Monetary Policy, Human Capital and Productivity in South Africa: an Empirical Analysis

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Abstract: South African has been striving to apply monetary policy that is conducive to productivity in the economy, but the latter has remained elusive. Human capital development in the country has also been a problem with a huge mismatch between the economy's needs and skills available. Whilst monetary policy operate through transmissions that affect investments, it is not clear how monetary policy, investment in human capital, as well as productivity are interdependent in South Africa. In this paper, we explore this interdependence using the vector autoregressive (VAR) methodology. Data for South Africa, covering the period 1980–2016 on changes in money supply, productivity and human capital were used to explore the interdependence. The null hypothesis of this study *(H_0)* is that there are no linear interdependencies among human capital, monetary policy and productivity in South Africa. The key questions of focus in this paper that are of interest to policy makers are 1) how fast do productivity respond to changes in human capital development and monetary policy in South Africa is considered in the model. 2) A related question concern how does monetary policy respond to productivity and human capital in the economy 3) finally, is the limited role of monetary policy due to the interdependence of this policy and human capital development? The evidence in respect to these questions is that, although productivity responded to both macro-economic variables around the same period, we noticed that productivity response more to human capital than its response to money supply in the model. Again, with respect to changes in money supply, it is expected that productivity would improve quickly in response to a sluggish monetary policy but reverse is the case. Economic performance in South Africa has not led to the expansion of human capital in the country. From the variance decomposition result, it was noted in response to question 3 that human capital development and its interaction with monetary policy are not doing enough to spur expansion in the economic activity in the country. Policy makers should know that given that human capital growth is crucial in a given economy, the lack of effect of monetary policy on human capital suggests that limited productivity has been a result of limited investment in human capital.

Keywords: Human Capital; Monetary Policy; Productivity; South Africa; Money supply; VAR Methodology

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1. Introduction

South Africa is regarded as an upper middle-income country, yet it still has an education profile of a low-income country (Gamede, 2017). The country is plagued with a problem of structural unemployment where the market demand high level skills but get supplied with low level skills (DHET, 2019). In addition to the limited skills development to meet the economy's need, the country has also suffered periods of sluggish productivity since 2010 (Economics Trend, 2019). Lower human capital development has been partly an outcome of the apartheid system of education which created the imbalances in the distribution of educational and other socioeconomic resources (Gamede, 2017). This is a problematic situation that faces South Africa as a country.

With respect to resources endowment, South Africa is home to the abundance of natural resources notably commodities and minerals. Whilst these resources are crucial for a strong and growing economy, this has not been the case lately. This could be due to limited human capital development in the country. In fact, human capital is nowadays considered crucial in development given that it does not only impact directly on productive processes but it also aids other factors of production to become more productive (Zakaria and Yusoff, 2011). The crucial role attributed to human capital cannot be played enough in an economy where such human capital development is deficient. It follows that the role of human capital in a country like South Africa needs to be established when it expected to be interdependent with monetary policy along-side with productivity in an intricate manner. This will in turn involve assessing the role of these other two variables within this interdependence. The results of the analysis are quite informative for the South African policy maker as it stands to clearly identify the disequilibrium condition of these macro-economic variables in South Africa.

The context of South Africa is resonating with the need for investigating human capital in the context of productivity. In fact, South Africa's diversity and human capital are increasingly being regarded as the South Africa's greatest asset as her growing young population offers ample opportunities for growth in the economy. By 2030 it is estimated that more than 60% of current African youth (South Africans inclusive) will be of working age (Bybee, 2016), guaranteeing a new generation of workers and entrepreneurs. These potentials require of course that the country upskills her populations quickly. This would require more investment in human capital. In addition, there has been a high level of human capital flight from South Africa. For instance, literature argues that between 1 million and 1.6 million skilled professional have emigrated the country since 1994, and for every exit an average of 10 unskilled workforce lose their jobs (Human capital Flight, 2004). These highlighted concerns pose a challenge to policy makers and calls for urgent human capital development in the country.

As problematic as the situation appears, the investment in human capital do not seem to clearly link to productivity in the economy. Figure 1, in particular, shows constant changes in productivity and constant change of human capital investment.

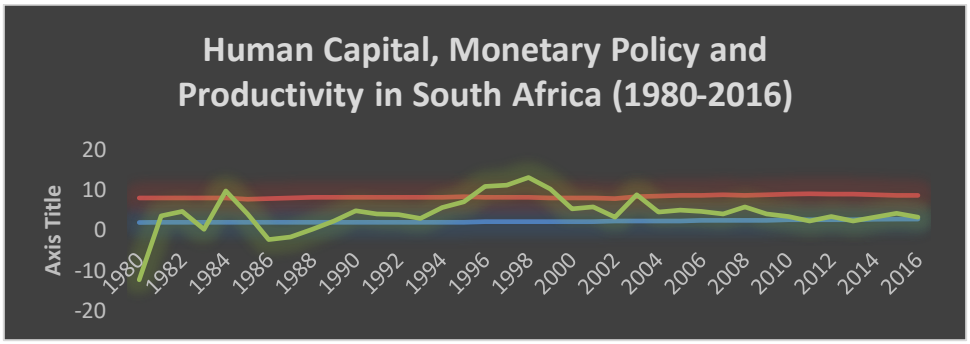

Figure 1. Behavior of the Human Capital, Monetary Policy and Productivity in South Africa (1980-2016)

Source: Authors' computation, 2019: Productivity is represented light red line; Human capital is represented by flat blue line

Figure 1 also shows, that change in human capital does not relate in a discernible pattern to changes in money supply (M2%GDP). This is quite problematic as one would expect the money supply to behave in an inverse manner in respect of productivity and in (investment) in human capital. The figure shows for example that money supply changed from -10% to 10% in the period 1980-1984 but there is no change in productivity in this period. This suggests an early indication of limited interdependence between the variables of interest in this study. This cannot be however confirmed at this stage as changes in human capital investments might have ripple effects on productivity and vice versa. So the linkage would essentially depend on the empirical evidence about the interdependence among these variables.

Whilst monetary policy has been in place to respond to short terms macroeconomic shocks via transmission mechanism, Figure 1 suggest that these policies are unrelated to investment in human capital which are crucial for productivity in the economy. A long-term policy targeted at productivity, needs to impact human capital which is important for increased productivity. Besides targeting productivity policy to human capital, another question for the policy maker is whether human capital would really have any effect on productivity in the long run. For this to happen, the human capital and productivity should be enforcing each other. This is important for policy maker as in case human capital exerts one-way influence on productivity, then human capital development should be a priority policy. If productivity exerts one-way influence on human capital, then the policy maker would focus on other factors influencing productivity whilst if both exert mutual influence, then one would target both variables. The problem however is that the way these key policy variables link to each other is not well known, especially in the context of South Africa. In trying

to bring clarity to this problem, this paper seeks to assess the interdependence between these variables by clarifying specific links as per evidence produced. Specifically the paper assesses are 1) how fast will the economy respond to each of the three variables when full interaction between human capital and monetary policy in South Africa is considered in the model. 2) A related question concern how human capital reacts to the monetary policy in the economy? 3) Finally, is the limited role of monetary policy due to the interdependence of this policy and human capital development? These linkage are investigated with the methodology that allows for the interdependence between the variables of interested to be captured in the estimation process, notably the VAR model.

The remainder of the paper is as follow. The next section discusses the literature, section three presents the methodology, section 4 presents and discusses the results, the last section provides the conclusion of the paper.

2. Literature Review

2.1. Theory

The interdependence among monetary policy, human capital and productivity can be explained by many theories and models in two types of theoretical linkages. The linkage between monetary policy and human capital development and then the linkage between human capital development and productivity. These theories and models are discussed starting with theories linking monetary policy and human capital development first.

Monetary Policy and Human Capital Development

The rationale behind the investigations of the linkages in this paper has been to respond to the limited productivity problem and human capital development in South Africa. While the relationship between productivity and monetary policy has been theoretically explained by many models such as metalist theory, classical theory of money, marginal theory of value, liberal theory (neoclassicism and neoliberalism), and Keynesian monetary theory, theory linking human capital to human capital development models are explained by investment theory of Higher Education (Keynes, 1936; Heylen et al, 2003; Cioran, 2014). Of relevance to this paper is the Keynesian model linking interest rate to investments (Cioran, 2014). Human capital having emerged as an important factor for productivity, monetary policy and investment on human capital can follow the normal theory of investment. By human capital it is referred to the sum of inborn or obtained knowledge, skills, competencies, and experiences facilitate in the production processes. One would then expect the human capital to increase when interest rate declines as a result of monetary policy. As the interest rate falls, all things being equal, the rate of

investment in human capital increases, resulting in long-term productivity (Berentsen et al. 2012;, Chu and Cozzi,2014; Chu et al. 2015; Chu, et al., 2016). In contrast to this theory it appears that investment in human capital has not produced expected outcomes in South Africa. To date, much of the literature has focused on the physical investment as opposed to investment in human capital while it can be argued that the transmission from interest rate to investment might not lead to higher levels of productivity without investment in education. (Goldin, 2014).

Hence, interdependence between human capital and monetary policy can be argued on the ground that the more the human capital the better the pro-growth policy can be implemented. The transmission process through human capital may work through engagement of small scale industries as a result of entrepreneurial skills. Another argument, although not appealing, is that employed people through the skills acquisition, can influence the existing policy makers to appropriate monetary policy to impact on growth (Ali 2002; Keep and James, 2010 and Gamede 2017). So while monetary policy can influence human capital development through investments in human capital, the latter might not have an effect on the policy making framework (James, 2010 and Gamede 2017).

Human Capital Development and Productivity

The interdependence between human capital, monetary policy and productivity take effect through the link between human capital and productivity. Theoretically, human capital theory is a component of intellectual capital which represents the investments made on humans and encompasses human-related factors such as skills, knowledge, experience, business quality, emotional intelligence, employee relations, flexibility, entrepreneurialism, employee loyalty, education, employee satisfaction and creativity to enhance productivity (Boztosun,et al., 2016). In fact, endogenous growth theory argues that productivity is facilitated by fixed capital accumulation (Barro, 1991). Fixed capital accumulation, which is believed to stimulate productivity, is also facilitated by strong human capital. (Barro, 1991; Fiador, 2015). The role of human capital on growth emanates from the fact that the level of education of workers determines the level of productivity, not only of labor itself but also of other factors of production. This aspect of human capital is important for long-term successful operation of the market in a given economy (Vodak, 2010). It follows that a country that has invested largely on human capital by having a large proportion of her citizen pursuing university or college education is likely to effectively and efficiently influence other determinants of productivity.

Investment in human capital, according to Schultz (1981) is the main long-term determinant of productivity. Investment in human capital is the total expenditure incurred in this regard. These costs are estimated in two steps: direct costs and opportunity costs (Becker, Schultz and Heckman 2016). In fact, in modern economies, investment in human capital has proven to go hand in hand forms of

technology and capital as it has been shown that productivity is propelled to the highest level in a world that adopt new technologies, particularly in the communication and information field (Tokarcikova, 2010). Human capital development plays a central role in the process where it acts as a multiplier to allow a faster growth of the economy. Human capital is at the center of control in the stock market, creation of enabling environment for market to strive effectively to enhance productivity through experience, organizational and market technology, customer relationships, and professional skills matter to facilitate growth in any given economies. Another channel in which the link between human capital and productivity is the short -term tradeoff between investment in human capital and getting involved in productive activities which have long term consequences. Chu, et al., (2016) postulate for example that as more time is allocated to production crowding out the time available for education currently, might reduce the growth rate of human capital and that of productivity in the long run.

All these theories suggest the interdependence that exist between monetary policy, human capital and productivity that this paper is focusing on. The next sections discusses other aspects of interdependence between the variables of interest to this study.

Interdependence Among Monetary Policy, Human Capital and Productivity

Whilst the key linkages above were discussed in terms of interdependence between monetary policy and investment in human capital and then from investment in human capital to productivity, there are other aspects of interdependence between these variables. Figure 2 below shows different avenue for interactions between the variables.

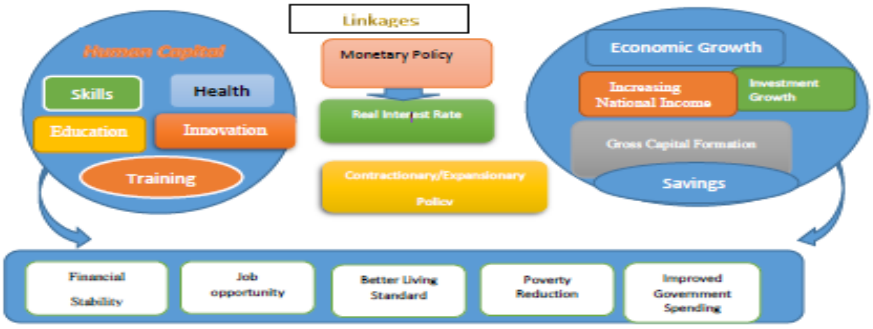

Figure 2. Others aspect of Interdependence Among Monetary Policy, Human Capital and Productivity as Represented with Growth in this Framework

Source: Authors' design, 2019

In fact, Figure 2 suggest that besides the conventional linkages from interest to investment and from investment to growth, there are other linkages such as skills , good health, higher education that work together to enhance human capital. The skill acquisition by a healthy human capital accelerates the investment growth process, through savings, increased productivity increased standard of living increased taxes and government spending on social activities, an employment of unskilled labour and makes the transmission mechanism of in the interest rate faster and smooth. This process is expected to continue until long run equilibrium is reached. The section that follows reviews the various works of scholars on the concept under investigation.

2.2. Human Capital, Monetary Policy and Productivity: Empirical literature

There is a large literature on the relationship between interest rate and investment and their possible effects on productivity (Al-Tarawneh, 2004; Bader and Malawi 2010). A study by Chu, et al., (2016) is one of the most recently conducted studies outside African continent. For European economy, the study assessed the welfare and growth effects of monetary policy in a scale invariant Schumpeterian model alongside endogenous human capital accumulation via a cash-in-advance (CIA) constraint on Research and Development investment. The study found that an increase in the nominal interest rate resulted in a decrease in human capital investment and research and development, which in turn impacted negatively the long-run growth rates of output and technology.

Amid a growing debate on whether human capital development has tangible effects on productivity growth in low income countries. Again, Malizole, (2014) argued that this debate could be resolved by using other refined measures of human capital. Using human development index (HDI) to proxy human capital and Gross Domestic Product (GDP) to proxy productivity in South Africa, the paper adopted Granger Causality methods to investigate the causal relationship between Productivity and HDI alongside with the Johansson co-integration test theoretical and OLS for the period 1980-2011. The result showed that in the long run HDI respond to changes in the growth of Gross Domestic Product. Hence, the changes in the human capital impacts positively on the productivity.

Vinayagathasan (2013) analyzed the effect of monetary policy on the real sector of the economy by adopting structural VAR model on a seven-variable equation on monthly time series data from Sri Lanka covering the period from early 1978 to late 2011. The investigation found that interest rate shocks impacted significantly on output based on the economic theory. The author also found that positive money shock offered inconsistent but significant results on economic output. However, output reduced instead of increasing. Chaudhry et al. (2012) examined long and short-run relationships among productivity, monetary policy and inflation in

Pakistan. For a period 1972 to 2010, co-integration technique and the ECM were adopted. From their result, it was found that in the short run, monetary policy variable of call money was not significant but became positively and statistically significant in the long run.

In Africa, some studies related to the study's enquiries have also been conducted. In Ghana, Havi and Enu (2014) investigated the relative importance of fiscal policy and monetary policy on productivity in Ghana for a period of 1980 to 2012. Their study adopted The Ordinary Least Squares (OLS) estimation and found that the supply of money as a proxy for monetary policy impacted a positive and statistical significance on growth. In Egypt. Moursi and El Mossallamy (2010) investigated the role of monetary policy on growth and inflation by adopting the Bayesian approach to analyse a dynamic stochastic general equilibrium (DSGE) model for a small closed economy. Using monthly data for the period 2002 to 2008, the study found that the effect of monetary policy is relatively less significant on inflation than on output, hence, this findings indicated that expansionary monetary policy has the capacity to stimulate the growth of the economic without necessarily imposing much pressure on prices.

In a survey of in survey of the literature on the relationship between monetary policy and economic Twinoburyo and Odhiambo (2018) found that there were obvious evidences to indicate working transmission mechanism: after a considerable high policy-induced increase in the short-term lending, interest rate, and other related factors, the exchange rate tends to appreciate, while output growth tends to decline in four East African economies which included Kenya, Uganda, Rwanda and Tanzania. They noted from their results that Mugume (2011) adopted a five-variable non-recursive VAR to investigate monetary transmission mechanisms in Uganda adopting quarterly data between 1999q1 and 2009q1. In their study, broad money and three month Treasury bill rate (lending rate) were adopted to proxy monetary policy. They found that a shock to interest rate was considered significant as the monetary shock. Again, the study threw more light on the fact that a contractionary monetary policy could slow down productivity for a period up to two quarters whereas broad money M2 innovation has no statistically significant impact on output.

A few studies have also been conducted in South Africa. One of these studies was conducted by Naraidoo (2013). The study assessed the effect of uncertainty in South Africa since the adoption of inflation targeting particularly as this has raised concern about the true state of the economy on monetary policy. Naraidoo investigated the impact of uncertainty on the interest rate setting financial market behavior that described the monetary policy decisions of the South African Reserve Bank over and above adopting output and inflation as indicator variables. The findings indicated that the impacts of uncertainty, resulted from how human capital, impacted on the

interest rates. This has resulted into a more stance of cautious monetary policy by the monetary authorities consistent with a large body of literature that argued that an increase in economic instability can lead to excessively activist policy. Again, the financial crisis which clusters around periods 2003 and from 2007 to 2009 from the result has an originating link with the uncertainty about the state of the economy. The inflation uncertainty was pertinent to the behavior of the interest rate setting in 2003, whereas the uncertainty about the conditions in financial markets was pertinent to the interest rate setting behavior 2007 and 2009 regime. Hence, policy makers were advised that the impacts of uncertainty, resulting from how human capital that has impacted on the interest rates should be given urgent attention.

The above-mentioned study also indicated is by Twinoburyo and Odhiambo (2018) reported that in South Africa most of the outcome result support the importance of monetary policy in enhancing the productivity in the economy, majorly in developed economies where financial system is highly sophisticated with relatively less dependent central banks. However, in developing economies it was noted that the relationship appears to be weaker particularly in underdeveloped financial markets and structural weaknesses that are poorly integrated into global markets. Hence, their works concluded that despite the predominant ambiguous relationship, monetary policy is highly relevant for country's productivity both for the short and long-run. From their findings, recommendations included an intensive financial development policy measure in the South African economies together with structural reforms to address the supply side inefficiencies.

From the critical examination on all the reviewed studies, there are clear indications that the studies under review are one sided in their approach. For instance, while Chu, et al., (2016) considered welfare and growth effects of monetary policy on growth, their interest was on what happens to human capital investment when nominal interest rate changes. Their study failed to indicate how human capital interact with monetary policy to enhance growth. Malizole, (2014) argued that human development index could be used to proxy human capital. In theory, human development index was not calculated to incorporate skill acquisitions as required in human capital, hence the result could be considered to have variable biasedness. Broadly, these studies focused on the linkage of the variables but did not assess the interdependence, furthermore these studies were mainly conducted in countries other than South Africa which has different economic and human capital contexts. Again, while works conducted in panel of countries (Twinoburyo and Odhiambo 2018) crowd out the country specific effects, the role of human capital when it interacts with monetary policy remain elusive all through the reviewed literature.

Therefore, this study contribute to the literature in that incorporate in the relationships human capital measured in terms of skills acquired or education level, assesses interdepended and report these results in south Africa in which the economy

si peculiar vis-à-vis other African economies. To the best of our knowledge, these features of the study have not been a subject of focus of any empirical paper.

3. Methodology

3.1. Model Specification

In investigating linear interdependence between monetary policy, human capital and productivity, the study adopt a VAR methodology. The VAR methodology is chosen because these variables are expected to influence each other so that there is no permanent dependent variable.it is also justified that it provides a framework where the effects of multiple factors can be evaluated in the context of endogenous growth (Barro, (1991); Fiador, (2015). Following this understanding, the equations depicting productivity, human capital and monetary policy are studies simultaneously in the VAR. we discuss each equation before merging the equations into the VAR model.

Within the endogenous growth model, the first model Growth, Human capital and monetary policy is the growth equation (3.1) specified as follows:

$$Prodc = f(HUMC, M2) \quad (3.1)$$

where Prodc is used to proxy Productivity, HUMC is Human capital and RIR (Money supply) is monetary policy. Transforming equation (3.1) in the form of an econometric model gives equation (3.2)

Explicitly: $Prodc_t = \beta_0 + \beta_1 HUMC_t + M2 + \delta_t$ ... ... (3.2)

For analysis of interdependence through VAR methodology, each variables need to be written in terms of how it evolves. In VAR, each variables, in addition to affecting other variables in the model, depend on its own past values. This lead to writing the evolution of each endogenous variable as function of its past value. In this respect, the evolution of the productivity variable at γth lag can be written as

$$Prodc_t = \beta_0 + \beta_1 y_{t-1} + \beta_2 y_{t-2} + \beta_3 y_{t-3} + \beta_4 y_{t-4} \ldots\ldots\ldots \beta_n y_{t-p} + \mu_t \quad (3.3)$$

Similarly to the above procedure, human capital equation can be written to take account of the fact that it can be affected by productivity (Prodc) and monetary policy (M2) as in equation (3.4).

$$HUMC = f(Prodc, m2) \quad (3.4$$

Also, equation (3.4) can be expressed in econometric format as equation (3.5)

$$HUMC_t = \varphi_0 + \beta_1\, prodc_t + \beta_2\, m2_t + \mu_t \quad (3.5)$$

In the context of VAR of order γ, the evolution of the human capital is expressed as equation (3.6)

$$Humc_t = \varphi_0 + \varphi_1 Humc_{t-1} + \varphi_2 Humc_{t-2} + \varphi_3 Humc_{t-3} + \varphi_4 Humc_{t-4} \ldots\ldots \varphi_n Humc_{t-p} + \gamma_t \quad 3.6$$

The equation for the monetary policy in this analysis is expressed as equation (3.7) and its econometric form as equation (3.8).

$$M2_t = \int (Prodc, Humc) \quad 3.7$$

$$M2_t = \beta_0 + \beta_1 prodc_t + \beta_2 Munc_t + \delta_t \quad 3.8$$

The evolution of the monetary policy variables (M2) in the context of VAR is written as equation (3.9)

$$M2_t = \rho_0 + \rho_1 M2_{t-1} + \rho_2 M2_{t-2} + \rho_3 M2_{t-3} + \rho_3 M2_{t-3} \ldots\ldots \rho_n M2_{t-n} + \omega_t \quad 3.9$$

The VAR model that is of interest in this paper to capture the independence of productivity, human capital and monetary policy models simultaneously is the evolutions of the three variables as depicted in equations (3.3), (3.6), (3.9). The VAR model is developed as equation 3.10.

$$\begin{bmatrix} Prodc_t \\ Humc_t \\ m2_t \end{bmatrix} = \begin{bmatrix} \beta_0 \\ \varphi_0 \\ \rho_0 \end{bmatrix} + \begin{bmatrix} \beta_{11} & \beta_{21} & \beta_{31} \\ \varphi_{21} & \varphi_{22} & \varphi_{23} \\ \rho_{31} & \rho_{32} & \rho_{33} \end{bmatrix} + \begin{bmatrix} Prodc_{t-n} \\ Humac_{t-n} \\ M2_{t-n} \end{bmatrix} = \begin{bmatrix} \mu_t \\ \gamma_t \\ \omega_t \end{bmatrix} \quad 3.10$$

Bayesian VAR (B-VAR) model.

In a reduced form the model is of the form

$$y_t = \sum_{j=1}^{N} . \sum_{l=1}^{P} b_{t,l}^{j} . \ y_{t-1} + d_t V_t + U_t \ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.11)$$

Where t=1,…T

$b_{t,}^{j} = G\ X\ G\ matrices\ of\ the\ coefficient,$

$d_t = G\ X\ q, V_t = q\ X\ 1\ Vector\ of\ the\ three\ endogenous\ variables,$:

In this model, the endogenous variables which relates to South African economy, are productivity (Prodc), Money supply (M2), and Human Capital (Humc).

$U_t = G\ X\ 1\ vector\ of\ random\ disturbances,$ P= no of lags, G= no of endogenous variables

q= no of exogenous variables plus constant.

It is this equation that forms the basis of the investigation under this study to assess the interdependence among monetary policy, human capital and productivity in the South Africa. In these analyses, it is expected that money supply is positively related to productivity, positively related to human capital because the increase in money supply makes it helpful to invest in human capital. Furthermore, it is expected that human capital relate positively to productivity, it is expected that based on our a priori expectation: all the variables by expectation are to be positively related. Such that:

$$\frac{\Delta m2_t}{\Delta Prodc_t} > 0, \frac{\Delta m2_t}{\Delta Humc_t} > 0, \frac{\Delta Humc_t}{\Delta Prodc} > 0, \quad 3.11$$

Where Prodc represents Productivity, Humc represents Human capital and Money supply (M2) to proxy monetary Policy.

3.2. Justification for Variables Adopted and the Relevance of VAR Model in this Paper

Productivity in this context is the spill-over effects of labour and capital in South African. The reason why productivity was selected is because it is an important policy variable. Human capital was used because it is also an important variables in the context of South Africa. In this study, human capital was measured as years of schooling. The linkage of years of schooling to monetary policy is assumed through the understanding that investment in human capital in terms of education affect the number of years of schooling achieved. Under this understanding, monetary policy would then affect years of schooling via the role of money supply on investment in education. Lastly, there are various instruments in the hands of monetary authority in South Africa by which economic activity can be controlled. Money supply has been one of the most commonly used instrument of monetary policy in South Africa.

The Vector auto regressive (VAR) model was adoption in this study because of the nature of the problem under investigation and the nature of available data. Apart from the fact that all variables were found stationary at levels, the co-integration test conducted indicated that there is no long run relationship among the variables. See appendices for test results.

3.3. Data Sources

We employed data for South Africa covering the period 1980–2016 on change in money supply change in productivity. These data were sourced from the World Development Indicators and Penn world Table 9.0.

4. Empirical Analysis

Before the analysis of interdependence, we conducted series of tests required to use the VAR methodology. The results of unit root confirmed that all variables are stationary at level. See appendix 1 for the result of the unit root test**.** Furthermore**,** co-integration tests (see appendix 2) confirmed that all variables are not co-integrated, meaning that there is no long-run relationship hence the use of VAR methodology which requires that all variables are I (0).

Answer to question 1: how fast do productivity respond to changes in human capital development and monetary policy?

Part of the answer to this question is provided by Figure 3. As the Figure shows, productivity failed to respond to changes in money supply and human capital until period 2 particularly during the early periods of the analysis after which there is a slow and a gradual response of productivity to money supply and human capital. Although productivity responded to both macro-economic variables around the same period, we noticed that productivity response more to human capital than its response to money supply. The slow response is an indication that both variables are not behaving enough in the economy to expedite the speed and the growth of productivity in the economy. However, the response of productivity to human capital is more pronounced in the economy than that of money supply. This is expected and shows that productivity continued to increase up to period 10 and never declined. With the range coverage in the Period 37 years (see data source) divided into 10 periods, the second period can be compared to the 7th year (3.7*2) from 1980. This results suggest that, allowing interdependence, human capital responded more positively to productivity both before 1994 and thereafter. This finding negates the work of Chu, et al., (2016) who found that an increase in the nominal money supply resulted in a decrease in human capital investment and research and development. This result signals the limited effect human capital development and monetary policy had on the South African economy.

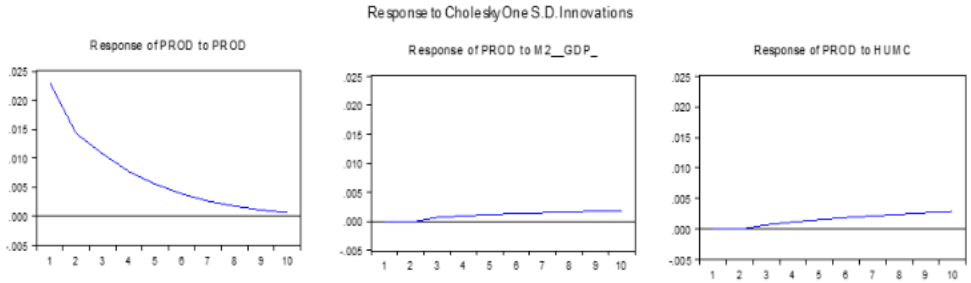

Figure 3. The response of Productivity to Money Supply (Monetary Policy) and Human Capital

With respect to changes in money supply, it is expected that productivity would improve quickly in response to a sluggish monetary policy but reverse is the case. This could also imply that the limited effect of monetary policy and human capital was due to the fact that human capital was not available to take advantage of investment opportunity that money supply offered to the economy. Alternatively, the investment in human capital has not been able to enhance productivity when monetary policy make such moves. The literature has argued that a greater proportion of economic activity in South Africa is being driven by formal sector (Economic Trend, 2019). This is because entrepreneurs are scarce in the economy. Small scale industries ought to proliferate the system to take advantage of the advance baking sector in South Africa. Practical aspect of entrepreneurial activities should be introduced into the system of higher education with the assurance of accessing investible fund immediately after graduating out of the University. The results show that human capital does not improve the effect of monetary policy on productivity remarkably.

Answer to question 2: how does monetary policy respond to productivity and human capital in the economy?

Figure 4 shows that the monetary policy's response to productivity is negative whereas its response to human capital is positive and slowly in upward trending. This upward movement of in the monetary policy's response to human capital was sustained at a steady state throughout the period under investigation. This means that policy reacted positively to the interacting effect of human capital. In respect of this results our question as to how do the policy responds to human capital development is answered. This evidence imply that the policy makers should know that the low human capital contribute to the sluggish depression in the 2000s as other studies have contended (Daniel, 2018; Economic Trend, 2019). Hence, as the policy makers battle

with the recovery of the economy, efforts geared toward human capital development would be an exercise in the right direction for a sustainable productivity.

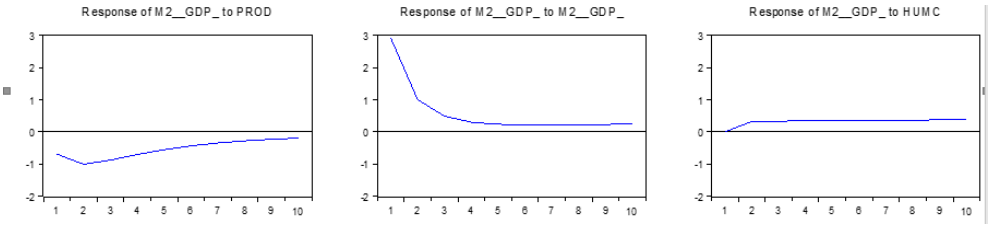

Figure 4. The Response of Monetary Policy to Productivity And Human Capital in the Economy

The results of Figure 4 show further that monetary policy at the earlier periods of 1980's, inversely impacted on productivity. Although the movement was towards recovery, however, it clearly indicates that the economy has not recovered from the pre-apartheid policies. The money supply did not feel the activity of human capital as much expected. Meaning that human capital did not take much advantage of money supply for investment purposes. Much opportunity to invest abound in South Africa due to sophisticated banking and loan facility but this privilege is underutilized due to low human capital. The result supports the findings from studies conducted by Vinayathasan (2013); Moursi and Mossallamy (2010) who found that monetary policy do not go hand in hand with human capital development. This result suggest that South African lack human capital to develop this investment. This could mean low higher education among the graduates to take advantage of policies.

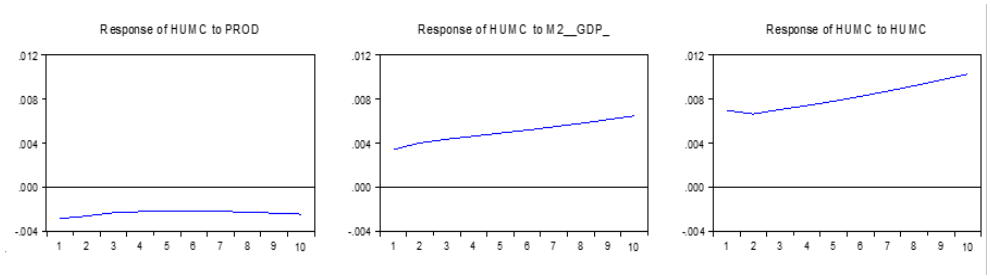

Figure 5. The Response of Human Capital to Productivity and Monetary Policy.

This study further examines how human capital in South Africa responded to productivity and the response in this regard is poor. This could not be unconnected with the low level of human capital in South Africa. It has been argued *that South Africa's* long-term *low* productivity growth could be attributed in part to low skilled workforce since higher *productivity* of *human capital* and higher output appear to interrelate. Although the response of human capital to monetary policy increase steadily to period 10. This agreed with Naraidoo (2013) on how human capital react to monetary policy. The steady increase of human capital to monetary policy is much desired as it has some economic implications. In the long-run, future positive

response to monetary policy is expected if well safeguarded with favourable economic policy.

Answer to question 3: Is the limited role of monetary policy due to the interdependence of Productivity and human capital development.

This section adopts variance decomposition technique to answer the question of interdependence of productivity and human capital development. The variance decomposition results are in Table 3

Table 3. The Variance Decomposition Human Capital

Period	Human Capital	M2%GDP	Productivity
2	93.41480	0.066240	6.518959
4	87.71208	1.987701	10.30021
6	82.14735	7.319013	10.53363
8	76.23857	13.39000	10.37143
10	71.56094	18.22572	10.21334
12	68.23626	21.75014	10.01360

In the second period under investigation, monetary policy and productivity indicate no significant variation in explaining human capital, although 6.5% was explained by the variations in productivity. Whereas in the fourth period, only 1.99% and 10.30% variations in money supply and productivity explained the variations in human capital respectively. Although the variation in the explanation is low at this initial period, it was discovered that this value increased remarkably over the period with its peak at period 12 particularly for period 12. The economic implication is that monetary policy and its interactive impact on productivity are not doing enough to spur the expansion of human capital in the country. The economy is being driven by other factors. Again, this appears true as about 85% of economic activity in South Africa is being undertaking by the formal sectors. Whereas the informal sector involving about 80% of the population are contribute only 15% of the economic activities. The economic policy to encourage the larger population to be actively involved in the formal sector has not been adequately implemented in South Africa. The direction of no response to steady response could be connected to initial years of apartheid to the period of policy dynamics.

Table 4. The Variance Decomposition of M2%GDP

Period	Human Capital	M2%GDP	Productivity
2	15.56214	72.53209	11.90577
4	22.09744	46.67298	31.22959
6	30.18773	33.88921	35.92306
8	37.52849	28.29413	34.17738
10	41.90248	27.14353	30.95399
12	43.49786	28.49266	28.00948

From Table 4, the result of period 2 to period 12 are in this section. For instance, table 4 explains the reasonable proportion of fluctuations in monetary policy variable caused by variations in the activities of human capital and varying levels of productivity in the economy. For instance, for period 4, while 31.22% in the variation of productivity explains the activities of monetary policy, a corresponding 22.10% explanation was recorded by human capital development in the country around the same period.

In the sixth period, adequate variations in money supply were explained by human capital and productivity. It means that human capital, responds contemporaneously up to 30.18% in explaining the variations found in money supply. It therefore implies that human capital and productivity do have much impact to explain money supply.

Table 5. The Variance Decomposition of Interdependence in Productivity

Period	Human Capital	M2%GDP	Productivity
2	2.890210	2.954211	94.15558
4	5.365452	9.232324	85.40222
6	7.177851	15.41121	77.41094
8	8.231599	15.85927	75.90913
10	8.317180	15.67341	76.00940
12	8.696048	15.61727	75.68669

Again, Table 5 reports the results of periods 2-12 consistently. The first result of period 2 explains the proportion of fluctuations in productivity variable as caused by variations in the activities of monetary policy and human capital. The impact of money supply and human capital to changes in productivity remain low at all periods. This may indicate that human capital and money supply in South Africa are not sufficiently supplied to be adequate to the supply of productive goods and services.

Furthermore, the analysis was conducted to see whether monetary policy and human capital jointly cause productivity in South Africa. The results are presented in Table 6.

Table 6. test of joint effect of human capital and monetary policy on productivity.

Wald Test:			
Test Statistic	Value	Df	Probability
Chi-square	10.46533	4	0.0333
Null Hypothesis: C(1) =C(2)=C(3)=0			
Null Hypothesis Summary:			

Source: Author's Computation, 2019

Note: C (1) = productivity, C (2) = Human Capital and C (3) = M2%GDP

H0: There is no causality between the two paired of explanatory variable.

H1: There is short run causality among the paired explanatory and outcome variable.

The decision rule: Accept null hypothesis (H0) when P-Value is greater than 5%

Reject null hypothesis (H0) when P-Value is less than 5%.

The Wald test in Table 6 show that H_O is rejected at 1% level of statistical significance, meaning that causality exists between the two pairs of variables. This shows that the two pairs of variables under investigation could jointly impact on productivity growth in South Africa. This result apart from the fact that it strongly supports the a priori expectation, particularly human capital theory, it also supports the findings of studies carried out by Havi and Enu (2014); Levine and Renlt (1992); Barro (1991) as they all found positive relationship between human capital and growth. The policy on human capital development coupled with monetary policy innovations in South Africa is envisaged to yield and to attract favorable result on productivity in the long run. The study then proceeded to carry out granger causality to assess whether there is a level of causation we can expect among these variable in the long run.

Table 7. Test for Granger Causality among the series Human capital, Productivity and monetary policy

Pairwise Granger Causality Tests			
Lags: 2			
Null Hypothesis:	Obs	F-Statistic	Prob.
productivity does not Granger Cause Human capital	35	0.64994	0.5293
Human capital does not Granger Cause *productivity*		4.04198	0.0279
Money supply does not Granger Cause Human capital	35	0.67324	0.5176
Human capital does not Granger Cause money supply		0.22626	0.7989
Money supply does not Granger Cause Productivity	35	1.43460	0.2541
Productivity does not Granger Cause money supply		0.15322	0.8586

Source: Author's Computation, 2018

This section showcases the Granger Causality result on the series of Human capital, Productivity and monetary policy.

H0: Variable X does not Granger cause Y.

H1: Variable X does Granger cause Y.

The decision rule: Accept null hypothesis (H0) when P-Value is less than 5%

Reject null hypothesis (H0) when P-Value is greater than 5%. Hence, from the outcome result of Table 7, it is clear that productivity does Granger Causes Human capital, monetary policy does Granger causes Human capital and this trend follows as indicated in the result of the Table.

4. Conclusion, summary and recommendation of the study

This study set out to investigate the linkages between monetary policy, human capital and productivity in South Africa. The motivation was to find some policy suggestions on the lingering poor economic performance alongside the limited human capital development. This was tested concurrently with vector auto regressive model (VAR). This study contributes to the body of knowledge from the following perspectives: (1) to the best of our knowledge, this study is the only known research work to conduct an investigation on the interacting impact of human capital, productivity and monetary policy among the emerging economies particularly in South Africa. (2) we provide evidence to establish that the two pairs of variables (human capital and monetary policy**)** under investigation could jointly impact on productivity in South Africa,

Although productivity responded to both macro-economic variables around the same period, we noticed that productivity response more to human capital than its response to money supply. (3) we also provide strong evidence from the result that productivity does slowly Granger Cause Human capital, monetary policy does Granger cause Human capital and this trend follows as indicated in the result. But it is puzzling to discover that human capital failed to Granger cause productivity in South Africa. This weak human capital to impact on productivity in South Africa is an indication that human capital is not doing enough to impact on productivity. Hence our objective questions in this study have been achieved. We recommend for policy application (1) an urgent policy restructuring to facilitate the development of human capital that is home base as their proliferation in the system would enhance productivity growth in South Africa. (2) Investment in human capital should include training on how to effectively translate monetary policy into investment through entrepreneurial skill and employment of lab our thereby improving the welfare of the citizens. (3) Result from variance decomposition even in period 12 shows that 8.7% and15.6% are contributed by human capital and money supply. Hence, the low contribution to productivity too. This is a challenge to policy makers. South Africa is investing a lot on education health but with little to show for it. Hence, they are to look into factors that dissuade human capital's continuity in the country.

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Appendix

Details on the Estimating Technique

The step one is to investigate whether data to be adopted for the time series contained in the model has a unit root. The most frequently adopted tests for a unit root in the cointegration literature includes, the Philips – Perron, Dickey-Fuller and Augmented Dickey-Fuller test. All The tests mentioned concurred in their treatment to the intercept parameter. Hence, the null hypothesis (Ho) model to test for unit root takes the following form:

$$X_t = \vartheta + aX_{t-1} + \zeta \qquad 3.2$$

Whereas, the model under the alternative hypothesis: The estimating technique engaged in this paper is co-integration and error connection model. According to Engle and Granger methodology,

$$X_t = \vartheta + \delta\left(t - \frac{T}{2}\right)aX_{t-1} + \zeta \qquad 3.13$$

Where X_t is a concision of the time series, and under the null hypothesis; a=1 and δ=0. While the number of observations is represented by T. In this study, to test for the stationarity of the time series, Augmented Dickey-Fuller is being adopted. We can obtain the ADF test by applying OLS to analyse the coefficients in the following relation:

$$\Delta X_t = \vartheta + \delta + X_{t-1}\sum_{1}^{n}\psi\Delta X_{t-1} + \eta_t \qquad 3.14$$

For autocorrelation to be eliminated, n is selected. For stationarity to exist, then $Y = a - 1$must not be statistically different from zero. The ADF test could be carried out as t-value on the X_{t-1} coefficient is compared with the critical values.

A progression from the unit root test is the Granger representation which shows that if X and ψ are integrated; the model would have the error correlation representation that follows in this form:

$$a(L)\Delta\rho_i = a_0 - \psi(y_t - a_t X) + b(L)\Delta\Psi_t + c(L)\,\zeta_t \qquad 3.15$$

Here, $c(L)$, $a(L)$ and $b(L)$ are polynomials that appear invertible and stable, respectively. Such equations offer a more interesting way of modeling and presenting the series in cointegration analysis. Along the same line the error

correction models (ECM) operates through the combinations of both long and the short run dynamics.

Again, the Johansen's test for maximum Likelihood procedure, as postulated by Johansen (1991) indicates a preference specifically when the total number of variables in the paper are more than two variables as a result of the possibility for the existence of multiple co-integrating vectors. However, the benefit offered by Johansen's co-integrating test is not restricted to multivariate case, but even with a two-variable-model, it appears to more preferable than Engle-Granger approach (Johansen and Juselius (1990).

In order to estimate the number of co-integrating vectors, two statistic tests has been suggested by Johansen and Juselius (1990); Johansen, (1991). The first step is the trace test (λ_{Trace}). This first step tests showcase the null hypothesis, particularly when the number of discrete co-integrating vectors is $\leq$ (q) as against a general unrestricted alternative where (q = r). Maximal eigenvalue test (λ_{Max}) is the second statistical test. This stage affects a test on the null hypothesis showing the presence of (r) in the co-integrating vectors as against the alternative that there is (r + 1) co-integrating vectors.

Test for stationarity on the series Y, Humc, RIR

The presence of unit roots in economic models has theoretical implications, which often leads to spurious regression analysis. This research followed that of other researchers to determine the true nature of the variables. We check for the presence of unit roots because certain variables tend to exhibit certain characteristics such as finite variance and mean reversion. This paper therefore tested for the stationarity (unit roots) of variables using a robust version of Augmented Dickey-Fuller Test (ADF), Phillip Peron and Dickey Fuller at the individual intercept. The results confirmed that all the variables were stationary at I (0), except the result from Phillip which records I(1) for Human capital and GDP per capita. However, when converted, were all made stationary after first differencing? The results are shown in the table 1 below.

Table 1. Test for Stationarity on the series Y, Humc, RIR

Variables	Phillip Peron		Dickey Fuller		Augmented Dickey Fuller	
RIR	I(0)	0.0001	I(0)	0.0570	I(0)	0.0257
Humc	I(1)	0.0595	I(0)	0.0201	I(0)	0.0183
Y	I(1)	0.0115	I(0)	0.0063	I(0)	0.0089

Source: Author's Computation, 2019

Table 2. Test of co-Integration on the Series GDPC, Humc, RIR

Series: ***Y***, Humc, RIR				
Lags interval (in first differences): 1 to 1				
Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None	0.357574	22.97147	29.79707	0.2475
At most 1	0.182754	7.483858	15.49471	0.5221
At most 2	0.011938	0.420338	3.841466	0.5168
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None	0.357574	15.48762	21.13162	0.2562
At most 1	0.182754	7.063520	14.26460	0.4817
At most 2	0.011938	0.420338	3.841466	0.5168
Max-eigenvalue test indicates no cointegration at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				

Source: Author's Computation, 2019