Article

Resource Rents, Human Development and Economic Growth in Sudan

Elwasila Saeed Elamin Mohamed [ID]

Department of Economics, University of Khartoum, P.O. Box 321, Khartoum 1115, Sudan;
elwasila.sem@gmail.com

Abstract: This study investigates the relationship between natural resource rents, human development and economic growth in Sudan using co-integration and vector error correction modelling (VECM) over the period 1970–2015. Institutions proved to play a role in determining a difference in whether a country is cured or blessed by resource abundance. In the case of Sudan, no time series data is available on institutional quality and is therefore excluded from the analysis. The role of institutions and macroeconomic policies is captured by other variables included in the empirical model. Co-integration tests confirm the existence of a long run equilibrium relationship between resource rents, human development and economic growth in Sudan. Empirical evidence from the estimated VECM shows that economic growth is positively affected by resource rents and development expenditure but surprisingly negatively affected by life expectancy at birth in the short run. In the long run, resource rents, school enrolment, life expectancy and financial development have negative significant effects on economic growth. Only development expenditure is found to affect economic growth positively. Resource rents are found to weaken education and health levels and this is indirectly channeled into negative effects of resource rents on economic growth. These results suggest that the government has been neglecting investments to build up human capital necessary for inclusive growth. Long run Granger causality tests show a unidirectional causal relationship running from resource rents to GDP growth as well as from development expenditure to GDP growth. School enrollment, life expectancy and financial development are found to be negatively Granger causing GDP growth. Long run causal relationships reconfirm that a resource curse exists indirectly mediated by weak human capital. The study recommends that the government should manage natural resource rents with a policy framework supporting creation of a virtuous economic circle between human development and economic growth. If pursued, this would promote sustained, inclusive and equitable growth in Sudan.

Keywords: resource rents; human development; development expenditure; financial development; economic growth; co-integration; VECM; Sudan

1. Introduction

Natural resources play important roles in economic growth of any country. Natural, man-made and human capitals are conventional factors of economic growth and represent the main components in environmental sustainability accounting. In developing countries, natural capital supplements man-made capital, if not substituting it in production. For example, resource revenues and taxes can be used by governments to finance infrastructure projects and human capital formation, which generate economic growth. Revenues from natural resources in capital-scarce developing countries supplement limited fiscal capacity of governments for spending in human capital assets (Venables 2016; Sabine et al. 2016). But, it proved difficult to transform resource revenues into productive assets in resource-rich countries, Venables (2016), and natural resources have negative effects on provision of productive

infrastructures, Sarr and Wick (2010). van der Ploeg and Poelhekke (2009) show that volatility of resource rents in particular contributes to poor planning and disturbs government spending. It has also been pointed out that in resource abundant countries policy frameworks are not strong enough to support implementation of sound fiscal policy in taxing and spending (Daniel et al. 2013). Rather than accumulating productive assets, it has been found that resource abundance crowds out human capital in education and investment and thus hinders economic growth (Gylfason 2001a, 2001b; Gylfason and Zoega 2003, 2006; Gylfason et al. 1999; Cockx and Francken 2015). The same crowding out effect of resource abundance is found in investment in health (Cockx and Francken 2014). To put it conversely, managing resources in ways that prioritize investments in human capital formation can play a significant role in economic growth, its quality and inclusiveness (Mejía 2012; World Bank 2011).

Sudan is a typical case of resource abundance. Since the late 1990s the Sudan economy becomes resource-dependent as oil exports as percentage of total exports amounted to 97 percent and resource revenues as a percentage of total revenue amounted to 55 percent over the period 2000–2012. Meanwhile, Sudan has deficient productive infrastructures, low human capital investments and outcomes resulting in poor economic growth. In particular, the country has experienced increasing resource rents since the mid-1990s, which could have been a real opportunity to finance investments in education and health, leading to human development and promoting inclusive growth. However, resource revenues and rents in Sudan have likely been squandered, aggravated by unstable economic policies, weak political institutions, bad governance and international resource market shocks. These factors have given the country a case of resource curse (RC).

This study adds to the debate on the RC with empirical testing from Sudan. It investigates the direct effect of resource rents on economic growth, and the indirect effects of resource rents on economic growth channeled through education and health. The case of Sudan is interesting for three reasons.

First, this study addresses the relevance of the RC in the case of Sudan as a single developing country. Sudan is endowed with vast and diverse natural resources including arable lands, water, oil and mineral resources. But the country has failed to achieve positive and stable economic growth rates since the 1970s.

Secondly, a nexus of resource rents, human development and growth is dynamically examined over a period of 46 years spanning over 1970–2015. This is a relatively long period to capture the historical processes of growth with resource rents in a single country. Panel country studies suffer the weakness of capturing such historical process on the RC (Lederman and Maloney 2008). Cross-sectional growth regressions, which are often used in investigations of the RC, have also been criticized for suffering from omitted variable bias because of the correlation between the initial income and the omitted initial level of productivity (van der Ploeg 2011).

Thirdly, the current study scrutinizes Elwasila Saeed Elamin (2017a) who finds a positive relationship between health and economic growth in Sudan but without consideration of the role of resource abundance.

Sudan has been performing poorly in human capital formation—both in terms education and health, despite remarkable annual economic growth records backed with an oil boom over the period 1999–2012. Resource rents as a percentage of gross domestic product (GDP) have been fluctuating from almost zero in the early seventies to as high as 21.76 in 2008, down to 8.64 in 2013 and further down to 4.20 in 2015. Over the period 1999–2012, natural resource exports as a percentage of total exports amounted to 97 percent and resource revenues as a percentage of total revenue amounted to 55 percent (Ministry of Finance and National Economy 2000–2013) of Sudan, Annual Economic Reports 2000–2013). These percentage contributions indicate the importance of natural resources to economic growth and place Sudan within a group of 51 countries classified by the IMF as resource-rich countries over the period 2000–2006 (Venables 2016). Sudan's annual current GDP growth averaged 4.28 percent over the period 1970–2015. It averaged 4.97 percent over the period 1990–2012. Sudan achieved the highest average GDP growth of 5.24 percent over the period of the oil boom (1999–2012). Immediately after losing oil revenues due to secession of South Sudan in July 2011, Sudan's current

GDP growth declined to minus 2.09 percent over the two years of 2011 and 2012. Real GDP growth rates have also been trending up positively over the period 1999 to 2012 in line with increasing oil revenues and rents. Over that period economic growth was also associated with a one-digit inflation rate and stable prices and exchange rate. But real GDP growth rate declined to negative records in 2012 and 2013, due to sharp decline of oil revenues. GDP growth again started to trend upward in 2014 and 2015, with increasing gold extraction and revenues. On the other hand, achievements in human development indicators have been low and slow over the period 1970–2015. For example, net primary school enrollment was 21.78 in 1970, increased to 26.52 in 1998, to 40.23 in 2000 and stood at 45.78 in 2015. Education expenditure as percentage of gross national income has increased from 3.70 in 1971 to 3.93 in 1980, but it has been decreasing since then to reach 2.18 in 2015. The lowest values of primary school enrollment were recorded over the period of the booming oil sector (1999–2012). Government expenditure on education as a percentage of GDP averaged 1.90 over the period 1999–2012, indicating a massive gap of 3.10 from the 5 percent suggested by the Educational for All initiative of the United Nations. Life expectancy at birth was 51.74 years in 1970, increased to 57.34 years in 1998 and stood at 63.92 years in 2015. Public health spending as percentage of GDP averaged 1.02 percent over the period 1970–2015, and was slightly higher at 1.61 in the sub-period of 1999–2012 (World Bank 2017a). Sudan has also been performing poorly in terms of governance and institutions. For example, in 2015, Sudan scored 3.94 in voice and accountability, 3.81 in political stability, 6.25 in government effectiveness, 4.81 in regulatory quality, 8.17 in rule of law and 2.40 in control of corruption (World Bank 2017b). According to the Natural Resource Governance Institute (2017) in 2017, Sudan scored just 21 out of 100 points in resource governance index and ranked as 86 out of 89 oil and gas rich countries. Sudan also scored the least value of an average of 0.27 in an institutional quality index constructed by Bakwena et al. (2009) for a sample of 53 countries over the period 1984–2003.

In light of the above introduction, the objective of this study is to empirically investigate the relationship between resource rents, human development and economic growth in Sudan over the period 1970–2015. The study addresses this objective through two questions; (i) how resource rents directly affect economic growth and (ii) how the effect of resource rents on human capital in terms of education and health is indirectly channeled to economic growth?

2. Literature Review

Experiences of developing resource-rich countries reveal that these countries not only have slow economic growth rates but that they are vulnerable to deterioration in all forms of capital. As such, it has been argued that natural resource abundance is more of a curse than a blessing for many developing countries (Brunnschweiler 2008) among many others. Karl (1997) uses the concept of paradox of plenty in explaining the RC hypotheses in oil-rich countries, namely Venezuela, Nigeria and Algeria, and concluded oil money depletes state capabilities. Even in well-established market economies and democracies, Papyrakis and Gerlagh (2007) find a negative correlation across the United States states between the growth rate of gross State product (GSP) and the share of the primary sector as well as between the share of employment in mining and GSP.

However, findings of empirical studies on the relationship between resource abundance and economic development are mixed, inconclusive and still controversial (Stern 2003; Stijns 2005; Brunnschweiler and Bulte 2008). Lederman and Maloney (2008) state that existing empirical evidence suggests that the curse remains elusive. This according to them is due to heterogeneity and the use of weak indicators of resource endowments, and to the inability of econometric analysis based on international data to capture historical growth processes. In contrast to the negative outcomes, Davis and Tilton (2005) in a cross-section study find that resource abundance has a positive relationship with economic development. Alexeev and Conrad (2009) show that large endowments of oil and minerals have a positive effect on long-term economic growth. Meanwhile, most studies find that resource abundance exerts negative effects on economic development within the context of RC, Havranek et al. (2016). But, the RC, first coined by Auty (1993) is a relative concept stating that resource-rich countries

have slower economic growth when compared with resource-poor countries. Existence and degree of the RC has been explained in a political economy context with focus on the role of democracy, rule of law, institutions and overall public policies and governance (Sachs and Warner 1995, 1997a, 1997b; Ascher 1999; Auty 2001a, 2001b, 2010; Auty and Sampsa 2001; Isham et al. 2005; Mehlum et al. 2006; Elbadawi and Soto 2015). In Sub Saharan (SSA) countries, Lundgren et al. (2013) stated that transforming natural resource wealth into productive human, physical and financial assets is hindered by weak institutional capacities in these countries. Another strand of literature in explaining the RC focuses on the role of rent seeking (Bulte et al. 2005; Wick and Erwin 2006; Deacon and Ashwin 2012) and conflicts and civil wars (Collier and Hoeffler 1998, 2004). van der Ploeg (2011) finds that resource booms reinforce rent grabbing and civil conflict, especially if institutions are bad. Resource booms induce corruption especially in nondemocratic countries, and resource rich developing economies seem unable to successfully convert their depleting exhaustible resources into other productive assets (van der Ploeg 2011). One prominent economic explanation of the RC is the Dutch Disease (DD) hypothesis. The DD hypothesis states that increases in resource revenues lead to appreciation of the domestic currency, which in turn enhances the non-tradable goods sector at the expense of the non-resource exports sector. The outcome is described as deindustrialization Corden and Neary (1982) and Corden (1984). Sachs and Warner (2001) show that natural resources crowd out manufacturing due to depressed competitiveness of manufacturers in export markets. van der Ploeg (2011) finds that resource abundance induces appreciation of the real exchange rate leading to deindustrialization and bad growth. According to them these adverse effects are more severe with bad institutions, lack of rule of law, corruption and underdeveloped financial systems. Warner (2015), for a sample of developing countries, shows that huge economic rents are associated with booming prices of nonrenewable resources and have no positive impacts outside the non-resource sectors. There are, however, some exceptions among the resource-abundant countries suggesting that the RC could be avoided or at least mitigated. Success stories are documented in Mehlum et al. (2011) for Norway, Havro and Santiso (2008) in comparing oil-rich Norway and copper-rich Chile, Gelb and Grasmann (2010) for Botswana, Chile, Indonesia and Malaysia. Upon critical discussions of findings of prominent studies on the RC, Peretto (2008) distinguishes between the effect of resource abundance on income growth and on welfare change. The author finds that while income and welfare are hump-shaped functions of resource abundance, the welfare effect depends on the whole path of consumption. The author argues that such distinction applies to all explanations of the curse including future research in the field. Mehrara and Javad (2015) descriptively investigate the effect of resource rents on economic growth in Iran and MENA countries, concluding that natural resources have been more of a curse than a blessing. Meanwhile, their empirical findings from an ordinary least square (OLS) model show that resource rents have positive and significant effect on economic growth. This controversy becomes a bit more complicated when human capital is included, together with government policies toward education and health sectors in resource-rich developing countries. However, Maty (2012) shows that education and economic institutions play no important role on whether a country is blessed or cursed by resources and the differing experiences are mainly explained by level of democracy. Review and assessment of the RC literature can be found in Stevens et al. (2015) and an elaborative survey can be found in Frankel (2012).

It seems from the empirical literature that the debate on existence of the RC evolves around three contexts, which are:

(i) how resource abundance and intensity is measured,
(ii) type of resources (point vs. diffuse sources), and
(iii) type of econometric setting and modeling adopted.

Some examples suffice to show this. Leite and Weidmann (1999) used resource exports over gross national product (GNP) in a cross-section study and found that resource abundance impedes growth through creation of rent seeking and corruption. Ross (2001) used resource rents over GDP

in a panel data study and found that while exports of oil and mineral are strongly associated with authoritarian rule, exports of agricultural goods were not. Bhattacharyya and Collier (2013) in a panel data study found that rents from mineral resources reduce the public capital stock, while rents from forestry and agriculture do not. Dietz et al. (2007) used natural resource exports over total exports in a panel data study and found that resource abundance has a negative effect on genuine saving. They argued that this effect can be mitigated by improvement of quality of governance. Boschini et al. (2013) used natural resource exports over GDP in panel and cross section study and found that ores and metals rents with low institutional quality have a negative effect on growth. Beck (2011) used natural resource exports over total exports in a cross-section study and found that resource windfall leads to underinvestment in the financial sector with long-term negative effects on economic growth. Beck and Steven (2017), in a panel data of 150 countries using structural vector autoregressive (VAR) models, found that natural resources undermine the development of the financial sector.

Investigations of the RC hypothesis need to be placed in the context of sustainability. This is simply because the RC is expected to be more associated with finite supply point-resources than with diffuse resources. It is thus argued that rents from non-renewable resources should be invested in the formation of physical capital (Hartwick 1977) or in renewable natural capital (Daly 1994). Hamilton and Clemens (1999) show that changes in human capital shift the genuine saving rates upwards in low- and high-income countries. Hamilton (2001) analyzed the sustainability of extractive economies and found that the genuine saving rate declined with the depletion share of GDP in resource-dependent economies in 1997. Neumayer (2004), for a sample of 20 countries, found that resource-intensive economies grow slower in terms of genuine income, but the RC is weaker in terms of growth of genuine income than growth of GDP. Hamilton et al. (2006) employed time series data on investment and rents for 70 countries resource-abundant countries in the context of the Hartwick Rule. They found that Venezuela, Trinidad and Tobago and Gabon would have produced as much capital as South Korea, while Nigeria would have five times its current level. Arrow et al. (2012) developed a comprehensive wealth measure including reproducible, human, natural capital and technological change. They applied it to five countries, namely the United States, China, Brazil, India and Venezuela. They show that technological change, natural and health capital fundamentally affect achievements in sustainability. Apergis and Payne (2014) examined the impact of oil abundance on economic growth in a number of Middle East and North African (MENA) countries for the period 1990–2013. Their results show that better institutional quality reduces the unfavorable effect of oil reserves on the economy.

It is not only abundance of natural resources, but also the fluctuation of prices of these resources that could have impacts on economic growth. Oil prices in particular are volatile and this volatility has negative impacts on macroeconomic performance in both oil producing and oil consuming countries. In oil consuming countries high price levels could reduce real wages, labor supply and demand for energy and, accordingly, negatively affect economic growth. Zhang (2008) investigated the relationship between oil price shocks and economic growth in Japan, and found that increases in oil prices have a larger impact on growth than decreases in oil prices. However, for oil-exporting countries, higher oil prices lead to increases in revenues, and if such booms lead to importation of capital goods and investments, oil revenues should increase production and economic growth. Keikha et al. (2012) investigated the impacts of oil prices on economic growth in 32 oil-rich countries, applying panel co-integration and an error correction model. They showed that sufficiently high institutional quality helps countries avoid the negative impacts of oil price fluctuations. They also found that trade openness has a positive and significant effect on economic growth.

Human capital has received great deal of attention in the empirical literature of economic growth, particularly in the context of the endogenous growth theory. The widely held argument is that human capital in terms of good education and health has positive effect on economic growth (Romer 1990; Barro and Lee 1994; Barro 1996, 2013; Sachs and Warner 1997b; Weil 2005). Bloom et al. (2004) in a neoclassical growth model find that schooling and life expectancy positively contribute to economic growth. However, such arguments and findings are challenged by the possibility of a resource curse

in education and health. Resource abundance may lead to underinvestment in human capital, in both education and health. Birdsall et al. (2001) state that resource-rich counties have low levels of education such as Brazil, while resource-poor countries have high levels of education such as Korea. These disincentives to invest in human capital are channeled into negative effects on economic growth. Papyrakis and Gerlagh (2004) used natural resource production over GDP in a panel data study and found that the natural resources have a negative impact on growth when considered in isolation, but a positive impact on growth when schooling is included. In a sample of developed and developing countries with pooled cross-section methods, Stijns (2006) found that resource abundance positively correlated with both education and life expectancy while resource dependence negatively correlated with both education and life expectancy. In contrast, Daniele (2011) in a panel data study found that human development is negatively correlated with resource dependence, but positively correlated with resource abundance. Pineda and Rodriguez (2010) show that exports of natural resources positively correlate with both economic growth and changes in the Human Development Index. Kurtz and Brooks (2011) empirically show that differences in human capital and trade openness make resource wealth either a curse or a blessing. Shao and Yang (2014) explain the RC in models involving human capital and the role of government in creating economic virtuous circle. They show that rise in the discount rate, the elasticity of intertemporal substitution and resource prices adversely affect the virtuous circle, while high-quality education and institutions prioritizing manufacturing are a necessary and sufficient condition for forming the virtuous economic circle between human capital, resource abundance and economic growth. Using panel data, Cockx and Francken (2014) show the existence a resource curse in public health spending. Also, Cockx and Francken (2015) in a panel of 140 countries over the period 1995–2009 found that resource rents, particularly from point-source resources, crowd-out public expenditure on education.

Kim and Lin (2016) examined the effect of natural resources on education and health in a sample of 19 OECD and 36 Non-OECD countries. They found that natural resource dependence has a significant positive effect on education but a negative effect on health. They also found that while agricultural exports lower education and health, non-agricultural primary exports promote both. Ibrahim et al. (2018) for 18 SSA countries show that government spending on education and health significantly enhances inclusive growth. In particular, they show that increasing government expenditure on health increases GDP per capita growth in these countries. In contrast, Oyinlola et al. (2019) examined how human capital development and natural resource rent affect industrial development in a sample of 17 SSA, using a fixed effect model. Their findings reveal that spending on health has a direct dragging effect and the negative effect is larger when rents are used for finance. However, they show that the indirect impact of resource rents was negatively mediated through education and but positively mediated through health. Studying economic growth in Uruguay over a period 1870–2014, Sandonato and Willebald (2018) conclude that natural capital abundance itself is an endogenous process caused by host of factors including human capital and terms of trade. Also, Santos (2018) finds that the gold boom is a curse for long run growth in Colombia as it leads to decreases in school enrolment and hurts capital accumulation through child labour.

Studies on resource rents, human development and economic growth in Sudan are rare. Constantinos et al. (2014) applied an autoregressive distributed lag model to investigate the role of institutions on economic growth in Sudan. They found that investment, trade openness and political freedom index as a measure of institutional quality all have negative effects on GDP growth of Sudan over the period 1972–2008. They found only population growth played a positive role. Arabi and Abdalla (2013) used a three-stage OLS method, and found that school attainment and health have positive and significant effects on economic growth in Sudan over the period 1982–2009. They found that the state of technology has a detrimental effect on both economic growth and human development. Nour (2010) shows that insufficient financial and human resources have hampered the potential role of R and D in contributing towards development and adaptation of imported technologies in Sudan. Selim and Zaki (2014) show Sudan as being among the Arab countries that experienced RC with

conflicts and large borrowing. However, none of these studies consider the role of human capital in the presence of resource abundance.

3. Analytical Framework and Econometric Modelling

3.1. Analytical Framework

This study establishes an analytical framework to investigate the relationship between resource rents, human development and economic growth in Sudan without explicit inclusion of institutions. Non-inclusion of a proxy to represent institutions is justified by two factors. First, the role of institution is implicitly reflected in the inputs and output variables linked to resource rents in our model. Second, there is no time series data for any proxy of institutional quality covering the period 1970–2015 in the case of Sudan. Thus, the study addresses this relationship through the direct effect of total resource rents (TRR) on GDP growth and via the indirect effects of TRR on GDP growth channeled through human development in terms of education and health. Education is measured by the average school enrollment (ASE) and health measured by life expectancy at birth (LE). Other variables which are important links to resource rents and economic growth included in our model are development expenditure (DEY), gross investment (INV), financial development measured by domestic credit provided by banks to private firms (DCB) and current account deficit (CAD). The reason for the inclusion of DCB is that resource abundance is found to undermine financial sector development in resource rich developing countries. Also, inclusion of DCB follows the supply-leading hypothesis in that increasing the supply of financial services leads to economic growth.

DEY and INV embody the extent of converting resource revenues and rents into productive assets which are known to create economic growth. CAD is theoretically linked to economic growth, domestic and foreign savings and resource rents, which in Sudan have been running low and are unsustainable (Elwasila Saeed Elamin 2017b). CAD also reflects large borrowing and running down of foreign capital. In order to capture these dynamic relationships, this study proposes an analytical framework in which the effect of natural resource rents on economic growth is mainly mediated through its effect on DEY, INV, ASE, LE, DCB and CAD as sketched in Figure 1.
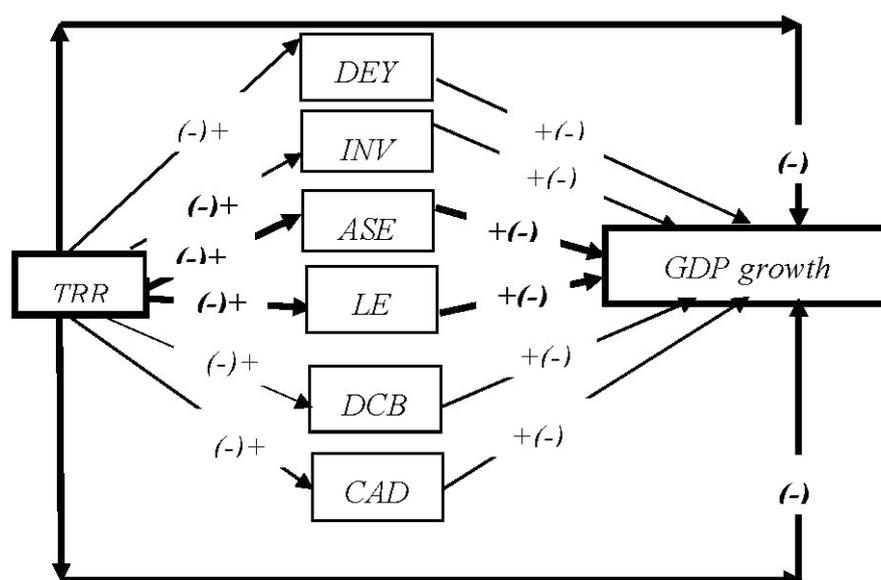

Figure 1. Analytical Framework of Intermediation of Effects of Total Resource Rents on Economic Growth.

In accordance with the objective of the study, the analytical framework enables us to set the following two hypotheses:

i.   The direct effect of TRR on GDP growth is negative.

ii.   The direct effect of TRR on education and health is hypothesized to be negative but it could be positive (−)+, while the transmissible effects of education and health to GDP are hypothesized to be positive but they could be negative +(−).

The analytical framework enables us to empirically test whether resource rents crowd out human capital, and if so, the transmitted effect to economic growth should be negative. This framework is also constructed in line with previous findings of empirical studies on resource abundance, rents, human capital and economic growth. The model also serves as empirical test of the virtuous circle of natural resource and human capital developed by Birdsall et al. (2001). This gives rise to the government role on social and development expenditures in enhancing or breaking possible virtuous circle. The study variables linked in the analytical framework above are defined as follows:

GDP is the current gross domestic product as conventionally defined and measured

TRR is the total rents from oil and forests as percentage of GDP and calculated from the World Development Indicators (WDI), (World Bank 2017a).

DEY is development expenditure as percentage of GDP.

INV is gross investment, including public and private investments as percentage of GDP.

ASE is average school enrolment in primary education.

LE is life expectancy at birth; taken as the total number of years a new born is expected to live. Because LE also serves as a proxy of other important variables, the relationship between LE and growth is far from being immediate (Sen 1988).

DCB is domestic credit provided by the banks to the private sector as percentage of GDP.

CAD is current account deficit as percentage of GDP.

Data on all variables is processed from the WDI of the World Bank (2017a).

3.2. Econometric Analysis

3.2.1. Model Specification and Estimations

In line with the theoretical analytical framework set in Figure 1, the study uses a model of aggregate production function to link and explain how resource rents affect economic growth in presence of human capital represented by education and health. With exception of CAD, all variables are expressed in natural logarithms (L) and the model is specified as follows:

$$
\begin{aligned}
L(GDP) = \alpha &+ \beta_1 L(TRR) + \beta_2 L(DEY) + \beta_3 L(INV) \\
&+ \beta_4 L(ASE) + \beta_5 L(LE) + \beta_6 L(DCB) + \beta_7 CAD + \mu
\end{aligned}
\tag{1}
$$

After checking the time series properties in terms of their distribution, stationarity and co-integration, the study builds and estimates a vector error correction model (VECM) to investigate the short run dynamics and long run equilibrium relationships of growth with resource rents and human development in Sudan. The study starts by visualizing the relationship between TRR and economic growth rate (EGR) in Sudan. As shown in Figure 2 over the period 1998–2012, TRR has grown faster than EGR, and in fact while the annual change of TRR averaged 1.16 percent, the annual change of EGR averaged −0.08 percent. These growth paths suggest a sign of a resource curse. The period 1998–2012 also showed a stable exchange rate of the Sudanese Pound against the US Dollar and perhaps an appreciated exchange rate with increasing resource rents.
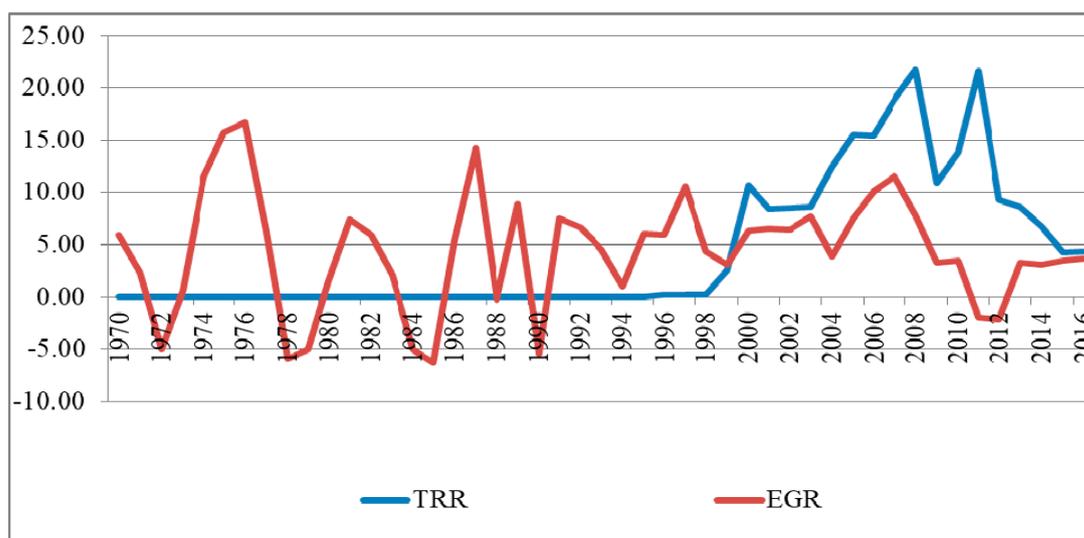
Figure 2. Resource rents and economic growth rates in Sudan (1970–2015).

Figure 3 shows that resource rents over the period 1998–2011 were trending up faster than development expenditure and domestic credit provided by banks. Investment as percentage of GDP has been steadily declining. This suggests that resource rents were not converted into productive assets.
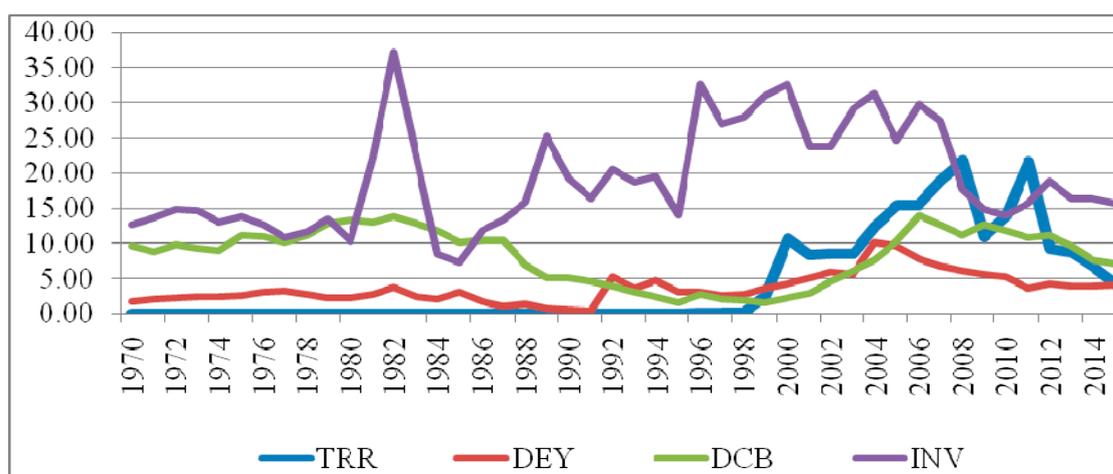
Figure 3. Resource rents, Development Expenditure, Investment and Financial Development in Sudan (1970–2015).

3.2.2. Stationarity and Co-integration Test of the Time Series

In econometric modeling, time series variables need to be stationary for meaningful and un-spurious regressions, Granger and Newbold (1974). This study uses the Augmented Dickey Fuller (ADF) test, Dickey and Fuller (1981) and Phillips Perron (PP) test, Phillips and Perron (1988) to examine presence of unit roots in the model variables. All variables are found to be non-stationary at level, but they all turn to be stationary and integrated at first difference I(1) as presented in Table 1.

Table 1. Unit toot test results.

	ADF	PP		ADF	PP
	Level		**First Difference**		
L(GDP)	−0.452	−0.480	ΔL(GDP)	−6.135 *	−6.135 *
L(TRR)	−0.463	−0.585	ΔL(TRR)	−6.745 *	−6.174 *
L(DEY)	−2.494	−2.476	ΔL(DEY)	−7.729 *	−8.490 *
L(INV)	−2.983	−2.834	ΔL(INV)	−6.341 *	−11.805 *
L(ASE)	1.450	0.906	ΔL(ASE)	−7.051 *	−14.063 *
L(LE)	1.600	2.431	ΔL(LE)	−5.268 *	−5.322 *
L(DCB)	−1.407	−1.550	ΔL(DCB)	−4.971 *	−4.995 *
CAD	0.150	−1.947	Δ(CAD)	−8.944 *	−9.494 *

* Indicates significance at 1% level, i.e., rejection of the hypothesis of no co-integration.

According to Granger (1986) and Engle and Granger (1987) if the series are individually stationary after differencing but a linear combination of their levels is stationary then the series are said to be cointegrated. Co-integration means existence of a long run equilibrium relationship among the variables which can be tested by applying the multivariate vector error correction (VEC) techniques of Johansen (1988) and Johansen and Johansen and Juselius (1990). We apply this method with assumptions of constant only and constant and trend in the time series and we use the trace statistics and the maximum Eigen value to establish co-integration. The tests indicate the existence of at least two co-integrating vectors as presented in Table 2.

Table 2. Co-integration test results.

H_0	**Intercept**			**Intercept and Trend**		
	Eigen Value	Trace Statistic	Max-Eigen Statistic	Eigen Value	Trace Statistic	Max-Eigen Statistic
r = 0	0.744	226.663 *	58.573 *	0.899	288.297 *	98.529 *
r ≤ 1	0.711	168.090 *	53.412 *	0.713	189.768 *	53.649 *
r ≤ 2	0.562	114.678 *	35.470	0.591	136.119 *	38.430
r ≤ 3	0.503	79.207 *	30.038	0.504	97.689 *	30.120
r ≤ 4	0.435	49.169 *	24.526	0.435	67.569 *	24.526
r ≤ 5	0.275	24.643	13.817	0.401	43.043 *	22.023
r ≤ 6	0.185	10.826	8.784	0.248	21.020	12.235
r ≤ 7	0.046	2.042	2.042	0.185	8.784	8.784

Note: * denotes rejection of the null hypothesis at the 0.05 level.

Thus, a long run equilibrium relationship between resource rents, human capital and economic growth in Sudan is established.

3.3. VECM Specification and Estimation

Based on the results of the order of integration and co-integration, a VECM corresponding to Equation (1) is specified as follows:

$$\Delta L(GDP)_{t-i} = \beta_0 + \alpha_1 L(GDP)_{t-1} + \alpha_2 L(TRR)_{t-1} + \alpha_3 L(DEY)_{t-1} + \alpha_4 L(INV)_{t-1}$$

$$+\alpha_5 L(ASE)_{t-1} + \alpha_6 L(LE)_{t-1} + \alpha_7 L(DCB)_{t-1} + \alpha_8 CAD_{t-1} + \beta_1 \sum_{j=1}^{k-1} \Delta L(GDP)_{t-j}$$

$$+\beta_2 \sum_{j=1}^{k-1} \Delta L(TRR)_{t-j} + \beta_3 \sum_{j=1}^{k-1} \Delta L(DEY)_{t-j} + \beta_4 \sum_{j=1}^{k-1} \Delta L(INV)_{t-j} + \beta_5 \sum_{j=1}^{k-1} \Delta L(ASE)_{t-j}$$

$$+\beta_6 \sum_{j=1}^{k-1} \Delta L(LE)_{t-j} + \beta_7 \sum_{j=1}^{k-1} \Delta L(DCB)_{t-j} + \beta_8 \sum_{j-1}^{k-1} \Delta(CAD)_{t-j} + \sum ECT_t + \varepsilon_t$$

(2)

The parameters $\alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_5, \alpha_6, \alpha_7,$ *and* α_8 are the long run equilibrium coefficients associated with GDP, TRR, DEY, INV, ASE, LE, DCB and CAD respectively. The parameters $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7$ *and* β_8 are their corresponding short run dynamic coefficients. ECT is the error correction term and ε_t is the white noise random term. The VECM is estimated with a lag length of 2 selected according to LR criterion as presented in Table 3.

Table 3. VAR lag order selection criteria.

Lag	LL	LR	FPE	AIC	SC	HQ
0	−378.620	NA	0.009	17.982	18.310	18.103
1	−97.867	443.981	3.92×10^{-7} *	7.901	10.850 *	8.988 *
2	−27.967	84.531 *	4.08×10^{-7}	7.626	13.197	9.681
3	38.105	55.316	9.74×10^{-7}	7.530 *	15.722	10.551

* indicates lag order selected by the criterion; LR: sequential modified LR test statistic (each test at 5% level); FPE: Final prediction error; AIC: Akaike information criterion; SC: Schwarz information criterion; HQ: Hannan-Quinn information criterion.

The estimated VECM results are summarized in Table 4 and represented by Equation (3).

Table 4. Summary results of the VECM.

VECM Short Run Dynamics				VECM Long Run Equilibrium		
Variable	Coefficient β	T. Stat.	Prob.	Variable	Coefficient α	T. Stat.
ECT_{t-1}	−0.58	−3.761	0.000 ***	$L(GDP)_{t-1}$	1.00	
$dL(GDP)_{t-1}$	0.33	1.616	0.108	$L(TRR)_{t-1}$	−0.03	−1.250
$dL(GDP)_{t-2}$	0.52	2.874	0.005 **	$L(DEY)_{t-1}$	0.35	4.452 ***
$dL(TRR)_{t-1}$	0.07	2.435	0.016 **	$L(INV)_{t-1}$	0.22	1.967
$dL(TRR)_{t-2}$	0.08	2.360	0.019 **	$L(ASE)_{t-1}$	−1.39	−2.176 *
$dL(DEY)_{t-1}$	0.12	2.149	0.033 **	$L(LE)_{t-1}$	−8.75	−2.635 **
$dL(DEY)_{t-2}$	0.12	1.700	0.091 *	$L(DCB)_{t-1}$	−0.36	−8.071 ***
$dL(INV)_{t-1}$	−0.04	−0.454	0.650	CAD_{t-1}	−0.00	−0.246
$dL(INV)_{t-2}$	−0.07	−0.753	0.452	C	29.90	
$dL(ASE)_{t-1}$	−0.51	−1.113	0.267			
$dL(ASE)_{t-2}$	0.62	1.466	0.144			
$dL(LE)_{t-1}$	−31.71	−3.212	0.002 ***			
$dL(LE)_{t-2}$	−1.15	−0.130	0.897			
$dL(DCB)_{t-1}$	0.07	0.458	0.647			
$dL(DCB)_{t-2}$	0.07	0.420	0.675			
$d(CAD)_{t-1}$	−0.00	−1.061	0.230			
$d(CAD)_{t-2}$	−0.00	−1.010	0.314			
C	0.13	2.145	0.033 **			

$R^2 = 0.68$; $\bar{R}^2 = 0.45$; SER = 0.143; SSR = 0.513; F. stat. = 3.06; LL = 34.20; AIC = −0.753; SC = −0.016; Durbin-Watson (DW) = 2.11

Diagnosis Tests		
Test Statistic	**Prob.**	
Autocorrelation	126.98	0.314
Heteroskedasticity	1242.96	0.347
Normality	55.80	0.000
Stability	VECM imposes 7 units, none is out the unit root circle	

***, ** and * indicate significance at 1%, 5% and 10% level respectively.

The estimated VEC model is represented by Equation (3).

$$
\begin{aligned}
dL(GDP) = &-0.58L(GDP)_{t-1} - 0.03L(TRR)_{t-1} + 0.35L(DEY)_{t-1} \\
&+0.22L(INV)_{t-1} - 1.39L(ASE)_{t-1} - 8.75L(LE) - 0.36L(DCB)_{t-1} \\
&-0.00(CAD) + 0.33dL(GDP)_{t-1} + 0.52dL(GDP)_{t-2} + 0.07dL(TRR)_{t-1} \\
&+0.08dL(TRR)_{t-2} + 0.12dL(DEY)_{t-1} + 0.12dL(DEY)_{t-2} - 0.04dL(INV)_{t-1} \\
&-0.07dL(INV)_{t-2} + 0.51dL(ASE)_{t-1} + 0.62dL(ASE)_{t-2} - 31.71dL(LE)_{t-1} \\
&-1.15dL(LE)_{t-2} + 0.07dL(DCB)_{t-1} + 0.07dL(DCB)_{t-2} - 0.00(CAD)_{t-1} - 0.00(CAD)_{t-2} + 0.13
\end{aligned}
\tag{3}
$$

From the diagnostic test statistics presented in Table 4, the VECM passes all necessary robustness tests.

The VECM estimates show that the positive effect of resource rents on economic growth in the short run (a coefficient of 0.07) is overwhelmingly outweighed by a negative effect of life expectancy at birth on economic growth (a coefficient of −31.71). In the long run, the direct effect of resource rents on economic growth turns to be negative combined with negative effects of school enrolment, life expectancy at birth and financial development. The positive effect of development expenditure is far less than to offset these negative effects on economic growth.

Table 5 presents the short Granger causality test results. The test shows the existence of a bidirectional relationship between GDP and TRR. The short run causality from resource rents to GDP is positive, thus ruling out existence of RC directly. Now we turn to the effect of TRR on the explanatory variables in our model. The test shows that the causality between TRR and DEY is negative in both directions although insignificant. TRR is found to negatively cause education but not significantly, while TRR is found to be highly positively and significantly causing life expectancy at birth. As far as transmission of the effect of resource rent is concerned, we found a negative causal relationship from education to GDP growth, but positive from GDP growth to education, although none of them is significant. Although the short run causality from TRR to LE is significantly positive, we find a negative and significant causality from life expectancy to GDP growth. Meanwhile, GDP is found to be positively causing life expectancy. Current account deficit is found to be the variable least dynamically affected by resource rents and by other variables.

Table 5. VECM Granger causality based test results.

	Short Run Dynamics								Long Run
Variable	*dL*(GDP)	*dL*(TRR)	*dL*(DEY)	*dL*(INV)	*dL*(ASE)	*dL*(LE)	*dL*(DCB)	*d*(CAD)	ECT_{t-1}
$dL(GDP)_{t-1}$		−2.80 (−2.124) *	−0.50 (−0.730)	−0.66 (−1.557)	0.03 (0.298)	0.01 (1.822) *	0.05 (0.172)	−157.53 (−0.096)	−0.58 **
$dL(TRR)_{t-1}$	0.07 (2.435) *		−0.08 (−0.829)	−0.03 (−0.491)	−0.01 (−0.795)	0.001 (2.381) *	−0.01 (−0.159)	51.18 (0.213)	−0.03 *
$dL(DEY)_{t-1}$	0.12 (2.149) *	−0.10 (−0.270)		−0.18 (−1.462)	0.05 (1.979) *	−0.0003 (−0.301)	0.02 (0.267)	172.87 (0.372)	0.35
$dL(INV)_{t-1}$	−0.04 (-0.454)	−0.22 (−0.412)	−0.03 (−0.094)		−0.05 (−1.517)	−0.001 (−0.894)	−0.16 (−1.250)	−403.20 (−0.599)	0.22 *
$dL(ASE)_{t-1}$	−0.51 (−1.113)	−2.04 (−0.687)	−1.28 (−0.829)	−0.48 (−0.500)		0.02 (2.138) *	1.24 (1.759)	−2658.86 (−0.722)	−1.39 *
$dL(LE)_{t-1}$	−31.71 (−3.212) **	142.01 (2.222) *	21.10 (0.632)	−2.14 (−0.104)	2.56 (0.624)		11.36 (0.750)	−10149.78 (−0.128)	−8.75 **
$dL(DCB)_{t-1}$	0.07 (0.458)	1.00 (1.057)	0.17 (0.336)	−0.62 (−2.042) *	0.03 (0.505)	0.004 (1.682)		−1158.73 (−0.986)	−0.36 **
$d(CAD)_{t-1}$	−0.00 (−1.061)	0.00 (0.913)	0.00 (0.424)	0.00 (0.222)	0.00 (0.014)	0.00 (0.318)	0.00 (1.067)		0.00

Note: **, * indicate significance at 1% and 5% respectively.

Based on Table 5, we extract and summarize the direct and indirect effects of resource rents on economic growth to identify existence of a resource curse as presented in Table 6.

<div align="center">**Table 6.** Direct and indirect effects of TRR on economic growth.</div>

Causality	β	Signif.	Causality	β	Signif.	Remark
TRR→GDP	0.07	(2.435) *	TRR→GDP	0.07	(2.435) *	Positive from TRR to GDP, no RC
TRR→DEY	−0.08	(−0.829)	DEY→GDP	0.12	(2.149) *	Negative from TRR to DEY but Positive from DEY to GDP, no RC
TRR→INV	−0.03	(−0.491)	INV→GDP	−0.04	(−0.454)	Negative from TRR to INV and Negative from INV to GDP, RC
TRR→ASE	−0.01	(−0.795)	ASE→GDP	−0.51	(−1.113)	Negative from TRR to ASE and Negative from ASE to GDP, RC
TRR→LE	0.001	(2.381) *	LE→GDP	−31.71	(−3.212) **	Positive from TRR to LE, but Negative from LE to GDP, RC
TRR→DCB	−0.01	(−0.159)	DCB→GDP	0.07	(0.458)	Negative from TRR to DCB but Positive from DCB to GDP, no RC
TRR→CAD	51.18	(0.213)	CAD→GDP	−0.00	(−1.061)	Positive from TRR to CAB but Negative from CAB to GDP, RC

Note: RC indicates existence of resource curse; ** and * indicate significance at 1% and 5% respectively.

As in Tables 5 and 6, while the effect of TRR on development expenditure is found to be negative, but the transmitted effect from development expenditure to GDP and is found to be positive and significant. This means that that development expenditure which is mainly financed by foreign borrowing affects GDP growth positively and significantly regardless of whether resource rents are used to finance such expenditure. The effect of TRR on investment is negative and transmitted into a negative effect on economic growth, but both of them are not significant. This indicates that resource rents were not effectively converted into productive physical capital. The effect of TRR on school enrollment is negative and transmits into a negative effect on economic growth. This result is partly in line with Mosquera (2019) who finds that resource boom affects educational attainment negatively in Ecuador after the oil discovery in 1973. Although the effect of TRR on life expectancy is found to be to be positive, the transmitted effect from life expectancy to economic growth is found to be negative, sizable and significant. Collectively, these results are in line with other studies which find that resource abundance crowd out physical and human capital formation. The effect of TRR on financial development is found to be negative but transmitted into positive effect on economic growth, although not significantly. The effect of TRR on current account deficit is positive, but the transmitted effect from the current account deficit to GDP is negative. The negative effect of current account deficit on GDP growth was also confirmed in Elwasila Saeed Elamin (2017b). These results imply that resource rent does not cause resource curse directly but indirectly mainly through health in terms of life expectancy at birth, followed by school enrollment and investment. The results also suggest that government policies have not been supportive for creating a virtuous economic circle in managing the resource rents. Granger non-causality or exogeneity of variables is also tested through the Wald test in order to judge which variables lead and which lag the others. Only GDP and life expectancy at birth are found to be lagging and the other variables of interest including resource rents are found to be leading (highly significantly exogenous), bearing the process of adjustments. The results also indicate that GDP is mostly affected by and affects life expectancy at birth on the one hand and GDP growth is affected by all other variables rather than affecting them as presented in Table 7.

Table 7. Granger causality/block Exogeneity Wald test results.

Dependent Variable	Chi-sq	DF	Prob.	Decision
L(GDP)|L(TRR), L(DEY), L(INV), L(ASE), L(LE), L(DCB), CAD	41.73	14	0.000 **	Reject
L(TRR)|L(GDP), L(DEY), L(INV), L(ASE), L(LE), L(DCB), CAD	15.83	14	0.324	Accept
L(DEY)|L(GDP), TRR, L(INV), L(ASE), L(LE), L(DCB), CAD	9.09	14	0.825	Accept
L(INV)|LGDP), L(TRR), L(DEY), L(ASE), L(LE), L(DCB), CAD	18.31	14	0.193	Accept
L(ASE)|L(GDP), L(TRR), L(DEY), L(INV), L(LE), L(DCB), CAD	19.39	14	0.150	Accept
L(LE)|L(GDP), (TRR), L(DEY), L(INV), L(ASE), L(DCB), CAD	25.57	14	0.029 *	Reject
L(DCB)|L(GDP), L(TRR), L(DEY), L(INV), L(ASE), L(LE), CAD	11.45	14	0.650	Accept
(CAD)|L(GDP), L(TRR), L(DEY), L(INV), L(ASE), L(DCB) L(LE)	4.46	14	0.992	Accept

** and * indicate significance at 1% and 5% level respectively.

Long run Granger causality test results as reported in Table 8 show a unidirectional causal relationship running from TRR to GDP. DEY, ASE, LE, and DCB are found to cause GDP, with no sign of feedback from these input variables to GDP growth. These results indicate non-existence of a reverse causality from GDP to the model's explanatory variables. As long as the indirect effect of TRR on economic growth is concerned, we investigated the long run causality between the explanatory variables of our model. The test reveals that resource rents negatively cause education and life expectancy at birth, and current account deficit. This suggests human and foreign capitals have been running down in Sudan. Investment is found to be led by school enrolment and financial development. Existence of a bidirectional causal relationship between school enrollment and life expectancy indicates that human capital components are augmented by one another. However, with insufficient government spending on health and education people are left to themselves to spend on education and health of their children, a fact that is seen in large and increasing private spending on health and education as percentage of total spending. These results also point out that Sudan is far behind on any path to social finance transition.

Table 8. Long run Granger causality results.

	F-Stat.	Prob.	Decision	Direction of Causality
H₀: Dependent GDP				
H₀: L(TRR) does not cause L(GDP)	2.868	0.069 *	Reject	TRR to GDP
H₀: L(GDP) does not cause L(TRR)	0.292	0.748	Accept	None
H₀: L(DEY) does not cause L(GDP)	10.52	0.000 ***	Reject	DEY to GDP
H₀: L(GDP) does not cause L(DEY)	0.254	0.777	Accept	None
H₀: L(INV) does not cause L(GDP)	0.060	0.942	Accept	None
H₀: L(GDP) does not cause L(INV)	0.160	0.853	Accept	None
H₀: L(ASE) does not cause L(GDP)	4.662	0.015 **	Reject	ASE to GDP
H₀: L(GDP) does not cause L(ASE)	0.269	0.766	Accept	None
H₀: L(LE) does not cause L(GDP)	3.246	0.040 **	Reject	LE to GDP
H₀: L(GDP) does not cause L(LE)	1.533	0.229	Accept	None
H₀: L(DCB) does not cause L(GDP)	3.572	0.038 **	Reject	DCB to GDP
H₀: L(GDP) does not cause L(DCB)	1.261	0.295	Accept	None
H₀: CAD does not cause L(GDP)	1.391	0.261	Accept	None
H₀: L(GDP) does not cause CAD	5.415	0.008 ***	Reject	None

Table 8. *Cont.*

	F-Stat.	Prob.	Decision	Direction of Causality
H_0: Independents				
H_0: L(TRR) does not cause L(ASE)	4.308	0.020 **	Reject	TRR to ASE
H_0: L(TRR) does not cause L(LE)	2.502	0.095 *	Reject	TRR to LE
H_0: L(TRR) does not cause CAD	4.882	0.013 ***	Reject	TRR to CAD
H_0: L(ASE) does not cause L(INV)	3.142	0.054 **	Reject	ASE to INV
H_0: L(DCB) does not cause L(INV)	3.603	0.037 **	Reject	DCB to INV
H_0: L(LE) does not cause L(ASE)	3.998	0.026 **	Reject	LE to ASE
H_0: L(ASE) does not cause L(LE)	2.829	0.071 *	Reject	ASE to LE
H_0: L(ASE) does not cause CAD	10.445	0.000 ***	Reject	ASE to CAD
H_0: L(LE) does not cause CAD	6.356	0.004 ***	Reject	LE to CAD

***, ** and * indicates significance at 1%, 5% and 10% level respectively.

4. Discussions and Conclusions

This study aimed at investigating the effects of resource rents on economic growth in the presence education and life expectancy at birth as proxies of human development in Sudan—a case of a single developing country. Descriptive statistical analysis reveals that while resource rents were growing faster and steadily since 1998, GDP has been growing at a slower pace and is highly volatile, suggesting a resource curse. Furthermore, over the period 1992–2012, we found that resource rents were trending up faster than development expenditure and domestic credit provided by banks, while investment as a percentage of GDP has been steadily declining. This suggests that resource rents were not converted into productive assets, which resulted in the slow pace of economic growth. Empirically, using conventional econometric time series methods, namely VECM with annual data covering the period of 1970–2015, the study finds evidences that natural resource rents inflict negative effects on long run economic growth. In fact, a positive effect of resource rents in the short run turns out to be negative and larger in the long run. Importantly, resources rents seem to crowd out investment in health and education in Sudan and the effect of resource rents on economic growth is indirectly mediated through human development. Specifically, the indirect negative effect of resource rents on economic growth is found to be mediated by a negative effect of rents on school enrollment and more evidently by sizable and significant negative effects on life expectancy, particularly in the long run. While resource rents tend to deter development expenditure, the transmitted effect from development expenditure to GDP is found to be positive and significant. This amounts to arguing that development expenditure enhances economic growth regardless of the effect of resource rents. A negative effect of resource rents on gross investment is also transmitted into a negative effect on economic growth. Both financial development and current account deficit have significant negative effects on economic growth. These results indicate that resource rents were not effectively converted into productive human, physical and financial capitals. As a matter of calculation, the short run direct positive effect of resource rents on economic growth (a coefficient of 0.07) is found to be overwhelmingly eroded by the negative effect of health on economic growth (a coefficient of −31.71). More importantly, in the long run the direct negative effect of resource rents on economic growth in the long run (a coefficient of −0.03) is aggravated by negative effects of school enrolment, life expectancy and financial development (a combined coefficient of 10.50). Thus, our results contradict Papyrakis and Gerlagh (2004) who, in a panel data study, find that the natural resources have a negative impact on growth when considered in isolation, but a positive impact on growth when schooling is included. Our results also indicate that education plays important role on whether a country is blessed or cursed by resource abundance, and thus contradicts, in part, Maty (2012). Long run Granger causality test results confirm that total resource rents negatively cause GDP, while development expenditure positively causes GDP growth. Both education and life expectancy at birth are found to cause GDP growth but with no feedback effect from GDP growth to either education or health. Such results suggest that the government has been

neglecting quantity and quality investments in human capital in the presence of resource rents. Put collectively, natural resource rents have been negatively affecting economic growth in Sudan mainly through their negative interaction with human capital. Thus, our results in part do not confirm Elwasila Saeed Elamin (2017a) who found a positive relationship between health and economic growth in Sudan, when considered in isolation of resource rents. Also, our results contradict Arabi and Abdalla (2013) who found that school attainment and health have positive and significant effects on economic growth in Sudan. However, our results are in line with Akpan and Chuku (2014) who found the negative effect of resource abundance on human capital accumulation in Nigeria through the channels of the DD and crowding out of human capital effects. Our results also confirm Amin et al. (2017) who found negative effect of resource rents on health and education in resource-rich SSA. Yet, our results partially confirm Oyinlola et al. (2019) on the negative indirect effect of education but contradict their finding of a positive indirect effect of health in their study of 17 SSA.

Overall, our empirical results from the case of Sudan suggest government policy was designed and implemented away from proper management of resource wealth, accumulation and re-investment of rents in productive human, physical and financial capitals. It is well established that all these capitals are necessary for sustainable growth in resource rich developing countries. Large revenues and rents from such resources might have induced the government to spend in populous projects without consideration of the effectiveness and efficiency of such projects, favoring military and security spending round point resources such as oil fields. Oil and gold resources have been overly contested between the governments and rebel groups in Sudan. On the other hand, successive governments in Sudan have been clearly neglecting spending on education and health. Large resource revenues and rents also worsen the level of corruption, especially where the rule of law and accountability are weak. Sudan has wasted an opportunity to make the appropriate use of resources rents for investing in productive human and physical capitals which are necessary for building a virtuous economic circle of resource utilization. If well managed, resource rents could have generated benefits to a large portion of population and made economic growth more equitable and inclusive. The apparent limitation of the study pertains to the omission of some conventional variables on the analysis of the RC. But in our case this is justified by: (i) non-availability of time series data on variables such institutional quality, rule of law, corruption, war and conflicts; (ii) these omitted variables are well embodied and reflected in the performance of how resources and rents are managed, and human capital formation is neglected in government decisions and policies; and (iii) the literature has already established that bad government policies, bad institutions, lack of rule of law, corruption, war and conflicts make natural resources a curse rather than a blessing in developing countries. It is a fact that institutions and rule of law in Sudan are bad, and can only be expected to aggravate the negative findings of the relationships between resource rents, human capital and economic growth if data permit their explicit inclusion in any growth regression. Also, Sudan is a country of armed conflicts since its independence in 1956, with unstable government regimes, mostly military with just a few years of immature democracy. In such an environment, successive governments, particularly since 1990, have been using natural resource revenues and rents with priorities given to military and security spending at the expense of spending on health and education. Aside from the role of institutions, Sachs and Warner (2001) conclude that there is little direct evidence that omitted geographical or climate variables explain the curse, or that there is a bias resulting from some other unobserved growth deterrent.

To conclude, for Sudan and other similar resource-rich countries there is no way to avoid the resource curse without proper and transparent resource wealth management policies. Priorities should be given to proper and sufficient spending on education and health, and even with sub-priorities in these sectors, for example primary education versus tertiary education and preventive versus curative health care services. If such policies are set and put in operation, they would reduce poverty and enhance inclusive economic growth.

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