A New Perspective on Managing Resource Revenues in Developing Economies: Key Lessons for Guyana

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Abstract:

This paper focuses on the efficient management of commodity revenues subsequent to a resource find. Specifically, it discusses the management of prospective oil resources in newly minted developing oil economies. The issues surrounding resource wealth volatility and exhaustibility are highlighted, and several strategies for managing resource wealth put forth in the literature are outlined and critically examined. The limitations of the ***optimal resource wealth management approach*** proposed in the literature for developing countries is highlighted when the country is characterized by poor institutions and weak political frameworks. A new proposed optimal approach is thus proffered for developing countries in order to address these limitations or shortcomings of the current approaches proposed by previous researchers.

Keywords: resource revenue management; resource wealth; fiscal policy; developing oil economies; Ghana.
JEL Classification: D60, E21, E62, F34, H00, H63, Q33

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1. Introduction

The issue of the efficient management of commodity revenues in resource abundant nations have surfaced in the recent literature; see for example the recent works done by Segura (2006), Venables (2010), Collier et al (2010), van der Ploeg and Venables (2011) and Arezki et al. (2012). Due to the volatility in prices for these commodities, along with their eventual exhaustibility, economies that are heavily dependent on these commodities must enact strict and stringent fiscal policies, avoiding procyclical spending tendencies[4]. Price volatility is a well-recognized problem for all economies that are fundamentally dependent on commodity production and export, Luciani (2011). Luciani notes that price volatility will ultimately have either a direct or indirect impact on government revenues given whether commodity producers are state owned or decentralized units. This variability in total revenues is the reality for a number of resource rich countries, where hydrocarbon revenues accounts for over 25% of the total government revenues, as displayed in Table 1[5]. Table 1 also exhibits the significance of hydrocarbons revenues to overall exports for the 28 listed resource rich countries. On average, hydrocarbon exports account for 67.7% of total exports, which highlights the vulnerability of these economies to being highly open to external shocks in the hydrocarbon market.

Table 1: Displaying Hydrocarbon revenues and export break down for various resource rich economies.

	Average annual Hydrocarbon Revenues 2013-15		Average annual Hydrocarbon exports 2013-15	
	% of total fiscal revenue	% of GDP	% of total exports	% of GDP
Algeria	56	18.6	97.1	25.8
Angola	65.2	22.8	97	44.4
Azerbaijan	54.5	65	93.1	34.1
Bahrain	-	-	94	-
Cameroon	21.8	3.9	39.3	8.3
Colombia	3.8	2.4	38.8	7
Republic Of Congo	-	-	97.8	33.8
Ecuador	27.1	10.3	47.2	11.8
Equatorial Guinea	84.3	20.9	90.4	55.1
Gabon	44.8	11.8	81.7	40.3
Indonesia	15.9	2.4	15.1	3
Iran	38.2	5.4	62.1	-
Iraq	91.3	37.6	99.7	40.6
Kazakhstan	49	12.6	61.5	24.4
Kuwait	76.5	48.7	91.7	55.5
Libya	94.8	68	96.9	61.2
Mexico	28.6	6.5	33.2	3.1
Nigeria	53.7	5.1	92.3	11.2
Norway	-	-	44	21
Qatar	45.9	20.1	65.6	53.4
Russia	28.1	9.5	63.5	15.5
Saudi Arabia	79.9	25.4	81.1	34.8
Sudan	18.7	2	29.3	1.8
Syria	17.7	3.8	18.1	-
Trinidad and Tobago	52.6	15.2	81.8	45.1
United Arab Emirates	61.7	22.3	28.3	23.9
Vietnam	11.1	2.5	-	-
Yemen	49.9	11.2	87.1	16.2
Average	46.9	18.2	67.7	28

[4] This paper focuses its attention on those resources that are non-renewable.

[5] Countries are selected on the bases that for each of the four categories in the table, the data for each country is greater than or equal to one percent in all categories. In addition, the table is also derived where data is available for resource rich economies.

Maximum	94.8	68	99.7	61.2
Minimum	3.8	2	15.1	1.8
Source: Own table derived using IMF staff estimates.				

Revenue volatility is one difficulty faced in managing resource revenues; another and often overlooked problem is that these resources are non-renewable and as a result would be eventually exhausted. This raises the question, how much of these revenues should be saved and how much should be spent and invested. As noted by van der Ploeg and Venables (2011), the answer to this question is country specific, what may be optimal for a high-income and capital abundant country like Norway or Kuwait may not for example, be appropriate for a capital scarce developing country such as Ghana or Uganda. To address the eventual exhaustibility of natural resource revenues, sovereign wealth funds (SWF's) are commonly proposed[6]. The objective of SWF's are generally twofold, in that the fund generally has a built in stabilization component which seeks to insulate and cushion fiscal policy and the economy from fluctuations to resource price shocks, as well to achieve intergenerational equity through a savings component.

This paper discusses three of the most common resource revenue management strategies outlined in the literature to manage volatile resource revenues. The paper makes a contribution to the literature on two accounts. Based on country case evidence or case studies, we highlight that the optimal policy approach can manifest into a suboptimal revenue management strategy in countries that are beleaguered with weak political and institutional capacities; which we term the '*Rent Seeking Disease*' (RSD) case. As such, a new proposed optimal approach is proffered to address the shortcomings of the approach proposed by Collier et al. (2010).

The rest of the paper proceeds as follows. Section 2 discusses strategies for managing resource wealth and includes a discussion of the Permanent Income Hypothesis (PIH) strategy, the Bird In Hand (BIH) strategy and the optimal policy approach for developing countries which was proposed by Collier et al. (2010). Section 3 discusses the conditions for the emergence of what we term the RSD case. Section 4 outlines four pillars under which the optimal policy strategy for developing countries proposed by Collier et al. (2010) can go wrong and perhaps evolve into an RSD. Section 5 outlines the new proposed optimal, whilst section 6 concludes.

2. Strategies for managing resource wealth:

2.1 Permanent Income Hypothesis (PIH)

To avoid procyclical fiscal spending and to cater for intergenerational equity, the permanent income hypothesis (PIH) approach has been proffered in the literature[7]. Under the PIH approach, resource revenues are saved in a SWF, leading to fiscal restraint and avoidance of procyclical spending. Figures 1a and 1b displays the time profiles of incremental consumption and incremental national asset accumulation, under the PIH and various revenue management strategies for consuming/saving a temporary anticipated windfall of revenue. In figure 1a,

[6] Note that the term sovereign wealth funds (SWF's) are commonly utilized in the literature to refer to a fund that comprises of both a stabilization fund and a savings fund combined. As such, when the term SWF is utilized herein, it's in reference to a fund that is developed to encompass both a stabilization component and intergenerational equity component as is the norm in the literature.

[7] The Permanent Income Hypothesis (PIH) was introduced in 1957 by Milton Freidman.

production starts at T_1 and ends at T_2 so that from T_1 to T_2, the natural resource is fully extracted. If a country were to consume all of the resources at the rate it was extracted, then its production and consumption path would coincide on the rectangular area associated with T_1 to T_2[8]. Under the incremental national assets curve (figure 1b), investments can take place in three types of assets; foreign assets (or debt reduction), public infrastructure and private capital stock, Ploeg and Venables (2009).

According to Collier et al. (2010), windfall earnings are perceived as an increment to wealth under the PIH approach, through which consumption is smoothed over time utilising this increment to wealth[9]. The PIH entails smoothing consumption from the very time or date that the resource windfall is discovered, which implies that countries should borrow against future flows, that enter permanent income. Hence, this method entails borrowing in the periods in which permanent income exceeds actual income and saving and accumulating assets, when actual income exceeds permanent income. As a result, due to the country borrowing in the initial years prior to production (i.e. between T_0 and T_1), incremental assets is negative and decreasing. It is only when the country begins to earn revenues in the period T_1 to T_2 that this debt is repaid and a SWF is built up, hence the incremental assets curve increases and becomes positive. After resource revenues have come to an end at T_2, the size of the SWF and the level of the consumption increment at all dates moving forward are such that interest payments received from the fund exactly finances the consumption increment. Post T_2 the incremental assets curve is constant on account of the SWF built up.

2.2 The BIH

A more conservative approach than the PIH, which was implemented in the Norwegian economy in 2001 is called the Bird in Hand (BIH) approach,[10] (refer to figures 1a and 1b). The BIH approach is more conservative than the PIH framework as it implies a higher rate of savings of the resource revenues and is based on financial returns on liquidated resource wealth and not identified natural resource reserves at T_0 (this therefore removes errors that may be associated with miscalculating resource wealth). Under the BIH approach, wealth is ignored until it has been extracted, i.e. between the periods T_0 to T_1, hence, there is no increment to consumption until the period T_1 onwards. During the period T_1 to T_2, countries place all resource revenues in a SWF and only consume the interest earnings from the fund, Barnett and Ossowski (2002), Bjerkholt and Niculescu (2004) and van der Ploeg and Venables (2011). Under this method, a larger SWF is developed in comparison to the PIH strategy, following which the PIH strategy is applied i.e. from period T_2 onwards.

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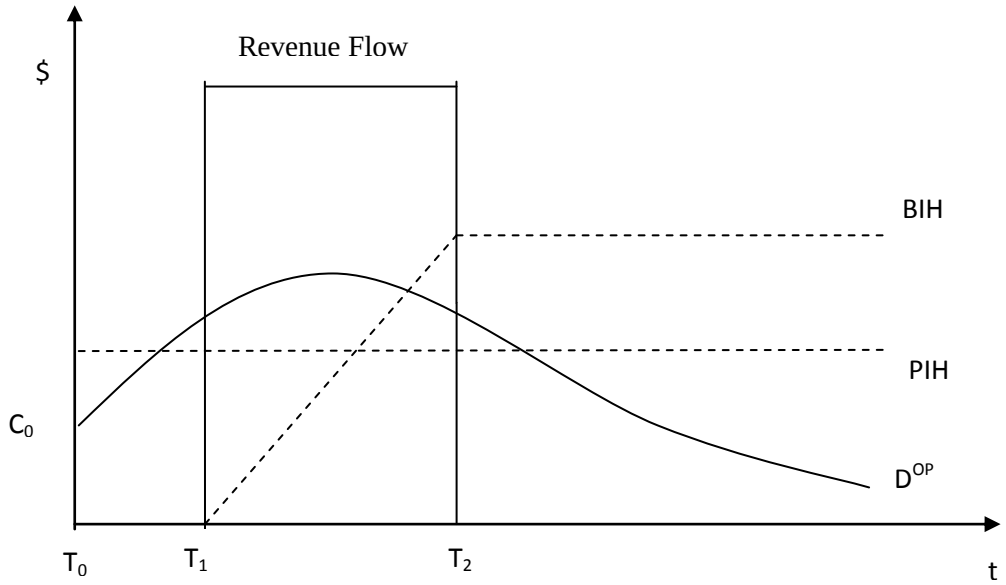
[8] It is essential to note, that this analysis abstracts from uncertainty and assumes that policy makers know the future flow of natural resource revenues with a high degree of certainty.

9 An increment to wealth differs from an increment to income. The increment to wealth is able to generate income and consists of all assets, in this case the reserves of the non-renewable resource discovered, which is able to generate income over a sustained period of time. An increment to income on the other hand results in a temporary inflow of money over a short period of time.

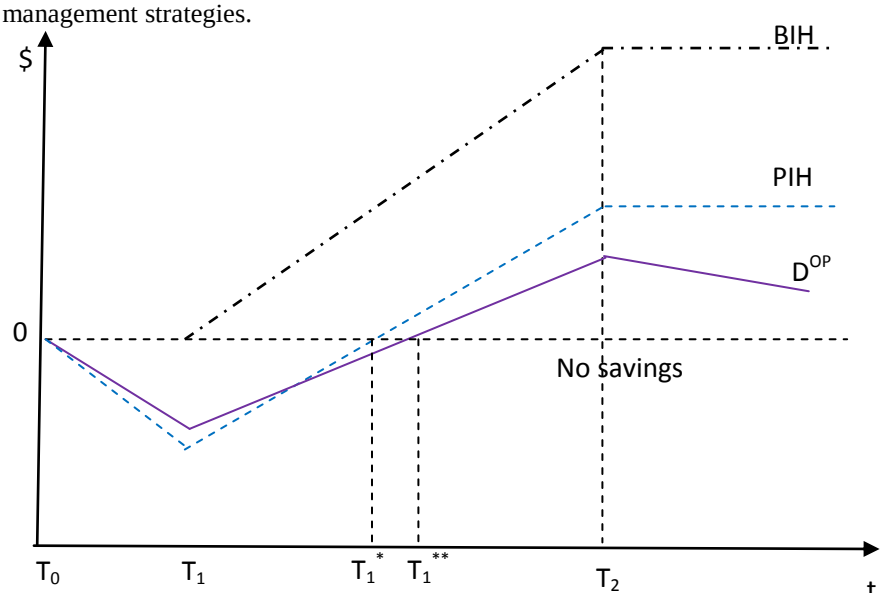
[10] The BIH is sometimes known as the Norwegian model. The BIH rule for the Norwegian economy states that all hydrocarbon revenues must go into a fund, and that 4% of the fund can be used to finance the general government deficit each year, Harding and Ploeg (2009).

Figure 1a: Displaying the time profiles of incremental consumption under various revenue management strategies.



Source: Author additions from Collier et al. (2010)
D^{0P}: optimal case for developing countries.

Figure 1b: Displaying the time profiles of incremental national asset accumulation under various revenue management strategies.



Source: Author additions from Collier et al. (2010)
D^{0P}: optimal case for developing countries.

2.3 The optimal Policy for a Developing Country

Under both the PIH and the BIH strategies, much of the increase to consumption is transferred to future generations[11]. According to van der Ploeg and Venables (2011), whilst this may be appropriate for high-income countries, it ignores the features of developing economies in which there is capital scarcity, low current income levels, scarce public funds as well as the potential for rapid growth and convergence. van der Ploeg and Venables (2011) are of the view that incremental consumption should be skewed towards the present generation and that investments should be made in the domestic economy in both private and public capital, rather than in foreign assets. Takizawa et al. (2004) posits that if the quality of investment were adequately high then the optimal short run level of investment in a capital starved economy is above the prescription from what the PIH infers.

Collier et al. (2010) also share the same view that both the PIH and BIH strategies, whereby a SWF is developed and implemented, are seriously inappropriate for developing countries. They argue that the issue of how much of the windfall revenue should be saved cannot be addressed before the prior and more important issue of what assets should be acquired has been taken into consideration. Reason being, capital is scarce in developing countries so that assets should be accumulated by investing within the country rather than in a foreign SWF, which will yield lower returns according to the authors. Investments in the local economy are assumed to yield higher returns on account of the limited capital stocks of the economy.

As a result, a new approach geared specifically towards developing countries which are usually characterised by capital scarcity was proposed by Collier et al. (2010); refer to figures 1a and 1b. Given that consumption is usually low in developing countries, initial consumption is funded by borrowing, which accounts for the fact that incremental assets is negative and decreasing in the period T_0 to T_1. However, the rate of return on investments is high which encourages investments to take place in the economy eventually leading to higher growth rates and consumption in the future. At the date of discovery of the resource windfall there is a substantial jump in consumption, but not as large as the jump experienced under the PIH strategy. This is due to the incentive of high-return investments in the domestic economy as well as the benefits in repaying foreign debt, Collier et al. (2010)[12]. Hence, the dip in incremental assets over the period T_0 to T_1 is not as deep as is under the PIH strategy. In the period T_1 to T_2, the incremental assets curve increases and eventually becomes positive but at a slower rate than the PIH (see T_1^* and T_1^{**} in figure 1b) on account of the larger increment to consumption under this approach as compared to the PIH. Furthermore, the incremental assets curve is much lower than both the BIH and PIH strategies respective at T_2 on account of the larger increment to consumption in the period T_0 to T_1. Following the period T_2 in which the revenue flow stops, both the incremental consumption curve and the incremental asset curve are positive, but asymptotically converge to zero due to the fact that no SWF had been established.

[11] This is on account of the fact that it is assumed future generations are better off on account of two facts, namely benefits from increased economic growth over the years on account of the windfall and secondly on account of the fact that future generations benefits from current generations stock of capital and wealth, i.e. inheritance. Hence, although the constant increment to consumption under the PIH strategy has the appearance of being equitable across all generations, the future generations stands to benefit more on account of the two aforementioned points.

[12] Collier et al. (2010) points out that lowering foreign debt and increasing public infrastructure investment makes private investment more attractive, whilst Akitoby and Stfratmann, (2008) suggests that indebtedness raises the interest paid by countries, so the marginal value of paying down foreign debt may be large. Furthermore, lowering of public foreign debt reduces the strain on precious foreign reserves.

3. When the optimal becomes suboptimal; Rent Seeking Disease (RSD):

A more extreme and general case occurs under what this paper terms as the '*Rent Seeking Disease*' (RSD) strategy, whereby the state wastefully fritters away the non-renewable resource revenues on consumption goods and on white elephant investments and other wasteful investments (refer to figures 2a and 2b). On account of poor institutions and weak political frameworks in developing oil producing countries (OPC's), in the period T_0 to T_1 the state sometimes undertakes excessive and unnecessary amounts of borrowing, using the prospective natural resource rents as collateral, Mansoorian (1991). The state often times splurges these funds on consumption goods, and a few high cost white elephant projects, Gelb (1988). As a result, during this period incremental consumption is higher than all three previously discussed strategies; however, this is offset by a larger dip in incremental assets, refer to figure 2b.

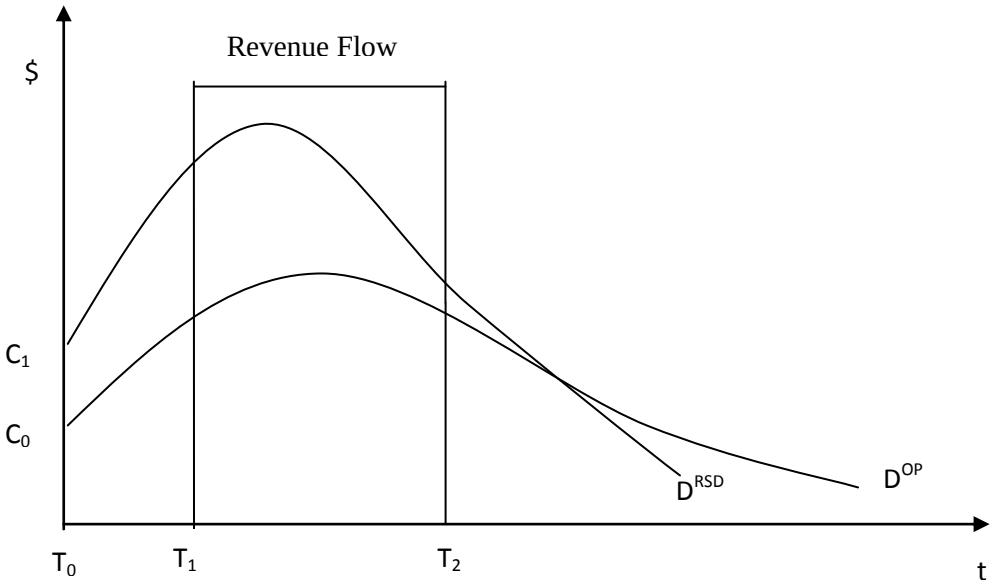
At the point T_1 when the state starts to earn revenues from the extraction of the natural resources, part of this revenue stream must be used to repay the debt, built up in the period T_0 to T_1 whilst attempting to maintain the inertia in consumption. Indeed the literature is replete with examples of procyclical fiscal spending, Erbil, (2011), El Anshasy and Bradley (2012), Arman and Moradi (2015), Chian (2016) and Hosein et al. (2017). Government spending tends to follow resource prices closely, therefore, during booms in commodity prices government expenditure usually increases and as a result becomes unsustainable, Fasano and Wang (2002), Husain et al. (2008) and El Anshasy and Bradley (2012). According to Deaton (1992, p.1) "*booms in government revenue can lead to hastily executed investment programs that involve low return and irreversible projects, or to good but over ambitious projects that are abandoned when revenue falls*". Hence incremental consumption starts to level off and eventually falls rapidly post T_2 due to the fact that no SWF had been built up along with the potential issue that with weak institutions, no strategic investments had been made to generate a stream of income to allow consumption to maintain a steady path[13]. It is important to note that the incremental assets curve increases and becomes positive, due to the fact that debt repayments is considered as one avenue through which investments can take place along with the white elephant investments undertaken under this strategy.

4. The sub-optimality of the optimal policy strategy for developing countries proposed by Collier et al. (2010):

At this point, we critically elaborate in detail four pillars under which the optimal policy strategy for developing countries proposed by Collier et al. (2010) can go wrong and perhaps evolve into an RSD. Developing countries in particular tend to possess the following characteristics, which in turn allow for the breakdown of applying the optimal policy approach by Collier et al. (2010) to these countries following a resource discovery. The four characteristics, namely weak governance, excessive public borrowing, low levels of investment yields and lastly excessive public consumption, are now discussed:

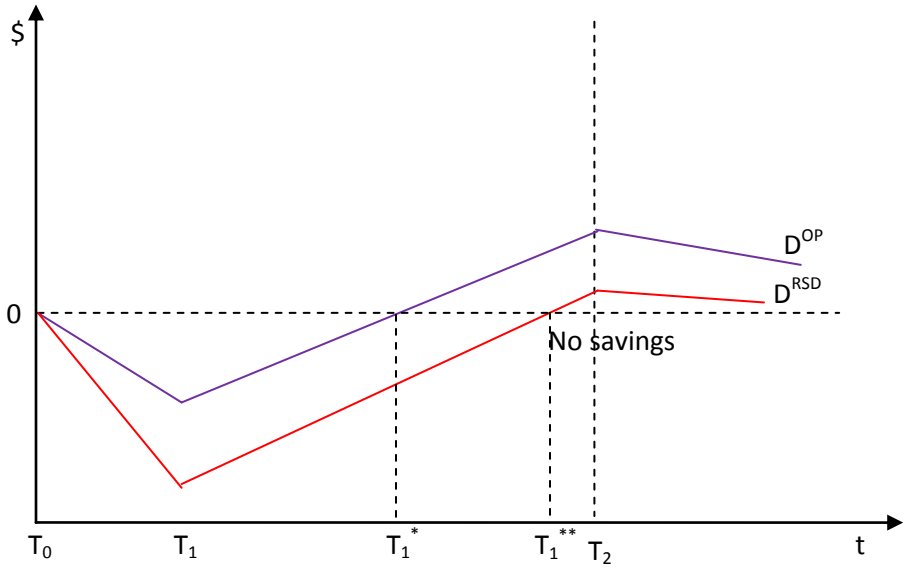
[13] Even if a SWF had been put in place, as in the case of Trinidad and Tobago (T&T), the value of the fund may most likely be small due to any of the following: weak institutions, poor political framework, procyclical fiscal policies or large unsustainable debt levels built up in the past.

Figure 2a: Comparing the time profiles of incremental consumption under the proposed RSD case and the optimal policy approach.



Source: Author additions from Collier et al. (2010).
D^{0P}: optimal case for developing countries. D^{RSD}: income rent redistribution hypothesis for developing countries.

Figure 2b: Displaying the time profiles of incremental national asset accumulation under the proposed RSD case and the optimal policy approach.



Source: Author additions from Collier et al. (2010).
D^{0P}: optimal case for developing countries. D^{RSD}: income rent redistribution hypothesis for developing countries.

4.1 Weak governance:

Collier et al. (2010) optimal policy approach for developing countries is implicitly heavily couched on the assumption that the developing countries that implements this revenue management strategy has both a strong political and institutional base, with the capacity to manage public investment and to utilize resource rents effectively and efficiently. Furthermore, this assumption is also necessary to keep in check public consumption levels to allow room for public investments, which under weak governance can become unsustainable, allowing for little to no fiscal space for public investments. However, in reality, this may not always be the case, as most developing resource rich countries tend to suffer from weak political and institutional capacities, see table 2 below.

Table 2: Table showing top 20 developing oil producing economies (proxied using oil rents as a % of GDP) poor performance on governance and institutional capacity, using Kaufmann's et al. (2010) governance indicators, CPI, EODB.

Country Name	CPI 2016 Rank	Average CPI score 2012-16	EODB 2018 Rank	Average Control of Corruption (1996 to 2016)	Average Government Effectiveness (1996 to 2016)	Average oil rents as a % of GDP (2010 to 2015)
Kuwait	75	44.2	96	0.83	0.68	52.7
Libya	170	16.8	185	-1.16	-1.21	51.7
Congo, Rep.	159	22.8	179	-1.11	-1.19	42.5
Iraq	166	16.6	168	-1.37	-1.49	41.7
Saudi Arabia	62	47.4	92	-0.07	-0.11	40.2
Oman	64	45.8	71	0.44	0.33	36.4
Angola	164	19.4	175	-1.33	-1.15	32.7
Gabon	101	35	167	-0.83	-0.68	30.2
Equatorial Guinea	n.a.	n.a.	173	-1.54	-1.49	28.3
South Sudan	175	13.8	187	-1.39	-1.94	26.4
United Arab Emirates	24	68.6	21	0.89	0.98	21.1
Chad	159	20.4	180	-1.35	-1.26	19.7
Iran, Islamic Rep.	131	27.2	124	-0.59	-0.50	19.7
Algeria	108	35.2	166	-0.63	-0.61	16.5
Brunei Darussalam	41	57.7	56	0.51	0.87	15.8
Venezuela, RB	166	18.4	188	-1.13	-1.04	14.2
Yemen, Rep.	170	18.4	186	-1.09	-1.04	13.8
Qatar	31	67.4	83	0.83	0.68	11.9
Nigeria	136	26.6	145	-1.17	-1.03	11.2
Ecuador	120	32.6	118	-0.74	-0.69	10.5

Source: Transparency International (TI), World Bank, World Bank World Development Indicators (WDI) and the Worldwide Governance Indicators (WGI).
Note: The EODB 2018 rankings for all economies are benchmarked to June 2017.

The table illustrates that majority of the top 20 developing oil producing countries in the world proxied using oil rents as a percent of GDP performs poorly under all indicators, with the general exceptions being the United Arab Emirates, Brunei Darussalam and Qatar. The majority of the

economies are ranked at the lower spectrum of the corruption perception index (CPI) rankings for 2016 which are based on a total of 176 countries. The regulatory environment to starting and operating a local firm or business in these economies also tended to be poor, with the majority of the economies being ranked above 100 based on a total of 190 countries. Both the Kaufmann et al. (2010) governance indicators also indicate that the perceptions of both the control of corruption and government effectiveness in these economies continue to be weak over time, as highlighted by their respective average over the period 1996 to 2016[14].

At the date of discovery of these natural resources, the level of political and institutional capacities in these economies may be low, or on the other hand resource wealth can lead to a weakening of governance over time. Several studies points to the fact that resource rents can undermine the quality of political institutions and increase the tendency of corruption, which consequently hampers economic growth and development (Leite & Weidmann, 1999; Bulte et al. 2005; Robinson et al. 2006)[15]. The weakening of governance is far greater for oil rich countries, as these windfalls tends to generate larger revenues for the state than other resources in general, which leads to weaker institutions and higher levels of corruption. Karl (2004) argued that countries dependent on oil are often characterized by corruption and exceptionally poor governance, a culture of rent-seeking and high incidences of civil conflict and inter-state war. Ross (1999) reviewed the political economy aspects of why resource rich countries tend to manage their economies poorly, and argued that state ownership of the resource industry leads politicians to abuse political power for private purposes[16]. Arezki and Brückner (2009) notes that due to the fact that income from oil rents accrues directly to the government budget in petrostates, this makes it easy for these oil rents to be diverted by the political elite into their own pockets. According to Gylfason (2001), resource rich developing economies are often characterized by ill-defined property rights, imperfect or missing markets and lax legal structures, which make rent seeking by politicians and bureaucrats even easier.

The presence of large resource windfalls induces corruption due to the huge economic temptations that are created by these large resource windfalls as well as opportunities for corrupt behaviour by government officials, see Karl (1997) and Leite & Weidmann, (1999). Furthermore, several studies that employed panel regressions and other various statistical analyses demonstrate that resource-rich countries tend to see lower levels of rule of law, government effectiveness and suffer higher degree of corruption, see (Leite & Weidmann, 1999; Ades & Di Tella, 1999; Isham et al. 2005; Bulte et al. 2005; Norman, 2009; Arezki & Bruckner 2011; Sala-i-Martin & Subramanian 2013).

4.2 Excessive public borrowing

This paper recognizes the distinct characteristics of developing natural resource exporters, whereby borrowing to improve welfare may seem beneficial at the discovery stage of natural

[14] The indices range between -2.5 and 2.5, with a lower value close to -2.5 indicating a weak performance whilst a higher value close to 2.5 indicates a strong governance performance, Kaufmann et al. (2010).

[15] Sala-i-Martin & Subramanian (2013, p.610) outlines the case of Nigeria whereby *"waste and poor institutional quality stemming from oil appear to have been responsible for its poor long-run economic performance"*.

[16] Ross also examined four other political economy aspects, namely cognitive theories, which blame policy failures on the shortsightedness of state actors; societal theories, which cite the pernicious influence of privileged classes, sectors, client networks, or interest groups; statist theories, which fault a state's institutional strength or weakness and lastly the failure of the state to enforce property rights.

resources. However, public debt levels in oil-exporting countries tends to be high, and a substantial number of them have run into debt problems (for example, Angola, Chad, Republic of Congo, Ecuador, Iraq, Mexico, Nigeria, the Russian Federation, Sudan, the Republic of Yemen, and Venezuela). Constant reliance on borrowing seems to be an issue that perpetually plagues these economies. Hence, given weak political and institutional quality in these economies as highlighted in the sub-section above, borrowing in the period T_0 to T_1 can lead to irrational debt build up in this period and borrowing may even persist post T_1, i.e. continues in the period T_1 to T_2.

As Newman et al. (2016) points out, the situation of a future windfall is unique as a number of unknowns are introduced, which includes the timing and gross amount of the resource windfall. Dinh and Dinh (2016) highlights that recent experience in the case of Uganda has revealed that estimates of the future windfall are inaccurately skewed to an earlier, larger revenue stream, to which they point out, can be a dangerous error as borrowing and investments in infrastructure may exceed the revenues to be gained from the future windfall. Dinh and Dinh (2016) notes that whilst early investments in areas such as human capital and infrastructure can promote diversification and allay the Dutch Disease, here debt management becomes particularly important for low income countries with future natural resource windfalls[17]. The authors, however, points out that infrastructure projects must be carefully analyzed before implementation. The initial investments in infrastructure and skills according to the authors tends to be large, hence the underlying uncertainties associated with future windfall revenues can drive the country to a debt overhang situation, with one of the major issues being that this excessive debt may impair the countries future ability to borrow.

Henstridge and Page (2012), at the time of their study in 2012 showed that even with oil production due to begin in 2015 in Uganda, it would take over a decade for revenues to reach close to 5% of GDP or just over a third of non-oil revenues[18]. They note that the estimated revenue stream to be derived from the production and extraction of oil may not materialize, if the price of oil which is notoriously difficult to forecast were to be sharply lower in the coming years ahead. This came to past in mid 2014, when oil prices took a severe turn in mid 2014, plummeting to all time lows in over ten years; remaining depressed over the last couple of years, barring a slight recovery in recent times[19]. The Ugandan example highlighted clearly outlines the grave dangers of borrowing in the period T_0 to T_1 on estimated or forecasted oil revenues, given the severe volatility and unpredictability associated with oil prices which gravely impacts these estimates. Overly optimistic estimates of oil revenues can result in excessive borrowing prior to the resource windfall.

According to Mansoorian (1991), in the 1970s a number of developing countries accumulated huge debts, following their discoveries of natural resources. Prominent among these were Mexico and Venezuela. According to Harberger (1985), Mexico and Venezuela should have

[17] The authors listed several low income African countries expecting resource windfalls from fuel discoveries in the coming years, namely, Ghana, Kenya, Mozambique, Tanzania and Uganda.

[18] Note that on account of delays caused by a series of regulatory disputes between the Ugandan government and the international oil companies, oil production is now due to come on stream in 2020 after the oil discovery was made in 2006.

[19] This recovery however, is in no relation to the prices enjoyed by OPC's over the last decade, adding to severe macroeconomic pressures currently being face by most of these OPC's.

treated their oil reserves as national wealth, and should have invested their oil revenues in long term investment projects. Instead, they borrowed extensively against these reserves, and used most of their borrowings to finance high levels of consumption or to invest in projects with low rates of return. Harberger argues that this lack of sufficient savings was one of the most important causes of the then current debt problems of these countries. Harberger (1985) noted that the proceeds from the oil boom should have been treated as endowments or pension funds, which would have been the most prudent method of investing the proceeds. In other words, the proceeds derived from the 1973-74 oil boom by these countries, should have been distributed into a diversified portfolio of investments in capital markets around the world, which was expected to earn a certain average real rate of return. He further goes on to state that these funds should have been slowly repatriated over time, as worthy investment projects, i.e. projects with high expectations to earn a higher average real rate of return are found in the local economy.

Furthermore, the possibility of excessive debt build up is not limited to the period T_0 to T_1, there can also be issues of debt management arising post T_1, i.e. in the period T_1 to T_2. During periods of economic upturns on account of commodity booms, several governments tend to increase external borrowing on the back of the booming commodity. This has been dubbed as the "boom-based borrowing capacity," by Usui (1997). As noted by Kaminsky et al. (2004, p.11) "*the roots of most of the debt crises in emerging markets are all too often found in governments that go through bouts of high spending and borrowing when the times are favorable and international capital is plentiful*". This seems to be on account of the fact that during the oil boom, oil exporting countries are attractive customers of donor countries due to their new found increased resource wealth, Usui (1997). Furthermore, to sustain high rates of growth of domestic absorption on account of the boom, some countries tend to drastically increase their dependence external borrowing.

4.3 Low Levels of Investment and Investments Yields

Collier et al. (2010) argues that countries would choose to utilize a part of their resource revenues to finance public investment in the domestic economy, over the option of spending all on public consumption, due to the high return opportunities on these investments. However, several questions arises as to whether or not this will actually manifest as well as if this is always the best approach to adopt for developing resource rich countries which as highlighted above, tends to be characterized by weak political and institutional capacities. In other words, this presumption by Collier et al. (2010) may have missed the critical fact that many of these countries face imperfections in the level of administrative capacity and economic institutions. As pointed out by Arezki et al. (2012, p.4), *"in deciding over their optimal level of spending following a resource windfall, resource rich countries thus need to take into account the level of corruption which is likely to affect the effectiveness of their expenditure"*. Similarly, this very notion can also be extrapolated to the case in which a country makes a significant new resource find as in our study. Indeed, the limited state capacity of many resource rich countries makes appropriate and effective public investment difficult to achieve.

Segal (2012) notes that while investments in the domestic economy might indeed yield higher returns than a SWF, in practice there remains the risk of inefficiency. Robinson and Torvik (2005) highlighted and discussed several examples of white elephant projects undertaken in several economies, which they argue, should be understood as clientelistic payments by

politicians to their supporters[20]. The presence of bottlenecks due to frictions both in the economy and in government expenditures may imply limited absorptive capacity, where too much investment may lead to inflation, rather than increased output, Segal (2012). Dabla-Norris et al. (2012) developed a composite index on the efficiency of the public investment management process for 71 countries which comprised of 40 low income countries; and showed that the oil exporting countries in the sample had lower index scores, i.e. oil exporters had markedly lower quality public investments[21]. Berg et al. (2013) in their study suggest a gradualist approach to increasing public investment. Through the use of a dynamic stochastic small open economy model, the authors are able to show how combining public investment with a resource fund (which they identify as a sustainable investing approach) can help address the macroeconomic problems that are associated with the exhaustibility and volatility of natural resource revenues.

During periods of high petroleum prices, authorities have a tendency to act based on excessively optimistic assumptions about the size and the extent of the oil price boom, Frankel (2011). In expectation of excessively optimistic revenues to be derived from the resource boom, officeholders undertake ambitious public domestic investment projects with low economic rates of return, inadequate screening, and undiversified risk, Kendall-Taylor (2011). As Talvi and Végh (2005) observes, most public investment projects associated with commodity booms in most countries were found to yield minimal, zero, or in few cases, even negative rates of return. Investments in infrastructure can have large long-term pay-off if it is well designed; too often in practice, however, it takes the form of white elephant projects, which are stranded without funds for completion or maintenance when commodity price goes back down Gelb (1988). Gavin (1993, p. 216) points out that there is a tendency *"for governments to invest in projects with high prestige or political payoff, but with little economic rationale"*.

For example, in September 2005, the Petroleum Company of Trinidad and Tobago Limited (Petrotrin) entered into a project agreement with World GTL (WGTL) to build and operate a gas-to-liquid plant at Petrotrin's Pointe-a-Pierre refinery, in south Trinidad[22]. The plant was to be constructed within approximately two years, by the relocation and repurposing of equipment from decommissioned methanol and other plants from the USA and Guatemala. Construction at the Pointe-a-Pierre site began in November 2006; however, there were many costly delays throughout the construction phase. The plant was initially estimated to cost 1 billion TT dollars, which included funds to cover equity participation by both companies and a loan to begin operations at the facilities. The plant was eventually discontinued in 2010, with the failed plant costing an overall 3.3 billion TT dollars, which includes construction activity, monies paid to the receiver PricewaterhouseCoopers as well as interest payments on loans taken out to construct and complete the plant. The total cost to date, less the interest payments place the cost of the failed plant at 2.5 billion TT dollars according to a JSC Report (2016).

[20] The authors define white elephant to be projects which yield a negative social surplus.

[21] The index comprises 17 indicators grouped into four stages of the public investment management cycle: (i) Strategic Guidance and Project Appraisal; (ii) Project Selection; (iii) Project Implementation; and (iv) Project Evaluation and Audit. The authors scored countries based on the different indicators and sub-indices, which were then combined to construct the overall index.

[22] Petrotrin is a state owned oil company of the republic of Trinidad and Tobago. World GTL is a New York based company founded in 2000 which builds, operates, and produces gas-to-liquid facilities that convert natural gas and hydrocarbons into fuels.

There are three major factors that may explain or account for the low returns of public investment projects associated with commodity booms according to Asfaha (2007). First off, because of competitive rent-seeking behaviour, a substantial share of public investment may find its way to projects that generate short-term political gains to governments rather than to projects that generate high economic returns. Arezki et al. (2012) argues that rent seeking is more prevalent in resource rich countries and is thus is likely to render public expenditure ineffective. Secondly, as commodity prices fall and revenues wane, good public investment projects may often get abandoned or take too long to complete[23]. Third, government agencies in charge of macroeconomic stabilization (typically ministries of finance) may lack control over government spending agencies. Spending agencies may include housing and urban development agencies, health and social welfare agencies, public works and transportation agencies. A lack of transparency and timely information on expenditure by the spending agencies also makes effective regulation difficult in developing countries.

4.4 Excessive public consumption on patronage

Buffie and Krause (1989) provide a comprehensive study of the Mexican economy. According to them when Mexico found large reserves of oil in 1977, the Mexican government increased its expenditures substantially. They report that in 1977 public sector expenditure was only 29.3% of GDP, whereas by 1982 this figure had risen to 46.4%. More importantly, most of this increased expenditure had gone into current expenditures, which had risen from 22% of GDP in 1977 to 36% in 1982. Public expenditure on capital accumulation did not rise by nearly as much; it rose from 7.5% of GDP in 1977 to only 10.6% in 1982.

It is widely accepted that in many resource-rich countries, where abuse and mismanagement of resource rents has resulted in low growth, governments may try to remain in power through the distribution of resource rents to those in official positions and other powerful groups, Kolstad and Soreide (2009). Similarly, Robinson et al. (2006) emphasize that resource rents tend to be used by politicians for patronage purposes in order to generate political support and achieve re-election. For example, the expansion of public spending was a contributory factor in the results of parliamentary and presidential elections in Russia in 2007, Sturm et al. (2009). Another way for political leaders to increase patronage is the allocation of lucrative and influential public sector posts to their supporters.

5. New Proposed Optimal Approach for Developing Economies Plagued with Weak Institutional and Political Quality

Due to the limitations of the optimal policy approach for developing countries (D^{OP}) outlined in the paper, it is necessary that the literature on how these countries should manage its highly volatile and transient natural resource revenues be readdressed. Furthermore, the high prevalence of the suboptimal RSD resource revenue management case amongst developing countries; which has been illustrated in the case of the Ghanaian economy (see appendix A1), calls for a relook into the literature on how these countries should manage its highly volatile and transient natural resource revenues. As such, this paper proposes a new optimal approach (N^{OP}) to address this gap and overcome several limitations we see expounding in the global economy that the existing breadth of literature covered in this paper fails to properly address. We divide the analysis into four sub-categories, namely debt, consumption, investment and sovereign wealth fund (SWF).

[23] This is due to the combination of the revenue variability and the procyclicality of fiscal policies that leads to poor management of windfall revenues.

Here the N^{OP} is compared with the PIH, BIH, D^{OP} and the proffered RSD strategies of resource revenue management under each of the sub-categories.

5.1 Debt

There are numerous adverse effects of over borrowing and building up excessive public debt levels to the overall macroeconomic health of an economy, more so for developing OPC's[24]. If the debt level is allowed to grow out of control in the period T_0 to T_1, then the majority of the inflow of resource revenues in the form of rents in the period T_1 to T_2 could be spent on servicing and repaying this debt, à la the Ghanaian case study outlined[25]. This will result in lowered incremental public consumption and investment expenditure levels by the state during this period, which ultimately impacts negatively on the welfare levels of the current generation, and hence will not result in the desired results as outlined or expected, under the optimal policy for developing countries of Collier et al. (2010).

Table 3: Displaying the debt profile of each resource revenue management strategy for the respective three time periods.

Period	Debt					Notes
	PIH	BIH	D^{OP}	RSD	N^{OP}	
T_0 to T_1	✓	-	✓	✓	-	RSD incurs the largest debt followed by the D^{OP} and lastly the PIH.
T_1 to T_2	-	-	-	✓	-	Debt occurs under the RSD due to excessive fiscal spending in the period T_0 to T_1.
Post T_3	-	-	-	-	-	-

Under the D^{OP} and RSD, debt is dependent on the estimated size of the windfall revenues to be accrued from the non-renewable natural resource over the period T_0 to T_1 and the borrowing limit or debt ceiling imposed in the respective economies. The debt in turn is determined by the larger of the two. In theory, this is the maximum the state can borrow given its debt rules and the estimated size of the windfall, therefore the threshold of borrowing under both D^{OP} and RSD lies between zero and this theoretical boundary. The PIH entails borrowing over the period T_0 to T_1 to maintain consumption on a constant path from the date of discovery of the natural resource. Therefore, debt under this approach is equal to the annuity present discounted value of all future flows of resource revenues evaluated at the date of discovery (T_0) by the duration of time in years in the period T_0 to T_1. The analysis for these three strategies assumes that the size and extent of the resource windfall is known with a high degree of certainty, Collier et al. (2010).

Note that both the optimal and RSD begins with the same initial conditions for borrowing. However, we argue that borrowing may become excessive in the RSD case due to either one of the following or both. The estimated or expected total windfall revenues may be overestimated or the economy may face lax debt rules or debt rules that can be easily altered given its developing status and weak political and institutional capacities. Moreover, developing economies may also face a default premium or risk premium on their respective borrowing as

[24] See the works by Feldstein (1986), Woodford (1994), Sims (1994), Loyo (1999), Christiano and Fitzgerald (2000), Cochrane (2001) and Reinhart et al. (2012).

[25] Given the added risk involved in investing in these economies, i.e. the risk premia, the rate at which these countries may be able to borrow on International markets may be above the world interest rate. Hence, these countries will be faced with higher interest payments when servicing their respective debts.

noted by Collier et al. (2010), van der Ploeg and Venables (2011) and van den Bremer and van der Ploeg (2013) which increases the rate of borrowing and overall debt [26].

In summary, we see that in the period T_0 to T_1 borrowing takes place under three strategies, namely the PIH, D^{OP} and RSD strategies respectively. The PIH strategy requires borrowing at discovery to maintain a one off constant increase to consumption, whilst the D^{OP} recommends borrowing to increase the current generations' welfare through an increase in consumption and investment. The RSD in summary is what could occur in economies plagued with weak political and institutional capacities. Therefore, if a country is to borrow in this period, borrowing should be undertaken to address/improve institutional capacity in the domestic economy or as Arezki et al. (2012) puts it, allow for "investing in investing" i.e. public investment in administrative capacity. Arezki et al. (2012) finds that weaker administrative capacity lowers the increase in optimal public capital subsequent to a resource windfall, whilst alternatively a higher initial stock of public administrative "know how" leads to a higher level of optimal public investment following a resource windfall. The authors highlights that investment in administrative capacity in resource rich countries can be done through increasing transparency in the handling of resource windfalls in addition to the better identification and implementation of projects. The PIH is not optimal in this case either, as borrowing to fund a one off increment to consumption does not take into account that levels of investment in developing economies are low Takizawa et al. (2004), Collier et al. (2010), van der Ploeg and Venables (2011), Berg et al. (2013), Samake et al. (2013).

On this basis, this paper argues that in the period T_0 to T_1 the state should not undertake any borrowing, as this can become persistent and unsustainable, potentially continuing into the period T_1 to T_2. This can occur under the RSD case when the increment to consumption exceeds the actual size of the windfall in the early stages of the period T_1 to T_2, which then requires the state to borrow to maintain the level of incremental consumption built up in the period T_0 to T_1. Moreover, the period T_0 to T_1 is in most cases a relatively short period of time lasting on average five years, as was the case for the Ghanaian economy and as is the estimated case for the Guyanese economy currently[27]. Arezki et al. (2015), states that the delay between a resource discovery and production is on average 4 to 6 years. Hence, we argue that the current generation will not be significantly worse off if the state does not borrow in this period, as is recommended under the optimal policy approach for developing countries proffered by Collier et al. (2010), whereby the state borrows to fund both an increment to public consumption and investment to increase the welfare levels, of the current generation[28]. Furthermore, the marginal increment to

[26] A risk or default premium is the additional amount a borrower must pay to compensate the lender for assuming this additional or added risk or default risk. The size of the interest premium ultimately depends on the level of foreign debt in the economy, van der Ploeg and Venables (2011). van den Bremer and van der Ploeg (2013) in their analysis assume that countries with a high debt level or capital scarcity pay an interest premium on their foreign debt, to which they assume holds in the case of Ghana, but not for Norway or Iraq.

[27] http://corporate.exxonmobil.com/en/company/worldwide-operations/locations/guyana#About

[28] We also wish to highlight or draw to the attention of the avid reader the case of Uganda, in which a series of oil discoveries were made in 2006, however, a series of regulatory disputes between the Ugandan government and international oil companies delayed development and production, with production being estimated to begin in 2020 at the earliest, Patey (2015). Under Uganda's case, it may seem that borrowing during this period as recommended under the optimal approach proffered by Collier et al. (2010) has merit in this case, however, this situation in its own right is fraught with problems as borrowing over this extended period of time would have definitely led to the debt levels becoming unmanageable and unsustainable at this point in time as no resource revenues are yet to be realized.

welfare levels of the current generation in the period T_0 to T_1 period on account of borrowing may eventually reverse, as witnessed in the Ghanaian economy. Over borrowing in this period can limit fiscal space in the following periods. Therefore, abstaining from borrowing in the period T_0 to T_1 can ultimately result in improved and lasting welfare levels of the current generation as the negative effects of over borrowing and building up debt levels are avoided allowing for greater fiscal space in the 'boom period' i.e. T_1 to T_2. As such, in the period T_0 to T_1, focus should be specifically geared towards improving the institutional and political capacity in the economy. These may include alleviating bottlenecks and absorptive capacity constraints, constraints to doing business, implementation of revenue management laws, improving transparency and accountability by implementing relevant laws and regulations in addition to becoming EITI compliant and so forth.

5.2 Increment to Consumption

Incremental Consumption takes place under the PIH, D^{OP} and the RSD strategies respectively in the period T_0 to T_1 on account of the borrowing undertaken in the period. The increment to consumption under the PIH strategy remains constant over all three periods. In the period T_0 to T_1, the increment to consumption is heavily couched on the debt undertaken in the period which is highly dependent on the estimated size of the windfall. Both the BIH and N^{OP} are more conservative in that consumption is based on actual revenues derived from the non-renewable natural resource. The major factor determining the level of consumption between the D^{OP} and the RSD case is the roi^d. The roi^d may not be as high as Collier et al. (2010) assumed, due to bottlenecks and institutional constraints in the economy in the early stages, which reduces the real rate of return on the increment to investments in the economy, van den Bremer and van der Ploeg (2013) and van der Ploeg and Venables (2013).

Table 4: Displaying the profile of incremental consumption under each resource revenue management strategy for the respective three time periods.

Period	Increment to Consumption					Notes
	PIH	BIH	D^{OP}	RSD	N^{OP}	
T_0 to T_1	✓	-	✓	✓	-	Requires borrowing in this period to fund this increment to consumption. Furthermore borrowing based on expected or estimated volatile windfall revenues.
T_1 to T_2	✓	✓	✓	✓	✓	Consumption is based on actual windfal revnues only under the BIH and N^{OP} strategies respectively.
Post T_3	✓	✓	asymptotically converges to zero	rapidly converges to zero	✓	The increment to consumption is maintained under the PIH, BIH and N^{OP} respectively on account of the implementation of a SWF.

In the period T_1 to T_2, the increment to consumption under the BIH and the N^{OP} is based on the actual revenues derived from the resource windfall, thereby eliminating the effects of price volatility as well as inaccurate forecasts of revenues in the prior period[29]. The level of

Hence borrowing in this initial period can lead to the downfalls of economies on both accounts, i.e whether the period is short or long.

[29] Future windfalls that are inaccurately skewed to an earlier, larger revenue stream due to inaccuracies in the estimated price of oil can be a dangerous error as borrowing and investments in infrastructure may exceed the revenues to be gained from the future windfall. For instance, in May 2011, the US Energy Information

consumption to be maintained under the PIH, D^{OP} and RSD are highly dependent on the accuracy of the estimates made in the period T_0 to T_1. If the estimated revenues were to exceed the actual revenues derived from the non-renewable natural resource, this would ultimately impact negatively on the level of consumption that the economy is able to maintain in the period and by extension ultimately its level of welfare. In light of this, the state may choose to borrow to maintain the increment to consumption, further increasing the level of debt in the economy. Furthermore, the level of debt undertaken in the period T_0 to T_1 can also place added strain on the fiscal balances. The level of incremental consumption in the period T_1 to T_2 under both the D^{OP} and RSD is determined by the actual windfall revenues derived less the debt undertaken in the period prior and the trade-off between investment. The trade-off between investment and consumption can be low in this period as well in theory, as both the D^{OP} and RSD fails to address/account for weak political and institutional capacities; therefore the roi^d may continue to be low in this period. Consumption in this period under the N^{OP} is based on actual revenues derived from the non-renewable resource less the amount saved in the SWF and the trade-off between investments. Here we argue that the steps taken in the period T_0 to T_1 to improve political, institutional and absorptive constraints in the economy will spill over into the subsequent period T_1 to T_2, and will lead to a gradual increase or improvement in the roi^d over time and hence a higher trade-off between the increment to investment and increment to consumption.

Post T_3, the N^{OP} is superior in relation to both the D^{OP} and RSD as it maintains a constant consumption path for developing economies, though the increment to consumption is higher under the BIH and PIH respectively in that order. In effect, the N^{OP} encompasses an intergenerational equity component whereby future generations are also able to benefit from the revenues accrued from the non-renewable natural resource. Segal (2012) points out that whilst in the first instance it may seem unfair for current generations to consume the value of the finite natural resources, they will in any case leave most of their physical assets to the future generations in the form of the capital stock. Hence intergenerational equity which is a core principle of sustainable development according to Jordan (2008), demands that current generations consume the majority of the finite natural resources than generations in the future which are assumed to be richer because of the fact that they will in any case leave most of their physical assets to future generations, in the form of the capital stock according to Segal (2012). Under both the D^{OP} and RSD strategies the increment to consumption asymptotically converges to zero and rapidly converges to zero respectively.

5.3 Increment to Investment

Under both the PIH and BIH there is no increment to investment utilizing the resource revenues, Segura (2006), Collier et al. (2010) and Venables (2016). Hence these approaches are not optimal for a developing economy which is usually characterized by capital scarcity, Collier et al. (2010) and van der Ploeg and Venables (2011, 2012). The D^{OP} takes this into account and borrows in T_0 to T_1 to raise both consumption and investment levels to increase welfare of the

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Administration's 95% confidence interval for the oil price only 18 months ahead ranged from $60 to $200 per barrel, highlighting the difficulty in predicting oil prices. Hamilton (2009) also emphasizes the difficulty in predicting oil prices using a 95% confidence interval. Hamilton illustrated in his study that the price of oil four years from 2008:Q1 ranged from as low as $34 to as high as $391 per barrel.

current generation. However, low political and institutional quality has seen this gone awry, à la the RSD case. "*Given the political and institutional failures in many oil-rich developing economies, it is a challenge to transform subsoil wealth into productive growth-enhancing physical and human capital*" van den Bremer and van der Ploeg (2013, p.131). The authors' further notes that investment projects in the domestic economy may face absorption, planning and legal constraints, for which in this scenario it may make sense to temporarily park part of the resource windfall until it is feasible to undertake these investment projects. Therefore, the choice of the optimal model in T_0 to T_1 ultimately depends on the level of political and institutional quality prevailing at this time.

Table 5: Displaying the profile of incremental investment under each resource revenue management strategy for the respective three time periods.

Period	Increment to Investment					Notes
	PIH	BIH	D^{OP}	RSD	N^{OP}	
T_0 to T_1	-	-	✓	✓	-	There N^{OP} does not recommend an increment to investment in this period due to potential bottlenecks and absorptive capacity constraints in the domestic economy which reduces the return on investment.
T_1 to T_2	-	-	✓	✓	✓	The N^{OP} may be the most optimal in this period on the assumption that the state begins the process to improve institutions and alleviate bottlenecks in the period T_0 to T_1.
Post T_3	-	-	-	-	Depends on size of SWF at this juncture.	-

The increment to investment in the second period, T_1 to T_2 under D^{OP} is subject to the levels of debt undertaken in the prior period as well as the consumption/investment decision before the state. As Collier et al. (2010) notes, if the roi^d is high, the initial increment to consumption is small and conversely resources are devoted to investment. Under the RSD investment is low due to large debt and consumption levels built up in the previous period. The N^{OP} may be the most optimal in this period on the assumption that the state begins the process to improve institutions and alleviate bottlenecks in the period T_0 to T_1. As Arezki et al. (2012) puts it, resource rich economies must take into account the level of corruption in the domestic economy in the decision making process pertaining to the optimal level of expenditure following a resource windfall, as this is likely to affect the effectiveness of these expenditures.

Post T_3 the N^{OP} provides the only case for an increment to investment continuing whereby given the size of the fund and its returns, a percentage of the interest can be used for investment and not all for consumption purposes leading to both consumption and investment smoothing post T_3. Under the D^{OP} and RSD, the increment to investment rapidly declines to zero.

5.4 SWF

The BIH approach accumulates the largest SWF; however this has the effect of pushing consumption further into the future and is not optimal for developing capital scarce economies as Collier et al. (2010) notes. The PIH builds up a lower SWF on account of debt incurred in period T_0 to T_1. The N^{OP} recommends saving a proportion of the windfall revenues in a SWF, as the approach recognizes the development needs that a developing economy faces upfront. However, the approach also recognizes the fact that there maybe be bottlenecks in the domestic economy and an influx of foreign exchange into the domestic economy can result in the Dutch disease.

Table 6: Displaying the SWF profile under each resource revenue management strategy for the respective three time periods.

Period	SWF				
	PIH	BIH	N^{OP}	RSD	N^{OP}
T_0 to T_1	-	-	-	-	-
T_1 to T_2	SWF	SWF	-	-	SWF
Post T_3	SWF	SWF	-	-	SWF

Furthermore, to avoid the adoption of suboptimal procyclical fiscal policies, i.e. overspending during booms and cut backs in expenditure during downturns, there is merit for the development and implementation of a SWF in order to decouple resource revenues from expenditures. In the absence of the development and implementation of a SWF, recurrent government expenditures on items such as wages and salaries and transfers and subsidies and other consumption goods will increase to unsustainable levels due to the 'voracity effects', which is attributable to weak institutions and political frameworks which plague developing OPC's, Tornell and Lane (1999). Additionally, rapid increases in investments in the domestic economy can suffer from bottlenecks due to limited absorptive capacities in developing countries. This can be manifested in the form of an appreciation of the real exchange rate which negatively affects the non-booming tradable sector (NBT) which is highly researched in the literature as the Dutch disease (see works by Corden and Neary 1982, and Sachs and Warner, 1997) as well as from supply bottlenecks in the non-traded goods sector, van der Ploeg and Venables (2011). Hence there is merit for the development of the SWF in order to 'park' resource revenues, until these administrative constraints can be properly addressed in the economy, van der Ploeg and Venables (2013). This idea of 'parking' resource revenues in a SWF can also prove to be useful as political and institutional framework deficiencies are addressed over time within the economy. Some countries harness these windfalls for growth and development, especially if institutions are good, but others suffer from poor growth despite large resource bonanzas, Sachs and Warner, (1997), Mehlum et al. (2006), Boschini et al. (2007) and van der Ploeg (2011). The latter has been come to known widely as the 'resource curse' or the paradox of plenty in the literature.

In addition to the aforementioned, the development of a SWF also has it merits upon exhaustion of the natural resources whereby resource revenues have come to a halt. Under the D^{OP}, consumption asymptotically converges back to the initial level that it would have attained on the optimal growth path without the occurrence of the windfall, however it is higher, at all dates, than it would have been without the windfall on account of the expected returns earned on investments and the accelerated and higher growth path the economy is now placed on due to the windfall. This along with the fact that the economy may still be in transition and may face various macro-economic shocks adds further support for a SWF being developed under the optimal case for a developing country. Indeed the depletion of non-renewable natural resources and the revenues accrued from the export of these commodities may act as a shock in itself. Furthermore, failure to diversify the economy during this period, which can be very difficult in the phase of a commodity boom, can lead to the economy stalling post T_3. Arezki et al. (2012) points out that the biggest challenge facing resource rich economies in the long run is their ability to rebalance their wealth away from exhaustible natural capital. The authors further highlights that in order to ensure economic sustainability, the non-resource sector needs to

eventually generate enough wealth after depletion of the stock of natural capital. The state will now also be faced with a sudden 'drop off' or decline in fiscal revenues, and without contingencies put in place through the development of the non-resource or non-oil sector during the period the economy will face fiscal shocks. In addition, reduced inflows of foreign exchange reserves can place added pressure on the real exchange rate. These are key factors that Collier et al. (2010) failed to account for in the case of developing economies.

Given the large heterogeneity that exists amongst these small oil producing developing countries, specific rules governing and outlining the development of a SWF must be developed for each respective country case. A SWF should be developed with clear policy guidelines outlining both the rules of deposits and withdrawals from the fund given the stated goals of the fund. Factors such as the level of underdevelopment of the economy in terms of welfare and income levels, infrastructural needs, current levels of public investment, as well as the size of the natural resource discovery must be taken into account. Additionally, public expenditure returns is also a key determinant. This is essential, as these factors will ultimately determine the amount of resource revenues that can be utilized for both consumption and investment spending in the economy; whilst maintaining a sufficient balance for intergenerational equity as well as for stabilization of the macroeconomy during periods of decreasing commodity prices.

However, several authors have argued that one of the biggest issues with SWFs is government overtake. Over time, savings accumulate in these funds and make them very attractive to governments. Governments, particularly populist governments in low quality institutional settings, are prone to deplete these funds and spend them on their populist agenda to get votes or popularity among the population. Humphreys and Sandbu (2007) highlighted that Chad remains one of the most corrupt and least democratic countries in the world, and as recent experience has shown, the government felt free to simply change the rules when it wanted greater access to the oil revenues. For these very reasons, it is much more difficult to have a SWF in a developing country than in Norway, particularly for this risk of government overtake. In light of this, it is essential that institutions and political quality in these economies be addressed in T_0 to T_1, so as to avoid potential overtake of the SWF as in the case of Chad in the period T_1 to T_2 or even post T_2.

5.5 Summary Diagnostics of N^{OP}

In light of the aforementioned, as well as seeking to avoid further RSD cases from emerging as highlighted in section 3, we propose a new optimal approach for developing countries (N^{OP}) which seeks to overcome the limitations of the D^{OP}, refer to figures 3a and 3b. In the period T_0 to T_1 no borrowing is undertaken to fund an increment to consumption or investment. Upon extraction of the natural resources, from T_1 onwards, a SWF is implemented. This will aid in addressing the issues of price volatility and expenditure inertia as well as uncertainties associated with resource revenue flows. Specifically, for OPC's we recommend that a specific percentage of the resource revenues be saved in the SWF[30]. Hence, post T_2 consumption levels are able to be

[30] The other option recommended in the literature is to use an estimated or reference price; when the actual price exceeds this estimated or reference price the excess windfalls are deposited into the SWF. However, we argue that this method leads to excessive amounts of resource revenues entering the budgetary process, in addition to the major fact that the estimated or reference price is subject to political pressures and can be easily influenced by the state. Furthermore, the derivation of this estimated price can become quite tedious and subjective in terms of the

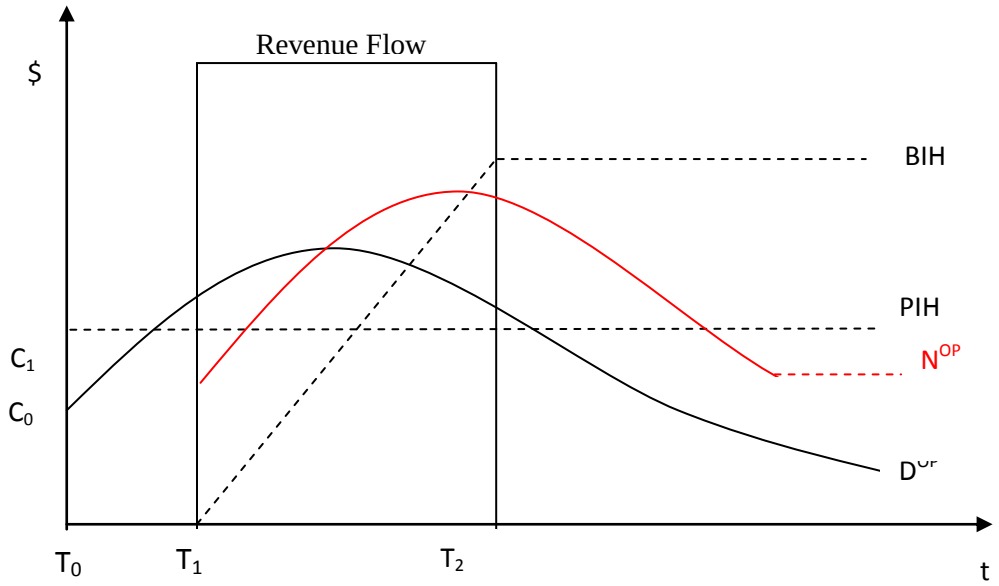
maintained on a constant path. Investments should be made gradually over time in the period T_1 to T_2, replacing some of the non-renewable natural resources with physical or reproducible capital as bottlenecks in the economy are addressed gradually over time, in order to get the growth process 'rolling' which will in turn raise the welfare and standard of living levels of the current generation through an increase in public consumption and the level of employment in the economy. As a result, both the current and future generations are able to benefit from a higher level of incremental consumption under our new proposed optimal strategy. Hence the new optimal overcomes three shortcomings of the old optimal, namely:

1) Corrects what we see as a major planning error in the period T_0 to T_1 under the optimal approach proffered by Collier et al. (2010), whereby borrowing in this period can become persistent and unsustainable on account of weak political and institutional capacities in the domestic economy, continuing into and possibly post the period T_1 to T_2.
2) A SWF is developed and implemented, which aids in avoiding procyclical fiscal spending, alleviating or reducing the impacts of business cycle shocks, reduces the transmission of oil and revenue volatility to the economy through the fiscal medium and allows for the intergenerational transfer of wealth as consumption is placed on a constant path post resource depletion, i.e. (T_2).
3) Does not assume away uncertainty of resource revenues which is a major limitation of the PIH and the D^{OP}.
    a. No borrowing on permanent or expected income in the period T_0 to T_1.
    b. A proportion of the resource revenues derived are saved in a SWF, which prohibits the consumption and investment of all resource revenues derived in a bid to cater for future uncertainty in resource revenues on account of price volatility and unpredictability.

In summary, whilst we do understand and accept the fact that most developing OPC's are largely underdeveloped with high levels of poverty; the presence of both weak political and institutional frameworks within these economies can lead to unsustainable debt built up as well as irrational fiscal spending (procyclicality) under the optimal policy for developing countries approach proposed by Collier et al. (2010), leading to the emergence of the RSD case. The increment to both consumption and investment under the N^{OP} is lower than the D^{OP} in the early stages, as both absorptive capacities as well as political/institutional framework deficiencies needs to be addressed over time. Hence investment spending in theory will on average yield higher returns over time, leading to increased economic growth and hence an increase in both consumption and investments levels. As a result, incremental consumption under the N^{OP} is able to exceed

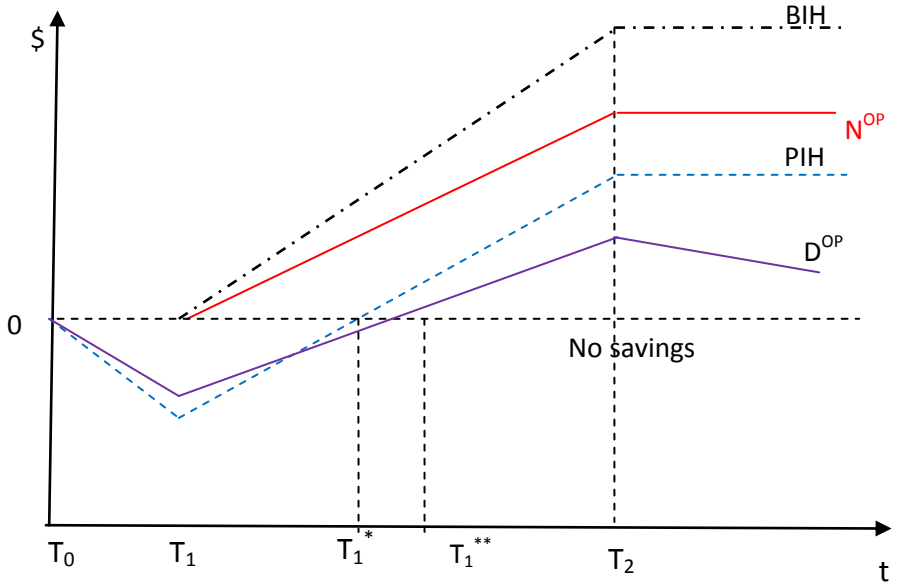
methodology applied and may lead to a lack of public transparency as to how each year's estimated price is derived, as is the case in Trinidad and Tobago.

Figure 3a: Displaying the time profiles of incremental consumption under various revenue management strategies.



Source: Author additions from Collier et al. (2010)
N^{0P}: New optimal case for developing countries.

Figure 3b: Displaying the time profiles of incremental national asset accumulation under various revenue management strategies.



Source: Author additions from Collier et al. (2010)
N^{0P}: New optimal case for developing countries.

incremental consumption under the D^{OP}. Lastly, due to the build up of a SWF, consumption is placed on constant path post resource depletion, i.e. (T_3).

6. Conclusion

Major new natural resource discoveries have occurred recently in small open developing economies; with Guyana, Ghana, Kenya, Mozambique, Tanzania and Uganda all discovering oil in the not so distant past. Unfortunately, most resource windfalls have historically failed to translate into economic development. Sound resource revenue management is thus critical. The policy advice from the IMF has long advocated the PIH strategy whereby resource windfalls are saved externally in a SWF. However, developing oil producing economies face credit constraints, which imply that they possess good, unexploited investment opportunities at home, e.g. in infrastructure and so forth. Hence, policymakers need to consider not just how much to save, but *where* to save: abroad in financial assets or at home in public capital. This is precisely the basis on which the arguments put forth by Collier et al. (2010), for the implementation of the optimal policy approach in these countries are couched upon. However, this decision must be made bearing the following factors in mind; absorptive capacity constraints, the tradeoff between the rate of return to these investments (i.e. locally or abroad), the possibility of the occurrence of the Dutch disease and by extension the resource curse, and lastly the volatility of commodity prices can create damaging effects on the country's business cycle as well as even lead to future debt crises. In addition to these, a major underlying factor that must also be taken into consideration is the level of political and institutional capacity in the domestic economy.

This paper recognizes the distinct characteristics of developing natural resource exporters, whereby borrowing to improve welfare may seem beneficial at the discovery stage of natural resources. However, public debt levels in oil-exporting countries tends to be high, and a substantial number of them have run into debt problems (for example, Angola, Chad, Republic of Congo, Ecuador, Iraq, Mexico, Nigeria, the Russian Federation, Sudan, the Republic of Yemen, and Venezuela). Constant reliance on borrowing seems to be an issue that perpetually plagues these economies. Additionally, oil producing countries, more so developing oil producing countries tends to adopt suboptimal fiscal policies by virtue of implementing a procyclical fiscal stance. It is imperative therefore, that these economies implement a sound SWF which aims at decoupling resource revenues from its budgetary allocations until it strengthens or even in parallel with strengthening its institutional capacity. This will aid in avoiding procyclical fiscal tendencies, large unsustainable debt build up and will aid in the battle against the Dutch disease and by extension the 'resource curse'. In addition, it will allow resources to be parked so to speak, as constraints such as political, institutional, absorptive capacities, low investment yields and so on are dealt with. Furthermore, this will aid in staving off the negative fiscal and macroeconomic effects associated with resource revenues fluctuations on account of price volatility and the impact of an inaccurate forecast of the estimated natural resource reserves at T_0.

As Coutinho (2011, p.47) rightly puts it "*the poor management of windfall revenues may indeed be one of the most important causes of the resource curse, to which most of the other causes of the curse can be tracked down (e.g., real exchange rate appreciation can be exacerbated by government borrowing and real exchange rate volatility can be exacerbated by pro-cyclical fiscal policies)*". As a result, this paper analysed the three main resource management strategies outlined in the literature. Both the PIH and BIH strategies as outlined in the literature may not be

optimal for a developing country characterised by current low levels of welfare and high poverty. The optimal approach sought to fill this gap in the literature for developing countries, but as outlined in this paper, this approach suffers from several shortcomings. As a result, a new strategy is proposed to overcome the shortcomings of the old optimal approach for developing countries as proposed by Collier et al. (2010).

Appendix

A1. Case Study of RSD

This section of the paper presents a case study on the Ghanaian economy which seemingly has followed the sub-optimal RSD case after discovering oil in 2007. The experience of the Ghanaian economy subsequent to its oil discovery is outlined below:

Ghana Case Study T_0 to T_1

Ghana's case study is a prime example of a large debt level being built up in the period T_0 to T_1 having discovered oil in 2007, with production getting on the way in 2011. The discovery of oil in 2007 along with high prices for other commodities exported by the economy, such as gold, led to the gradual increase in lending to the country. This coming on the backdrop that prior to the oil discovery, Ghana had benefited immensely from two debt relief schemes conducted by the IMF and World Bank, namely the Heavily Indebted Poor Countries initiative and Multilateral Debt Relief Initiative respectively, which saw their debt to GDP ratio fall to 26.2% in 2006 from 123.3% in 2000. As such Ghana was able to borrow on international markets; the end result being that the debt to GDP ratio jumped from 31% in 2007 to 46.2% by 2010. The discovery of oil led to an improvement in Ghana's borrowing capacity on international markets, as these future oil revenues could be used as collateral for oil-backed loans, Bawumia and Halland (2017)[31].

Fiscal deficits during this period led to the significant increases in public debt, which eroded the fiscal buffers created by the earlier debt relief schemes as fiscal spending in the Ghanaian economy became procyclical. For the period 2007 to 2010, fiscal deficit as a percentage of GDP were -8%, -13.9%, -6.8% and -6.1% respectively with the overall average for the period being -8.7%[32]. Large increases in recurrent spending, particularly non-discretionary spending on wages and salaries, interest payments, earmarked transfers to statutory funds and energy subsidies, accounted for these large deficits. A major impact of this increased debt level to date is that, 30% of Ghana's government revenues must be now used to repay its external debt each year[33]. By 2016, Ghana's debt to GDP ratio stood at 73.4% which highlights that borrowing in developing OPC's with weak institutions and political capacity can lead to debt becoming persistent and unsustainable even post the period T_1, into the period T_1 to T_2.

Furthermore, this increased borrowing was not commensurate with an increase in public capital formation, highlighting or suggesting that the loans were used to fund mainly recurrent expenditures which is not in line with what should take place in terms of spending decisions

[31] Bawumia (2017) notes that Ghana's the large scale borrowing were made possible by its large expected oil revenues.

[32] Sourced from the Bank of Ghana Statistical Bulletins for August 2010 and December 2011 respectively.

[33] IMF and World Bank Debt Sustainability Analysis, December 2015.
http://www.imf.org/external/pubs/ft/dsa/pdf/2016/dsacr1616.pdf

between public consumption and investment spending under Collier et al. (2010) optimal policy approach for developing economies. Bawumia and Halland (2017) in their study cited the importance of the Hartwick rule in resource-rich countries, which states that for these countries to maintain wealth and build strong foundations for economic growth, commensurate levels of investments in produced capital, primarily infrastructure and human capital should offset the depletion of their natural resources. However, he notes that in *"the case of Ghana, notwithstanding the new oil revenues and the massive increase in the debt stock, capital expenditure as a percentage of GDP has actually been in decline since 2007"* p.17. Data provided in the study shows that capital expenditure in the Ghanaian economy declined from an average of 12% of GDP between 2004 and 2008, with the lowest level over this period being 9.1% in the 2008 election year, to 4.8% by 2014. The downward trend in capital expenditure continued in the Ghanaian economy, with the budgeted estimate for 2016 declining to 4% of GDP.

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