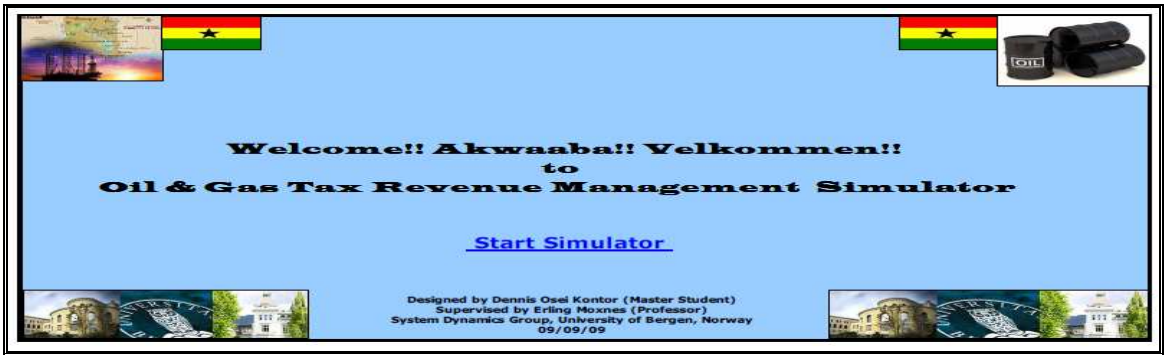


Fig.3.1. Welcome Page

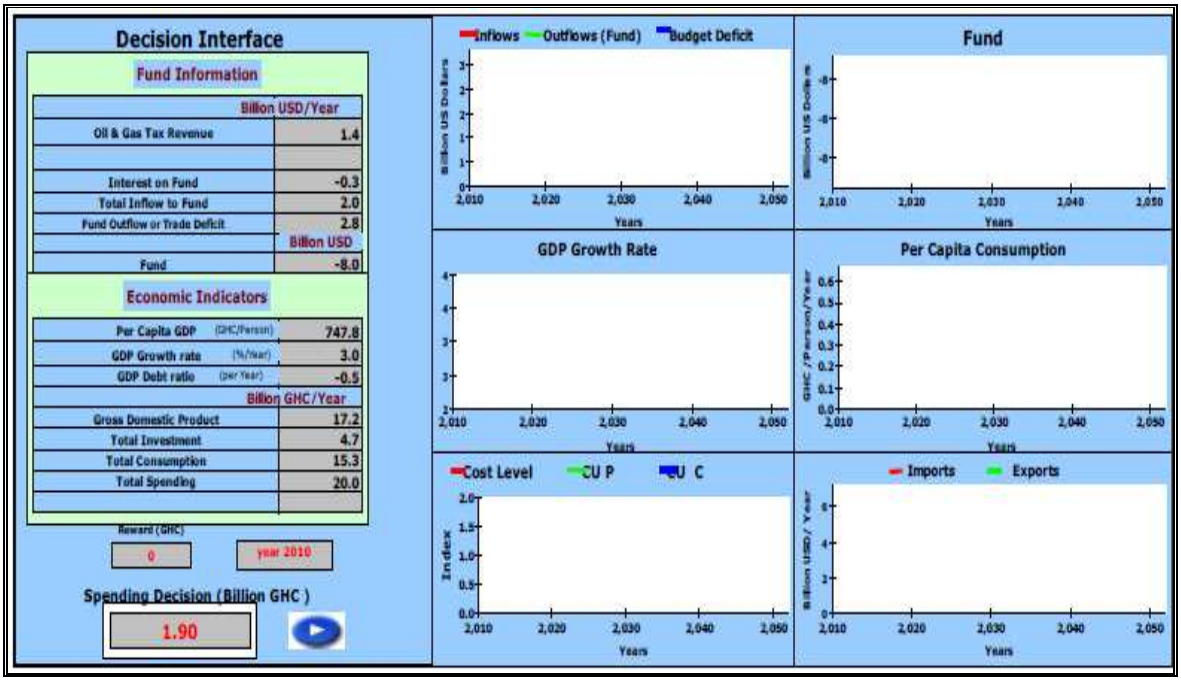


Fig.3.2. Simulator Interface (Decision Interface)

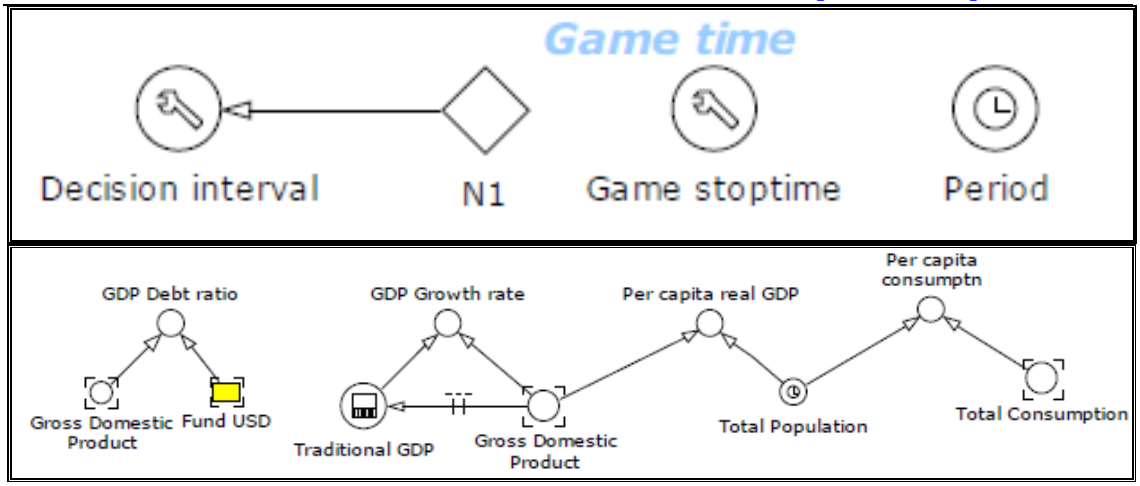


Fig.3.3. Additional Model Structure for Simulator Purpose

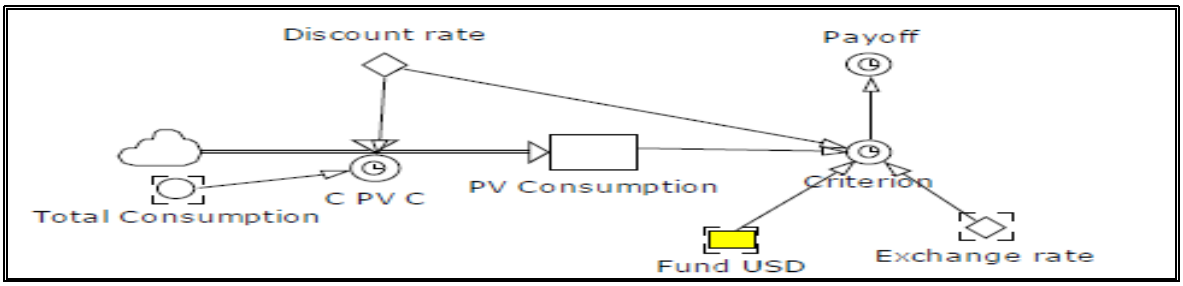


Fig.3.4. Experiment Payoff Model Structure

GDP Growth rate

=100(GDP-Traditional GDP)/Traditional GDP*

Where, traditional GDP= DELAYINF(GDP, λ , ∞ ,GDP/1.03).

GDP is the gross domestic product (total output) of the economy at any given time. Traditional GDP is the GDP for the previous year. The symbols; λ and ∞ denote a delay time of one year and a first order delay, respectively. GDP/1.03- assumed initial GDP. For other equations, see appendix V.

3.3 Subject Information and Experiment Setting

A good experiment report does not only depend on the accuracy of model behind it but also the subjects composite. This explains why the staffs from the following bodies were selected as subjects of an experiment, which attempts to address issues of importance to Ghana's petroleum revenue management:

First body: Bank of Ghana. Seven senior staffs of the central bank were selected from five different departments. The departments with two representatives were grouped into one and that led to five groups for the exercise. The exercise took place at a conference room in the Bank's premises.

Second body: Parliamentary Committee on Finance. Six members of the committee in addition to two clerks formed the parliamentary core for the exercise. The six are also members of Ghana's parliament and also representing both the major and minor sides of the house. The exercise was carried out in the office of the committee's chairman.

Third body: Ministry of Finance and Economic Planning. Eleven staffs of the ministry were selected for the exercise. They included four senior staffs and seven assistants. The exercise was carried out at a conference room in the ministry's premises.

In all, twenty four policy makers formed the subjects for the experiment. The results of three subjects were excluded because of typographical error, which was realised after the experiment. The results of the remained twenty-one formed a strong basis for making a conclusion from the experiment results. A single treatment[14] was given to all subjects. A greater percent of the subjects had an informed knowledge on issues concerning Ghana's petroleum revenue management and economics. A greater interest in the exercise was shown by all, which led to independent work. The experiment lasted for an hour at maximum. It was carried out in the months of November to December 2009 at Accra, Ghana. Since the experiment was a computer-based simulator, laptops were arranged for subjects.

[14] Single treatment implies that the same information and requirements were given to all subjects.

After the experiment, subjects were given a questionnaire to answer. This formed the basis for explaining the rationale behind subjects' behaviours produced by the simulator. They were asked about their impression on the whole exercise. After that a debriefing exercise was carried out to discuss the simulated behaviours. In addition, they were given a debriefing document (appendix III), which explains the outcomes of their decisions and some of the misperceptions surrounding petroleum revenue spending.

Given the subjects involved, the experiment setting was designed in a form of a seminar dubbed "oil and revenue management training seminar". The seminar began with a quick introduction to the exercise. Followed by the training session, where subjects interacts with the simulator, which also formed the experiment. This was the first time that policy makers had the opportunity to interact with such kind of a computer-based model system. After the training session, a debriefing exercise was carried as explained above. In all, the exercise seemed like a learning experience for the subjects.

Before the main experiment in Ghana, a pilot experiment was carried out in Norway at the University of Bergen, using the first year master students of System Dynamics as subjects. This provided an opportunity for model verification and validation.

3.2. Hypotheses

H1: Policy makers in Ghana will mismanage its petroleum revenue through a Fund

The primary null hypothesis was formulated based on the commonly faced challenges of natural resource endowed countries specifically, the revenue management or the Fund management challenges (Tsalik, 2003; and Ugo, 2000). The null hypothesis ($H1_0$) is as follows:

$$\mathbf{H1_0: FB_s = -1}$$

$$\mathbf{H1_a: FB_s \neq -1}$$

Where, $\mathbf{FB_s = -1}$ and $\mathbf{FB_s \neq -1}$ represent the negative and positive Fund balances of subjects at the end of the simulator, respectively. The $H1_0$ implies that Ghana will experience the unsuccessful stories of Venezuela- managing its Fund into deficits during 1999 and Oman struggling to ensure a good Fund balance (Ugo, 2000). On the contrast, the alternative hypothesis ($\mathbf{H1_a}$) states that: Ghana will manage its petroleum revenue through a Fund ($\mathbf{FB_s \neq -1}$). Thus, experiencing the successful story of countries like Norway and Chile- (Ugo, 2000).

H2: Misperception of the dynamics of a petroleum economy when making spending decisions

The second hypothesis was formulated based on the assertion that people commonly based decisions on too simple mental models and tend to misperceive the dynamics of systems (Moxnes, 2004, 1998b and Sterman, 1989). By the term 'simple mental model', we imply that subjects will focus much on development of the Fund inflows than the total capacity utilisation (TCU) when making spending decisions. This hypothesis was tested by measuring the significant influence of Fund inflows ($\mathbf{FI_s}$) on subjects' spending decisions ($\mathbf{PSD_s}$) in a comparison to the total capacity utilisation ($\mathbf{TCU_s}$). The $\mathbf{TCU_s}$ as fairly represents the dynamics of the system as described.

$$\mathbf{H2_0: PSD_s = FI_s \text{ not } TCU_s}$$

$$\mathbf{H2_a: PSD_s \neq FI_s \text{ not } TCU_s}$$

The alternative hypothesis ($\mathbf{H2_a}$) states that: policy makers will not misperceive the dynamics of a petroleum economy when making spending decisions. Thus subjects tend to focus more on the $\mathbf{TCU_s}$ than $\mathbf{FI_s}$ when making spending decisions.

H3: Misperceptions of the dynamics of petroleum economy lead to a cyclical development in the total CU.

The third hypothesis was also based on the poor performance of subjects, who tend to misperceive the dynamics of systems when making decision (Moxnes, 2004, 1998b and Sterman, 1989). To test this hypothesis, the average standard deviations (**ASD_s**) of subjects' TUC_s from the assumed normal TCU of one were measured. The **ASD_s** of TCU of subjects with negatives or positive Fund balances were also measured to understand if differences exist in misperceptions among the two groups. *(Note the focus is still on the whole group).* The null hypothesis (**$H3_0$)** is as follows:

$$\mathbf{H3_0: ASD_s \text{ of } TUC_s \neq 1}$$

$$\mathbf{H3_a: ASD_s \text{ of } TUC_s = 1}$$

The alternative hypothesis (**$H3_a$**) is that: policy makers, who do not misperceive the dynamics of a petroleum economy, tend to have a smooth development of the TCU.

The rest of the chapter explains the feedback structures that are responsible for the stated hypotheses. In addition, other interesting dynamics of the model (**fig.6**) and how they are misperceived are also explained. The section further explains the dynamics of the model as described in chapter two.

3.3 Causal Loop Diagram: Model Feedback Structures

The concept of a causal loop diagram (CLD) is frequently used in the field of system dynamics (Sterman, 2000). The concept is applied in explaining the model feedback structures in reference to the hypotheses. CLD is a diagramming tool used to explain how system structures are related. The polarity of the relationship is represented in plus and minus signs, which indicates whether the relationship is positive (reinforcing loop) or negative (counteracting loop). Plus (+) indicates an increase in B, which leads to an increase in C whilst, minus (-) denotes an increase in B, which leads to a decrease in C.

Again, in the diagrams below, R denotes reinforcing loops whilst B represents counteracting or balancing loop. Below are the feedback loops that explain main relationships or dynamics of the model in line with the hypotheses;

Reinforcing Loops- R1 and R2: The Multiplier Effect Loops- Investments/Savings (R1) and Total Consumption (R2)

How an increase in spending tends to increase the other variables in the economic activity (a cyclical movement) is illustrated in F**ig.3.5**. In short, as spending increases so do the other variables increase. An increase in subjects' spending decisions in addition to the assumed constant grants tends to increase the ready increased spending from the previous economic activity (spending domestic income). Spending then increases all the variables in the loops for the next economic activity as follows; firstly, spending increases savings / investments (Loop **R1**), which tend to increase production capacity (PC) through capital investments with a time delay of two years. An increase in PC with corresponding increase in capacity utilisation (CU) tends to increase production and gross domestic product (GDP). The GDP then increases the expected income (EI) and multiply spending for next economic activity.

On other hand, an increase in spending increases total consumption (Loop **R2**), which in addition to total capital investments increase total domestic market demands (DMDs) for both sectors. The DMDs then increase through demand supply ratio effect on capacity utilisation that is the more the DMDs, the more the CU and production with a short delay time of 0.4 year. Production then increases the GDP, which multiply spending for the next economic activity. The time gap between production capacity adjustments and demand changes, affects the operations of the other loops: R3 (**fig.3.6**) and B1 **(fig.3.7**). On other hand, loops R3 and B1 feedback to either strengthen or weaken multiplier effect loops R1 and R2 through the domestic demand c. This is because the domestic demand c is influenced by these variables of loops **R3** and B1; imports and export and price index c since the modelled system is an opened economy. Subjects who based their spending decisions on the Fund inflows, tends not to recognise this time gap and others dynamics

within the multiplier loops. This leads to the second null hypothesis ($H2_0$) of misperceptions. Subjects, who tend to recognise these dynamics, lower their level of spending decisions' aggressiveness. This allows the PC to adjust gradually to demands to reduce the time gap effect, which is well explained in other loops B1 and R3.

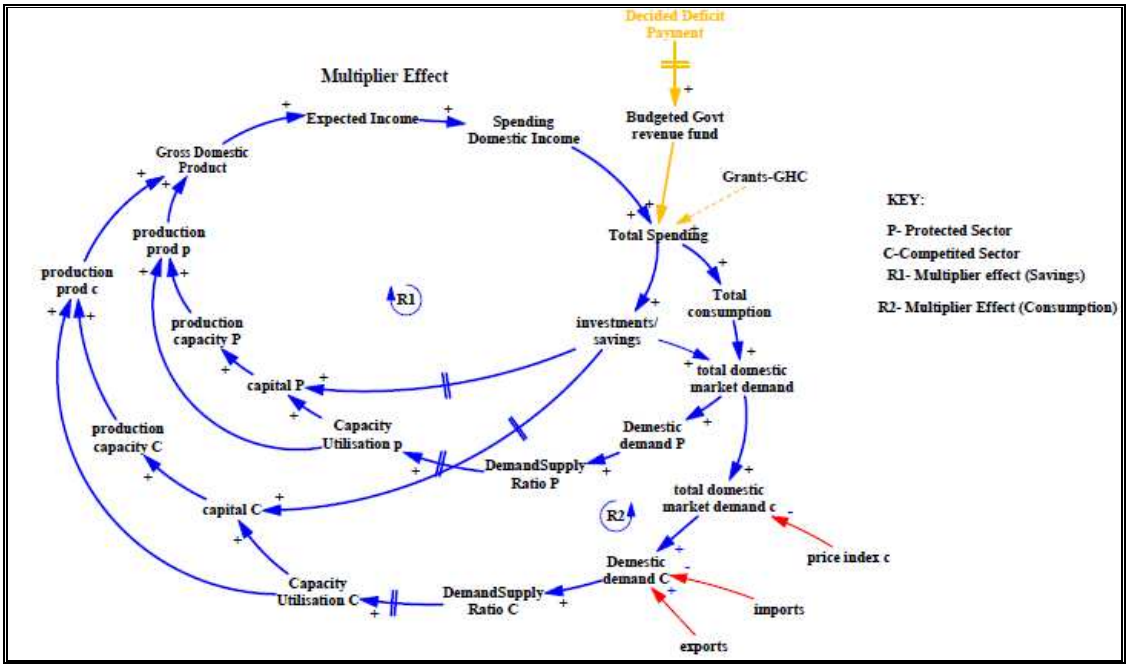


Fig.3.5. Multiplier Effect loops- investments/Savings (R1) and Total Consumption (R2)

Reinforcing loop R6: Effect of production capacity on total capacity utilisation (TCU)

As mentioned earlier, an increased in savings/investments (loop **R1)** increases production capacity (PC) whilst an increased in total consumption (loop **R2)** increases the demand supply ratio (DS ratio), if demands are greater than PC. Both DS ratio and PC adjust the TCU. In **fig 3.6**, the effect of PC on TCU is assumed to be stronger than the effect of DS ratio on TCU (**fig.3.7**). Thus, the reinforcing loop R3 (**fig 3.6**) is dominating the counteracting loop **B1** (**fig.3.7**). This decreases the effect of TCU on domestic cost level (DCL), which increases exports and decreases both imports and price index c to strengthen the multiplier loop through an increased in domestic demand c. The increased in domestic demands c tends to increase other variables in the loops (**R1** and **R2**).

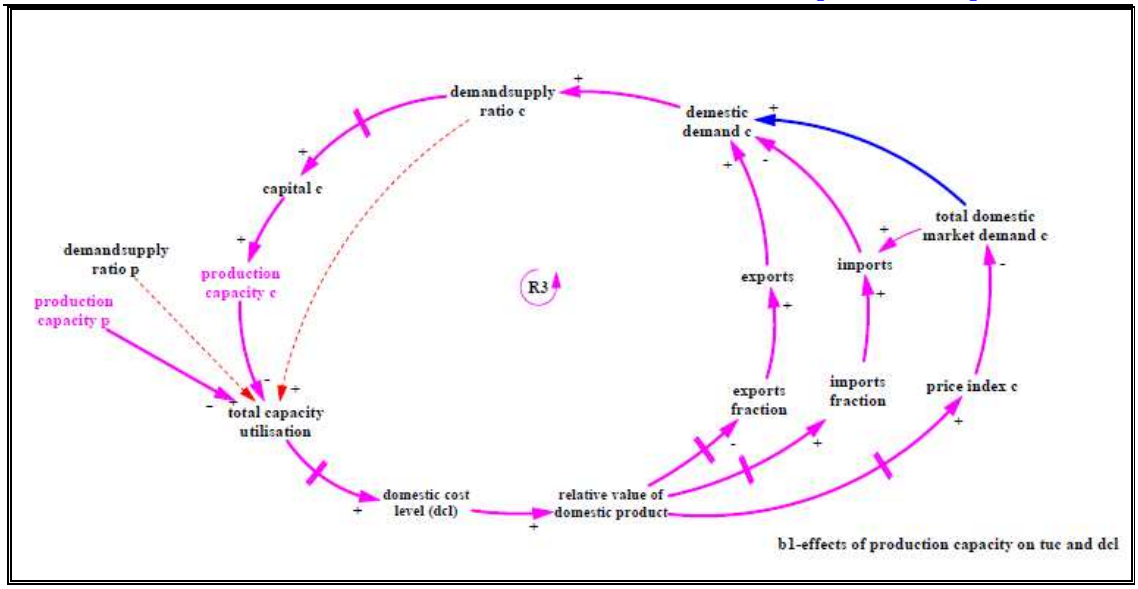


Fig.3.6. Effect of production capacity on total capacity utilisation (TCU)

Interestingly, the misperceptions of the time delay between PC adjustments to demands by subjects, leads to the shift in the dominance from loop R3 to loop B1 as described below. Again, this shifting of dominance creates the cyclical development of TCU (third hypothesis- **H3**).

Counteracting loop B1: effect of demand supply ratio on total capacity utilisation

The shift in dominance from the between loop R3 to B1 occurs when the increase in demand supply ratio (DS ratio) is greater than one, which increases the TCU and the domestic cost level (DCL). An increase in DCL then leads to a decrease in exports and increase in both imports and price index c. The negative net balance between exports and imports (trade deficit) does not only decrease domestic demand c but also the Fund balance. In addition, the increase in price index c decreases domestic demand c through its effects on the total domestic market demands c. There are time delays within the adjustment of TCU to DCL, DCL to exports and imports and back to DS ratio.

On the contrast, there is no time delay between the adjustments of TCU to DS ratio as compared to TCU to PC in loop R3. This is because it takes a long time for PC to adjust to demands, whilst the impacts of DS ratio are felt quickly on the TCU. This makes it

difficult for subjects who do not recognise this time delay when making decisions to correct the cyclical development of TCU and its impacts on DCL, exports and imports as well as its feedback to the multiplier effect loops.

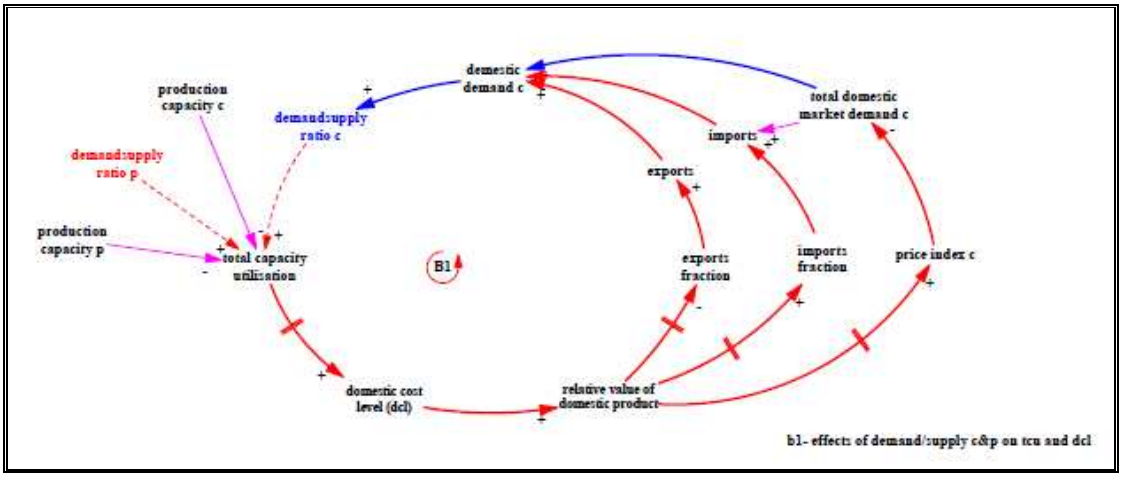


Fig.3.7. effect of demand supply ratio on total capacity utilisation

Lastly, a full view of the broader feedback structure of model and how they are interconnected is shown in **Fig.3.8**. A failure to recognise these connections and their dynamics leads to spending decisions, which create cyclical development in the system.

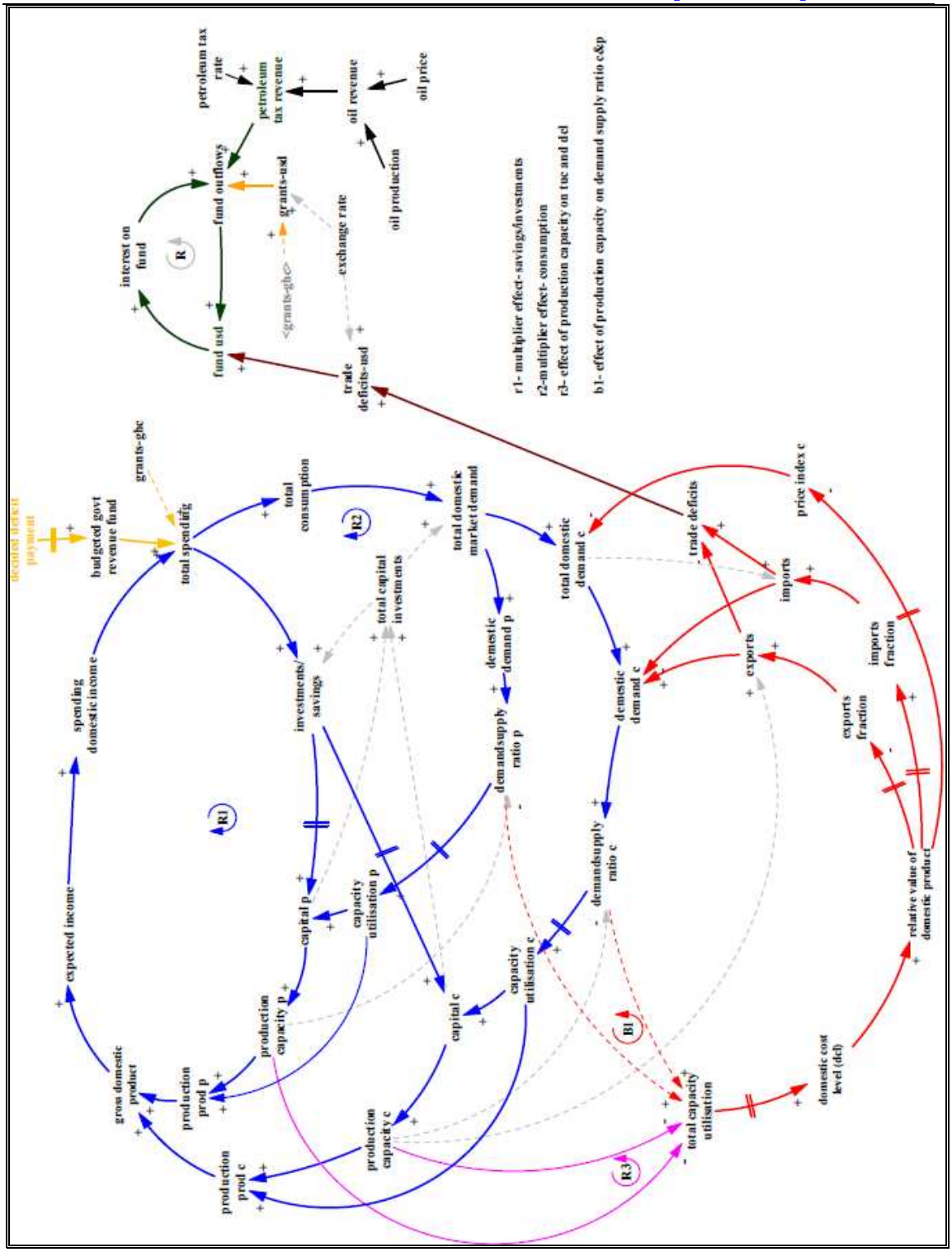


Fig.3.8. Model Feedback Structure (full view)

4. Experimental Outcome (Results)

H1:

The histogram (**fig.4.1**) indicates the Fund balances of subjects at the end of the simulator. In addition, the Fund balances of the three bodies engaged in the exercise are shown. We focused on the collectivity that is the total outcome for all subjects.

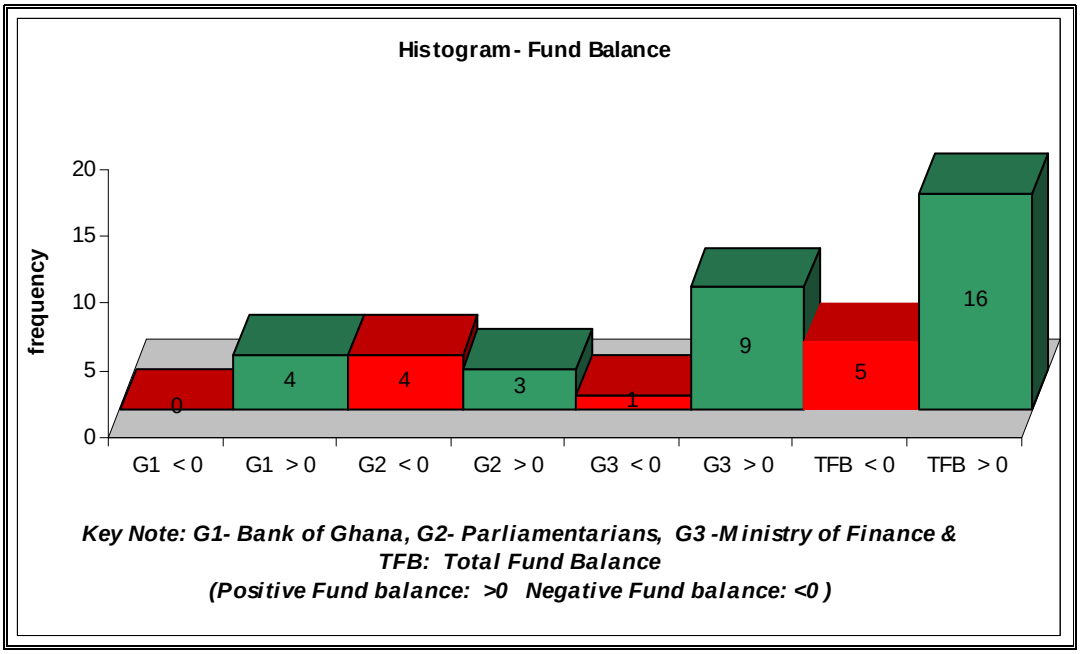


Fig.4.1. Subjects' Fund balances at the end of the simulator

Only five out of the twenty-one subjects managed the Fund into negative balances at the end of the simulator as indicated in **Fig. 4.1**. From this result, we ask: should the null hypothesis (**$H1_0$: FB_s= -1**) be accepted or not? Before the answer, One-Sample T-test was performed on subjects' Fund balances at the end to determine the statistical significance of **$H1_0$** as shown in **table 4.1** below:

Table 4.1. One-Sample T-Test Statistics

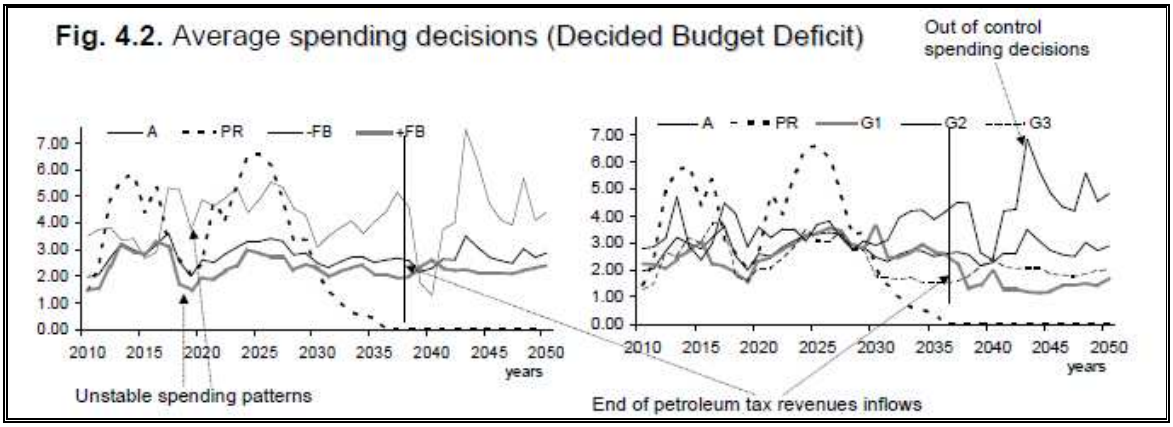
One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
1=FB+ -1=FB-	21	,52	,873	,190

One-Sample Test

	Test Value = -1					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
1=FB+ -1=FB-	8,000	20	,000	1,524	1,13	1,92

Statistically speaking, with a **p-value** (significance level) = **0.00** lower than the critical alpha of 0.05, we failed to accept the null hypothesis (**$H1_0$**) whilst the alternative hypothesis (**$H1_a$: $FB_s \neq -1$**) is accepted (Gujarati, 113). The rationales behind these outcomes of the experiment are discussed in the next chapter. For more graphs, refer to appendix **V**. Fig. **4.2** gives a graphical representation of an average subjects' spending decisions over time (2010 to 2050) that led to the indicated Fund balances as shown in Fig. 4.1 above. Interestingly, the unstable spending patterns of subjects (Fig.4.2**)** follow the public expenditure patterns in relation to petroleum revenue inflows of countries like Norway, Venezuela, Oman and others from 1981-1999, Ugo (2000).



Keynote: AveDBD: Average spending for all subjects.–FB: subject with negative Fund balance and + FB subjects with positive Fund balances. G1 to G3- the three bodies involved in the exercise.

H2:

Table 4.2 summarised the results of a standard multiple regression analysis, which was performed to determine the significant influence of Fund inflows (**FI_s**) on average subjects' spending decisions as compared to the total capacity utilisation (**TCU_s**). Subjects were further grouped as: subjects with negative and positive Fund balances, thus TFB<0(**-FB**) and TFB>0 (**+FB**) respectively. The purpose here was to understand the different levels of misperceptions among the subjects.

Table 4.2. The Influence of (**FI_s**) and (**TCU_s**) on average spending decisions (**ASD_s**) [15]

Selection	All subj.	Subj. with TFB<0 (-FB)	Subj. with TFB<0 (+FB)
No. of subj.	21	5	16
Pearson's r: FI	0.619	-0.054	0.642
TCU	0.358	0.180	0.620
Sig.(1-tailed) r: FI	0.00	0.368	0.00
TCU	0.011	0.130	0.00
Beta (B): FI	0.567	-0.095	0.436
TCU	0.127	0.200	0.390
R^2	0.397	0.041	0.522
p-value full model	0.00	0.450	0.00
t-statistic: FI	4.111	-0.588	3.302
TCU	0.923	1.230	2.952
Std. Error of the Estimate	0.3174	1.13037	0.31039

The results from the standard multiple regression analysis indicates that on an average, subjects' spending decisions were significantly influenced by the Fund inflows as compared to the TCU. This implies that, the null hypothesis (**$H2_0$**) could not be rejected at *p*-value (full model) 0.00, greater than the critical alpha of 0.05, R squared of 0.397

[15] The word 'Influence' implies the tendency of subjects to base their spending decisions on Fund inflows and failing to recognise the dynamics of the system (**$H2_0$**).

and Pearson's r of 0.619 (FI) and 0.358 (TCU). To be more precise, subjects based spending decisions on their simple mental model that is focusing on more Fund inflows, which prevented them from recognising the development of TCU as hypothesised. Interestingly, the spending decisions of subjects with **+FB** were significantly influence by both the $\mathbf{FI}_s$ and the $\mathbf{TCU}_s$ at r= 0.642 and 0.620 respectively but still the $\mathbf{FI}_s$ did dominate. On the contrast, subjects with **-FB** (only five subjects) experienced what we call: 'out of control spending misperceptions'. Thus, spending beyond ones means, which we explained in the next chapter. (Refer to appendix V, for more statistical information). **Fig. 4.3** further explains these relationships between spending decisions and Fund inflows in a comparison to the TCU in a graphical representation form.

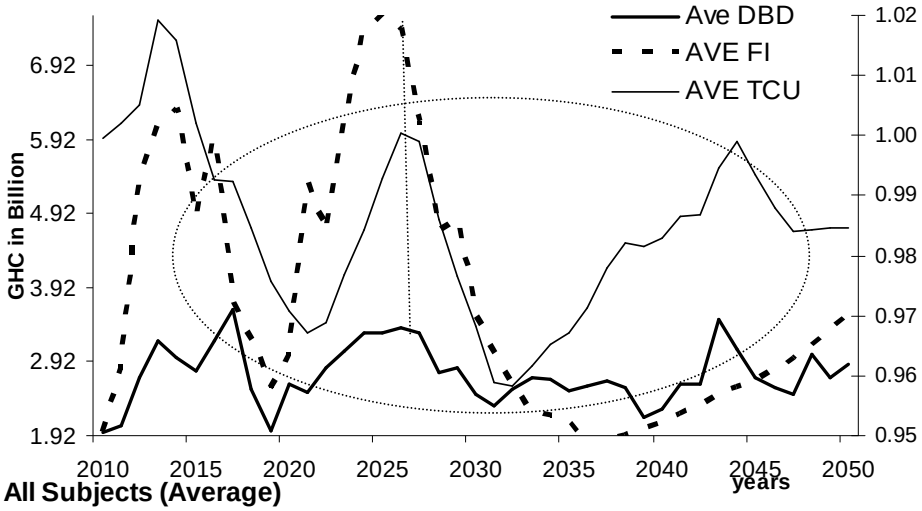


Fig.4.3.1

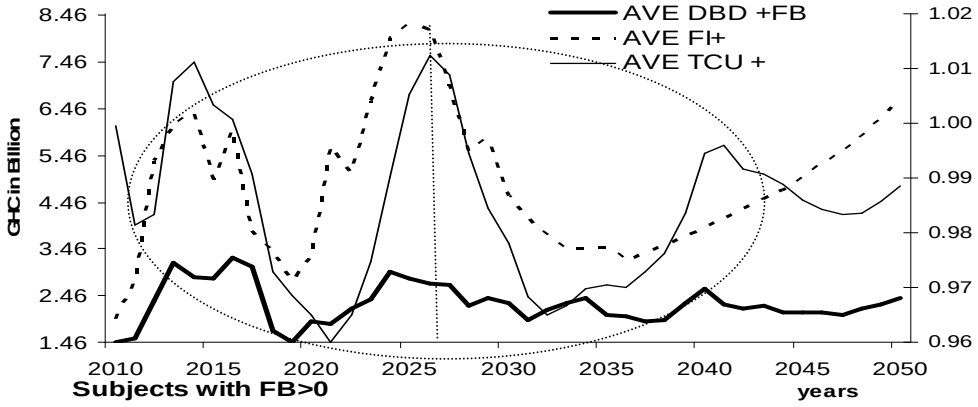


Fig.4.3.2

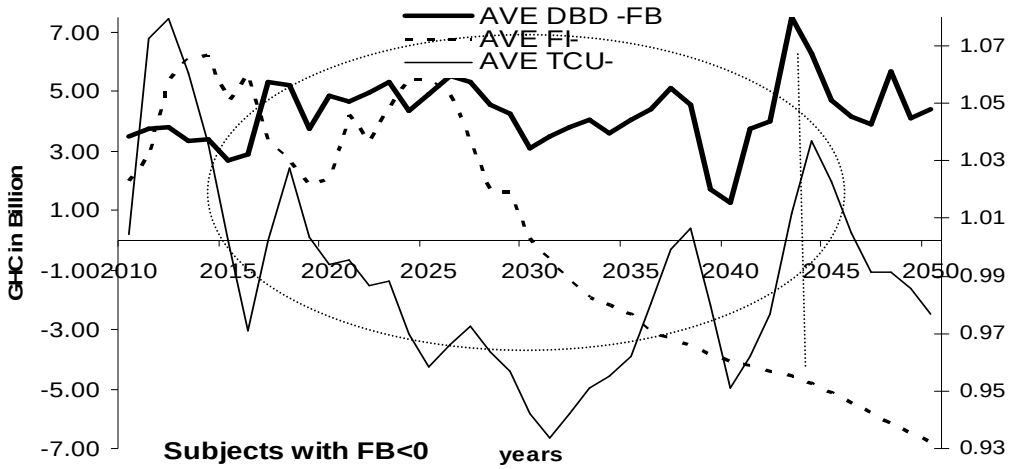


Fig.4.3.3

From **fig.4.3** on an average, subjects' spending decisions change more frequently in relation to the development of the Fund inflows as compared to TCU over time. Thus, as Fund inflows (FI) increases so does spending decisions (Ave DBD) increases even when TCU>1. In addition, when TCU<1, is still spending decreasing instead of increasing. This indicates misperceptions. The outcomes of these behaviours led to the results shown for the third hypothesis (**H3**). The dotted line indicates the relationship between FI and the Ave DBD for fig.4.3.1 to 2.

H3:

Table 4.3 provides a summarised result of one sample T-test statistics, which indicates the average standard deviations of subjects' $\mathbf{TCU_s}$ from the normal TCU over time and their significance levels (*p*-values). (Refer, appendix V- for more statistical data)

Table 4.3. Average standard deviations of subjects

Averages	All subj.	Subj. with TFB<0 (-FB)	Subj. with TFB<0 (+FB)
	21	5	16
Standard Deviation	0.05	0.04	0.07
p-value (Sig.)	0.24	0.20	0.40

The results from the T-test indicates that, on an average, subjects deviated from reaching the normal TCU at a *p-value* of 0.24 greater than $\alpha = 0.05$. This validates the null hypothesis (**H3$_0$**): misperceptions of the dynamics of the petroleum economy leads to cyclical development in the TCU. In addition, subjects with –FB experienced a high level of fluctuations in the TCU in a comparison to those with +FB. This implies that each level of misperceptions has its own impact on the development of TCU. *Note: the higher the deviations of subjects' TCU from normal TCU, the less the p-value (significance level). At p-value of 0.24 for all subjects confirms the null hypothesis.* This is explained further through **Fig.4.4.1-4**, the graphical representation of the average deviations of TCU and the cyclical development of TCU over time with the corresponding p-values.

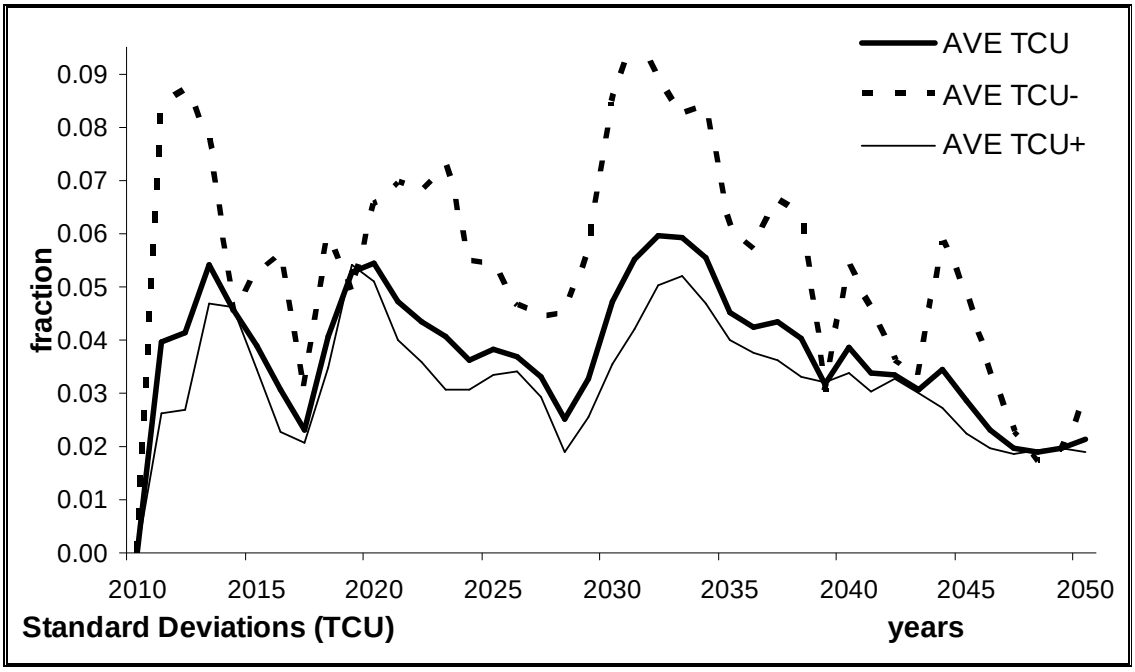


Fig.4.4.1

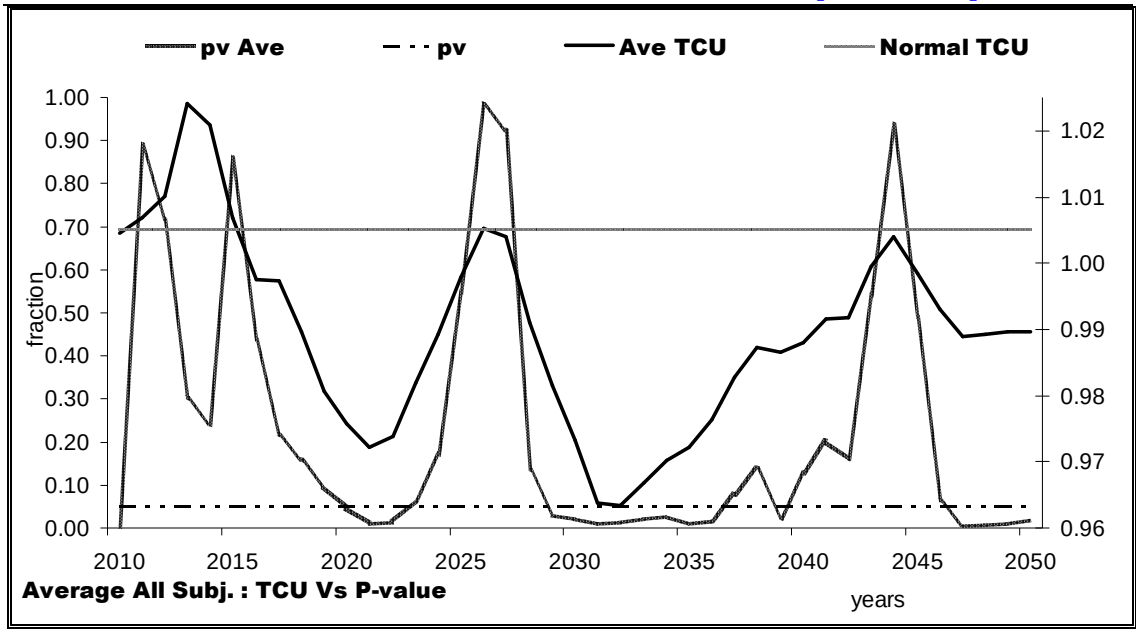


Fig.4.4.2

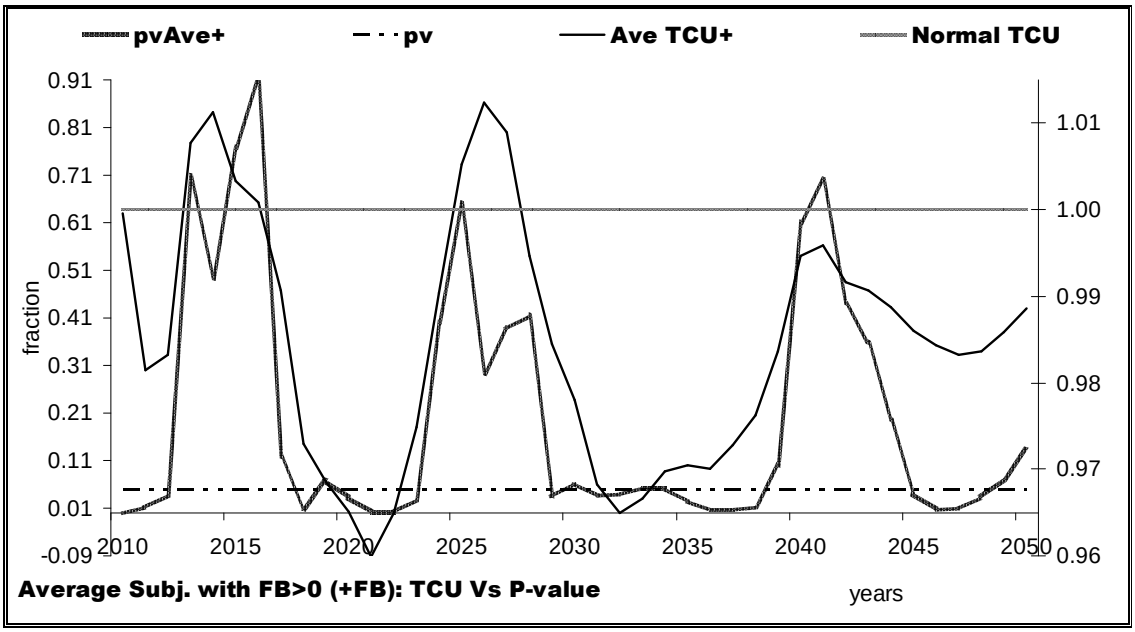


Fig.4.4.3

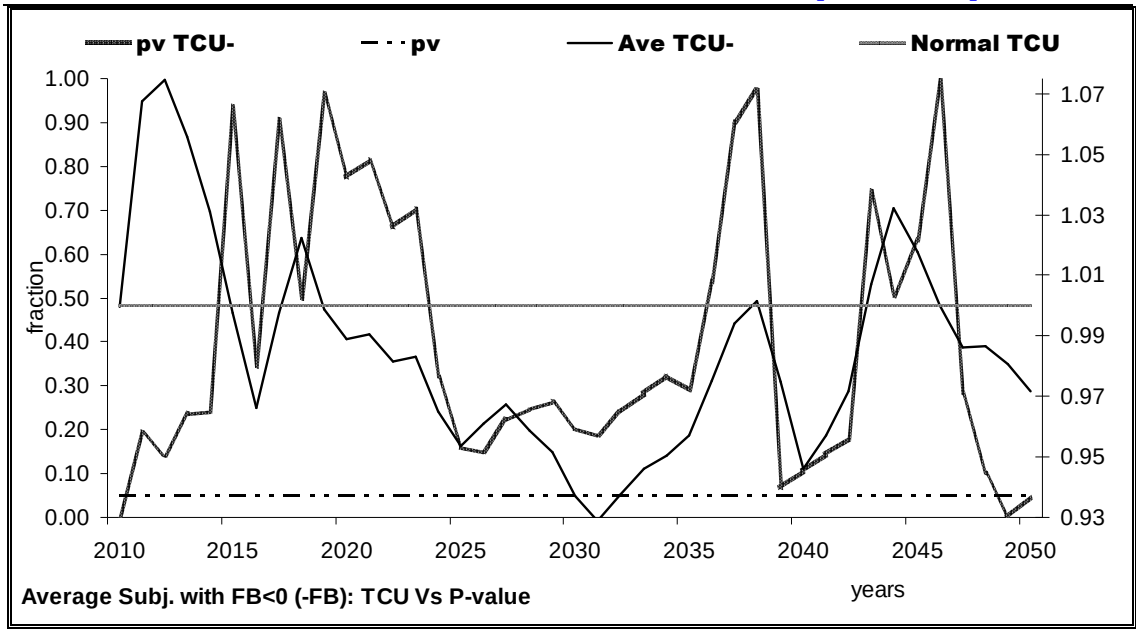


Fig.4.5

(Note, refer to appendix V for individual supporting cases for the results shown above)

5. Discussions

The experimental results are discussed in line with the three hypotheses. In discussing these results, we focus much on the rationales behinds these results. This, we referred to the information provided by the subjects through the questionnaire and the debriefing time of the experiment. In addition, results are supported with existing literature as well as interview proceedings of experts in the field of Ghana's petroleum revenue management.

5.1. H1: Policy makers in Ghana will mismanage its petroleum revenue through a Fund

As mentioned in the previous chapter, we failed to accept the null hypothesis at a statistical significance level of 0.00, lower than the critical alpha of 0.05. As a standard rule of thumb, the alternative hypothesis then is accepted (Gujarati, 113). As indicated in

Fig.4.1, only five out of 21 subjects managed the Fund into negatives, with the rest recording positive balances at the end of the simulator. This implies that a majority of the policy makers managed Ghana's petroleum revenue. In the context of this experimental outcome, it can only be deduced that Ghana has the potentials of managing its petroleum revenue through a Fund. In addition, it departs from the unsuccessful stories of countries like Venezuela and Oman, which has faced problems of managing their Funds well (Ugo, 2000). The result also follows the well known success story of Norway-managing its petroleum revenue well (Gelb and Grasmann, 2008; Tsalik, 2003; Gylfason, 2001 and Ugo, 2000).

With this adage in mind: 'behind every successful man, there is a woman'. The next section focuses on the subjects' spending decisions that resulted to both stories and the rationales behind these strategies or decisions. As mentioned earlier, the observed subjects' spending patterns (fig.4.2) reflected the public expenditure patterns of the petroleum producing countries in reality. The spending patterns also followed the petroleum tax revenue inflows, modelled to fluctuate over time reflecting the unstable oil prices in reality (Econ. Devt. and Pros., 2005). This created instability in spending decisions over time. On average, subjects with negative balances (-FBs) experienced a severe instability in their spending decisions over time as compared to those with positives (+FBs). The spending instability made subjects with –FBs to spend beyond their revenue inflows- 'out of control spending'. This explains why they recorded a negative balance (public debts) at the end thus, mismanaging Ghana's petroleum tax revenue. Again, subjects with –FBs initially increased spending with the intention of creating the enabling environment for economic growth as one of them puts it: *'I start from high spending to enable me, lay down the foundation for progress. I believe, without deficit there wouldn't be effective growth'*. This spending strategy failed them, leading to –FBs as one put it; *''I tried to increase payment but did not help'*. The strategy signalises misperceptions that is failing to recognise the dynamics of a petroleum economy when spending.

On the contrast, subjects with +FBs spent below the revenue inflows less as compared to those with –FB. In addition, some adopted a fixed spending rule that is spending only a portion of the yearly revenue inflows or the Fund balance (subjects 4 and 16, below). Below are the some spending strategies of subjects with +FBs:

Subject 18: *'Build reserves to spend during post oil revenue flow; you need to build locally adsorptive capacity before spending large'.*

Subject 4: *'Started off by assuming that 60% of the petroleum tax revenue will be used at the initial stages. As the oil fund reserves built up, I increased my spending decisions and gradually lowered them as the oil production period leveled out'*

Subject 3: *'Main objective was to bring budget-deficits payments (spending) low so as to ensure higher inflows into the Fund since after 2035, revenue from oil cease'*

Subject 16: *'Adopt a fixed budget deficit payment=min*$[0.65 of oil rev, budget deficit]$*'*

The underlying principle for these spending strategies was saving for future generation or oil down turn era and avoiding aggressive spending increases or decreases. This tended to minimise the cyclical development of their TCUs (section 5.3) as compared to those with –FB. These spending strategies further explain why they recorded positive Fund balances at the end of the simulator. On average, Fund inflows exceeded subjects' spending decisions explaining why a majority of the subjects recorded +FBs. This follows the expenditure and revenue patterns of petroleum producing countries like Norway and Chile from 1981 to 1999 (Ugo, 2000).

Besides the different spending strategies and Fund balances, we discovered that subjects were challenged with the following mental model questions[16] to answer before making decisions: firstly, when to invest more or less and also when to spend less or more. Secondly, the aggressiveness level of spending decisions that is to what extent should spending be increased or decreased to minimise the economic shocks (TCU).

[16] Mental model questions are the questions or issues to be answered by subjects mentally before making spending decisions. These were discovered during the debriefing stage of the experiment.

Lastly, most subjects increase or decrease spending by observing the development of these economic indicators; the GDP growth rate, per capita consumption, GDP Debts ratio and most importantly, the Fund inflows. For example, subject 23 described what he observed in course of the experiment as: *'I observed the path for; per capita consumption, the GDP growth rate and export-imports balance'*. These variables motivated desire for high spending sometimes, leading to –FB with subject 23 as an example. On the other hand, only few subjects observed the development of other indicators like TCU and DCL as the base for making spending decisions. Since the Fund balance was influenced by the trade deficit, subjects were expected to consider these indicators. Failure to do so could lead subjects to –FB when coupled with high spending.

After discussing subjects' observed behaviours with reference to the Fund management and spending strategies, other findings made from the experiments (through the questionnaire) are discussed as follows:

First, subjects were asked if Ghana should establish a Petroleum Fund. All subjects agreed that it should establish a Petroleum Fund for the effective management of the revenue. They disagreed on where to establish it, whether domestic or abroad. Only six subjects agreed that it should be established in Ghana but not abroad with the reason being; Ghana is able of managing its petroleum revenue well. Their argument is summarised in a comment by subject 11- '*No. We have adequate institutions and regulations of trust for managing the Funds'*. On the contrast, majority of the subjects agreed that the Fund should be abroad. They commonly expressed the fear of political interference in its management if established in Ghana. They also argue that a Fund abroad serves as safe investments and insulate domestic economy against shocks. Subject 18 describes it as; *'Yes, This will help create funds that the country can fall on, during periods of shocks and to finance negative imports on exports'*.

Subjects recommended that the appropriate institutions should be put in place to manage the Fund with transparency, public involvement and accountability. It should be independent from the government to avoid political interference. In addition, the politicians need to have a strong political will to establish it. This is because in a

developing country like Ghana, most citizens will be expecting the revenue to be spent now to impact on their lives than to save for the future generation when people are hungry. All the experts and subjects disagreed on this belief and strongly recommend a Petroleum Fund establishment based on the above reasons.

Secondly, subjects were asked if Ghana should have a spending rule, which all agreed. Mostly shared comment here was: 'Yes, to avoid unnecessary political interference and misuse of oil revenue for personal benefit of few. Save for future generation' (Subject 18). These concerns were also shared by some of the Ghana's development partners interviewed in the course of the field work. As one diplomat puts it; 'Yes. Ghana does not have enough experience with resource revenue yet to avoid boom and bust spending cycles, if it is left to year to year decision-making. The temptation to spend is very high'. This statement explains why subjects with negative Fund balance experienced ups and downs in the spending patterns (fig.4.2). Without a spending rule, the temptation to spend is certainly high. In all, it was discovered that policy makers in Ghana strongly accepted the concepts of spending rule.

Thirdly, policy makers were asked to list the main factors that influence or may influence spending of Ghana's petroleum tax revenue in reality- thus, rationales behind public spending decisions;

Development needs; infrastructural gap, social services and welfare issues

Political consideration (desire to win election) and public expectation

Savings for generation and the size of government expenditure

Economic indicators improvement; growth rate, inflations, GDP debt ratio, non-oil sector development

Poverty alleviation programmes and population growth

Stakeholders; Citizens of Ghana, civil society, development partners (world bank and IMF)

Changes in Petroleum revenue inflows (oil production and price changes)

Among these factors, subjects expressed a greater concern about the tendency of public spending decisions to be motivated by political consideration, thus the desire to win election. To illustrate this concern, subject 24 made his spending decisions to replicate the budget deficits figures over time for the government of Ghana in the course of experiments (see, appendix IV). As explained by him, different government regimes tend to reduce budget deficits after elections and increase it in the election year (1992 to 2009). This explains why subjects agreed on the establishment of a Fund with a spending rule to minimise the attitude of spending to win elections.

In addition, subjects expressed concerns about the influence of public expectations on Ghana's petroleum revenue spending. As one expert puts it; *'in order to get the public support for the establishment of a Fund, the government needs to provide incentives to the people'*. By the word 'incentives' he implied improving upon the welfare of the people to get their support for its establishment. He further recommended that the citizens of Ghana should be educated on the need to have a petroleum Fund.

Lastly, experts interviewed commonly recommended that the revenue should not treated as any other form of government revenue. They described it as transforming revenue because of the depleting nature of oil. When asked about Ghana experiencing the Dutch disease syndrome, all disagreed with that assertion. This is because the petroleum tax revenue is not big enough to appreciate the real exchange rate of the country by causing Dutch disease. In addition, the revenue could be used to finance the country's huge external debts and trade deficits. Instead of experiencing the Dutch disease, it was discovered that the country could experience another form of disease, which we describe as the *"wasteful spending disease" or "Unaccountable disease"*. This means spending the revenue on projects, which do not contribute economically to development of the country. *"Unaccountable spending disease"* is when spending cannot be tracked or in simple words – the issue of corruption.

The section 5.1 is concluded with a comment from a diplomat as an advice to the government on the spending decisions: *'Filling a large government deficit. Aid will also decline as oil revenue increases. The windfall will not be as great as many expect. Debate will be between spending on operation/current spending to reduce hardships of*

many citizens and investment/capital spending on infrastructure that will help grow the non-oil economy in the longer term'.

After discussing these issues relating to Ghana's petroleum tax revenue management through a Fund, the section 5.2 focuses on the problem of misperceptions surrounding public spending decisions in a newly petroleum economy like Ghana.

H2: Misperceptions of the dynamics of a petroleum economy when making spending making decisions:

Upon a careful observation of subjects' spending decisions in a comparison to Fund inflows and total capacity utilisation (TCU) as shown in Fig. 4.3.1-3 and table 4.2 respectively, we fail to reject the null hypothesis. This implies that on an average, subjects misperceived the dynamics of a petroleum economy when making decisions. This means that spending decisions were significantly influenced by Fund inflows as compared to the development of TCU. This result is in line with the following experimental works on misperception of systems, feedback structures, stock and flow concept (Moxnes, 2004, 1998b and Sterman, 1989). In all these experimental works, subjects misperceived the dynamics of the modelled systems or feedback structures. The problem of misperceptions occurs when subjects make decisions based on too simple and static mental model (Moxnes, 2004, 1998b). This leads to failing to recognise the dynamics of the systems, in which their decisions affect. This explains why on average subjects' spending decisions followed the Fund inflows as compared to the development of TCU (Fig.4.3.1-3), which control the modelled economy. In this case, the static mental models of subjects were; spending increases when Fund inflows increases or spending decreases when Fund inflows decreases. This is too simple and an easy feedback rule to apply when making decisions as compared to trying to understand how TCU adjusts in relation to spending. Being human, we love to have easy ways of doing things without sometimes recognising its impacts. This also explains why subjects failed to recognise these dynamics of the petroleum economy as described in the chapter three (section 3.3). For a quick recap, these dynamics are described as the impact of spending decisions on the multiplier effect, which influence the development of TCU through the interaction

between production capacity (PC) and demand supply ratio (DS ratio). And also the long term impacts of TCU on Fund balance through cost levels and trade deficit.

After observing all subjects on average, the next section will focus on subjects with +FB to those with negative -FB. The intention here is to explain the different levels of misperceptions experienced by subjects when divided into –FB and +FB. It was discovered that subjects with +FB had a significant influence of both Fund inflows and TCU on their spending decisions (table 4.2) as compared to those with –FB and all subjects on average. In reference to the listed spending strategies (section 5.1), subjects with +FB understood the dynamics of the systems to the some extent by increasing or decreasing spending gradually as they put it- to minimise the economic shocks (TCU). This implies that misperceptions surrounding spending decisions can also be attributed to the aggressiveness of subjects' spending decisions. In addition, as shown in fig.4.3 subjects with –FB even increased spending when there were negative inflows starting from year 2032 to 2050. This behaviour can be attributed to their desire of improving upon the economic indicators shown on the simulator. These indicators influenced subjects who focused on them when making decisions to spend more to improve upon them without recognising their decisions' impacts on the development of TCU. In addition, the problem of misperceptions was mostly experienced during the periods of the petroleum tax revenue inflows (2010 to 2035) as observed in fig. 4.3.1-3.

As mentioned earlier, on an average, subjects misperceived the dynamics of the petroleum economy when making spending decisions. Since misperceptions of systems often affect subjects' performance in an experiment (Moxnes, 2004, 1998b and Sterman, 1989), the next section of the chapter focuses on subjects' performance, specifically the development of the TCU.

H3: Misperception of the dynamics of petroleum economy lead to a cyclical development in the total capacity utilisation (TCU)

From the observed average standard deviations of subjects' TCU from the normal TCU (TCU=1), the second null hypothesis could not be rejected. This indicates that on an average, subjects who misperceived the dynamics of the petroleum economy experienced a cyclical development of TCU (deviating from TCU=1). The continuous deviations of subjects' TCU from one indicate poor performance as assumed. Subjects' poor performance is in line with the poor performance of subjects who participated in the experiments conducted by Moxnes, (2004), (1998b) and Sterman, (1989). Sterman attributed the poor performance of the subjects of the 'beer distribution game' experiment to their insensitivity to feedback. Moxnes (1998b) also attributed subjects' poor performance in the renewable resource management experiment to making decisions based on inappropriate and static mental models.

As shown in fig.4.4 on an average, subjects experienced cyclical developments in the TCU leading to deviations from TCU=1. As explained in the previous sections, subjects with +FB experienced a different level of misperceptions from those with –FB. These different levels of misperceptions are also reflected in their performance. As observed from fig.4.4, subjects with –FB experienced a high level of deviations as compared to those with +FB. The *p*-values of deviations over time were measured to know how significant the deviations (1>TCU>1) were. All deviations or change in TCU with a *p*-value less than one indicates a strong deviation. On average, the *p*-value was 0.24 greater than one, which makes it difficult for the null hypothesis to be rejected.

The cyclical development of TCU as mentioned in the chapter three (section 3.3) is because of the shifting of dominance between the reinforcing loop R3 (production capacity) and the counteracting loop B1 (demand supply ratio). This is attributed to effect of spending decisions on the multiplier effect. Failing to recognise these dynamics when making spending decisions tend to shift dominance between R3 and B1. This creates the cyclical development of TCU. TCU then affects the cost level, which influence the Fund balance in the long run by determining the net balance between imports and exports (trade deficit). Again, the aggressiveness of spending decisions increases the shift in dominance (cyclical developments in TCU) and its impacts on the Fund. This explains

why subjects who strongly misperceived the dynamics of the modelled petroleum economy of the simulator, tended to record –FB. And also focused on the revenue inflows in the initial stages of the simulator (Fig.4.3), leading to a high ups and downs (Fig.4.3).

In summary, on average subjects deviated from the normal TCU (TCU=1) over time making it difficult for the null hypothesis to be rejected as observed from table 4.3 and fig.4.4. The level of deviations depended on the level of misperceptions with subjects with negative balance being the most affected (fig.4.4.). Refer to appendix V, for examples of individual cases explaining the nature of problems discussed above.

Conclusion

At the end of the experiment, it was discovered that policy makers in Ghana were able to manage its petroleum tax revenue well through a Fund. Thus, a majority of the experiment subjects recorded a positive Fund balances at the end of the simulator. This implies that Ghana has the potentials of following the success stories of natural resources countries like Chile and Norway (Ugo, 2000). Subjects' ability to record a positive balance depended on their spending strategies such as spending gradually and saving for the future. Through the questionnaire and interviews administered, it was found out that all the subjects agreed to the establishment of Petroleum Fund for Ghana but disagreed on whether abroad or domestic. Majority of them agreed that, it should be abroad to avoid political interference, safe investments and insulate the economy against shocks. All the subjects also agreed that there should be a spending rule to ensure discipline in government expenditure in relation to revenues inflows. In addition, to minimise the chances of politically motivated spending decisions thus spending to win elections. Again, it found out that in reality, Ghana's petroleum revenue spending decisions may be influenced by development needs, public expectation and political consideration. Lastly, Ghana is less likely to experience the Dutch disease syndrome but stands the chance of

experiencing 'wasteful spending disease'- spending on projects of less economic contributions.

On average, subjects misperceived the dynamics of the petroleum economy when making decisions. Thus, spending decisions were greatly influenced by the Fund inflows in a comparison to the development of the TCU. It was discovered that the level of misperceptions differed from subjects with positive Fund balance to those with negatives. Subjects with negatives experienced a level of misperceptions, which was difficult to be explained but it can be attributed to the aggressiveness of their spending decisions. This is because on an average, they recorded high initial spending decisions and even at times of negative Fund inflows from 2035 to 2050. Interestingly, subjects with positive balances experienced less level of misperceptions. This implies that they observed the dynamics of the petroleum economy to some extent as indicated in the table 4.1 but still their spending decisions were also influenced by Fund inflows greatly. It can also be linked to the aggressiveness of their spending decisions (gradual spending approach). In all, it was discovered that subjects' levels of misperceptions also depended on the aggressiveness of spending decisions as mentioned above.

In general, subjects who misperceived the dynamics of the petroleum economy experienced a cyclical development in the TCU, thus deviations from a normal TCU of one. Subjects with a negative balance experienced the highest deviations as compared to those with positive balances. This indicates that different levels of misperceptions lead to different developments of TCU. It was found out that subjects who failed to recognise these modelled dynamics; spending influence on the multiplier effect and the shifting of dominance between production capacity and demand supply ratio, tend to experience the cyclical development of TCU. And its long term effects on the Fund balance through trade deficit.

Looking at the experimental outcomes; misperceptions surrounding public spending decisions making and the development of TCU and the long term effect on the Fund development- it will be more appropriate that further studies are carried out to explore the

following; first, if policy makers will tend to misperceive other macroeconomic dynamics when making decisions and how these misperceptions impact on the natural resources blessed economies as well as the revenue management (Fund). Second, as suggested by subjects, the underlying model assumptions should be expanded to include the following macroeconomic indicators; inflation, interest rate and real exchange rate for economic analysis for Ghana, the new petroleum producing country and others.

Appendix I: Experimental Instructions.

Paper No: One PC No:

Introduction to simulator

You have been appointed by the President to manage Ghana's oil revenue - in a simulator of the national economy. Your task is to decide on yearly budget deficit to be financed mainly by oil and gas tax revenue over the period 2010 to 2050. Your goal is to maximise welfare for Ghana over those 40 years. You will get a reward varying from 30 to 60 Ghana Cedi depending on how high welfare you obtain. Welfare is measured by the present value of consumption over the 40 year period plus the present value of a fund held abroad.

The simulator

The simulator represents a national economy similar to the one of Ghana. The country is just starting to produce and export oil. Oil production is expected to last for twenty to thirty years. At peak production governmental oil and gas tax incomes are expected to be nearly 4.0 billion US dollars per year, if we assume an oil price of 100 USD/barrel. The exact amount of petroleum tax revenue is revealed year by year as the simulation progresses. The country also receives a fixed amount of grants every year (900million GHS/year). These grants are automatically spent each year and are outside your control.
Your only decision is the size of the budget deficit *(Spending Decision as indicated on the decision interface)*. You can not control the national cost level, which reflects wages, prices and capital costs. This cost level is assumed to increase whenever the production sectors of the economy have a capacity utilisation above normal. The cost level declines whenever the capacity utilisation is below normal; in which case capacity utilization indicates unemployment. Note: You cannot use price and wage controls. Nor can you influence costs by changing the exchange rate. For simplicity we assume that the exchange rate is fixed (1 GHS corresponds to 1 US dollar).

The underlying macroeconomic model is split in two sectors: one which faces no competition from abroad and another which competes with imported products and also produces for export markets. The model captures production capacity and production,

which determines GDP and income, and it also, calculates consumption and investments as well as imports and exports. When income or budget deficit changes, total spending changes after a time delay. Investments reflect both product demand and total national savings. Imports depend on domestic demand and the national cost level. Exports depend on the cost level and the production capacity of the competing sector. It takes several years before the full effects of cost changes are observed in imports and exports.
The simulator does not distinguish the public and private sector except for the budget deficit that you control. This means that the fund abroad represents all debts and savings abroad. Historically the country has been a net borrower such that the fund starts out with a negative value in 2010. There are three income streams that flow into the fund: tax revenue from oil and gas production, grants received, and interest payments with a fixed interest rate of 4 % p.a. (negative inflow when the fund is negative, denoting debts). The outflow from the fund is made up of the trade deficit measured by the value difference between imports and exports.

The following aspects are not covered by the model. The cost level only captures changes in costs relative to other countries; there is no general price inflation in the simulator. Abroad prices for exports and imports are assumed constant. There is no short-term business cycle activity in demand for export products from other countries or in the supply of imports from abroad. The only source of external variation is the uncertain oil and gas tax revenue. The oil producing sector is not captured by the simulator; focus is on spending of oil and gas tax revenue.

The PC screen shows important economic indicators as they develop from year to year. You may ask clarifying questions about definitions, but should not discuss decisions with others. Note that in the figures, scales adjust automatically over time. When you have reached year 2050, please do not touch the PC any more. You will now see on the screen how much you have earned. Please fill in the questionnaire you will receive, and sign the receipt to get your payment. You and your institution will remain anonymous. Payments are made in private after the simulation.

We are grateful for your participation and your contribution to our research. We also hope the experience will be rewarding for you.

Abbreviations:
GDP: Gross Domestic Product. GHS: Ghana Cedi. USD: American Dollars
CU P: Capacity Utilisation for protective sector and CU C: for competitive sector.

Your payment is: _____ (Ghana Cedi)

Received by: _____
(Signature)

Date:
_____

Appendix II: Questionnaires

Paper No: Three PC No:

Kindly answer the following questions after the simulation.

1. Do you think Ghana should establish a petroleum fund abroad? Give reasons why yes or no.

2. Do you think it is important for Ghana to establish a firm rule for government's spending of oil and gas tax revenue? Give reasons why yes or no.

3. Kindly explain the strategy you followed when deciding on budget deficit payments in the simulator.

4. In reality, what do you think are the main factors that will influence spending of oil and gas tax revenue?

5. Finally, please comment on your experience with this simulator. Did you find the simulator realistic, if not why? Were you surprised by its behaviour?

Thank you

Appendix III: Simulation Debriefing

Debriefing of simulator experience

Policy

1. A petroleum *fund* invested abroad is important for three main reasons:

- To buffer the national economy from big and rapid changes in oil prices, oil production rates, and thus in oil tax revenue.
- To have a minimum of reserves of foreign exchange to stabilize the exchange rate through open market operations.
- To avoid a depression when oil production ends, possibly through a big enough fund to replace use of oil revenue with use of the return on the fund. The size of this fund depends on expected returns on investments at home versus abroad.

2. A firm and well founded spending *rule* is important for two main reasons:

- The effects of spending oil tax revenue at home are complex and are likely to be misperceived by large fractions of the population. If such misperceptions come to dominate spending policy, instability and overshoots are likely results.
- It is probably easier to obtain political agreement on firm spending rules in separate political discussions than in year to year budget discussions. To avoid that promises of excessive oil tax revenue spending become the main selling point in election campaigns, wide political agreement is essential. Such an agreement has been very important in Norway.

What misperceptions?

Receiving oil tax revenue, or windfall profits, is different from winning in lotto. The lotto winner can have a big and costly party without long-term consequences for the nation because he is small compared to the national economy. Oil tax revenue is large and requires analysis and information campaigns for three reasons:

- In general, in the heat of the moment, people tend to be short-sighted and neglect important long-term consequences. Expectations about future wealth are easy to form. Long-term consequences are difficult to foresee, even for economists that either rely on intuition or formal models that do not capture the dynamics of the adjustment process.

- The first specific complexity is the multiplier effect. As oil tax revenue is spent, the effect on consumption and investments is amplified through the multiplier effect: an increase in spending leads to more production, more income, and more spending. It takes a few years to see the full effect of this reinforcing feedback loop. For those who observe an unexpectedly large increase in spending, external

events are likely to be used to explain. Thus, for most people the multiplier effect remains unknown theory that is not easy to learn through experience.

- The second effect comes through the trade deficit. As spending increases, capacity utilization increases and creates an upward pressure on wages, prices and capital costs: on the domestic cost level. This cause the demand for competing products to swing towards relatively cheaper imported goods and services. Similarly, higher costs put downward pressure on exports. As a consequence the trade deficit increases. To some extent this is exactly what one wants to happen. The oil tax revenue is exchanged with goods from abroad. However, the multiplier effect makes costs go higher than they would otherwise. Furthermore, the effect of the cost level on the trade deficit is much delayed; it takes time to adjust the real economy. Eventually, increased imports and reduced exports lead to reduced demand for products from the competing sector of the economy. This reduces the sector's capacity utilization and sector unemployment develops (the Dutch Disease). However, it takes time to bring the cost level down. Meanwhile, the trade deficit grows much bigger than what it ought to be. Reduced production in the competing sector leads to reduced income and spending. In addition the government may reduce budget deficit to force down the cost level. Thus also the protected sector's capacity utilization will be reduced. This is a situation that can lead to political unrest because development goes in the opposite direction of expectations caused by increasing oil tax revenue.

The simulator can be used to explore different spending rules to obtain growth combined with stability.

Appendix IV: Model Documentation (Equations only)

Name	Unit	Definition
Capital c	GHC	0.5*51.6<<GHC>>
Capital p	GHC	0.5*51.6<<GHC>>
Expected CCI		
Expected DCL	USD/GHC	1<<USD/GHC>>
Expected Income	GHC/year	(17200<<GHC/year>>/1.04)/1000
Fund USD	USD	-8002.5<<USD>>/1000
PV Consumption	GHC	0<<GHC>>
Unused Income	GHC	650<<GHC>>/1000
Budgeted Govt revenue from Fund	GHC/year	DELAYINF(Decided Budget Deficit Payment,0.5<<year>>,1)
C PV C	GHC/year	Total Consumption*EXP(-Discount rate*(TIME-STARTTIME))
capacity cost index CCI		Expected CCI*(1-0.2*(Normal savings/total capital investments-1))
Capacity Demand ratio P		Demand p/Production Capacity p
Capacity Supply ratio C		Demand c/Production Capacity c
Capacity Utilisation c		DELAYINF(Indicated CU c,0.4<<year>>,1,1)
Capacity Utilisation p		DELAYINF(Indicated CU p,0.4<<year>>,1,1)
capital Investments c	GHC/year	DELAYINF(MAX(0<<GHC/year>>,(Capacity Utilisation c* Capital c/capacity cost index CCI-Capital c)/2<<year>>+ Depreciation c),investments delay c,3, 2.330<<GHC/year>>)
capital investments p	GHC/year	DELAYINF(MAX(0<<GHC/year>>,(Capacity Utilisation p* Capital p/capacity cost index CCI-Capital p)/2<<year>>+ Depreciation p),investment delay p,3,2.330<<GHC/year>>)
change in ECCI	year^-1	(capacity cost index CCI-Expected CCI)/1<<year>>
Change in EDCL	USD/(year *GHC)	(Domestic Cost Level-DCL-Expected DCL)/change time
change in expected income	GHC/year²	(Gross Domestic Product-Expected Income)/ expectation formation time
change time	year	4<<year>>
consumption fr p		
Criterion	GHC	PV Consumption+Fund USD*EXP(-Discount rate* (TIME-STARTTIME))/Exchange rate
Decided Budget Deficit Payment	GHC/year	1.902<<GHC/year>>
Decision interval		PAUSEIF((TIME-STARTTIME)/N1 MOD 1=0)
Demand c	GHC/year	Domestic market demands c*(1-Import fraction)+Exports
Demand p	GHC/year	Total Consumption*consumption fr p+total capital investments*Investment fr p
Depreciation c	GHC/year	Capital c/Lifetime c
Depreciation p	GHC/year	Capital p/Lifetime p

Discount rate	year^-1	0.04/1<<year>>
Domestic Cost Level-DCL	USD/GHC	effect of TCU on DCL*Expected DCL
Domestic market demands c	GHC/year	(Total Consumption*(1-consumption fr p)+total capital investments*(1-Investment fr p))/Price index c
effect of DCL on export fraction		GRAPH(Relative value of domestic product,0,0.25,{0.8,0.746,0.685,0.6,0.5,0.415,0.346,0.29,0.26//Min:0;Max:1.2//})
effect of DCL on import fraction		GRAPH(Relative value of domestic product,0,0.25,{0.4,0.43,0.49,0.57,0.6228,0.67,0.72,0.75,0.78,0.82,0.87,0.88,0.88,0.88//Min:0;Max:1.5//})
effect of TCU on DCL		GRAPH(Total Capacity Utilisation,0,0.1,{0.37,0.37,0.38,0.4,0.42,0.46,0.5,0.58,0.64,0.77,1,1.29,1.49,1.64,1.71//Min:0;Max:2//})
Exchange rate	USD/GHC	1<<USD/GHC>>
expectation formation time	year	1.5<<year>>
Export fraction		DELAYINF(effect of DCL on export fraction,4<<years>>,1,0.5)
Exports	GHC/year	Production Capacity c*Export fraction
Foreign substitute Cost level in USD	USD/GHC	1.0<<USD/GHC>>
Fund inflows	USD/year	Petroleum Tax Revenue+Interest on Fund+Grants-USD
Fund outflows	USD/year	Trade Deficits USD
Game stoptime		PAUSEWHILE(TIME=2051<<@year>>)
GDP Debt ratio		((Fund USD*1<<1/USD>>)/(Gross Domestic Product*1<<year/GHC>>))
GDP Growth rate		100*(Gross Domestic Product-Traditional GDP)/Traditional GDP
Grants	GHC/year	0.898<<GHC/year>>
Grants-USD	USD/year	Grants*Exchange rate
Gross Domestic Product	GHC/year	Production p+Production c
Import fraction		DELAYINF(effect of DCL on import fraction,2<<year>>,1,0.6228)
Imports	GHC/year	Domestic market demands c*Import fraction
Indicated CU c		GRAPH(Capacity Supply ratio C,0,0.1,{0,.1,.2,.3,.41,.51,.62,.72,.82,.92,1,1.09,1.18,1.23,1.26//Min:0;Max:2//})
Indicated CU p		GRAPH(Capacity Demand ratio P,0,0.1,{0,.1,.2,.3,.41,.51,.62,.72,.82,.92,1,1.09,1.18,1.23,1.26//Min:0;Max:2//})
Interest on Fund	USD/year	Fund USD*Interest rate
Interest rate	year^-1	0.04<<1/year>>
investment delay p	year	1<<year>>
Investment fr p		
investments delay c	year	1<<year>>
Lifetime c	year	15<<year>>
Lifetime p	year	15<<year>>
N1	year	1000000000000000000000000<<year>>

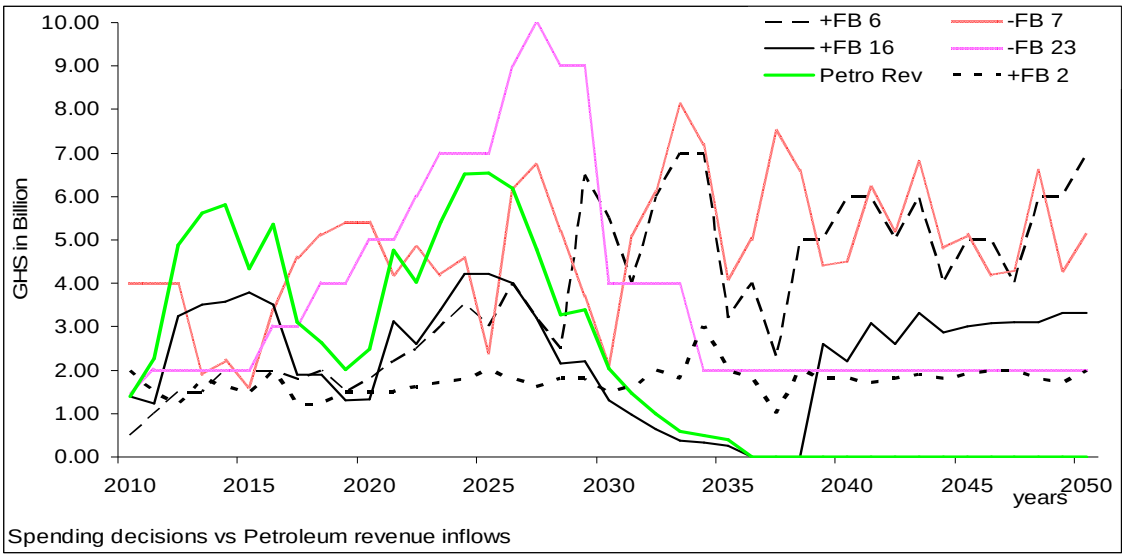
Normal savings	GHC/year	Spending*Saving rate
Oil Price-USD	USD/barrels	GRAPHLINAS(TIME,2009<<@year>>,1<<year>>,{75,75,85,126,145,150,112,138,80,68,52,64,123,104,141,172,179,172,141,99,117,81,79,71,71,69,68,64,52//Min:0;Max:200//})*1<<USD/barrels>>
oil production	barrels/year	GRAPHLINAS(TIME,2009<<@year>>,1<<year>>,{0,43.8,63.072,91.25,91.25,91.25,91.250,91.250,91.250,91.250,91.250,91.250,91.250,91.250,90,89,86,84.6,80,77.6,68,59,43.6,33,20,17,14,0,0,0//Min:0;Max:100//})*1<<barrels/year>>
Oil Revenues	USD/year	(oil production*Oil Price-USD)/1000
Payoff		IF(TIME<2050<<@year>>,0,MAX(45,MIN(60,45+0.3*(Criterion-500<<GHC>>)/1<<GHC>>)))
Per capita consumptn	GHC/person	Total Consumption/Total Population
Per capita real GDP	GHC/person	(Gross Domestic Product/Total Population)*1000
Period	@year	TIME
Petroleum Tax Revenue	USD/year	Oil Revenues*Petroluem tax rate
Petroluem tax rate		42.5/100
Price index c		DELAYINF((1-Import fraction)+Import fraction/Relative value of domestic product,1<<year>>,1,1)
Production c	GHC/year	Capacity Utilisation c*Production Capacity c
Production Capacity c	GHC/year	EXP(technology improvement c*(TIME-STARTTIME))*(Capital c/(0.5*51.648<<GHC>>))*(0.5*17.216<<GHC/year>>)
Production Capacity p	GHC/year	EXP(technology improvement p*(TIME-STARTTIME))*(Capital p/(0.5*51.648<<GHC>>))*(0.5*17.216<<GHC/year>>)
Production p	GHC/year	Capacity Utilisation p*Production Capacity p
Relative value of domestic product		Domestic Cost Level-DCL/Foreign substitute Cost level in USD
Saving rate		0.25*Expected CCI
Spending	GHC/year	Spending domestic income+Budgeted Govt revenue from Fund+Grants
Spending domestic income	GHC/year	Expected Income+MAX(0<<GHC/year>>,Unused Income/time to spend excess)
technology improvement c	year^-1	0.005/1<<year>>
technology improvement p	year^-1	0.005/1<<year>>
time to spend excess	year	1<<year>>
Total Capacity Utilisation		(Capacity Demand ratio P*Production Capacity p+Capacity Supply ratio C*Production Capacity c)/(Production Capacity c+Production Ca
total capital investments	GHC/year	capital investments p+capital Investments c
Total Consumption	GHC/year	Spending-total capital investments

Total Population	person/year	EXP(0.01<<1/year>>*(TIME-STARTTIME))*23<<person/year>>
Trade deficits	GHC/year	(Imports-Exports)
Trade Deficits USD	USD/year	Trade deficits*Exchange rate
Traditional GDP	GHC/year	DELAYINF(Gross Domestic Product,1<<year>>,1, Gross Domestic Product/1.03)

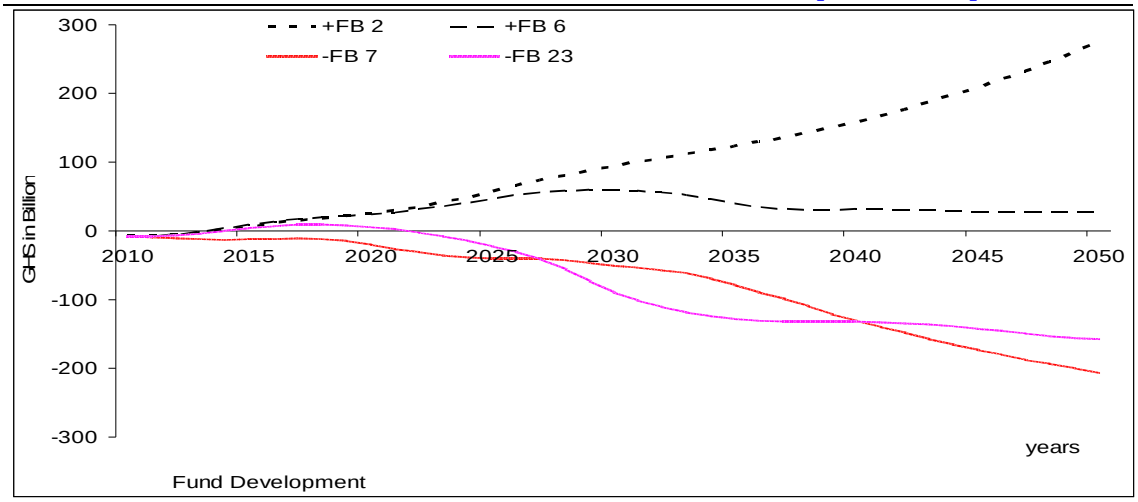
Appendix V: Extra figures and graphs

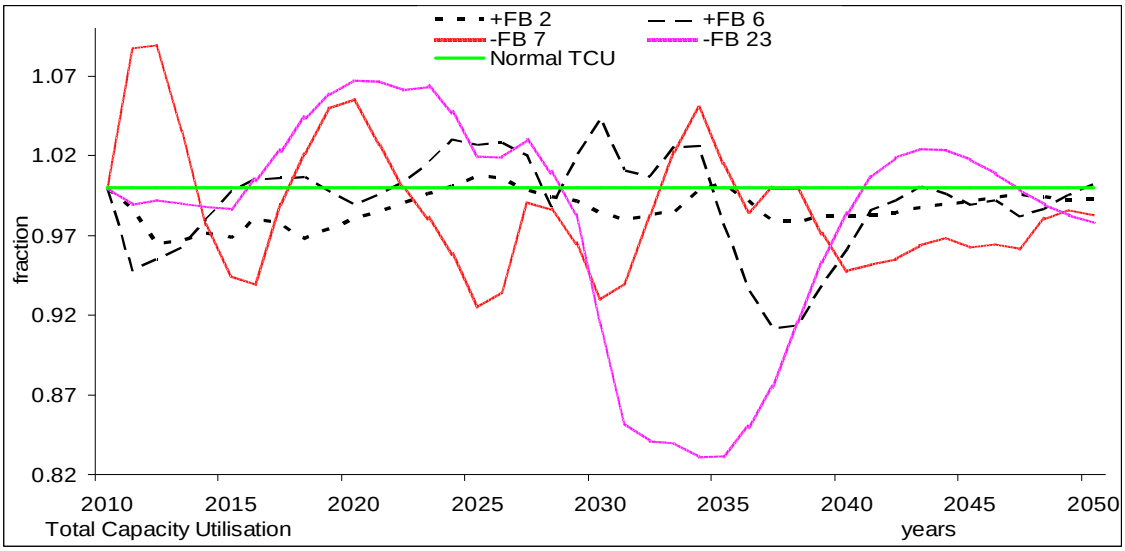
Individual Supporting Cases

Under this section, we show the results of four subjects representing both subjects with positive Fund balance (+FB) and negative Fund balance (-FB). These below figures further explains the nature of the problems discussed above (misperception surrounding spending decisions and the cyclical development of the TCU as well as its possible effect on the Fund balance).



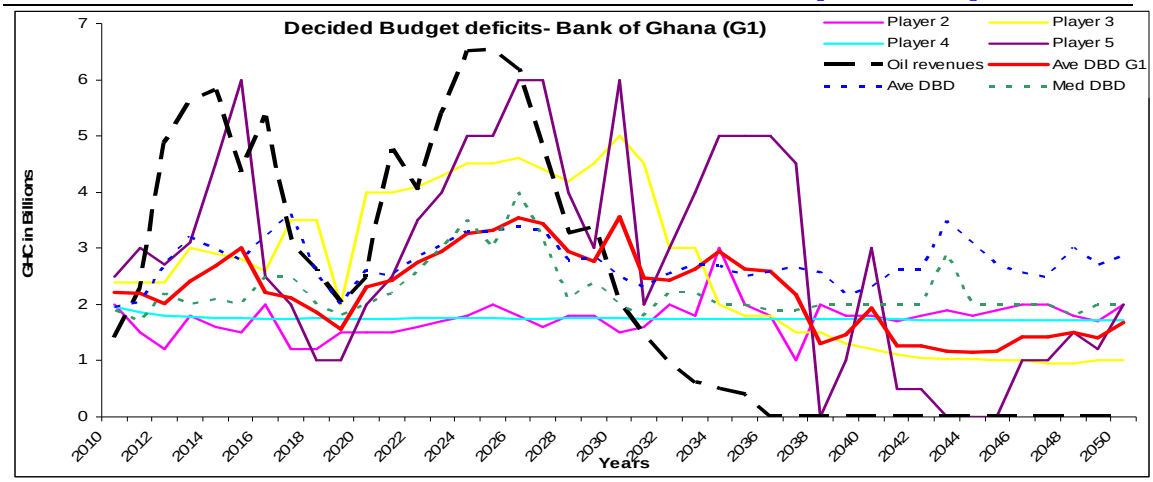
Spending decisions vs Petroleum revenue inflows

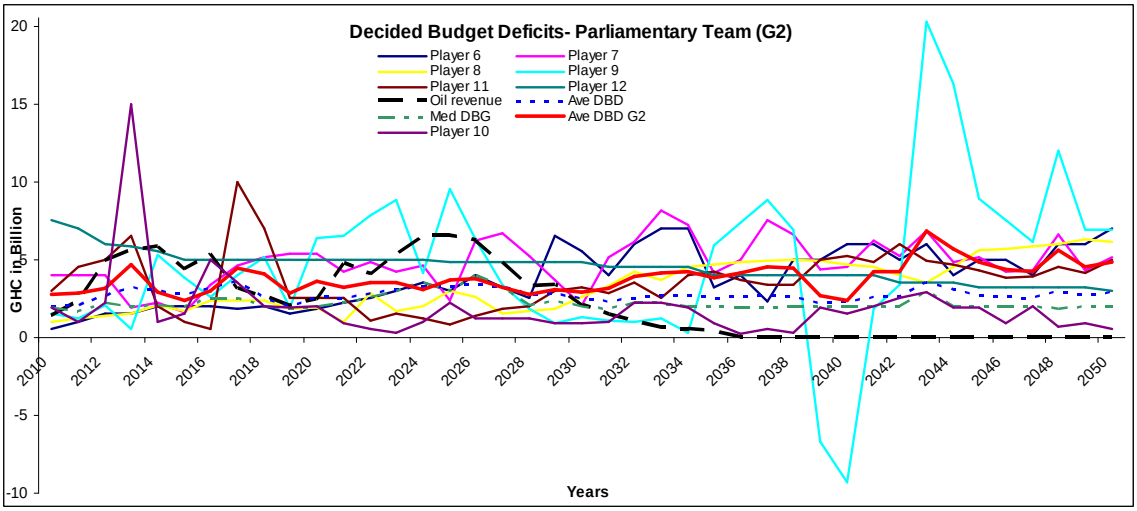


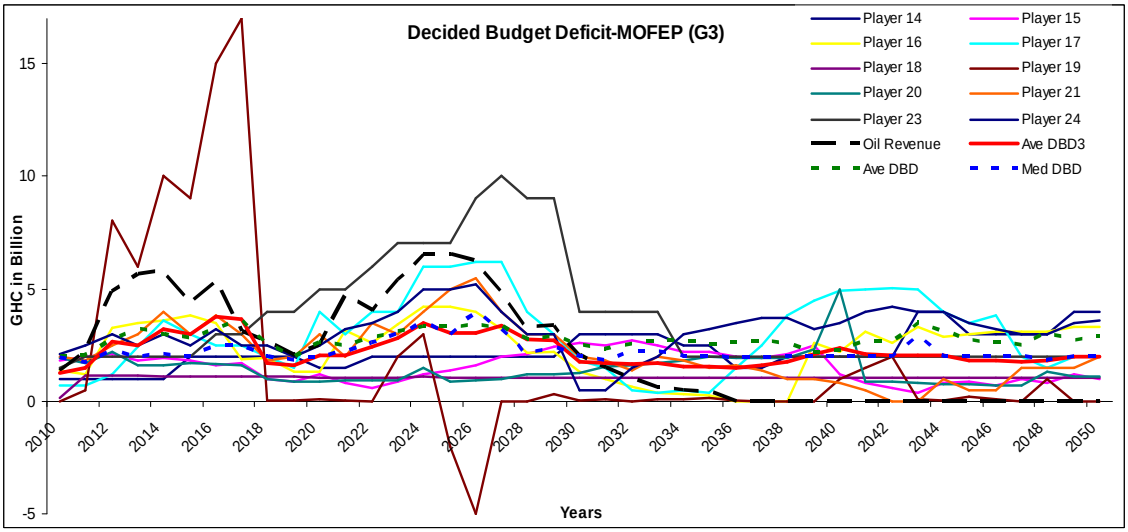


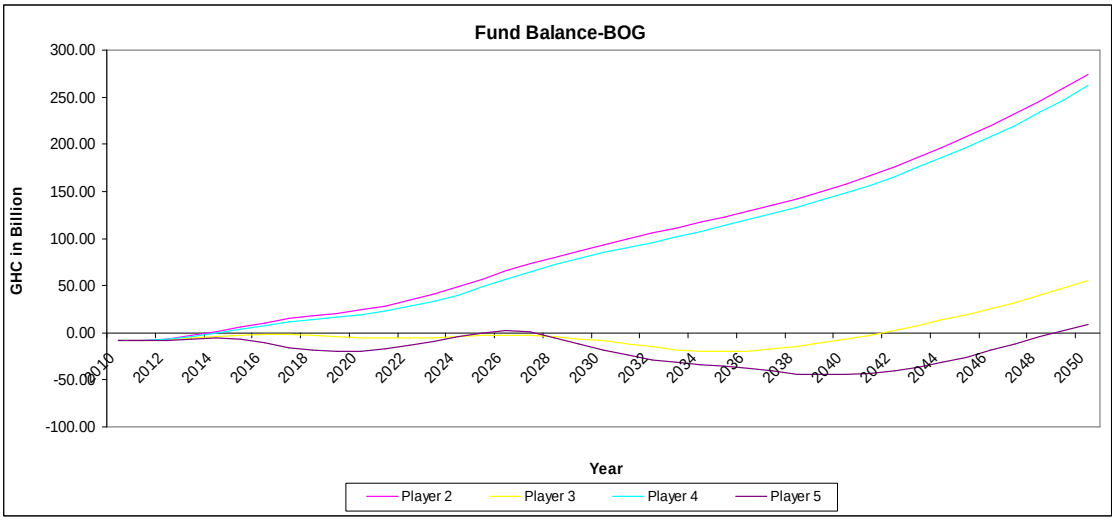
Spending Decisions (Three bodies involved in the experiment)

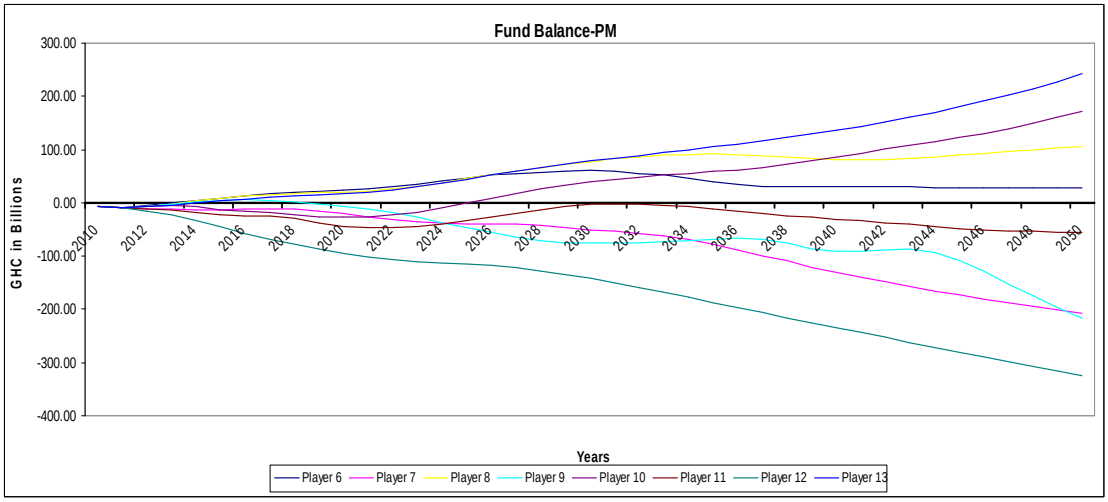
Key note: BOG- Bank of Ghana, MP/ PM- Member of Parliament, MOFEP- Ministry of Finance and Economic Planning. (GHS=GHC)

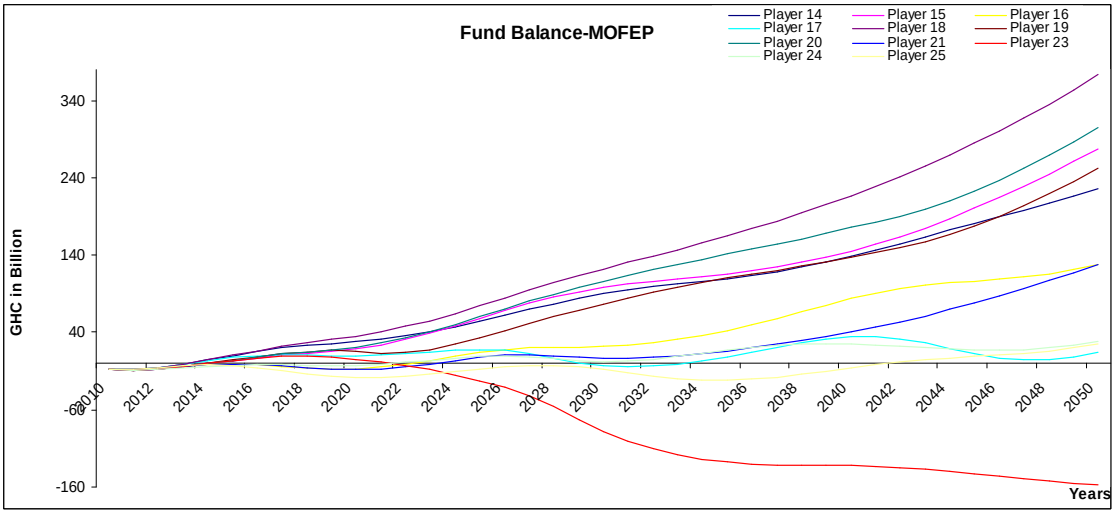

Decided Budget deficits- Bank of Ghana (G1)
Player 2
Player 3
Player 4
Player 5
Oil revenues
Ave DBD G1
Ave DBD
Med DBD
GHC in Billions
Years


Decided Budget Deficits- Parliamentary Team (G2)
Player 6
Player 7
Player 8
Player 9
Player 11
Player 12
Oil revenue
Ave DBD
Med DBG
Ave DBD G2
Player 10
GHC in Billion
Years

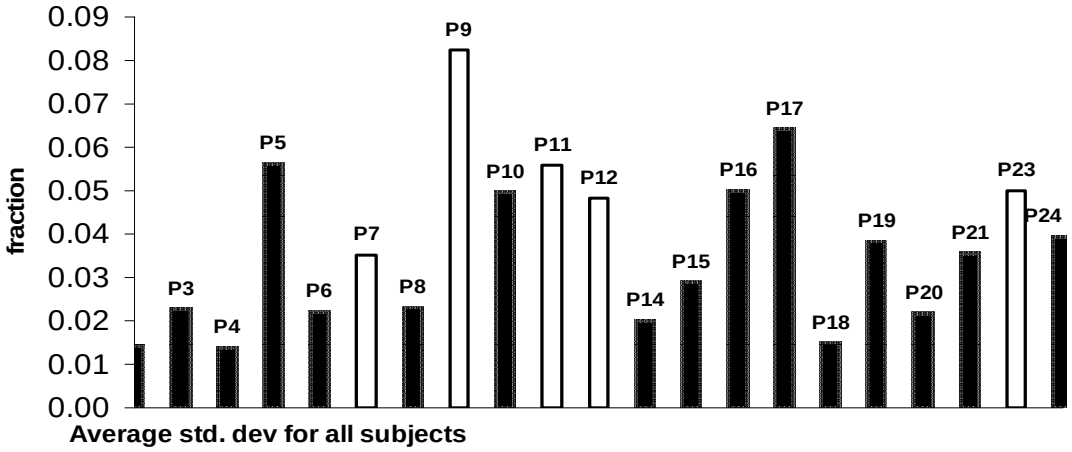

Decided Budget Deficit-MOFEP (G3)
Player 14
Player 15
Player 16
Player 17
Player 18
Player 19
Player 20
Player 21
Player 23
Player 24
Oil Revenue
Ave DBD3
Ave DBD
Med DBD
GHC in Billion
Years

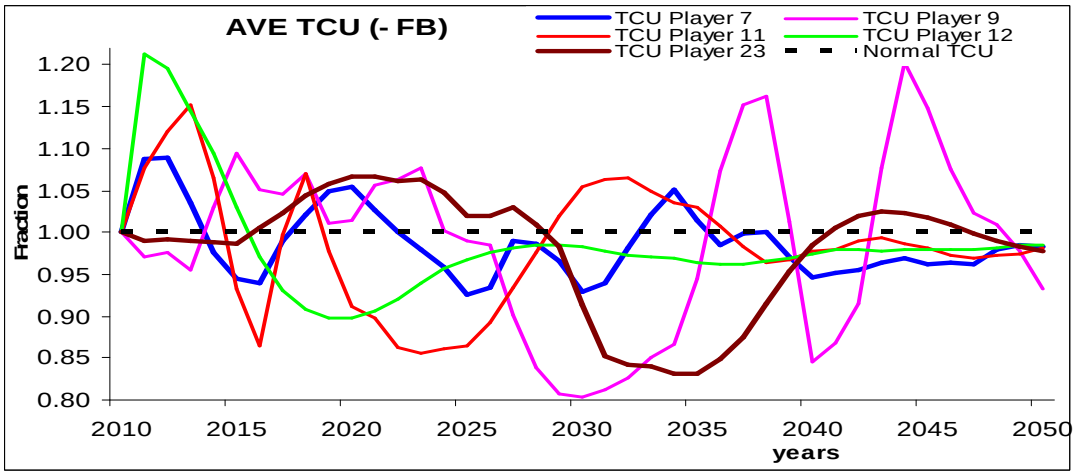

Fund Balance-BOG
GHC in Billion
300.00
250.00
200.00
150.00
100.00
50.00
0.00
-50.00
-100.00
2010
2012
2014
2016
2018
2020
2022
2024
2026
2028
2030
2032
2034
2036
2038
2040
2042
2044
2046
2048
2050
Year
Player 2
Player 3
Player 4
Player 5

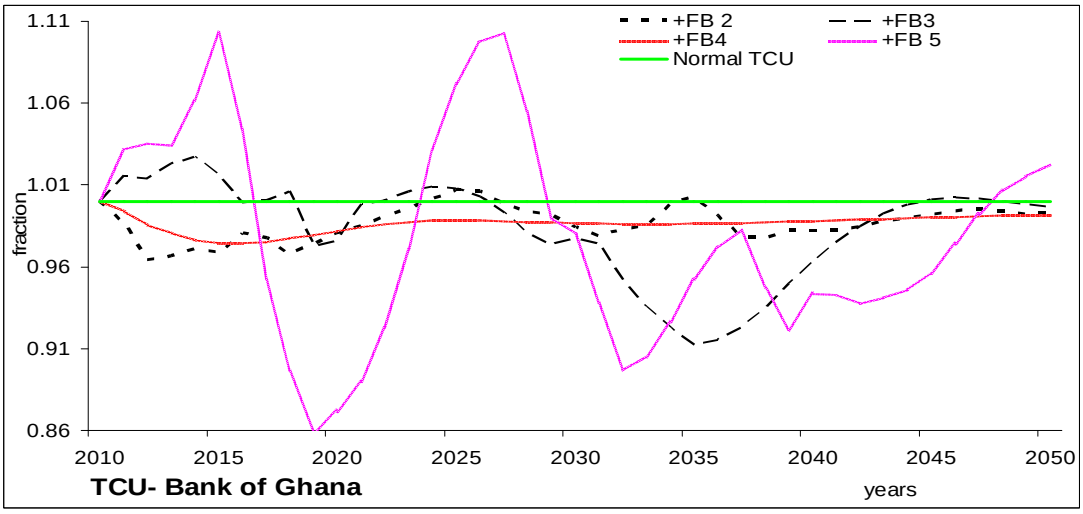

Fund Balance-PM
GHC in Billions
300.00
200.00
100.00
0.00
-100.00
-200.00
-300.00
-400.00
2010
2012
2014
2016
2018
2020
2022
2024
2026
2028
2030
2032
2034
2036
2038
2040
2042
2044
2046
2048
2050
Years
Player 6
Player 7
Player 8
Player 9
Player 10
Player 11
Player 12
Player 13

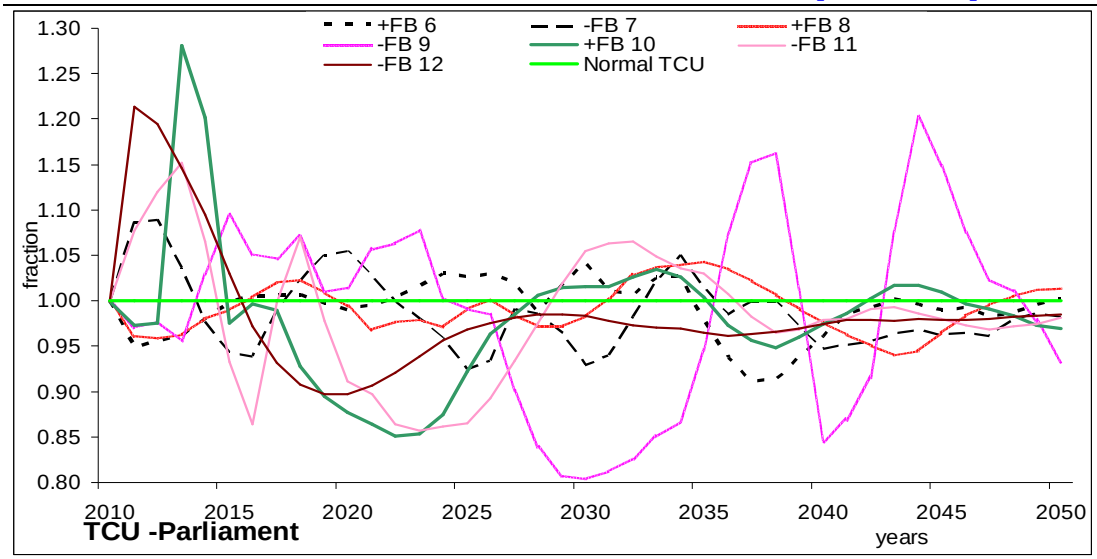

Fund Balance-MOFEP
Player 14
Player 15
Player 16
Player 17
Player 18
Player 19
Player 20
Player 21
Player 23
Player 24
Player 25
GHC in Billion
340
240
140
40
-60
-160
2010
2012
2014
2016
2018
2020
2022
2024
2026
2028
2030
2032
2034
2036
2038
2040
2042
2044
2046
2048
2050
Years

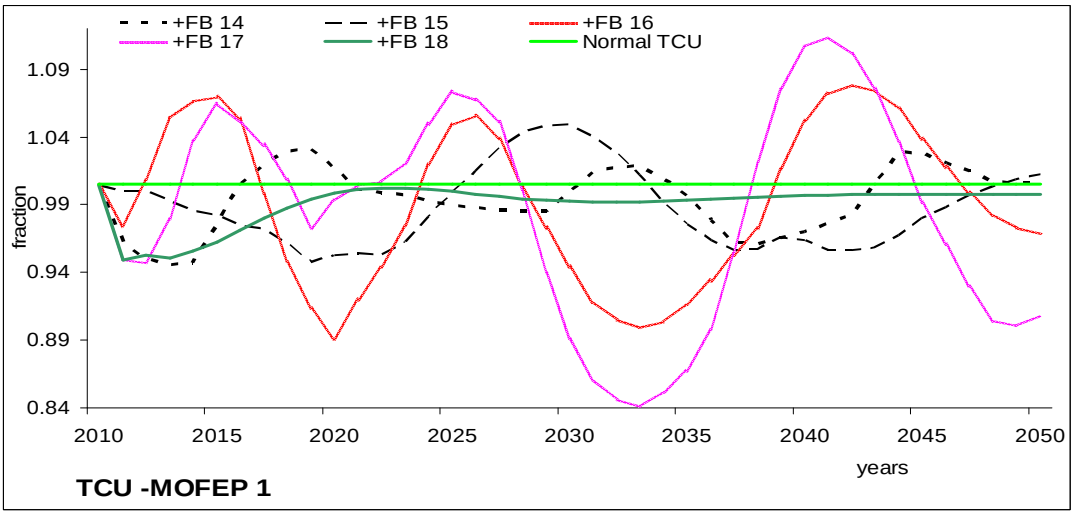
Total Capacity Utilisation

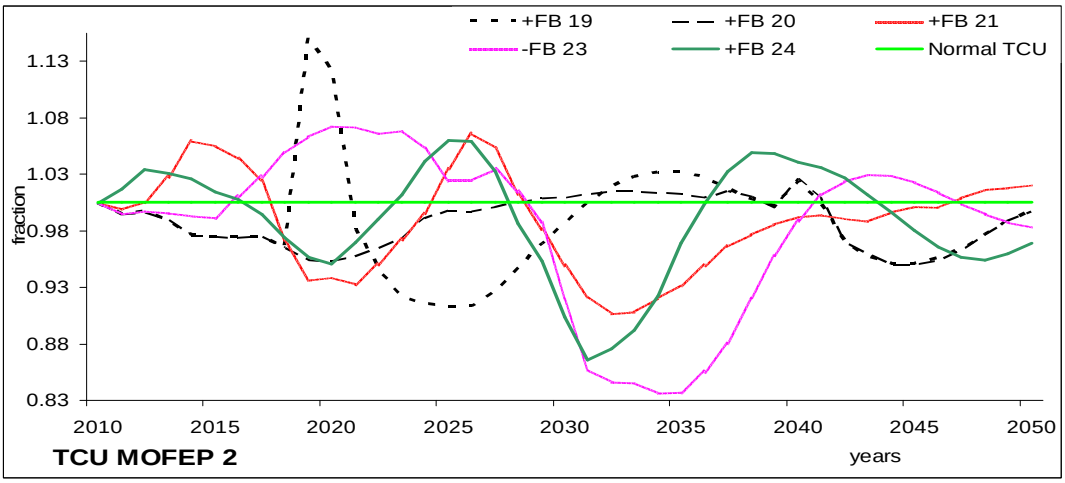




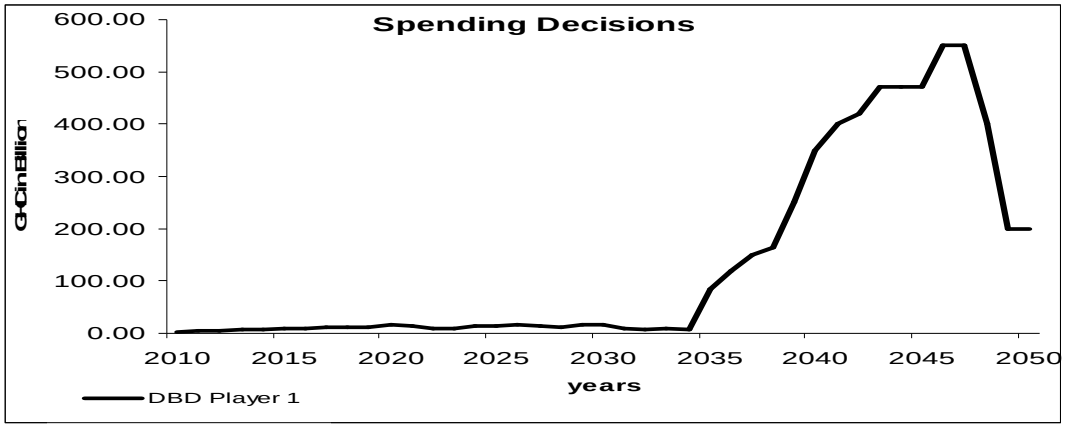


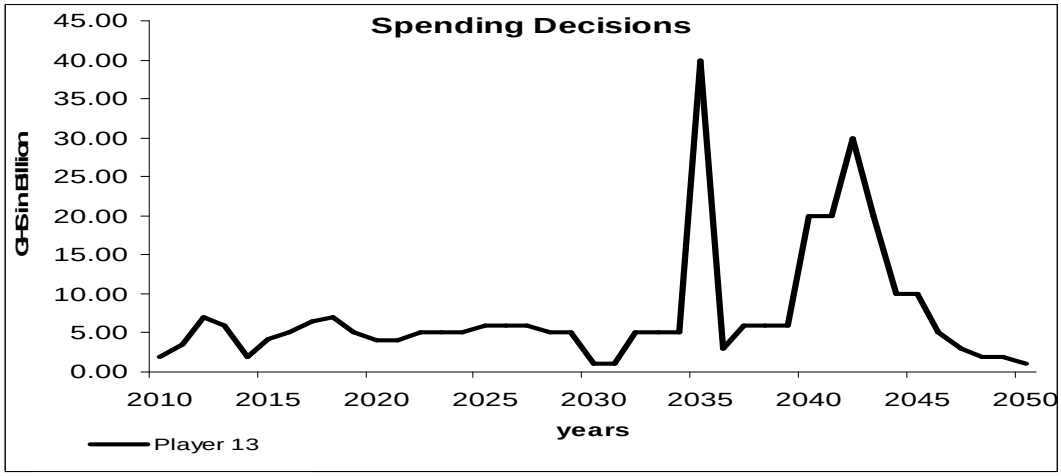

+FB 6
-FB 7
+FB 8
-FB 9
+FB 10
-FB 11
-FB 12
Normal TCU
1.30
1.25
1.20
1.15
1.10
1.05
1.00
0.95
0.90
0.85
0.80
fraction
2010
2015
2020
2025
2030
2035
2040
2045
2050
years
TCU -Parliament

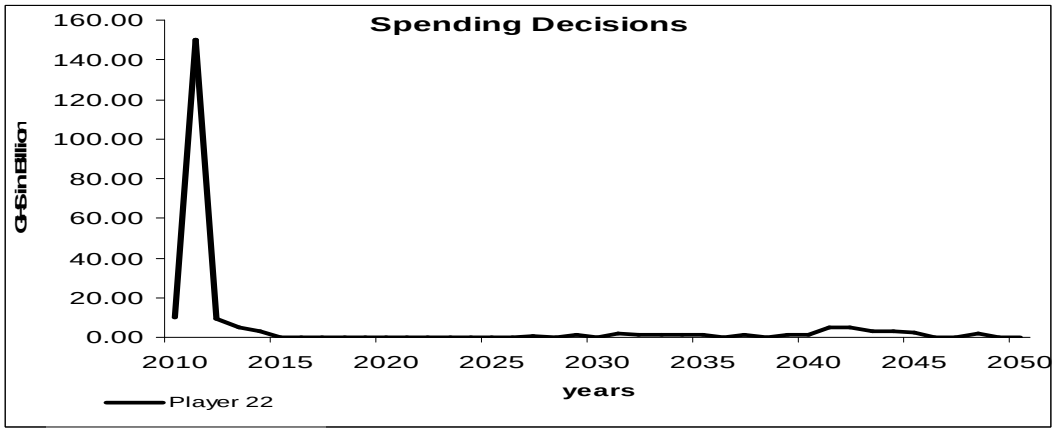

+FB 14
+FB 15
+FB 16
+FB 17
+FB 18
Normal TCU
1.09
1.04
0.99
0.94
0.89
0.84
fraction
2010
2015
2020
2025
2030
2035
2040
2045
2050
years
TCU -MOFEP 1

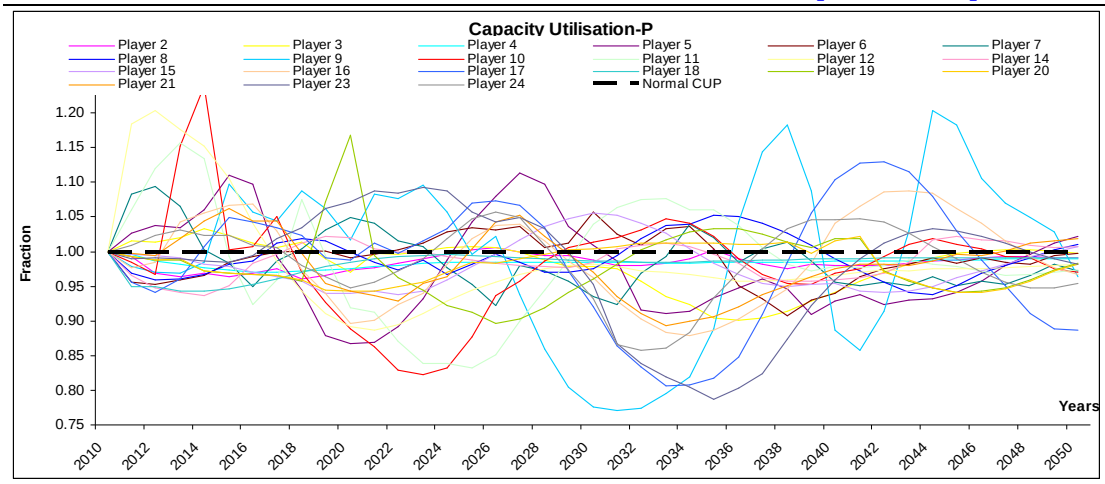

+FB 19
+FB 20
+FB 21
-FB 23
+FB 24
Normal TCU
1.13
1.08
1.03
0.98
0.93
0.88
0.83
fraction
2010
2015
2020
2025
2030
2035
2040
2045
2050
years
TCU MOFEP 2

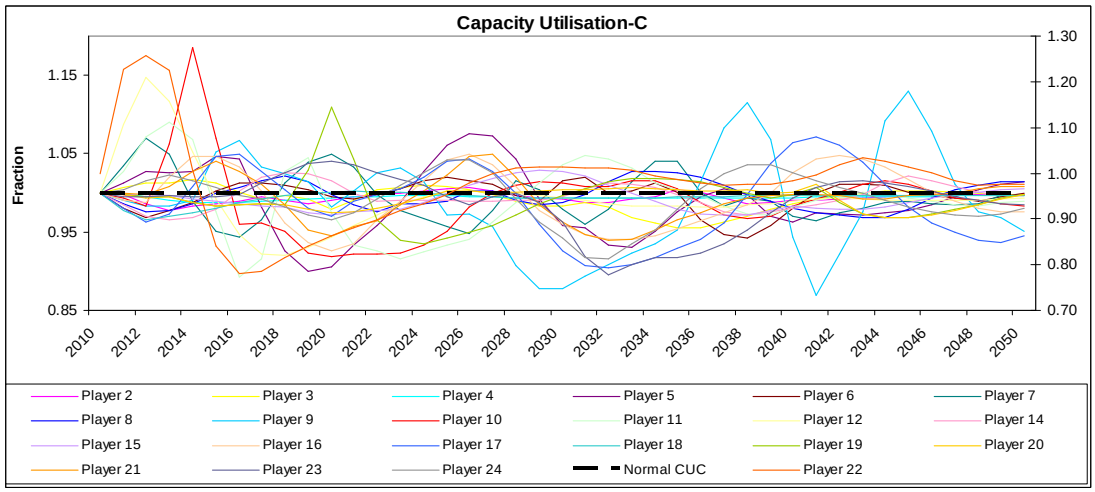
Spending Decisions for excluded players or subjects: (1, 13, 22)



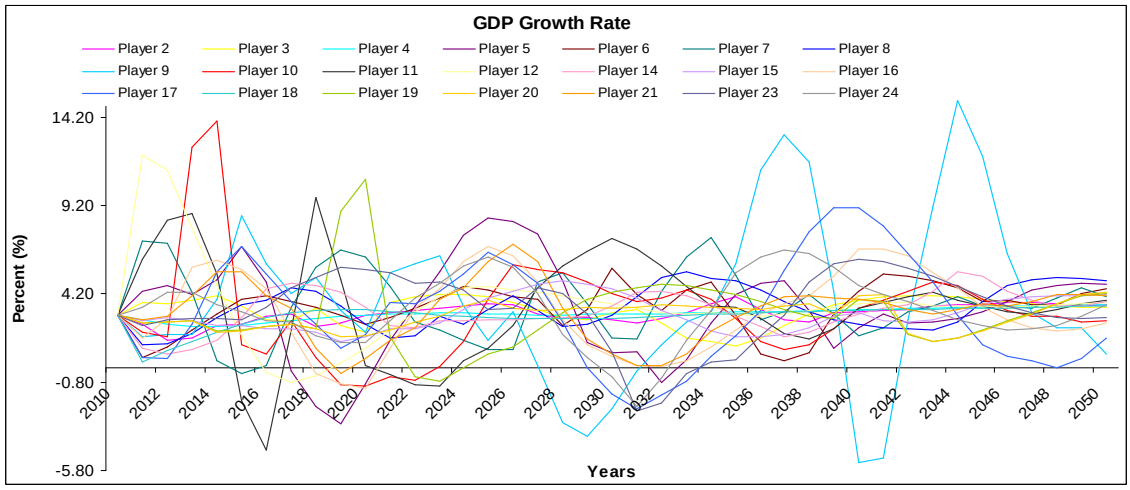


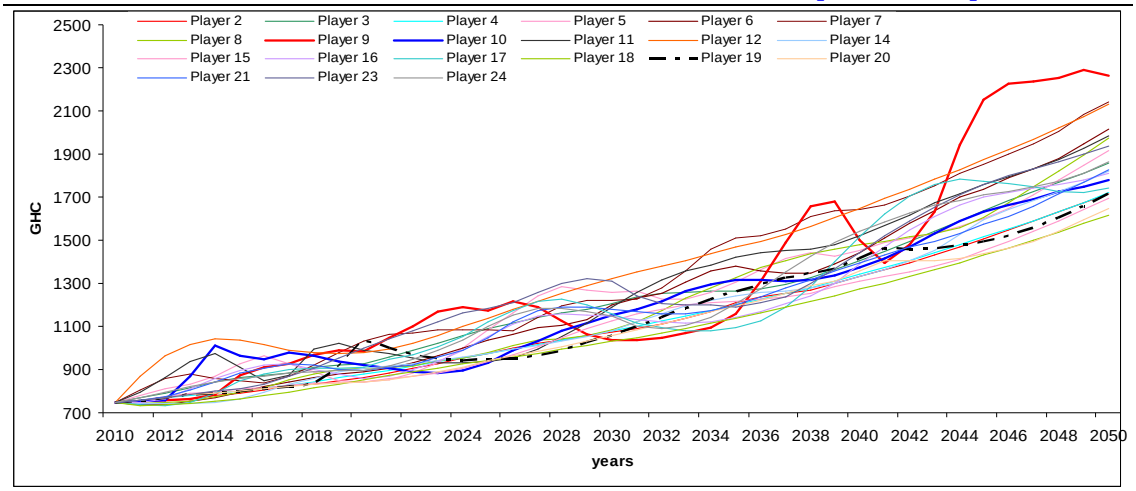


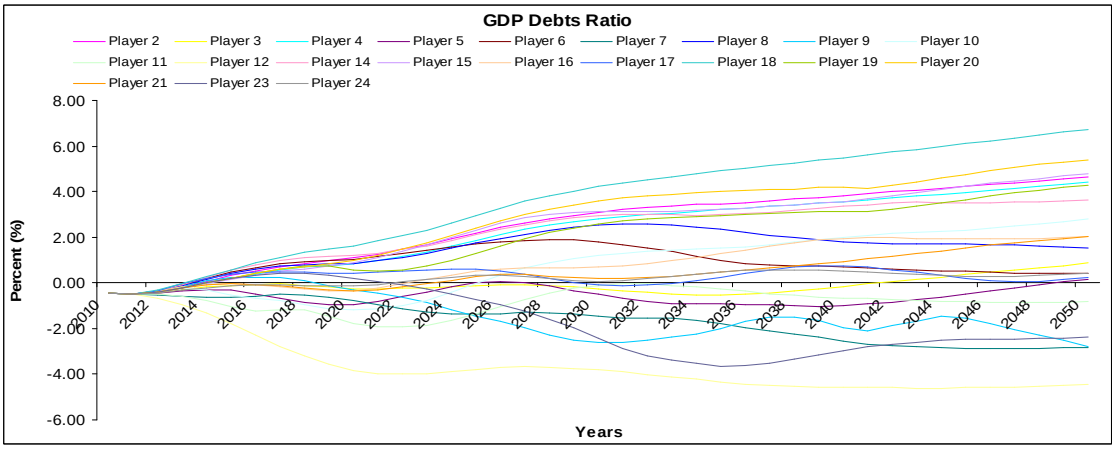


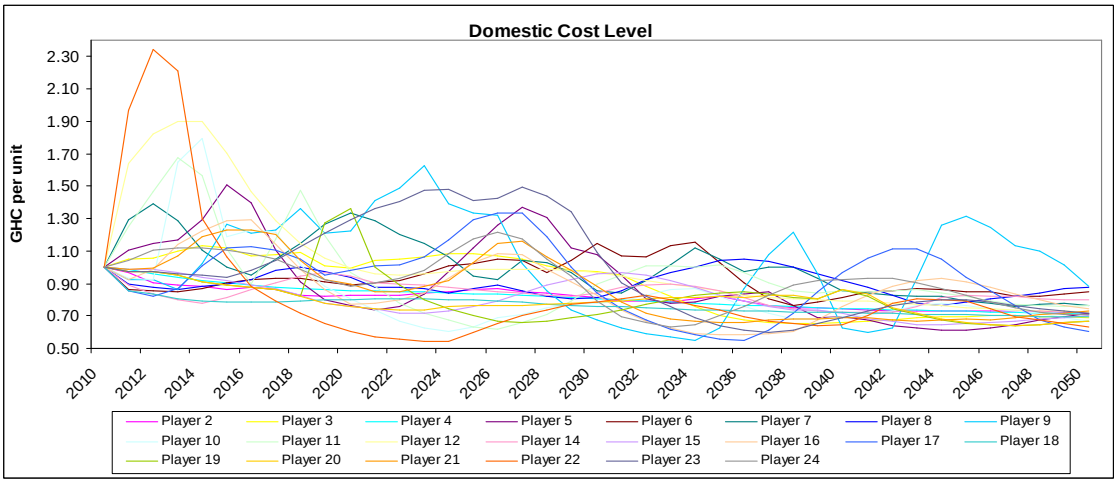


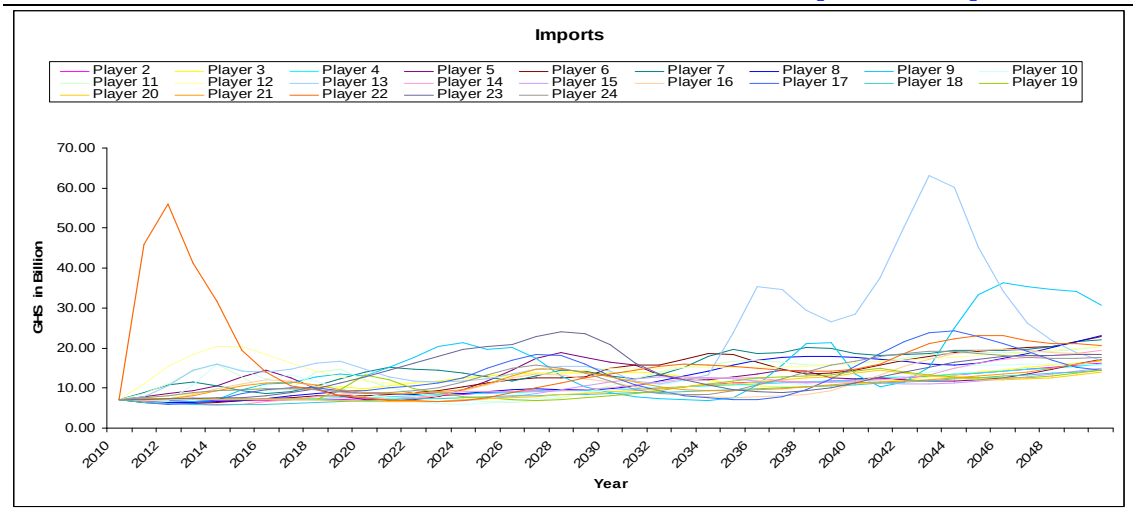
Other graphs:

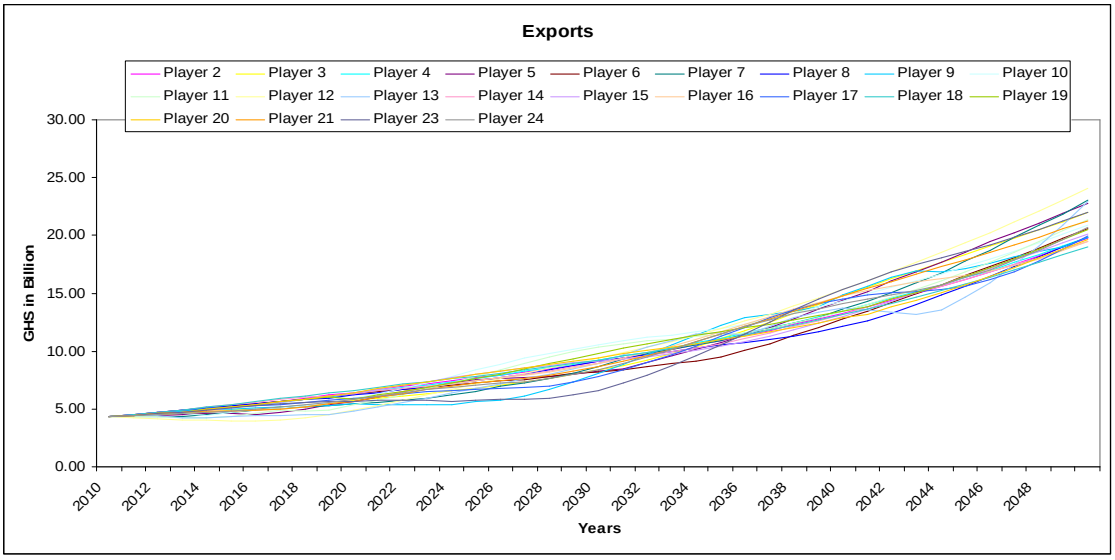


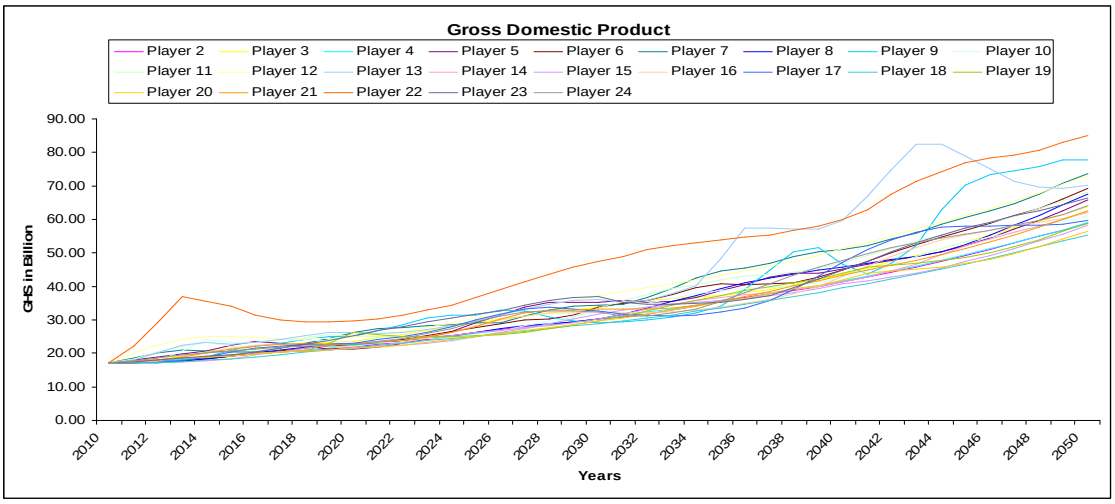

Player 2
Player 3
Player 4
Player 5
Player 6
Player 7
Player 8
Player 9
Player 10
Player 11
Player 12
Player 14
Player 15
Player 16
Player 17
Player 18
Player 19
Player 20
Player 21
Player 23
Player 24
GHC
years


GDP Debts Ratio
Player 2
Player 3
Player 4
Player 5
Player 6
Player 7
Player 8
Player 9
Player 10
Player 11
Player 12
Player 14
Player 15
Player 16
Player 17
Player 18
Player 19
Player 20
Player 21
Player 23
Player 24
Percent (%)
Years


Domestic Cost Level
GHC per unit
Player 2
Player 3
Player 4
Player 5
Player 6
Player 7
Player 8
Player 9
Player 10
Player 11
Player 12
Player 14
Player 15
Player 16
Player 17
Player 18
Player 19
Player 20
Player 21
Player 22
Player 23
Player 24


Imports
Player 2 Player 3 Player 4 Player 5 Player 6 Player 7 Player 8 Player 9 Player 10
Player 11 Player 12 Player 13 Player 14 Player 15 Player 16 Player 17 Player 18 Player 19
Player 20 Player 21 Player 22 Player 23 Player 24
GHS in Billion
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
2010 2012 2014 2016 2018 2020 2022 2024 2026 2028 2030 2032 2034 2036 2038 2040 2042 2044 2046 2048
Year


Exports
Player 2 Player 3 Player 4 Player 5 Player 6 Player 7 Player 8 Player 9 Player 10
Player 11 Player 12 Player 13 Player 14 Player 15 Player 16 Player 17 Player 18 Player 19
Player 20 Player 21 Player 23 Player 24
GHS in Billion
30.00
25.00
20.00
15.00
10.00
5.00
0.00
2010 2012 2014 2016 2018 2020 2022 2024 2026 2028 2030 2032 2034 2036 2038 2040 2042 2044 2046 2048
Years


Gross Domestic Product
Player 2 Player 3 Player 4 Player 5 Player 6 Player 7 Player 8 Player 9 Player 10
Player 11 Player 12 Player 13 Player 14 Player 15 Player 16 Player 17 Player 18 Player 19
Player 20 Player 21 Player 22 Player 23 Player 24
GHS in Billion
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
2010 2012 2014 2016 2018 2020 2022 2024 2026 2028 2030 2032 2034 2036 2038 2040 2042 2044 2046 2048 2050
Years

Subjects Spending Decisions

	Subj 1	Subj 2	Subj 3	Subj 4	Subj 5	Subj 6	Subj 7	Subj 8
2010	2.5	2	2.4	1.95	2.5	0.5	4	1
2011	3.9	1.5	2.4	1.85	3	1	4	1.2
2012	3.9	1.2	2.4	1.8	2.7	1.5	4	1.4
2013	6	1.8	3	1.78	3.1	1.5	1.9	1.5
2014	7.2	1.6	2.9	1.76	4.5	2	2.2	2.1
2015	8.6	1.5	2.8	1.76	6	2	1.6	1.7
2016	9.2	2	2.6	1.75	2.5	2	3.4	2.4
2017	12.5	1.2	3.5	1.75	2	1.8	4.6	2.4
2018	12	1.2	3.5	1.76	1	2	5.1	2.4
2019	12.5	1.5	2	1.75	1	1.5	5.4	1.8
2020	16	1.5	4	1.75	2	1.8	5.4	1.9
2021	15	1.5	4	1.75	2.5	2.2	4.2	1
2022	10	1.6	4.1	1.76	3.5	2.5	4.8	2.8
2023	9.5	1.7	4.3	1.76	4	3	4.2	1.7
2024	13.5	1.8	4.5	1.76	5	3.5	4.6	2
2025	15	2	4.5	1.76	5	3	2.4	3
2026	17	1.8	4.6	1.74	6	4	6.2	2.6
2027	13	1.6	4.4	1.74	6	3.2	6.7	1.5
2028	11.5	1.8	4.2	1.76	4	2.5	5.2	1.7
2029	16	1.8	4.5	1.76	3	6.5	3.7	1.8
2030	17.5	1.5	5	1.76	6	5.5	2.1	2.6
2031	10	1.6	4.5	1.75	2	4	5.1	3.3
2032	6.5	2	3	1.75	3	6	6.1	4.2
2033	8.5	1.8	3	1.75	4	7	8.1	3.7
2034	7.5	3	2	1.75	5	7	7.2	4.5
2035	85	2	1.8	1.75	5	3.2	4.1	4.7
2036	120	1.8	1.8	1.74	5	4	5	4.8
2037	150	1	1.5	1.74	4.5	2.3	7.5	4.9
2038	165	2	1.5	1.74	0	5	6.6	5
2039	250	1.8	1.3	1.74	1	5	4.4	4.9
2040	350	1.8	1.2	1.74	3	6	4.5	4.7
2041	400	1.7	1.1	1.74	0.5	6	6.2	4.5
2042	420	1.8	1.05	1.73	0.5	5	5.2	4
2043	470	1.9	1.02	1.73	0	6	6.8	3.5
2044	470	1.8	1.02	1.73	0	4	4.8	4.5
2045	470	1.9	1	1.73	0	5	5.1	5.6
2046	550	2	1	1.73	1	5	4.2	5.7

2047	550	2	0.95	1.73	1	4	4.3	5.8
2048	400	1.8	0.95	1.73	1.5	6	6.6	6
2049	200	1.7	1	1.73	1.2	6	4.3	6.3
2050	200	2	1	1.73	2	7	5.1	6.1
	Subj 9	**Subj 10**	**Subj 11**	**Subj 12**	**Subj 13**	**Subj 14**	**Subj 15**	**Subj 16**
2010	1.5	1.9	3	7.5	2	1	1.8	1.4
2011	1.2	1	4.5	7	3.5	1	2	1.23
2012	2.1	2.2	5	6	7	1	2.1	3.25
2013	0.5	15	6.5	5.8	6	1	1.8	3.5
2014	5.3	1	2	5.5	2	1	1.9	3.57
2015	3.8	1.5	1	5	4.16	2	1.8	3.793
2016	2.6	5	0.5	5	5	2	1.6	3.5
2017	4	3.5	10	5	6.4	2	1.7	1.89
2018	5.1	2	7	5	7	2	1	1.9
2019	1.9	1.9	2.5	5	5	2	0.9	1.3
2020	6.4	2	2.5	5	4	1.5	1.2	1.33
2021	6.5	0.9	2.5	5	4	1.5	0.8	3.12
2022	7.8	0.5	1.1	5	5	2	0.6	2.6
2023	8.8	0.3	1.5	5	5	2	0.9	3.4
2024	4.1	1	1.2	5	5	2	1.2	4.22
2025	9.5	2.2	0.8	4.8	6	2	1.4	4.22
2026	6.3	1.2	1.4	4.8	6	2	1.6	4
2027	3.4	1.2	1.8	4.8	6	2	2	3.2
2028	1.8	1.2	2	4.8	5	2	2.1	2.145
2029	0.9	0.9	3	4.8	5	2	2.4	2.21
2030	1.3	0.9	3.2	4.8	1	3	2.6	1.3
2031	1.1	1	2.8	4.5	1	3	2.5	0.97
2032	1	2.22	3.5	4.5	5	3	2.7	0.65
2033	1.2	2.22	2.5	4.5	5	3	2.5	0.39
2034	0.3	1.9	4	4.5	5	2.5	2.2	0.325
2035	5.9	0.9	4.2	4	40	2.5	2.2	0.26
2036	7.4	0.2	3.7	4	3	1.5	2	0
2037	8.8	0.5	3.4	4	6	1.5	1.9	0
2038	6.9	0.3	3.4	4	6	2	2.1	0
2039	-6.7	1.9	5	4	6	2	2.5	2.6
2040	-9.3	1.5	5.2	4	20	2	1.2	2.21
2041	1.8	2	4.8	4	20	2	0.8	3.09
2042	3.4	2.5	6	3.5	30	2	0.6	2.6
2043	20.3	2.9	4.9	3.5	20	4	0.4	3.31
2044	16.3	1.9	4.7	3.5	10	4	0.8	2.86
2045	8.9	1.9	4.3	3.2	10	3	0.9	3

2046	7.5	0.9	3.8	3.2	5	3	0.7	3.09
2047	6.1	2	3.9	3.2	3	3	1	3.1
2048	12	0.7	4.5	3.2	2	3	0.8	3.1
2049	6.9	0.9	4.1	3.2	2	4	1.2	3.31
2050	6.9	0.5	5	3	1	4	1	3.32
	Subj 17	**Subj 18**	**Subj 19**	**Subj 20**	**Subj 21**	**Subj 22**	**Subj 23**	**Subj 24**
2010	0.7	0.1346	0	1.9	2	10	1.5	2.1
2011	0.7	1.1296	0.5	1.7	1.8	150	2	2.5
2012	1.2	1.1246	8	2.2	2.5	9	2	3
2013	2.4	1.1244	6	1.6	3	5	2	2.5
2014	3.6	1.1106	10	1.6	4	3	2	3
2015	3	1.1064	9	1.7	3	0	2	2.5
2016	2.5	1.1022	15	1.65	3.8	0	3	3.2
2017	2.5	1.09	17	1.62	3	0.1	3	2.5
2018	2	1.07	0.05	1	1.8	0.1	4	2.5
2019	1.5	1.08	0.02	10.9	2	0	4	2
2020	4	1.05	0.1	0.9	3	0	5	2.5
2021	3	1.05	0.04	0.92	2	0	5	3.2
2022	4	1.05	0.002	0.93	3.5	0	6	3.5
2023	4	1.05	2	0.95	3	0.2	7	4
2024	6	1.07	3	1.5	4	0.15	7	5
2025	6	1.06	-2	0.9	5	0.3	7	5
2026	6.2	1.06	-5	0.94	5.5	0.3	9	5.2
2027	6.2	1.06	0	0.97	4	0.35	10	4
2028	4	1.06	0.0001	1.2	3	0	9	3
2029	3	1.06	0.3	1.2	3	1	9	3
2030	1.8	1.06	0.02	1.25	2	0.12	4	0.5
2031	1.5	1.06	0.1	1.55	1.8	2	4	0.5
2032	0.5	1.06	0.001	1.6	1.4	1.5	4	1.5
2033	0.4	1.06	0.11	1.7	2	1	4	2
2034	0.5	1.059	0.1	1.8	1.8	1	2	3
2035	0.4	1.056	0.15	2	1.5	1.1	2	3.2
2036	1.5	1.054	0.02	1.9	1.6	0	2	3.5
2037	2.5	1.052	0	1.9	1.4	1	2	3.7
2038	3.8	1.05	0	1.9	1	0	2	3.7
2039	4.5	1.048	0	2.3	1	1	2	3.2
2040	4.9	1.046	1	5	0.8	1.1	2	3.5
2041	4.95	1.044	1.5	0.9	0.5	5	2	4
2042	5.05	1.042	2	0.85	0	5	2	4.2
2043	5	1.04	0.1	0.8	0	3	2	4
2044	4	1.038	0.06	0.75	1	3	2	4

2045	3.5	1.036	0.2	0.74	0.5	2.5	2	3.5
2046	3.8	1.034	0.1	0.73	0.5	0	2	3.2
2047	2	1.032	0.005	0.72	1.5	0	2	3
2048	1.5	1.03	1	1.3	1.5	2	2	3
2049	2	1.03	0.008	1.1	1.5	0.3	2	3.5
2050	2	1.028	0.00001	1.1	2	0	2	3.6

Subjects Total Capacity Utilisation

	Player 2	Player 3	Player 4	Player 5	Player 6	Player 7	Player 8
2010	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2011	0.99	1.02	0.99	1.03	0.95	1.09	0.96
2012	0.96	1.01	0.99	1.04	0.95	1.09	0.96
2013	0.97	1.02	0.98	1.03	0.96	1.04	0.96
2014	0.97	1.03	0.98	1.06	0.98	0.98	0.98
2015	0.97	1.02	0.97	1.10	1.00	0.94	0.99
2016	0.98	1.00	0.97	1.04	1.01	0.94	1.00
2017	0.98	1.00	0.98	0.95	1.01	0.99	1.02
2018	0.97	1.01	0.98	0.90	1.01	1.02	1.02
2019	0.97	0.97	0.98	0.86	1.00	1.05	1.01
2020	0.98	0.98	0.98	0.87	0.99	1.06	0.99
2021	0.98	1.00	0.98	0.89	1.00	1.03	0.97
2022	0.99	1.00	0.99	0.92	1.00	1.00	0.98
2023	1.00	1.01	0.99	0.97	1.02	0.98	0.98
2024	1.00	1.01	0.99	1.03	1.03	0.96	0.97
2025	1.01	1.01	0.99	1.07	1.03	0.92	0.99
2026	1.01	1.00	0.99	1.10	1.03	0.93	1.00
2027	1.00	0.99	0.99	1.10	1.02	0.99	0.98
2028	0.99	0.98	0.99	1.06	0.99	0.99	0.97
2029	0.99	0.97	0.99	0.99	1.02	0.96	0.97
2030	0.98	0.98	0.99	0.98	1.04	0.93	0.98
2031	0.98	0.97	0.99	0.94	1.01	0.94	1.00
2032	0.98	0.95	0.99	0.90	1.01	0.98	1.03
2033	0.98	0.94	0.99	0.90	1.03	1.02	1.04
2034	1.00	0.92	0.99	0.93	1.03	1.05	1.04
2035	1.00	0.91	0.99	0.95	0.98	1.01	1.04
2036	0.99	0.92	0.99	0.97	0.94	0.98	1.03
2037	0.98	0.92	0.99	0.98	0.91	1.00	1.02
2038	0.98	0.93	0.99	0.95	0.91	1.00	1.01

2039	0.98	0.95	0.99	0.92	0.94	0.97	0.99
2040	0.98	0.96	0.99	0.94	0.96	0.95	0.97
2041	0.98	0.97	0.99	0.94	0.99	0.95	0.96
2042	0.98	0.98	0.99	0.94	0.99	0.95	0.95
2043	0.99	0.99	0.99	0.94	1.00	0.96	0.94
2044	0.99	1.00	0.99	0.95	1.00	0.97	0.94
2045	0.99	1.00	0.99	0.96	0.99	0.96	0.97
2046	0.99	1.00	0.99	0.97	0.99	0.96	0.98
2047	1.00	1.00	0.99	0.99	0.98	0.96	1.00
2048	0.99	1.00	0.99	1.01	0.99	0.98	1.00
2049	0.99	1.00	0.99	1.02	1.00	0.99	1.01
2050	0.99	1.00	0.99	1.02	1.00	0.98	1.01

	Player 9	Player 10	Player 11	Player 12	Player 14	Player 15	Player 16
2010	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2011	0.97	0.97	1.08	1.21	0.96	0.99	0.97
2012	0.98	0.98	1.12	1.19	0.95	1.00	1.00
2013	0.96	1.28	1.15	1.15	0.94	0.99	1.05
2014	1.03	1.20	1.07	1.09	0.94	0.98	1.06
2015	1.09	0.98	0.93	1.03	0.97	0.98	1.06
2016	1.05	1.00	0.86	0.97	1.00	0.97	1.05
2017	1.05	0.99	1.00	0.93	1.01	0.97	0.99
2018	1.07	0.93	1.07	0.91	1.02	0.96	0.94
2019	1.01	0.89	0.98	0.90	1.03	0.94	0.91
2020	1.01	0.88	0.91	0.90	1.01	0.95	0.89
2021	1.06	0.86	0.90	0.91	1.00	0.95	0.91
2022	1.06	0.85	0.86	0.92	0.99	0.95	0.94
2023	1.08	0.85	0.86	0.94	0.99	0.96	0.97
2024	1.00	0.87	0.86	0.96	0.99	0.98	1.01
2025	0.99	0.92	0.87	0.97	0.98	0.99	1.04
2026	0.98	0.96	0.89	0.98	0.98	1.01	1.05
2027	0.90	0.98	0.93	0.98	0.98	1.03	1.03
2028	0.84	1.01	0.98	0.98	0.98	1.04	1.00
2029	0.81	1.01	1.02	0.98	0.98	1.04	0.97
2030	0.80	1.02	1.05	0.98	0.99	1.04	0.94
2031	0.81	1.02	1.06	0.98	1.01	1.04	0.91
2032	0.83	1.03	1.07	0.97	1.01	1.02	0.90
2033	0.85	1.04	1.05	0.97	1.01	1.01	0.89
2034	0.87	1.03	1.04	0.97	1.00	0.99	0.90

2035	0.95	1.00	1.03	0.96	0.99	0.97	0.91
2036	1.07	0.97	1.01	0.96	0.97	0.96	0.93
2037	1.15	0.96	0.98	0.96	0.96	0.95	0.95
2038	1.16	0.95	0.96	0.97	0.96	0.95	0.97
2039	1.01	0.96	0.97	0.97	0.96	0.96	1.01
2040	0.85	0.97	0.98	0.97	0.96	0.96	1.05
2041	0.87	0.99	0.98	0.98	0.97	0.95	1.07
2042	0.91	1.00	0.99	0.98	0.98	0.95	1.07
2043	1.08	1.02	0.99	0.98	1.00	0.95	1.07
2044	1.20	1.02	0.99	0.98	1.02	0.96	1.06
2045	1.15	1.01	0.98	0.98	1.02	0.97	1.03
2046	1.07	1.00	0.97	0.98	1.02	0.98	1.01
2047	1.02	0.99	0.97	0.98	1.01	0.99	0.99
2048	1.01	0.98	0.97	0.98	1.00	1.00	0.98
2049	0.98	0.97	0.97	0.98	1.00	1.00	0.97
2050	0.93	0.97	0.98	0.98	1.00	1.01	0.96

	TCU	**TCU**	**TCU**	**TCU**	**TCU**	**TCU**	**TCU**
	Player 17	**Player 18**	**Player 19**	**Player 20**	**Player 21**	**Player 23**	**Player 24**
2010	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2011	0.94	0.94	0.99	0.99	0.99	0.99	1.01
2012	0.94	0.95	0.99	0.99	1.00	0.99	1.03
2013	0.97	0.95	0.98	0.98	1.02	0.99	1.03
2014	1.03	0.95	0.97	0.97	1.05	0.99	1.02
2015	1.06	0.96	0.97	0.97	1.05	0.99	1.01
2016	1.04	0.97	0.97	0.97	1.04	1.00	1.00
2017	1.03	0.98	0.97	0.97	1.02	1.02	0.99
2018	1.00	0.98	0.96	0.96	0.97	1.04	0.97
2019	0.97	0.99	1.15	0.95	0.93	1.06	0.95
2020	0.99	0.99	1.12	0.95	0.93	1.07	0.95
2021	1.00	1.00	0.98	0.95	0.93	1.07	0.96
2022	1.00	1.00	0.94	0.96	0.94	1.06	0.99
2023	1.02	1.00	0.92	0.97	0.97	1.06	1.01
2024	1.04	1.00	0.91	0.99	0.99	1.05	1.04
2025	1.07	0.99	0.91	0.99	1.03	1.02	1.05
2026	1.06	0.99	0.91	0.99	1.06	1.02	1.05
2027	1.05	0.99	0.92	1.00	1.05	1.03	1.03
2028	1.00	0.99	0.94	1.00	1.01	1.01	0.98
2029	0.93	0.99	0.96	1.00	0.98	0.98	0.95

2030	0.89	0.99	0.98	1.00	0.94	0.91	0.90
2031	0.86	0.99	1.00	1.01	0.92	0.85	0.86
2032	0.84	0.99	1.01	1.01	0.90	0.84	0.87
2033	0.84	0.99	1.02	1.01	0.90	0.84	0.89
2034	0.85	0.99	1.03	1.01	0.92	0.83	0.92
2035	0.86	0.99	1.03	1.01	0.93	0.83	0.96
2036	0.89	0.99	1.02	1.00	0.94	0.85	1.00
2037	0.95	0.99	1.01	1.01	0.96	0.87	1.03
2038	1.02	0.99	1.00	1.01	0.97	0.92	1.04
2039	1.07	0.99	1.00	1.00	0.98	0.95	1.04
2040	1.10	0.99	1.02	1.02	0.99	0.98	1.04
2041	1.11	0.99	1.00	1.00	0.99	1.01	1.03
2042	1.10	0.99	0.96	0.96	0.99	1.02	1.02
2043	1.07	0.99	0.95	0.95	0.98	1.02	1.01
2044	1.03	0.99	0.95	0.95	0.99	1.02	0.99
2045	0.99	0.99	0.95	0.95	1.00	1.02	0.98
2046	0.96	0.99	0.95	0.95	1.00	1.01	0.96
2047	0.92	0.99	0.96	0.96	1.00	1.00	0.95
2048	0.90	0.99	0.97	0.97	1.01	0.99	0.95
2049	0.90	0.99	0.98	0.98	1.01	0.98	0.95
2050	0.90	0.99	0.99	0.99	1.02	0.98	0.96

Fund Inflows

	Player 1	Player 2	Player 3	Player 4	Player 5	Player 6	Player 7	Player 8
2010	1.97	1.97	1.97	1.97	1.97	1.97	1.97	1.97
2011	2.83	2.84	2.83	2.84	2.83	2.85	2.81	2.85
2012	5.41	5.50	5.46	5.49	5.44	5.55	5.36	5.53
2013	6.12	6.39	6.29	6.36	6.23	6.47	6.04	6.44
2014	6.18	6.78	6.57	6.72	6.47	6.88	6.20	6.84
2015	4.37	5.48	5.14	5.40	4.96	5.60	4.74	5.55
2016	4.82	6.67	6.18	6.57	5.81	6.78	5.78	6.74
2017	1.74	4.59	3.95	4.47	3.38	4.69	3.58	4.64
2018	0.05	4.25	3.44	4.11	2.78	4.32	3.06	4.24
2019	-2.10	3.75	2.75	3.58	2.11	3.77	2.31	3.66
2020	-3.37	4.34	3.15	4.14	2.59	4.32	2.57	4.17
2021	-3.01	6.82	5.43	6.58	4.97	6.75	4.63	6.56
2022	-5.72	6.31	4.70	6.04	4.39	6.19	3.68	6.00
2023	-6.00	7.92	6.07	7.62	5.92	7.73	4.85	7.56

2024	-6.18	9.34	7.22	9.02	7.24	9.06	5.85	8.93
2025	-7.36	9.72	7.30	9.38	7.44	9.32	5.84	9.27
2026	-9.07	9.70	6.97	9.36	7.16	9.16	5.49	9.21
2027	-12.03	8.63	5.57	8.28	5.71	7.92	4.09	8.09
2028	-15.27	7.38	3.99	7.03	3.96	6.49	2.45	6.80
2029	-16.83	7.76	4.03	7.41	3.80	6.69	2.40	7.15
2030	-19.98	6.67	2.59	6.32	2.21	5.35	0.90	6.04
2031	-22.56	6.34	1.89	5.98	1.40	4.70	0.21	5.67
2032	-24.97	6.11	1.29	5.74	0.75	4.12	-0.38	5.37
2033	-27.07	5.96	0.78	5.57	0.25	3.58	-0.97	5.09
2034	-28.75	6.09	0.61	5.69	0.06	3.26	-1.36	5.04
2035	-30.59	6.23	0.50	5.84	-0.11	2.90	-1.85	4.96
2036	-34.55	6.06	0.13	5.69	-0.61	2.29	-2.66	4.52
2037	-41.12	6.30	0.20	5.94	-0.73	2.16	-3.05	4.45
2038	-51.30	6.58	0.32	6.22	-0.85	2.13	-3.48	4.35
2039	-66.25	6.89	0.46	6.52	-0.90	2.14	-3.93	4.26
2040	-89.36	7.22	0.62	6.83	-0.86	2.15	-4.35	4.19
2041	-123.83	7.57	0.80	7.17	-0.81	2.16	-4.71	4.15
2042	-170.71	7.94	1.00	7.53	-0.71	2.14	-5.05	4.16
2043	-231.31	8.35	1.22	7.91	-0.56	2.11	-5.38	4.21
2044	-308.69	8.77	1.44	8.32	-0.37	2.06	-5.70	4.33
2045	-403.68	9.22	1.68	8.76	-0.13	2.03	-6.03	4.48
2046	-519.49	9.70	1.93	9.22	0.14	2.01	-6.33	4.62
2047	-662.64	10.20	2.19	9.71	0.42	1.99	-6.60	4.77
2048	-830.71	10.73	2.48	10.23	0.71	2.00	-6.85	4.89
2049	-1013.71	11.29	2.78	10.79	0.99	2.02	-7.12	5.00
2050	-1206.46	11.88	3.10	11.38	1.27	2.02	-7.39	5.09

	Player 9	**Player 10**	**Player 11**	**Player 12**	**Player 13**	**Player 14**	**Player 15**	**Player 16**
2010	1.97	1.97	1.97	1.97	1.97	1.97	1.97	1.97
2011	2.84	2.84	2.82	2.77	2.84	2.85	2.84	2.84
2012	5.52	5.51	5.37	5.17	5.50	5.54	5.49	5.52
2013	6.41	6.36	6.01	5.60	6.36	6.46	6.35	6.37
2014	6.80	6.44	6.00	5.40	6.72	6.89	6.70	6.66
2015	5.44	4.74	4.32	3.44	5.39	5.65	5.37	5.20
2016	6.47	5.63	5.25	3.97	6.54	6.88	6.52	6.17
2017	4.20	3.26	3.00	1.29	4.43	4.82	4.42	3.84

2018	3.63	2.60	2.37	0.41	4.05	4.48	4.06	3.28
2019	2.81	1.86	1.42	-0.57	3.50	3.94	3.55	2.61
2020	3.08	2.27	1.61	-0.43	4.05	4.48	4.14	3.08
2021	5.20	4.60	3.78	1.62	6.47	6.90	6.64	5.48
2022	4.21	4.01	3.03	0.70	5.92	6.35	6.17	4.90
2023	5.22	5.59	4.47	1.90	7.49	7.91	7.83	6.44
2024	5.92	7.01	5.77	2.89	8.87	9.29	9.32	7.77
2025	5.59	7.43	6.06	2.83	9.22	9.64	9.77	8.01
2026	4.88	7.45	6.01	2.36	9.18	9.60	9.83	7.80
2027	3.12	6.42	4.93	0.82	8.09	8.51	8.82	6.49
2028	1.32	5.20	3.65	-0.93	6.82	7.25	7.61	4.98
2029	1.30	5.59	3.98	-1.08	7.18	7.62	7.99	5.12
2030	-0.11	4.48	2.79	-2.72	6.07	6.52	6.87	3.82
2031	-0.69	4.13	2.29	-3.63	5.71	6.16	6.47	3.32
2032	-1.13	3.85	1.81	-4.46	5.45	5.86	6.13	2.97
2033	-1.46	3.61	1.34	-5.23	5.26	5.62	5.85	2.75
2034	-1.47	3.63	1.11	-5.72	5.36	5.65	5.86	2.86
2035	-1.43	3.65	0.87	-6.20	5.49	5.69	5.92	3.03
2036	-1.75	3.37	0.27	-6.99	5.31	5.44	5.68	2.91
2037	-1.82	3.54	0.07	-7.37	5.54	5.63	5.89	3.22
2038	-2.09	3.76	-0.09	-7.74	5.79	5.86	6.13	3.56
2039	-2.52	4.03	-0.21	-8.11	6.06	6.13	6.41	3.92
2040	-2.77	4.32	-0.33	-8.48	6.35	6.43	6.71	4.25
2041	-2.73	4.62	-0.46	-8.85	6.66	6.75	7.06	4.53
2042	-2.64	4.93	-0.59	-9.23	6.99	7.10	7.46	4.76
2043	-2.58	5.23	-0.74	-9.60	7.34	7.47	7.90	4.94
2044	-2.79	5.52	-0.88	-9.97	7.72	7.83	8.39	5.07
2045	-3.41	5.82	-1.02	-10.34	8.12	8.16	8.92	5.16
2046	-4.27	6.13	-1.13	-10.70	8.55	8.48	9.48	5.26
2047	-5.18	6.48	-1.22	-11.05	9.01	8.82	10.07	5.37
2048	-6.06	6.86	-1.27	-11.40	9.50	9.17	10.69	5.53
2049	-6.95	7.29	-1.30	-11.75	10.01	9.54	11.34	5.73
2050	-7.78	7.78	-1.32	-12.09	10.57	9.94	12.01	5.99

	Player 18	**Player 19**	**Player 20**	**Player 21**	**Player 22**	**Player 23**	**Player 24**
2010	1.97	1.97	1.97	1.97	1.97	1.97	1.97
2011	2.86	2.84	2.84	2.84	2.36	2.84	2.83
2012	5.56	5.50	5.50	5.49	2.84	5.50	5.47
2013	6.49	6.37	6.36	6.34	2.05	6.36	6.28

2014	6.91	6.73	6.72	6.64	1.03	6.71	6.55
2015	5.67	5.41	5.40	5.20	-1.19	5.38	5.13
2016	6.91	6.58	6.57	6.20	-0.57	6.52	6.17
2017	4.89	4.49	4.48	3.90	-3.07	4.37	3.94
2018	4.61	4.14	4.13	3.32	-3.73	3.92	3.44
2019	4.16	3.60	3.63	2.62	-4.51	3.25	2.79
2020	4.79	3.99	4.23	3.06	-4.15	3.60	3.25
2021	7.31	6.20	6.73	5.39	-1.86	5.75	5.61
2022	6.85	5.51	6.27	4.76	-2.51	4.85	4.98
2023	8.51	7.02	7.93	6.25	-1.01	5.97	6.44
2024	9.98	8.38	9.41	7.54	0.33	6.81	7.67
2025	10.42	8.75	9.85	7.76	0.65	6.54	7.81
2026	10.48	8.76	9.91	7.53	0.57	5.84	7.48
2027	9.50	7.75	8.92	6.16	-0.60	4.02	6.04
2028	8.34	6.57	7.75	4.56	-1.99	1.91	4.39
2029	8.81	7.04	8.21	4.61	-1.80	1.37	4.42
2030	7.81	6.02	7.19	3.21	-3.13	-0.62	3.03
2031	7.58	5.76	6.92	2.63	-3.75	-1.70	2.49
2032	7.45	5.57	6.74	2.19	-4.31	-2.54	2.12
2033	7.39	5.44	6.62	1.88	-4.85	-3.23	1.86
2034	7.64	5.58	6.78	1.89	-5.11	-3.57	1.91
2035	7.91	5.71	6.96	1.95	-5.34	-3.82	1.99
2036	7.88	5.52	6.82	1.71	-5.86	-4.32	1.73
2037	8.27	5.72	7.08	1.89	-5.94	-4.37	1.84
2038	8.68	5.93	7.35	2.09	-5.99	-4.39	1.91
2039	9.11	6.16	7.63	2.30	-6.00	-4.39	1.93
2040	9.57	6.40	7.92	2.53	-5.99	-4.40	1.91
2041	10.05	6.62	8.19	2.78	-5.98	-4.43	1.87
2042	10.57	6.87	8.49	3.05	-6.01	-4.48	1.80
2043	11.11	7.19	8.87	3.35	-6.13	-4.56	1.71
2044	11.68	7.58	9.31	3.68	-6.30	-4.67	1.63
2045	12.28	8.03	9.81	4.03	-6.49	-4.80	1.58
2046	12.92	8.53	10.38	4.40	-6.68	-4.94	1.56
2047	13.59	9.09	10.99	4.79	-6.80	-5.08	1.60
2048	14.30	9.69	11.65	5.18	-6.85	-5.21	1.70
2049	15.04	10.32	12.35	5.59	-6.85	-5.32	1.84
2050	15.83	10.98	13.08	5.99	-6.79	-5.40	2.02

Appendix VI: Extra Statistical Data

Standard Multiple Regression Analysis Report for testing (H2)

In this section, we adopted the procedure for reporting a standard multiple regression stated by Pallant (2007).

Key Note: **AVE DBD** refers to the average decided budget deficit or spending decisions of subjects over time. AVE TCU- average total capacity utilisation and AVE FI- average Fund inflows.

Test 1: For all subjects (average score)

The syntax generated from this procedure is:

```
REGRESSION
 /DESCRIPTIVES MEAN STDDEV CORR SIG N
 /MISSING PAIRWISE
 /STATISTICS COEFF OUTS CI R ANOVA COLLIN TOL CHANGE ZPP
 /CRITERIA=PIN(.05) POUT(.10)
 /NOORIGIN
 /DEPENDENT AveDBD
 /METHOD=ENTER AVEFI AVETCU
 /SCATTERPLOT=(*ZRESID ,*ZPRED )
 /RESIDUALS NORM(ZRESID)
 /CASEWISE PLOT(ZRESID) OUTLIERS(3)
 /SAVE MAHAL COOK .
```

The output generated from this procedure is shown below:

Correlations

		Ave DBD	AVE FI	AVE TCU
Pearson Correlation	Ave DBD	1,000	,619	,358
	AVE FI	,619	1,000	,407
	AVE TCU	,358	,407	1,000
Sig. (1-tailed)	Ave DBD	.	,000	,011
	AVE FI	,000	.	,004
	AVE TCU	,011	,004	.
N	Ave DBD	41	41	41
	AVE FI	41	41	41
	AVE TCU	41	41	41

Model Summary(b)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					Sig. F Change	R Square Change	F Change	df1	df2
1	,630(a)	,397	,365	,31740	,397	12,488	2	38	,000

a Predictors: (Constant), AVE TCU, AVE FI
b Dependent Variable: Ave DBD

ANOVA(b)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2,516	2	1,258	12,488	,000(a)
	Residual	3,828	38	,101		
	Total	6,344	40			

a Predictors: (Constant), AVE TCU, AVE FI
b Dependent Variable: Ave DBD

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95% Confidence Interval for B			Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF	B	Std. Error	
1	(Constant)	-1,163	3,672		-,317	,753	-8,597	6,270						
	AVE FI	,129	,031	,567	4,111	,000	,066	,193	,619	,555	,518	,834	1,198	
	AVE TCU	3,484	3,776	,127	,923	,362	-4,160	11,127	,358	,148	,116	,834	1,198	

a Dependent Variable: Ave DBD

Collinearity Diagnostics(a)

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions		
				AVE TCU	(Constant)	AVE FI
1	1	2,880	1,000	,00	,02	,00
	2	,120	4,895	,00	,83	,00
	3	9,00E-005	178,892	1,00	,16	1,00

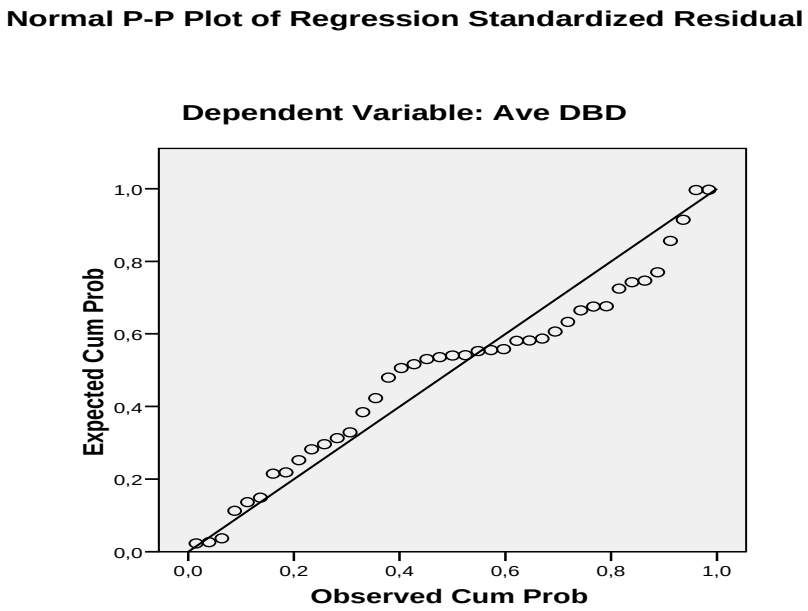
a Dependent Variable: Ave DBD

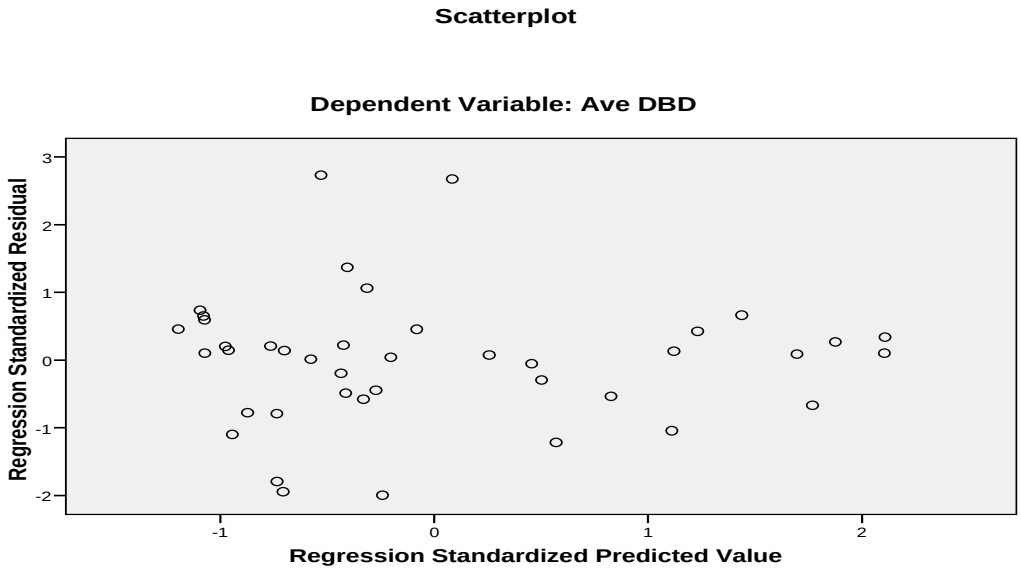
Residuals Statistics(a)

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	2,4512	3,2798	2,7513	,25080	41
Std. Predicted Value	-1,197	2,107	,000	1,000	41
Standard Error of Predicted Value	,050	,130	,083	,022	41
Adjusted Predicted Value	2,4415	3,2735	2,7531	,25192	41
Residual	-,63293	,86723	,00000	,30936	41
Std. Residual	-1,994	2,732	,000	,975	41
Stud. Residual	-2,090	2,829	-,003	1,010	41
Deleted Residual	-,69556	,92937	-,00187	,33233	41
Stud. Deleted Residual	-2,193	3,141	,005	1,064	41
Mahal. Distance	,009	5,764	1,951	1,561	41
Cook's Distance	,000	,191	,025	,047	41
Centered Leverage Value	,000	,144	,049	,039	41

a Dependent Variable: Ave DBD

Charts





Test two: Subjects with a positive Fund balance
The syntax generated from this procedure is:

```
REGRESSION
  /DESCRIPTIVES MEAN STDDEV CORR SIG N
  /MISSING PAIRWISE
  /STATISTICS COEFF OUTS CI R ANOVA COLLIN TOL CHANGE ZPP
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT AVEDBD_B
  /METHOD=ENTER AVEFI_B AVETCU_B
  /SCATTERPLOT=(*ZRESID ,*ZPRED )
  /RESIDUALS NORM(ZRESID)
  /CASEWISE PLOT(ZRESID) OUTLIERS(3)
  /SAVE MAHAL COOK .
```

The outcomes generated from this procedure are:

Correlations

		AVE DBD+	AVE FI+	AVE TCU+
Pearson Correlation	AVE DBD+	1,000	,642	,620
	AVE FI+	,642	1,000	,528
	AVE TCU+	,620	,528	1,000
Sig. (1-tailed)	AVE DBD+	.	,000	,000
	AVE FI+	,000	.	,000
	AVE TCU+	,000	,000	.
N	AVE DBD+	41	41	41
	AVE FI+	41	41	41
	AVE TCU+	41	41	41

Model Summary(b)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					Sig. F Change	R Square Change	F Change	df1	df2
1	,722(a)	,522	,497	,31039	,522	20,741	2	38	,000

a Predictors: (Constant), AVE TCU+, AVE FI+
b Dependent Variable: AVE DBD+

ANOVA(b)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3,997	2	1,998	20,741	,000(a)
	Residual	3,661	38	,096		
	Total	7,658	40			

a Predictors: (Constant), AVE TCU+, AVE FI+
b Dependent Variable: AVE DBD+

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95% Confidence Interval for B			Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF	B	Std. Error	
1	(Constant)	-10,100	3,897		-2,592	,013	-17,989	-2,211						
	AVE FI+	,124	,038	,436	3,302	,002	,048	,200	,642	,472	,370	,721	1,387	
	AVE TCU+	11,960	4,052	,390	2,952	,005	3,757	20,164	,620	,432	,331	,721	1,387	

a Dependent Variable: AVE DBD+

Collinearity Diagnostics(a)

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions		
				AVE TCU+	(Constant)	AVE FI+
1	1	2,941	1,000	,00	,01	,00
	2	,059	7,079	,00	,73	,00
	3	7,55E-005	197,329	1,00	,26	1,00

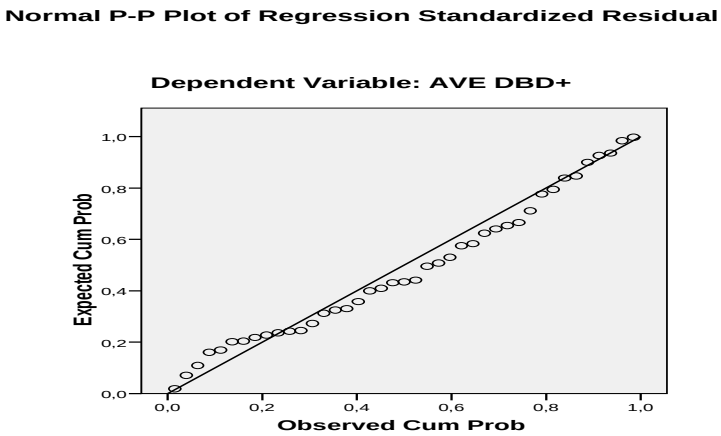
a Dependent Variable: AVE DBD+

Residuals Statistics(a)

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	1,8286	3,0228	2,2833	,31609	41
Std. Predicted Value	-1,438	2,340	,000	1,000	41
Standard Error of Predicted Value	,049	,158	,081	,024	41
Adjusted Predicted Value	1,8445	3,0821	2,2879	,31706	41
Residual	-,64573	,86649	,00000	,30254	41
Std. Residual	-2,080	2,792	,000	,975	41
Stud. Residual	-2,415	2,874	-,007	1,024	41
Deleted Residual	-,87005	,91851	-,00468	,33533	41
Stud. Deleted Residual	-2,590	3,206	,002	1,069	41
Mahal. Distance	,008	9,338	1,951	1,897	41
Cook's Distance	,000	,675	,038	,107	41
Centered Leverage Value	,000	,233	,049	,047	41

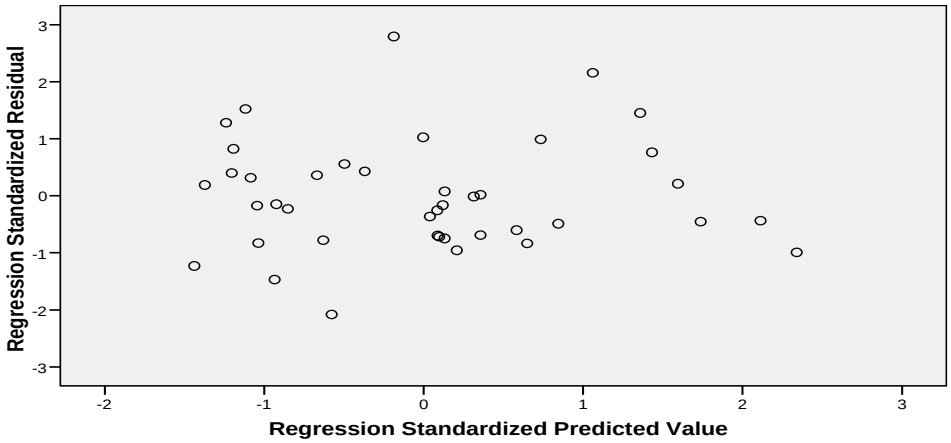
a Dependent Variable: AVE DBD+

Charts



Scatterplot

Dependent Variable: AVE DBD+



Test three: Subjects with a negative Fund balance

The syntax generated from this procedure is:

```
REGRESSION
  /DESCRIPTIVES MEAN STDDEV CORR SIG N
  /MISSING PAIRWISE
  /STATISTICS COEFF OUTS CI R ANOVA COLLIN TOL CHANGE ZPP
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT AVEDBD_A
  /METHOD=ENTER AVETCU_A AVEFI_A
  /SCATTERPLOT=(*ZRESID ,*ZPRED )
  /RESIDUALS NORM(ZRESID)
  /CASEWISE PLOT(ZRESID) OUTLIERS(3)
  /SAVE MAHAL COOK .
```

The outcomes generated from this procedure are:

Correlations

		AVE DBD-	AVE TCU-	AVE FI-
Pearson Correlation	AVE DBD-	1,000	,180	-,054
	AVE TCU-	,180	1,000	,206
	AVE FI-	-,054	,206	1,000
Sig. (1-tailed)	AVE DBD-	.	,130	,368
	AVE TCU-	,130	.	,098
	AVE FI-	,368	,098	.
N	AVE DBD-	41	41	41

	AVE TCU-	41	41	41
	AVE FI-	41	41	41

Model Summary(b)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					Sig. F Change	R Square Change	F Change	df1	df2
1	,203(a)	,041	-,009	1,13037	,041	,815	2	38	,450

a Predictors: (Constant), AVE FI-, AVE TCU-
b Dependent Variable: AVE DBD-

ANOVA(b)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2,084	2	1,042	,815	,450(a)
	Residual	48,554	38	1,278		
	Total	50,637	40			

a Predictors: (Constant), AVE FI-, AVE TCU-
b Dependent Variable: AVE DBD-

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95% Confidence Interval for B			Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF	B	Std. Error	
1	(Constant)	-2,211	5,251		-,421	,676	-12,841	8,418						
	AVE TCU-	6,557	5,329	,200	1,230	,226	-4,231	17,345	,180	,196	,195	,957	1,044	
	AVE FI-	-,025	,043	-,095	-,588	,560	-,112	,062	-,054	-,095	-,093	,957	1,044	

a Dependent Variable: AVE DBD-

Collinearity Diagnostics(a)

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions		
				AVE FI-	(Constant)	AVE TCU-
1	1	2,000	1,000	,00	,00	,00
	2	1,000	1,415	,00	,00	,96
	3	,001	59,475	1,00	1,00	,04

a Dependent Variable: AVE DBD-

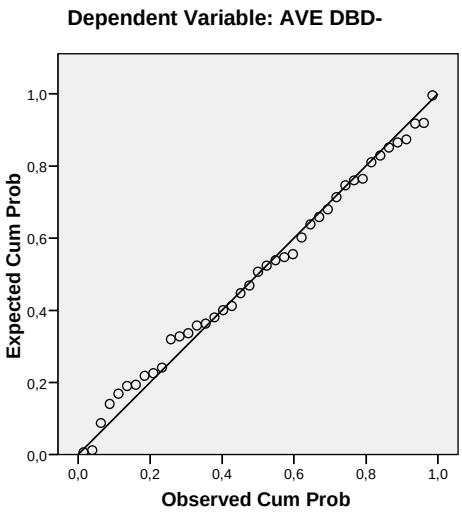
Residuals Statistics(a)

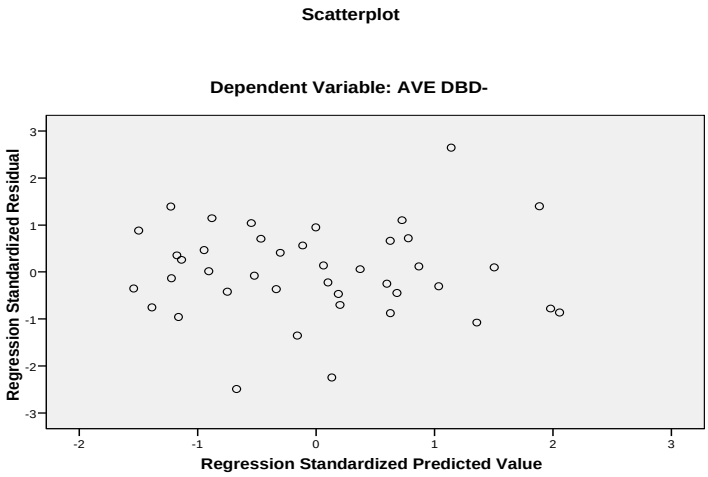
	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	3,8960	4,7167	4,2473	,22824	41
Std. Predicted Value	-1,539	2,057	,000	1,000	41
Standard Error of Predicted Value	,199	,519	,298	,071	41
Adjusted Predicted Value	3,7933	4,9347	4,2560	,26324	41
Residual	-2,81422	2,99228	,00000	1,10175	41
Std. Residual	-2,490	2,647	,000	,975	41
Stud. Residual	-2,581	2,748	-,004	1,014	41
Deleted Residual	-3,02369	3,22494	-,00869	1,19350	41
Stud. Deleted Residual	-2,804	3,029	-,005	1,058	41
Mahal. Distance	,261	7,471	1,951	1,518	41
Cook's Distance	,000	,196	,028	,044	41
Centered Leverage Value	,007	,187	,049	,038	41

a Dependent Variable: AVE DBD-

Charts

Normal P-P Plot of Regression Standardized Residual





Excluded Analysis from the report:

Other Regression analysis performed but excluded in the analysis report because of the research purpose (**H2**). In additions, some of these variables were excluded because of multicollinearity and their statistical significance to the research.

Correlations

		Ave DBD	AVE FI	AVE FB	AVE FO	Petro Rev	AVE TCU	AVE DCL	AVE PCC	AVE GR
Pearson Correlation	Ave DBD	1,000	,619	,002	,203	,477	,358	,196	-,016	,414
	AVE FI	,619	1,000	-,447	,637	,937	,407	,615	-,462	,172
	AVE FB	,002	-,447	1,000	-,913	-,729	-,180	-,882	,992	,363
	AVE FO	,203	,637	-,913	1,000	,843	,198	,878	-,927	-,319
	Petro Rev	,477	,937	-,729	,843	1,000	,368	,807	-,738	-,016
	AVE TCU	,358	,407	-,180	,198	,368	1,000	,547	-,153	,630
	AVE DCL	,196	,615	-,882	,878	,807	,547	1,000	-,872	-,134
	AVE PCC	-,016	-,462	,992	-,927	-,738	-,153	-,872	1,000	,372
	AVE GR	,414	,172	,363	-,319	-,016	,630	-,134	,372	1,000
Sig. (1-tailed)	Ave DBD	.	,000	,494	,102	,001	,011	,109	,460	,004
	AVE FI	,000	.	,002	,000	,000	,004	,000	,001	,141
	AVE FB	,494	,002	.	,000	,000	,131	,000	,000	,010
	AVE	,102	,000	,000	.	,000	,107	,000	,000	,021

	FO									
	Petro Rev	,001	,000	,000	,000	.	,009	,000	,000	,460
	AVE TCU	,011	,004	,131	,107	,009	.	,000	,170	,000
	AVE DCL	,109	,000	,000	,000	,000	,000	.	,000	,202
	AVE PCC	,460	,001	,000	,000	,000	,170	,000	.	,008
	AVE GR	,004	,141	,010	,021	,460	,000	,202	,008	.
N	Ave DBD	41	41	41	41	41	41	41	41	41
	AVE FI	41	41	41	41	41	41	41	41	41
	AVE FB	41	41	41	41	41	41	41	41	41
	AVE FO	41	41	41	41	41	41	41	41	41
	Petro Rev	41	41	41	41	41	41	41	41	41
	AVE TCU	41	41	41	41	41	41	41	41	41
	AVE DCL	41	41	41	41	41	41	41	41	41
	AVE PCC	41	41	41	41	41	41	41	41	41
	AVE GR	41	41	41	41	41	41	41	41	41

Model Summary(b)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					Sig. F Change	R Square Change	F Change	df1	df2
1	,771(a)	,595	,493	,28344	,595	5,871	8	32	,000

a Predictors: (Constant), AVE GR, Petro Rev, AVE TCU, AVE FB, AVE FO, AVE DCL , AVE PCC, AVE FI
b Dependent Variable: Ave DBD

ANOVA(b)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3,773	8	,472	5,871	,000(a)
	Residual	2,571	32	,080		
	Total	6,344	40			

a Predictors: (Constant), AVE GR, Petro Rev, AVE TCU, AVE FB, AVE FO, AVE DCL , AVE PCC, AVE FI
b Dependent Variable: Ave DBD

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95% Confidence Interval for B			Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF	B	Std. Error	
1	(Constant)	2,643	10,150		,260	,796	-18,032	23,319						
	AVE FI	-1,824	,907	-8,013	-2,011	,053	-3,672	,023	,619	-,335	-,226	,001	1253,260	
	AVE FB	,085	,038	5,269	2,246	,032	,008	,162	,002	,369	,253	,002	434,342	
	AVE FO	,030	,084	,157	,351	,728	-,142	,202	,203	,062	,040	,063	15,819	
	Petro Rev	1,916	,896	11,138	2,138	,040	,091	3,742	,477	,354	,241	,000	2142,820	
	AVE TCU	-,707	13,475	-,026	-,052	,959	-28,155	26,742	,358	-,009	-,006	,052	19,142	
	AVE DCL	1,293	2,734	,381	,473	,639	-4,275	6,861	,196	,083	,053	,019	51,329	
	AVE PCC	-,599	1,698	-,361	-,353	,726	-4,058	2,859	-,016	-,062	-,040	,012	82,765	
	AVE GR	,231	,224	,307	1,032	,310	-,225	,686	,414	,179	,116	,143	7,002	

a Dependent Variable: Ave DBD

Collinearity Diagnostics(a)

Model	Dimension	Eigenvalue	Condition Index	Va bgyriance Proportions								
				AVE FB	AVE FO	Petro Rev	AVE TCU	AVE DCL	AVE PCC	AVE GR	(Constant)	AVE FI
1	1	7,309	1,000	,00	,00	,00	,00	,00	,00	,00	,00	,00
	2	1,479	2,223	,00	,00	,00	,01	,00	,00	,00	,00	,00
	3	,164	6,673	,00	,00	,00	,03	,00	,00	,00	,00	,00
	4	,034	14,569	,00	,00	,01	,45	,00	,00	,00	,00	,02
	5	,011	25,535	,00	,00	,00	,22	,00	,00	,00	,00	,22
	6	,002	68,196	,00	,00	,02	,02	,00	,00	,14	,03	,01
	7	,000	127,628	,01	,00	,09	,12	,00	,00	,00	,90	,00
	8	8,31E-005	296,583	,00	,98	,88	,11	,97	,00	,04	,04	,00
	9	6,91E-006	1028,122	,99	,02	,00	,05	,02	1,00	,81	,03	,75

a Dependent Variable: Ave DBD

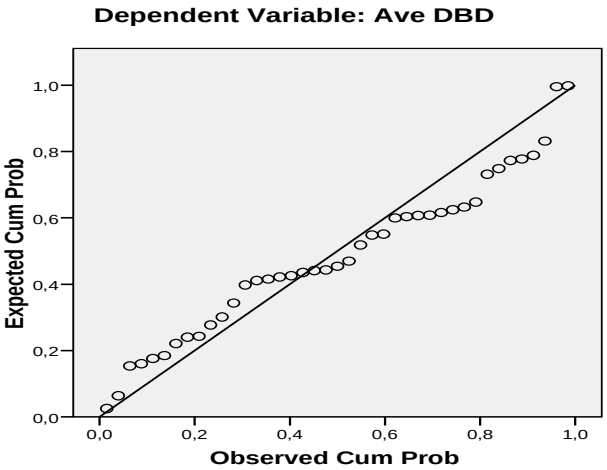
Residuals Statistics(a)

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	1,9990	3,4203	2,7513	,30713	41
Std. Predicted Value	-2,449	2,178	,000	1,000	41
Standard Error of Predicted Value	,082	,257	,129	,033	41
Adjusted Predicted Value	2,1932	3,4302	2,7585	,29800	41
Residual	-,55578	,81954	,00000	,25352	41
Std. Residual	-1,961	2,891	,000	,894	41
Stud. Residual	-2,189	3,220	-,008	,985	41
Deleted Residual	-,69266	1,01658	-,00721	,30967	41
Stud. Deleted Residual	-2,337	3,855	,012	1,074	41
Mahal. Distance	2,378	31,918	7,805	5,536	41
Cook's Distance	,000	,277	,024	,049	41
Centered Leverage Value	,059	,798	,195	,138	41

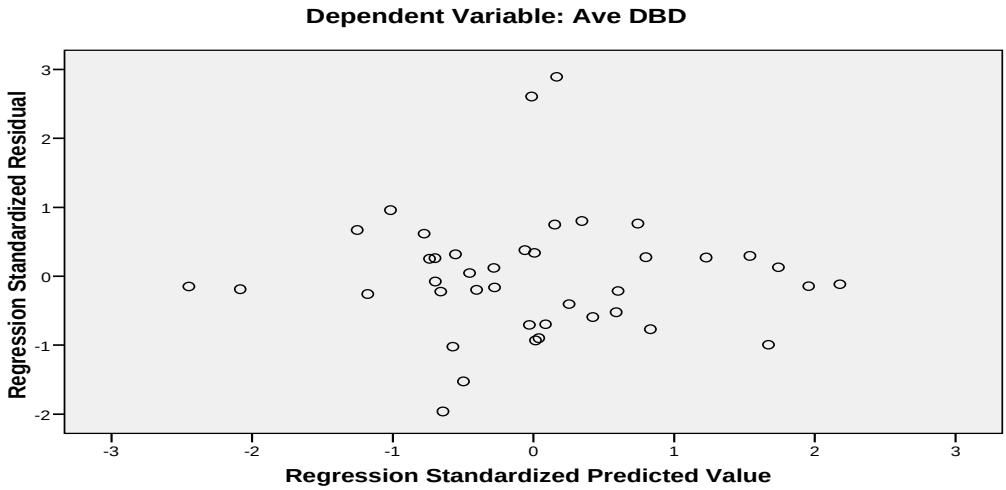
a Dependent Variable: Ave DBD

Charts

Normal P-P Plot of Regression Standardized Residual



Scatterplot



T-Test for the Deviation in Total Capacity Utilisation

The syntax generated from this procedure is:

T-Test

```
T-TEST
  /TESTVAL = 1
  /MISSING = ANALYSIS
  /VARIABLES = TCU2010 TCU2011 TCU2012 TCU2013 TCU2014 TCU2015 TCU2016
  TCU2017 TCU2018 TCU2019 TCU2020 TCU2021 TCU2022 TCU2023 TCU2024 TCU2025
  TCU2026 TCU2027 TCU2028 TCU2029 TCU2030 TCU2031 TCU2032 TCU2033 TCU2034
  TCU2035 TCU2036 TCU2037 TCU2038 TCU2039 TCU2040 TCU2041 TCU2042 TCU2043
  TCU2044 TCU2045 TCU2046 TCU2047 TCU2048 TCU2049 TCU2050
  /CRITERIA = CI(.95) .
```

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
TCU2010	21	,9996	,00000	,00000
TCU2011	21	1,0019	,06160	,01344
TCU2012	21	1,0050	,06241	,01362
TCU2013	21	1,0191	,08253	,01801
TCU2014	21	1,0159	,06039	,01318
TCU2015	21	1,0019	,04799	,01047
TCU2016	21	,9925	,04316	,00942
TCU2017	21	,9923	,02767	,00604
TCU2018	21	,9847	,04767	,01040
TCU2019	21	,9757	,06404	,01398
TCU2020	21	,9708	,06360	,01388
TCU2021	21	,9672	,05331	,01163
TCU2022	21	,9689	,05299	,01156
TCU2023	21	,9769	,05426	,01184
TCU2024	21	,9843	,05067	,01106
TCU2025	21	,9929	,05277	,01152
TCU2026	21	1,0002	,05030	,01098
TCU2027	21	,9990	,04515	,00985
TCU2028	21	,9860	,04103	,00895
TCU2029	21	,9766	,04627	,01010
TCU2030	21	,9683	,05896	,01287
TCU2031	21	,9588	,06783	,01480
TCU2032	21	,9583	,07157	,01562
TCU2033	21	,9618	,07064	,01541
TCU2034	21	,9652	,06679	,01458
TCU2035	21	,9673	,05446	,01188

TCU2036	21	,9713	,04976	,01086
TCU2037	21	,9779	,05460	,01191
TCU2038	21	,9822	,05283	,01153
TCU2039	21	,9816	,03412	,00745
TCU2040	21	,9830	,04885	,01066
TCU2041	21	,9866	,04660	,01017
TCU2042	21	,9868	,04144	,00904
TCU2043	21	,9946	,04002	,00873
TCU2044	21	,9990	,05564	,01214
TCU2045	21	,9935	,04253	,00928
TCU2046	21	,9880	,02788	,00608
TCU2047	21	,9839	,02281	,00498
TCU2048	21	,9843	,02475	,00540
TCU2049	21	,9846	,02551	,00557
TCU2050	21	,9846	,02756	,00601

One-Sample Test

	Test Value = 1					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
TCU2010	-80926351 11136,050	20	,000	-,00038	-,0004	-,0004
TCU2011	,140	20	,890	,00189	-,0262	,0299
TCU2012	,369	20	,716	,00503	-,0234	,0334
TCU2013	1,060	20	,302	,01908	-,0185	,0567
TCU2014	1,208	20	,241	,01592	-,0116	,0434
TCU2015	,180	20	,859	,00189	-,0200	,0237
TCU2016	-,792	20	,438	-,00746	-,0271	,0122
TCU2017	-1,277	20	,216	-,00771	-,0203	,0049
TCU2018	-1,474	20	,156	-,01533	-,0370	,0064
TCU2019	-1,740	20	,097	-,02431	-,0535	,0048
TCU2020	-2,104	20	,048	-,02920	-,0581	-,0002
TCU2021	-2,818	20	,011	-,03278	-,0571	-,0085
TCU2022	-2,694	20	,014	-,03115	-,0553	-,0070
TCU2023	-1,955	20	,065	-,02315	-,0478	,0016
TCU2024	-1,417	20	,172	-,01566	-,0387	,0074
TCU2025	-,613	20	,547	-,00706	-,0311	,0170
TCU2026	,022	20	,983	,00024	-,0227	,0231
TCU2027	-,097	20	,924	-,00096	-,0215	,0196
TCU2028	-1,561	20	,134	-,01397	-,0326	,0047
TCU2029	-2,316	20	,031	-,02338	-,0444	-,0023
TCU2030	-2,467	20	,023	-,03175	-,0586	-,0049
TCU2031	-2,783	20	,011	-,04119	-,0721	-,0103

TCU2032	-2,668	20	,015	-,04167	-,0742	-,0091
TCU2033	-2,481	20	,022	-,03825	-,0704	-,0061
TCU2034	-2,389	20	,027	-,03481	-,0652	-,0044
TCU2035	-2,754	20	,012	-,03273	-,0575	-,0079
TCU2036	-2,640	20	,016	-,02867	-,0513	-,0060
TCU2037	-1,858	20	,078	-,02214	-,0470	,0027
TCU2038	-1,543	20	,139	-,01778	-,0418	,0063
TCU2039	-2,478	20	,022	-,01845	-,0340	-,0029
TCU2040	-1,591	20	,127	-,01696	-,0392	,0053
TCU2041	-1,318	20	,202	-,01340	-,0346	,0078
TCU2042	-1,454	20	,161	-,01315	-,0320	,0057
TCU2043	-,620	20	,542	-,00541	-,0236	,0128
TCU2044	-,080	20	,937	-,00097	-,0263	,0244
TCU2045	-,705	20	,489	-,00654	-,0259	,0128
TCU2046	-1,971	20	,063	-,01199	-,0247	,0007
TCU2047	-3,225	20	,004	-,01605	-,0264	-,0057
TCU2048	-2,902	20	,009	-,01567	-,0269	-,0044
TCU2049	-2,765	20	,012	-,01539	-,0270	-,0038
TCU2050	-2,557	20	,019	-,01538	-,0279	-,0028

T-Test

```
T-TEST
  /TESTVAL = 1
  /MISSING = ANALYSIS
  /VARIABLES = TCU2010 TCU2011 TCU2012 TCU2013 TCU2014 TCU2015 TCU2016
  TCU2017 TCU2018 TCU2019 TCU2020 TCU2021 TCU2022 TCU2023 TCU2024 TCU2025
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  TCU2035 TCU2036 TCU2037 TCU2038 TCU2039 TCU2040 TCU2041 TCU2042 TCU2043
  TCU2044 TCU2045 TCU2046 TCU2047 TCU2048 TCU2049 TCU2050
  /CRITERIA = CI(.95) .
```

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
TCU+2010	16	,9996	,00000	,00000
TCU+2011	16	,9814	,02642	,00660
TCU+2012	16	,9833	,02939	,00735
TCU+2013	16	1,0077	,07972	,01993
TCU+2014	16	1,0113	,06399	,01600
TCU+2015	16	1,0033	,04347	,01087
TCU+2016	16	1,0008	,02921	,00730
TCU+2017	16	,9906	,02262	,00566
TCU+2018	16	,9729	,03453	,00863
TCU+2019	16	,9685	,06410	,01602

TCU+2020	16	,9651	,05957	,01489
TCU+2021	16	,9599	,04157	,01039
TCU+2022	16	,9649	,04026	,01006
TCU+2023	16	,9749	,04106	,01027
TCU+2024	16	,9903	,04464	,01116
TCU+2025	16	1,0053	,04544	,01136
TCU+2026	16	1,0124	,04551	,01138
TCU+2027	16	1,0089	,04007	,01002
TCU+2028	16	,9946	,02571	,00643
TCU+2029	16	,9844	,02699	,00675
TCU+2030	16	,9780	,04378	,01094
TCU+2031	16	,9682	,05526	,01382
TCU+2032	16	,9649	,06232	,01558
TCU+2033	16	,9667	,06360	,01590
TCU+2034	16	,9698	,05711	,01428
TCU+2035	16	,9704	,04764	,01191
TCU+2036	16	,9701	,03887	,00972
TCU+2037	16	,9728	,03429	,00857
TCU+2038	16	,9762	,03409	,00852
TCU+2039	16	,9837	,03738	,00935
TCU+2040	16	,9946	,04105	,01026
TCU+2041	16	,9959	,04193	,01048
TCU+2042	16	,9916	,04216	,01054
TCU+2043	16	,9907	,03916	,00979
TCU+2044	16	,9887	,03321	,00830
TCU+2045	16	,9859	,02506	,00627
TCU+2046	16	,9843	,02075	,00519
TCU+2047	16	,9832	,02301	,00575
TCU+2048	16	,9837	,02759	,00690
TCU+2049	16	,9858	,02924	,00731
TCU+2050	16	,9887	,02847	,00712

One-Sample Test

	Test Value = 1					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
TCU+2010	-11665233116383,760	15	,000	-,00038	-,0004	-,0004
TCU+2011	-2,814	15	,013	-,01858	-,0327	-,0045
TCU+2012	-2,276	15	,038	-,01672	-,0324	-,0011
TCU+2013	,384	15	,706	,00765	-,0348	,0501
TCU+2014	,705	15	,492	,01127	-,0228	,0454
TCU+2015	,302	15	,767	,00328	-,0199	,0264

TCU+2016	,109	15	,914	,00080	-,0148	,0164
TCU+2017	-1,656	15	,118	-,00937	-,0214	,0027
TCU+2018	-3,142	15	,007	-,02712	-,0455	-,0087
TCU+2019	-1,965	15	,068	-,03148	-,0656	,0027
TCU+2020	-2,344	15	,033	-,03491	-,0667	-,0032
TCU+2021	-3,858	15	,002	-,04009	-,0622	-,0179
TCU+2022	-3,486	15	,003	-,03509	-,0565	-,0136
TCU+2023	-2,448	15	,027	-,02513	-,0470	-,0033
TCU+2024	-,865	15	,401	-,00965	-,0334	,0141
TCU+2025	,463	15	,650	,00526	-,0190	,0295
TCU+2026	1,093	15	,292	,01243	-,0118	,0367
TCU+2027	,890	15	,388	,00891	-,0124	,0303
TCU+2028	-,837	15	,416	-,00538	-,0191	,0083
TCU+2029	-2,305	15	,036	-,01555	-,0299	-,0012
TCU+2030	-2,006	15	,063	-,02196	-,0453	,0014
TCU+2031	-2,299	15	,036	-,03177	-,0612	-,0023
TCU+2032	-2,252	15	,040	-,03509	-,0683	-,0019
TCU+2033	-2,097	15	,053	-,03335	-,0672	,0005
TCU+2034	-2,115	15	,052	-,03020	-,0606	,0002
TCU+2035	-2,485	15	,025	-,02959	-,0550	-,0042
TCU+2036	-3,077	15	,008	-,02990	-,0506	-,0092
TCU+2037	-3,171	15	,006	-,02719	-,0455	-,0089
TCU+2038	-2,793	15	,014	-,02380	-,0420	-,0056
TCU+2039	-1,749	15	,101	-,01634	-,0363	,0036
TCU+2040	-,522	15	,609	-,00536	-,0272	,0165
TCU+2041	-,394	15	,699	-,00413	-,0265	,0182
TCU+2042	-,793	15	,440	-,00836	-,0308	,0141
TCU+2043	-,950	15	,357	-,00931	-,0302	,0116
TCU+2044	-1,360	15	,194	-,01130	-,0290	,0064
TCU+2045	-2,246	15	,040	-,01408	-,0274	-,0007
TCU+2046	-3,029	15	,008	-,01571	-,0268	-,0047
TCU+2047	-2,917	15	,011	-,01678	-,0290	-,0045
TCU+2048	-2,370	15	,032	-,01635	-,0310	-,0016
TCU+2049	-1,942	15	,071	-,01420	-,0298	,0014
TCU+2050	-1,595	15	,132	-,01135	-,0265	,0038

T-Test

```
T-TEST
  /TESTVAL = 1
  /MISSING = ANALYSIS
  /VARIABLES = TCU2010 TCU2011 TCU2012 TCU2013 TCU2014 TCU2015 TCU2016
  TCU2017 TCU2018 TCU2019 TCU2020 TCU2021 TCU2022 TCU2023 TCU2024 TCU2025
  TCU2026 TCU2027 TCU2028 TCU2029 TCU2030 TCU2031 TCU2032 TCU2033 TCU2034
  TCU2035 TCU2036 TCU2037 TCU2038 TCU2039 TCU2040 TCU2041 TCU2042 TCU2043
  TCU2044 TCU2045 TCU2046 TCU2047 TCU2048 TCU2049 TCU2050
  /CRITERIA = CI(.95) .
```

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
TCU- 2010	5	,9996	,00000	,00000
TCU- 2011	5	1,0674	,09651	,04316
TCU- 2012	5	1,0746	,09106	,04072
TCU- 2013	5	1,0557	,08961	,04008
TCU- 2014	5	1,0308	,05017	,02244
TCU- 2015	5	,9974	,06630	,02965
TCU- 2016	5	,9661	,07049	,03153
TCU- 2017	5	,9976	,04316	,01930
TCU- 2018	5	1,0224	,06750	,03019
TCU- 2019	5	,9986	,06509	,02911
TCU- 2020	5	,9891	,07982	,03570
TCU- 2021	5	,9906	,08268	,03697
TCU- 2022	5	,9815	,08775	,03924
TCU- 2023	5	,9832	,09129	,04082
TCU- 2024	5	,9651	,06898	,03085
TCU- 2025	5	,9535	,06029	,02696
TCU- 2026	5	,9612	,04883	,02184
TCU- 2027	5	,9675	,05033	,02251
TCU- 2028	5	,9585	,06853	,03065
TCU- 2029	5	,9516	,08333	,03727
TCU- 2030	5	,9369	,09266	,04144
TCU- 2031	5	,9287	,10029	,04485
TCU- 2032	5	,9373	,10157	,04543
TCU- 2033	5	,9461	,09683	,04331
TCU- 2034	5	,9504	,09857	,04408
TCU- 2035	5	,9573	,07845	,03509
TCU- 2036	5	,9752	,08179	,03658
TCU- 2037	5	,9940	,10033	,04487
TCU- 2038	5	1,0015	,09481	,04240
TCU- 2039	5	,9748	,02249	,01006
TCU- 2040	5	,9459	,05790	,02589
TCU- 2041	5	,9569	,05309	,02374
TCU- 2042	5	,9715	,03917	,01752
TCU- 2043	5	1,0070	,04474	,02001
TCU- 2044	5	1,0321	,09772	,04370
TCU- 2045	5	1,0176	,07572	,03387
TCU- 2046	5	,9999	,04516	,02020
TCU- 2047	5	,9863	,02464	,01102
TCU- 2048	5	,9865	,01413	,00632
TCU- 2049	5	,9808	,00470	,00210
TCU- 2050	5	,9717	,02204	,00986

One-Sample Test

	Test Value = 1					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
TCU- 2010	-53678305448704,800	4	,000	-,00038	-,0004	-,0004
TCU- 2011	1,562	4	,193	,06740	-,0524	,1872
TCU- 2012	1,833	4	,141	,07463	-,0384	,1877
TCU- 2013	1,389	4	,237	,05567	-,0556	,1669
TCU- 2014	1,374	4	,242	,03082	-,0315	,0931
TCU- 2015	-,087	4	,935	-,00257	-,0849	,0798
TCU- 2016	-1,075	4	,343	-,03388	-,1214	,0536
TCU- 2017	-,125	4	,906	-,00242	-,0560	,0512
TCU- 2018	,742	4	,500	,02239	-,0614	,1062
TCU- 2019	-,047	4	,965	-,00136	-,0822	,0795
TCU- 2020	-,306	4	,775	-,01091	-,1100	,0882
TCU- 2021	-,254	4	,812	-,00941	-,1121	,0933
TCU- 2022	-,472	4	,661	-,01854	-,1275	,0904
TCU- 2023	-,412	4	,702	-,01681	-,1302	,0965
TCU- 2024	-1,132	4	,321	-,03491	-,1206	,0507
TCU- 2025	-1,723	4	,160	-,04645	-,1213	,0284
TCU- 2026	-1,776	4	,150	-,03879	-,0994	,0218
TCU- 2027	-1,446	4	,222	-,03255	-,0950	,0299
TCU- 2028	-1,353	4	,248	-,04146	-,1266	,0436
TCU- 2029	-1,300	4	,264	-,04843	-,1519	,0550
TCU- 2030	-1,522	4	,203	-,06307	-,1781	,0520
TCU- 2031	-1,591	4	,187	-,07134	-,1959	,0532
TCU- 2032	-1,380	4	,240	-,06271	-,1888	,0634
TCU- 2033	-1,245	4	,281	-,05393	-,1742	,0663
TCU- 2034	-1,125	4	,324	-,04957	-,1720	,0728
TCU- 2035	-1,218	4	,290	-,04275	-,1402	,0547
TCU- 2036	-,677	4	,536	-,02475	-,1263	,0768
TCU- 2037	-,134	4	,900	-,00600	-,1306	,1186
TCU- 2038	,035	4	,974	,00147	-,1163	,1192
TCU- 2039	-2,503	4	,067	-,02518	-,0531	,0027
TCU- 2040	-2,088	4	,105	-,05407	-,1260	,0178
TCU- 2041	-1,814	4	,144	-,04307	-,1090	,0229
TCU- 2042	-1,626	4	,179	-,02849	-,0771	,0202
TCU- 2043	,352	4	,742	,00705	-,0485	,0626
TCU- 2044	,734	4	,504	,03208	-,0892	,1534
TCU- 2045	,519	4	,631	,01758	-,0764	,1116
TCU- 2046	-,005	4	,997	-,00009	-,0562	,0560
TCU- 2047	-1,246	4	,281	-,01373	-,0443	,0169
TCU- 2048	-2,139	4	,099	-,01352	-,0311	,0040

TCU- 2049	-9,153	4	,001	-,01923	-,0251	-,0134
TCU- 2050	-2,870	4	,045	-,02828	-,0556	-,0009

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