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Effectiveness of Monetary Policy on Industrial Growth of Ethiopia: ARDL Modeling on Monetary Framework

Tamirat Beyene[1], Inderjeet Singh[2]
[1](PhD Research Scholar, Department of Economics, Punjabi University, Patiala, India)
[2](Professor and Supervisor, Department of Economics, Punjabi University, Patiala, India)
Corresponding Author: Tamirat Beyene

Abstract: *The issue of industrialization is at the heart of economic transformation. For its dynamic remunerations and resiliencies, economies at all levels strive to realize the flourishment of the sector. In Ethiopia, however, the sector remains to be the least performer in output share, employment creation and on its contributions to growth and export shares. The UNIDO CIPI reports further enlighten its weakness in inter-sectoral linkages and the low technological levels of the firms, which makes it even the least performer in SSA standard. The stagnation of the sector and unintended structural jump in Ethiopian economy requires a close look and systematic approach in cracking the bottlenecks, despite the various governmental attempts starting from the 1920s; which mainly depends on the external pushes and fiscal gadgets. This paper followed a stylized approach in inculcating, presenting and maximizing the roles of monetary policy on industrial growths; shadowing lights on the relevance and appropriate taming of monetary policies for industrial growth of Ethiopia. In addressing its objectives, the paper used the Bound Testing ARDL modeling framework which is used for its superiority among the alternatives. Annual data is used ranging from 1974-75 to 2016-17, obtained from various sources, used at logarithmic form, after periodic adjustments. Both the ADF and PP tests of stationarity identified that the series are all I (1), and cointegrated-confirmed using Bound Testing approach. In the long-run, except the interest rate (LR), the remaining variables; the growth in broad money supply, inflation rate and the nominal exchange rate were found to significantly impact industrial value additions, exchange rate came with unexpected sign. Following coefficient restrictions; approached by both the Wald test and Adjusted R-square methods, the VEC short-run parsimonious model revealed that one period lag of industrial output (LINDY(-1)), interest rate & its one period lagged value (LR(-1)) determines the short-run industrial productions of Ethiopia. The ECT has the expected negative sign with significant coefficient, showing the possibilities of adjustment of 70% of disequilibrium in the subsequent period. Moreover, the post estimation evaluation tests for both models depicted credibility of the results for further uses. The study revealed that Ethiopian industrial problem could be tamed by appropriate managements of the monetary policies. In doing so, the structural shift observed in Ethiopia & its impacts on economic transformation need close & systematic look. Given that money is found to be non-neutral, the enhancements in the efficiency of monetary policy institution and its affiliations towards gearing the industrial growth have to be realized. Moreover, the government policies towards exchange rate, interest rate and domestic inflation need a closer check-up, as the unintended results become pitfall towards Ethiopian industry. Moreover, interplay between monetary & sector-specific authorities is required. The need of considering the industrial goals might be required by the monetary authorities in the adoption and executions of the intermediate monetary targets.*

Key Words: *Industrial Growth, ARDL Modeling, Ethiopia, Monetary Policy, VECM*

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I. Introduction

The recent decades of Ethiopia has been praised in local and global arenas for its rapid and successive economic growth registry, especially 2003-04 onwards, following the strong involvement of the government through its development policies and plans of eradicating poverty and bringing accelerated and sustained growth. This helped the country to enjoy more than 9 percent growth, taking the annual average rate between 2003 & 2017. If we take the period of GTP-I, the economy performed more than 10 percent average growth. Due to this, considerable socio-economic developments, with Gini index of less than 0.30 has been observed in Ethiopia (MoFED, 2016). Most of what has happened in Ethiopian economy is, however, broadly explained by the performance of agriculture and service sectors. Especially, regarding the issues of employment, the agricultural sector is the dominant determiner, contributing about 80 percent of employment, industry being the least in both output and employment contributions (NBE, 2015). It contributed only 28 percent of the registered economic growth in 2014-15, service and agricultural contributing 41 percent and 31 percent, respectively.

There are great deals of acknowledgement that industrial sector is one of the dynamic and 'modernizing' sectors of an economy. Irrespective of the levels of their incomes, all economies of the world strive to enhance the utilizations and competences of this sector, for its multidimensional remunerations. It is believed to play pivotal role in increasing the effectiveness of existing capital, labor and other resources in a given economy. It transforms the economy from subsistence and static nature to a dynamic, self-reliant and resilient one. Its creations of enhanced per capita income, durable employment, and use of the local resources coupled with its promotions of efficiencies and generations of investible surpluses, the sector is quoted to be the backbone of a country's development. Its linkage effects, helps in hastening the growths of other sectors of the economy, and it also assures the existences of foreign reserves, which comes as a result of the sector's provisions of durable and diversified exports. Through innovation and creations of modern technology, it builds the images of the country in the world arena as politically powerful and influential, through building unshaken economy that ensures sustainability.

Recognizing the significant role of the sector, countries through history have tried to implement various measures to realize it. In moving out of such chronic problems, the willingness and ability of the government is believed to be unquestionably important (Tilman, 2011). Of the many measures, the attentions given for the macroeconomic policy approaches are of the out-mentioned. However, regarding the actual roles of monetary and fiscal policies, controversies aroused by the 1960s is never dead and will never die-out. The two broad groups dominates the arguments; while the Keynesian's argued for the superiority of the fiscal policy, the monetarists counteracted that the roles of monetary policy is effective in affecting output and other real variables. The results of a bunch of empirical attempts made so far, both in DCs and LDCs are inconclusive regarding the supremacy of the policies. Empirical work by Chipote and Makhetha (2014), Ezie (2012) supported the Keynesians that monetary policy is found to be ineffective, where as studies by Asghar (2014), Safdari and Motiee (2011), Owolabi (2014) revealed that monetary policy is highly effective in affecting output and prices. Furthermore, study by Gert and Frank (2005) revealed that monetary policy is effective even in DCs, with due attentions for anticipated part. Besides, for scholars like Munshi and Labonnya (2015) the combination and harmonization of the two policies are found to be effective empirically. The mixed results of the policies across economies, entails the need for practical attempts to resolve the debates and maximize the policies outcomes.

Despite a multitude of governmental attempts, Ethiopian industrial sector remains to be stagnant and weak performer both in Africa (30^{th} out of 33) and in the world (130^{th} out of 133 countries) (UNIDO, 2013). It contributes only 12 percent share in RGDP, lowest in employment, export contributions and in inter-sectoral linkages (NBE, 2015). Furthermore, the share of manufacturing is lowest, only 5 percent of the national income and also the technological levels of the firms are the lowest as per the UNIDO's CIP Index, even less than the SSA level. The current government issued a new industrial strategy envisaging the transformation of the sector. The 1990s till date ADLI policy, however, doesn't bring the expected result; rather it gives the domination for service sector (46 percent) (NBE, 2016). The sole concentration of the government on agriculture as a way-out, absence of clear cut policies, the problem of capability and technological gaps, and lack of transformational leaderships and corruptions are highly quoted for Ethiopian industrialization problem (Lulit, 2010; Tsegaye, 2011; Tesfahun, 2016). The small and micro scale industries which were envisaged to be a spring board for the medium and large scale industries remain lagged behind in their growth as well as on their contributions to the sector, 19 percent and 9.5 percent, respectively (MoFED, 2016). These weakened the roles of the private sectors in gearing the sector's output, and the economy, beside the stringent controls by the government.

The Ethiopian industrial potential is yet untapped. Even much of what comes from the industrial sector is explained by the construction sub-sector (57%), leaving the assignment for the high value adding manufacturing and other subsectors. The weak attention given for the monetary policy side, manifested in industrial policy document of Ethiopia, again leave the dominance for the fiscal gadgets (MoI, 2013). For the developing world like Ethiopia, which produced below the potential levels of production, the monetary policy directed could be highly effective (Kuris, 2006). The dependence of the government and the private sector, furthermore the existences of high asymmetric information makes the monetary authorities option highly valuable and totally effective in altering the industrial and national outputs. It attracts the required resources and maintains both the internal and external balances to realize the transformation of Ethiopian economy towards industrialization. Decades epochs of researches towards economic transformation in general and to that of the industrial sector growth in particular due make little or no emphasis in enhancing the monetary policy remunerations in Ethiopia. The immense potentials attached here would be revealed through its handling of variables like inflation, interest rate, foreign reserves and many others that could have ample roles in altering the fates of a given economy. The exchange rate, money supply and facilitations of finance and financial systems for the real sides coupled with balancing the credits required in the market, can dictate the performances of a given economy (Lars, 2004). The monetary authority, National Bank of Ethiopia, has long been engaged with the objective of stability and sustainability of growth. However, given the unintended shift in the structure of the

economy towards service, and the stagnations of industry, closer look at its objectives and setting ways ahead for the industrial realization is expected.

II. The Growth Triumph, Industrial Performance and Policy Dynamics in Ethiopia

Low outputs and erratic nature of growth has been an explanation of Ethiopian economy, historically. The economy lies at the frontier in terms of poverty and prolonged war and drought that priced the life of many. The growth in output falls below zero in times of drought (e.g.-13% in 1984) and in times of war (-6% in 1990) (NBE, 2016). Taking the periods prior to 2000s, the average annual growths fall below 3%. However, the renewal of hope and the resurge of the economy start to happen after the evolvement of the government by the subsequent development plans, especially 2002-03 onwards. Following the enactment of successive development plans, Ethiopian economy registered rapid and sustained growth for the past 12 years. It makes the country among the top performing economies in the world with inclusive & poverty reducing growth (8.3%) in 2017, followed by Uzbekistan, Nepal, India and Tanzania, 7.6, 7.5, 7.2, and 7.2%, respectively (Oqubay, 2018).

Taking a closer look, the growth triumph in Ethiopia brought the shift in the relative importance of sectors through time. While the role of agriculture falls in both its share and contributions to the national output, that of the service sector is taking the lead. It falls from 65% share of output around 2000s to 38% in 2014/15, 36% in 2015/16.

Table 1: Growth performances in Ethiopia

Years		1974/75-2002/03	2003/04-2016/17	2010/11-2016/17
Growth by Sectors	**RGDP**	2.68	10.8	10.24
	Agriculture	1.41	8.40	6.41
	Industry	3.62	18.43	26.67
	Service	3.9	10.76	21.51
Share to RGDP	**Agriculture**	65.1	45.45	40.6
	Industry	9.8	12.8	15.1
	Service	32.58	42.72	45.01
Contribution To RGDP Growth (%)	**Agriculture**	52	37	35
	Industry	2.6	20	14
	Service	52	43	51

The service sector fit above 47% % in 2014/15 & 2015/16, about 45% taking the last seven years average, which were less than 33% taking the annual average periods between 1974-75 & 2002-03. Considering the performance of the industrial sector, it remains calm through periods. As depicted in table above, it remains stagnant in terms of its contributions for overall growth and sectoral shares; stagnated at around 10-12% in the period under study, and about 18% taking the average annual growth between 2003-04 and 2016-17.

Given its ancient civilization, the exercises of traditional industrial and economic cultures are as old the age of the country itself (Bank, 1985). However, the architecture of modern economic structure in Ethiopia was as late as the beginning of the 20th century. Moreover, the attempts of industrial sector prospectus started by the imperial regime, the first quarter of twentieth century. The first manufacturing industry in Ethiopia was established by the 1927 as a private household cottage enterprise (Gebreeyesus, 2013a). The first group of 27 factories, mainly aimed at import substituting and mostly owned by foreigners, commenced operation by producing limited outputs, paved the way for the modern manufacturing industries in Ethiopia. Pertinent to the ideology of the market economy, where the private sector take the crucial play in the field, the subsequent Five Year Plans (FYPs)/FFYP (1958-1962), SFYP (1963-1967) and TFYP (1968-73)/ clearly stipulated the important role the manufacturing, hence the industrial sector was envisaged to play in transforming the economy. Despite the efforts, the sector remains weak in job creations and in output contribution, and remains to be dualistic in its structure (Gebreeyesus, 2013a); (Bank, 1985). The sources of the weakness broadly ascertained to the structural problems. The neglect of agriculture, lack of land reform, focuses on consumer good and absence of export horizons for manufactured goods were some of the short comings of the industrial approaches used in the regime (Gebreeyesus, 2013b).

After the overthrow of the imperial regime, September 1974, with a coup d'état, the regime that came to power, the Derg, came up with a new economic philosophy that mainly focuses on the nationalization of resources, the government being the leading actor in the economy; limiting the power of the market. Oqubay (2018) termed this era as the 'The Lost Decade of Ethiopia.' There was a fall in per capita GDP by 1.3%, and agriculture & the industrial sectors grew only by 0.7 and 1 percent, respectively, fall in the number of MLSM establishments from 380 in 1987 to 275 in 1990 with the subsequent fall in employment (Gebreeyesus, 2013a). The high protective tariffs, the anti-export bias, dominance of the state in imports and exports and monopolization of the financial systems and anti-private ownerships of resources killed productivity and dampen the industrial and overall growth economy.

The new era of the post 1991 came up with a new ideology and political philosophy. EPRDF after winning the chair, have announced the turn of the economic policies towards the market-orientation. Series of reforms were made backed-up by the IMF/WB sponsored initiatives. As stipulated in (Gebreeyesus, 2013b), the vital commitments of the government were seen in its initiation and enactment of the industrial development strategy, which is called to be 'Agriculture Development Led Industrialization' strategy in 1994. Furthermore, the Industrial development strategy of Ethiopia instituted in 2002, which further lightened the basic principle that the country has to follow to win the industrial ground, under the umbrella of ADLI (MoFED, 2002). Growths and improvements in social indicators have been observed following the reforms, but the industrial sector remains stagnant in many respects despite the efforts. It remains to be the lowest in output share, growth contribution, export shares and employment generations for the overall economy. The sector is structurally dominated by the performance of the construction sector (57%) followed by manufacturing about 33% share. The role of manufacturing in the general value-additions of the economy is low, only 5% of the RGDP. Regarding the export contribution of the manufacturing sub-sector, the receipts from the manufactured exports cannot even cover back the import costs paid for raw material; only 25 percent of the import raw materials costs paid by the manufacturing export revenues, in GTP-I period (EEA, 2017). If we consider the pre plan periods, 2002/03 till GTP-I performance, manufacturing contributed better in terms of share for outputs in 2005/06 and 2012/12, contributing about 14.5 and 15% share, respectively. In most of the remaining plan periods, the contributions fluctuated even reached less than 5% in 2009/10. This poses challenge ahead despite the desired diversification of the export items away from the traditional-primary ones.

The change in the structure of the economy from agriculture dominance to industrial sector was the central objectives set in ADLI strategy. To address the goals, ADLI strategy was devised in 1994-95, and later elevated by additional measures inculcated in the Industrial Development Strategy of Ethiopia in 2002-03. The focus of the strategy is mainly on promotion of agriculture-led industrialization; to lift up agriculture and rural centered industrial development. The core aspects of the strategy are;

- Special direct support sectors: to realize the success of the strategy, special attention sectors are chosen; agro processing industries, textile and garment industry, meat, leather and leather products industry, and construction industry.
- Labor intensive industries- focusing on the expansion of labor intensive industry
- Export-led industrialization implementation- focusing on export productions
- Private Sector- considering private sector as an engine of the industrial development
- Implementing effective domestic-foreign investment partnership
- Implementing principles that encourages active participation of government & public
- Creating favorable macroeconomic conditions conducive for investors

Despite the policy endeavors, the industrial sector remains dormant at about 11-12% contributions to the national income (Gudeta, 2009), (Oqubay, 2018), (Gebreeyesus, 2013b).

For the poor, developing economy like Ethiopia, government spending believed to play paramount importance. The pro-poor and growth-enhancing investments of the government is praised recently (Zerihun, Wakiaga, & Kibret, 2016). The government spending which were about 15.8 billion ETB in 2000-01 now has grown to more than 272.9 billion ETB in 2015-16. There are also shifts in the structures of the government spending. Up until 2006/07 the current spending was the dominant contributor to the total expenditure, but the period onwards, capital spending undertaken the lead, except for the year 2008/09, and the gap between the current and capital expenditure is enlarging, entailing the focus of the government towards productive investment. In revenue front, though improvements observed in nominal revenue collection performance, 10.17 billion ETB in 2000-01 to 230 billion ETB in 2015-16, the efficiencies related with collection capabilities remains staggering. Between 2000-01 and 2016-17, the average annual revenue as a percentage of GDP is at about 11.36%. The highest performance observed in 2014-15 (13.3%) & the lowest in 2008-09 (7%), the remaining period's achievements are between 11-12% annual performances. This is broadly attributed with the problems of tax base narrowness (Zerihun et al., 2016).

The National Bank of Ethiopia, since its establishment by law (proclamation no. 30/1963 and amended proclamation no. 591/2008) as a monetary authority, is playing the monetary management role effecting the monetary targeting regime, to realize stabilities in macro variables and maintain the growth and development in the economy. The objective of the central bank of Ethiopia, as given in 591/2008, is to maintain price and exchange rate stability, and to support hasten and sustainable economic growth in the country. To do so, it has devised a monetary intermediate targets and uses the growth in money reserve (base money) as an operational target. OMO, reserve requirements, standing credit facilities and floor deposit interest rates are some of the monetary policy instruments the central bank of Ethiopia are using. For appropriate functioning of the authority, a Board of Directors composed of seven members, as per the amended NBE establishment proclamation no.

591/2008, shall be the control of the bank. To effect this, the Monetary Policy Committee is also established so as to produce and submit the regular information and policy proposals to the board of governors.

III. Data and Methodology of the Study

Economic literatures acknowledged thoroughly that monetary policy could alter the workings of both the nominal and real variables like the growth in the levels of the national income and employment. However, the intensities of its effectiveness vary across periods, the long-run versus short-run, and across economies. These of course could further enlighten the broad spectrum of the controversies among various schools and economic practitioners. Such controversies are still ongoing, and the empirical findings of a bunch of researches are still an open inconclusive fact of the actual workings of the policies.

This paper attempt to resolve the debate in two perspectives, one is the developing world case; taking the specific case of Ethiopia and the other is by articulating the sector-specific impacts of the policies; the industrial sector. In doing so, secondary data obtained from various domestic sources are used for periods ranging from 1974-75 to 2016-17 on annual bases for macroeconomic series incorporated. The growth literatures advocate starting with the specification of the basic model which elaborates the interactions among the policy variables, the monetary framework and growth. Following (Fisher, 1911), (Friedman, 1970), (Osati, 2015) and (Waliullah & Rabbi, 2011) the growth-monetary policy model specified as;

$$Y_t = f(P_t, M_t) \quad \text{..... (1)}$$

Taking in to consideration that the relationships between P (price level) and Y (Industrial output) are inverse whereas it is direct between M (money supply) and Y, and it is assumed that the velocity of money circulation is held constant for simplicity and for most nature of the developing financially rigid or semi-rigid regions. The model would help to see the roles monetary policy on the stabilization of output-gap and inflation.

The enactments of the monetary policy goes beyond the mere supply of money and further encompasses the controls of the inflation rate and/or interest rate to ensure stability and sustainability in the economy. In this respect, the real money demand L (y, r), influenced by the interest rate policy decisions of the government altering the behavior of economic agents, for which the money demand is negatively dependent on the nominal interest rate (r). Meaning that the money holding behavior of individuals affects their wealth holding or investment decisions; which in turn affect the functionality related to the industrial growth and the prospects in the economy at large. Taylor further argues that interest rate determination has prolonged effects beyond determining the money demand, it can also shape the money supply decisions, which further creates the endogenous determination possibilities of the money supply (Andolfatto, 2005).

Rearranging and incorporating the real demand part of the monetary policy, the industrial growth equation for monetary policy interaction could be restated as;

$$Y_t = f(P_t, M_t, R_t) \quad \text{..... (2)}$$

Ethiopia being an open economy, the foreign economic interactions could be seized by introducing exchange rate instruments in to play. The effects of exchange rate on economic activities could be introduced by the famous Keynesian three market model (Khondker, Bidisha, & Razzaque, 2012). Given the expenditure equation;

$$Y_t = C + I + X - M \quad \text{..... (3)}$$

The national income identity rearranged as;

$$Y - C - G = I + X - M \quad \text{..... (4)}$$

$$\cong S = I_d + I_f \quad \text{..... (5)}$$

$$S = S(Y, r)$$
$$I_d = I_d(Y, r)$$
$$I_f = I_f(Y, e)$$

Where, e, I_d and $I_f$are nominal exchange rate, domestic investment expenditures and net export or foreign investment, respectively, other variables as defined above. Hence equation 5 could be given as;

$$S = f(Y, r, e) \quad \text{..... (6)}$$

Now using equation 4, S could be represented by the left hand equation (Y-C-G), & given as;

$$Y - C - F = f(Y, r, e) \quad \text{..... (7)}$$

Excluding the non-monetary variables for the time being and rearranging equation (7) further could give us;

$$Y = f(r, e) \quad \text{..... (8)}$$

Equation (8) is just a summarized version of the Keynesian framework so as to depict the monetary version of the exchange rate impact on growth.

Inculcating equation (8) in to equation (2) could give us the basic framework model to see the impact of monetary policy on the growths of industrial productions in Ethiopia.

$$Y_t = f(P_t, M_t, R_t, E_t) \text{ …… … …… ..…….. (9)}$$

Equation (9) is the general model which will be used to estimate the effectiveness of monetary policy on the industrial growth prospects of Ethiopia.

Stationarity tests

Given the nature of time series data, contemporary literatures advocates for testing the stationarity of the series to make the analysis made on them realistic. The subsequent sections presented the approaches related with handling the unit-rot test, cointegration and the basic error correction mechanisms that have to be addressed in resolving the basic problem. The unit root test helps us to conclude whether the variable under study could be relied to use it as it is or it needs further integration to render it stationary.

The most famous test to do so is the Augmented Dickey Fuller (ADF) and the Phillips-Petron (PP) unit-root tests. The ADF test is the test of a particular series say, Y_t, such that;

$$Y_t = \alpha + \delta t + \rho Y_{t-1} + \beta_i \sum_{i=1}^{n} \varphi_i \Delta Y_{t-i} + U_t \quad 10$$

Where Δ is a first difference operator and n is the lag length. The parameter of interest here is ρ and the statistical test procedure for unit roots in ADF is similar to that of the DF test.

In cases where the series exhibits considerable structural breaks, the ADF test is biased towards accepting the null unit root (Maddala, 1992), an extension of the basic DF test could give some robust result (Green, 2003). In the presence of structural breaks, the Phillips-Perron test (Phillips & Perron, 1988) gives more robust estimates than that of DF and ADF tests. Furthermore, (Green, 2003) resorts to the use of PP test for its importance in improving the result in cases of the finite sample properties and in others to accommodate more general modeling frameworks. The test specified as:

$$Y_t = \alpha + \delta\left(t - \frac{T}{2}\right) + \rho Y_{t-1} + \beta_i \sum_{i=1}^{n} \varphi_i \Delta Y_{t-i} + U_t \quad 11$$

Where T is the number of observations and n is lag length. The lag length is determined based on Newey-West (1987) procedure. The statistical test procedure for unit roots in PP is similar to that of the ADF test. Hence, this paper could use the two tests alternatively.

The ARDL Modeling

Though individual time series are not stationary at level, a linear combination of these variables could have meaningful long-run relationships, entailing the need for testing cointegration of the series. If these variables are co integrated, then they have a stable relationship and cannot move "too far" away from each other. Given the various famous tests of cointegration, this paper used the ARDL framework depending on the nature of data and the methodological riches of the test. The ARDL approach overcomes the short comings of other, previous, techniques by introducing the **bound testing** procedures to establish the long-run relationships among the variables (Fatukasi, Olorunleke, Olajide, & Alimi, 2015). The ARDL analysis doesn't require a pre-symmetry of the levels of integrations of the variables in the model, unlike the previous tests; meaning that the ARDL comes to relief the researcher wherever the series displayed a mixed order of integration (Osati, 2015). Furthermore, the technique does not require the symmetry of lag lengths, different variables in the model can be assigned different lag lengths. Moreover, its single-equation set-up makes it simple to implement and conducive to interpret. The basic form of ARDL model given by;

$$y_t = \alpha + \sum_{i=1}^{p} \theta_i \, y_{t-i} + \sum_{j=1}^{k} \sum_{i=0}^{q_j} x_{j,\ t-i}\,' \beta_{j,i} + \varepsilon_t \quad 12$$

Where; X is the explanatory variables, α, θ and β are the coefficients of respective variables, and ε_t is the error term of the model.

The existence of cointegration among the variables is checked by the Bound test. The Bound test representation transforms the above equation and given as;

$$\Delta y_t = -\sum_{i=1}^{p-1} \theta_i \, \Delta y_{t-1} + \sum_{j=1}^{k} \sum_{i=0}^{q_j-1} \Delta X_{j,\ t-i}\,' \beta_{j,i} - \rho y_{t-1} - \alpha - \sum_{j=1}^{k} X_{j,\ t-1}\,' \delta_j + \varepsilon_t \qquad 13$$

Then, the test for the existence of level relationships is simply the test for; $\rho = 0$ and
$\delta_1 = \delta_2 = \delta_j = \cdots = \delta_k = 0$, mean there are no long-run relationships among the variables.
$\delta_1 \neq \delta_2 \neq \delta_j \neq \cdots \neq \delta_k \neq 0$, prove existence of long-run relationships among the variables.

Following (Pesaran, Shin, & Smith, 2001); (Waliullah & Rabbi, 2011), the test results are summarized as follows;

- If the test F-statistics exceeds the upper critical value, the null hypothesis of no long-run relationship can be rejected regardless of the underplaying order of integration of the variables, whether it is zero or one.
- If the test statistic falls below a lower critical value, the null hypothesis is not rejected.
- However, if the test statistic falls between the two bounds, the result is inconclusive. When the order of integration of the variables is known and all the variables are I (1), the decision is made on the upper bound. Similarly, if all the variables are I (0), then the decision is made on the lower bound.

The ARDL methods estimates (p+1)k number of regression in order to obtain optimal lag length for each variable, where 'p' is the maximum number of lag to be used and 'k' is the number of regressors in equation (Waliullah & Rabbi, 2011). However, note that, as depicted in (Osati, 2015) and (Fatukasi et al., 2015), the bound techniques of cointegration requires that the dependent variable is of I (I), and none of the explanatory variables is I (II) or higher.

Estimating the Effectiveness of Monetary Policy on Industrial Growth

Proceeding with equation 9, and following (Pesaran et al., 2001), (Osati, 2015), (Waliullah & Rabbi, 2011), (Mehdi & Reza, 2011) and (Fatukasi et al., 2015), the bound test ARDL modeling approach for analyzing the effectiveness of monetary policy in altering the industrial output of Ethiopia is represented as, taking logarithmic form;

$$\Delta LINDY_t = \alpha_0 + \alpha_1 LINDY_{t-1} + \alpha_2 LM_{t-1} + \alpha_3 LP_{t-1} + \alpha_4 LR_{t-1} + \alpha_5 LEXR_{t-1} + \sum_{i=1}^{n} \alpha_6 \Delta\, LINDY_{t-i} + \sum_{i=1}^{n} \alpha_7 \Delta\, LM_{t-i} + \sum_{i=1}^{n} \alpha_8 \Delta\, LP_{t-i} + \sum_{i=1}^{n} \alpha_9 \Delta\, LR_{t-i} + \sum_{i=1}^{n} \alpha_{10} \Delta\, LEXR_{t-i} + \varepsilon_t \qquad 14$$

Where; $INDY_t$ is industrial annual value additions, M_t is the broad money supply (M2), P_t is the price level (CPI) - represent domestic inflation, R_t is nominal interest rate, EXR_t is the exchange rate, and Δ and ε_t are as defined above.

The bound testing procedure of checking the existence of long run relationships is made on the null and alternative hypothesis presented below;

H_0: $\alpha_1 = \alpha_2 = \alpha_3 = \alpha_4 = \alpha_5 = 0$ -> No cointegration; no long run relationships
H_1: $\alpha_1 \neq \alpha_2 \neq \alpha_3 \neq \alpha_4 \neq \alpha_5 \neq 0$ -> Cointegration; a long run relationship exists

Once the long-run relationships has been established, now it is possible to obtain the short-run effects between the dependent and independent variables generated by the size of the coefficients of the differenced variables. If there exists a long-run relationship among the variables, then it is possible to generate the error correction counterpart. The navigation or the speed of adjustment of the variation of the series is captured now by the error correction term (ECT), as depicted in equation 15. The short run model for the impact of monetary policy on industrial output, following equation 14, given by;

$$\Delta LINDY_t = \beta_0 + \sum_{i=1}^{p} \beta_{1i} \Delta L\, INDY_{t-i} + \sum_{i=1}^{p} \beta_{2i} \Delta\, LM_{t-i} + \sum_{i=1}^{p} \beta_{3i} \Delta\, LP_{t-i} + \sum_{i=1}^{p} \beta_{4i} \Delta\, LR_{t-i} + \sum_{i=1}^{p} \beta_{5i} \Delta\, LEXR_{t-i} + \beta_6 ECT_{t-1} + \varepsilon_t \qquad 15$$

The above equation captures the short-run dynamics of the variables and ECT, the error correction term, reflects the magnitude in which the disequilibrium in the process occurs and their possibilities of returning in to its place; the remaining variables as defined above.

The parsimonious model will be adopted depending on the result, and appropriate post estimation tests will be undertaken to ensure the validity of the results.

IV. Estimation Results, Analysis and Discussions of Findings

The skeptics on monetary policy have never died-out in economic literatures. Its roles in the macro functioning is the centre of contentions in both the developed as well as the developing world. Moreover, particular attention of the policy towards a specific sector has not been paid thus far. Given the macro dynamics and the distributional concerns across distinct economies, attracting policies towards specific sectors and observing its performance across time enlarges the gains obtained from the policies and reduces the waste over undue hopes.

Unit Roots Test Results

The unit root test results for the variables involved in equation 14 and 15 is reported in table 2. Both the results of ADF and PP test results for both level and first difference tests with their significance levels are presented below.

Table 2: Augmented Dickey Fuller (ADF) and Phillips-Perron (PP) Test Results

Variables		Test Equations					
		ADF			PP		
		With Intercept	With Intercept & Trend	With Out Intercept & Trend	With Intercept	With Intercept & Trend	With Out Intercept & Trend
LINDY	At Level	4.42146	1.02958	2.809619	3.55417	0.43209	3.55809
	1st Difference	-3.71567*	-4.35094*	-2.4571**	-3.81718*	-4.48263*	-2.4645**
LM2	At Level	3.6464	0.91447	4.36631	3.415198	1.311384	12.67839
	1st Difference	-3.0958**	-4.86914*	-1.00858	-3.2834**	-5.05514*	-1.00858
LCPI	At Level	0.268316	-1.11736	4.684441	0.178938	-1.39706	4.30209
	1st Difference	-5.72646*	-5.68277*	-4.02346*	-5.75294*	-5.70253*	-4.18246*
LEXR	At Level	-0.16104	-2.813202	1.397050	0.55266	-2.06265	2.859541
	1st Difference	-3.998432	-4.02854**	-3.51860*	-3.81391*	-3.78862**	-3.4588*
LR	At Level	-1.905958	-2.487055	0.218866	-1.95273	-2.595569	0.24500
	1st Difference	-6.78551*	-6.700184*	-6.84114*	-6.78551*	-6.700185*	-6.84114*

* and ** indicates that the series are significant at one and five percent, respectively.

The critical value at 1 and 5 percent for the test with intercept is -3.610453 and -2.93897, with intercept & trend is -4.205004 and -3.526609, and without intercept & trend is -2.625606 and -1.949609, respectively for ADF test. And for PP test, the critical values at 1 and 5 percent for the test with intercept is -3.600987 and -2.935001, with intercept & trend is -4.198502 and -3.523622, and without intercept & trend is -2.622585 and -1.949097, respectively. The result depicted in table 2 revealed that the variables included in the model all have unit roots at their levels, for both ADF and PP tests. However, the first differences of the variables are stationary at 1 and 5 percent levels of significance for both test statistics; indicating that all the variables are I (1). The existence of unit roots at the levels of the variables, and its difference being rendered to stationary might helps to further manipulate the series by cointegrating them and checking their long run relationships. Such a test is preceded in the following section.

ARDL Estimation Results

Lag Order Determination

Prior to undertaking the bound testing procedures, it is customary to determine appropriate lags the variables should employ so as to have an optimum output. Following the analysis of the various famous lag order determination criteria, the significance level and the lag length chosen are reported in table 3 below.

Table 3: Various Lag Order Selection Criterions for Effectiveness of Monetary Policy on Industrial Growth*

Variables	Optimum lag length chosen	Lag length criteria decided on	Remarks
LINDY	2	All	Except LR, all produces 2 lag lengths
LM2	2	AIC & FPE	LR & SC gives 1, while others produce 2 lag. Due to their efficiencies in small samples (Liew, 2004), AIC & FPE chosen.
LCPI	3	All	All produces 3 lag lengths
LR	1	All	All test criterion produce 1 lag length
LER	3	All	All produces 3 lag lengths

Given the possibilities that the ARDL model could be specified with asymmetric lay structure, the model is estimated as per the results presented in table 3 above.

Bound Testing

The issue of checking the existence of long-run relationships among the variables has to proceed following the non-stationarity in the series at their levels, which could be handled using the bound testing approach (Pesaran et al., 2001). The bound test result for the variables involved in the model is reported in table 4 below.

Table 4: Bound Test Result

ARDL Bounds Test		
Test Statistic	**Value**	**k**
F-statistic	8.580996	4
Critical Value Bounds		
Significance	I0 Bound	I1 Bound
10%	1.9	3.01
5%	2.26	3.48
2.5%	2.62	3.9
1%	3.07	4.44

The result depicted in the above table revealed that there exist stable long-run relationships between the variables involved in the model, as the F-calculated value is greater than the upper bound critical values at conventional levels of significance.

The Long-run Coefficients

As the results of the bound test analysis shows, the existence of long run relationships among the variables helps us to estimate both the long-run and the short-run vector error correction (VEC) models so as to have a comprehended look on the effectiveness of monetary policy on industrial growth of Ethiopia.

Table 5: Long Run Coefficients

Long Run Coefficients				
Variables	**Coefficients**	**Std. Errors**	**t-Statistics**	**Prob.**
LM2	1.702728	0.301997	5.638225	0.0000
LCPI	-1.650277	0.644056	-2.562318	0.0147
LER	-1.494494	0.317747	-4.703412	0.0000
LR	0.077424	0.531263	0.145735	0.8849

Table 5 above presents the long-run estimates for the variables involved in the model. The result indicates that the logarithms of broad money supply, the growth in CPI and the nominal exchange rates are significant, but the nominal interest rate (lending rate) is found to be insignificant at the conventional level of significance. The post estimation tests of the above result shows that the model passes the basic criteria, and this renders the outputs of the model reliable to use for the intended policy purposes and further analysis. The null of serial correlation using Breusch-Godfrey Serial Correlation LM Test (Obs*R-squared (0.5790), the Q-square of the Correlograms of Residuals, and the Cusum and Cusum Square tests of Parameter Instability (do not cross the 5 percent critical lines) and tests of normality (Jarque-Bera 1.2114 (0.545)) is not rejected at the conventional levels of significance.

The long-run industrial growth empirical model borrows the fact to non-neutrality of monetary policy in developing economies like Ethiopia, effective of monetary policy in determining industrial outputs. Money supply, represented by M2, found to significantly and positively influence industrial growth. A one percent increase in broad money supply leads to a 1.7 percentage enhancement in the industrial output of Ethiopia. Domestic inflation, represented by the log of CPI has significant and negative, as expected, impact on industrial value additions. A percentage rise in domestic price leads to more than one and half percentage fall in industrial productions of the country. The interactions between exchange rate and industrial output is found to be inverse; a percent rise in the nominal exchange rate leads to about 1.5 percent fall in the output of the industrial sector. Regarding the interest rate, the real interest rate in Ethiopia have been negative for long, more than negative 6 percent taking the past twenty years average, even it reaches up to -13 percent taking the average annual nominal indicators for the past decade. It reaches its picks -15, -33 and -51 percent for the year 2012-13, 2011-12 and 2009-10, respectively. These make economic decision makings based on real interest rate inefficient for macroeconomic functioning in Ethiopia. Moreover, the output in the long-run model depicted that the nominal interest rate though positive but has no significant impact on the industrial productions of Ethiopia. Interest rate is not responsive; moreover it's almost inelastic, with only 0.077 beta-coefficients.

The Short-run Estimates (VECM)

Following the existence of long-run relationships among the variables, and the determination of the appropriate lag lengths, the VEC model is estimated and presented in table 6 below. The VECM presents the

short-run behavior of the economy conditioned on the adjustment of the equilibrium diversion from its original positions.

Table 6: VECM Estimation Results

Variables	Coefficients	Std. Errors	t-Statistics	Prob.
D(LINDY (-1))	1.158668	0.366771	3.159110	0.0045
D(LINDY (-2))	-0.050383	0.263712	-0.191053	0.8502
D(LM2)	-0.367614	0.290525	-1.265344	0.2190
D(LM2 (-1))	0.169895	0.288715	0.588452	0.5622
D(LM2 (-2))	0.009349	0.277196	0.033725	0.9734
D(LCPI)	0.018559	0.104598	0.177427	0.8608
D(LCPI (-1))	0.109392	0.102478	1.067466	0.2973
D(LCPI (-2))	0.127275	0.095685	1.330142	0.1971
D(LCPI (-3))	0.050871	0.102385	0.496857	0.6242
D(LER)	-0.037979	0.187158	-0.202924	0.8411
D(LER (-1))	0.016749	0.146086	0.114651	0.9098
D(LER (-2))	-0.058373	0.111582	-0.523142	0.6061
D(LER (-3))	-0.107984	0.110345	-0.978607	0.3384
D(LR)	0.251295	0.088983	2.824066	0.0099
D(LR (-1))	-0.189007	0.125364	-1.507664	0.1459
ECT (-1)	-0.956659	0.393431	-2.431578	0.0236
C	0.005493	0.012587	0.436400	0.6668
R-squared	0.742219	Mean dependent var		0.031833
Adjusted R-squared	0.554742	S.D. dependent var		0.034541
S.E. of regression	0.023048	Akaike info criterion		-4.403183
Sum squared resid	0.011687	Schwarz criterion		-3.678040
Log likelihood	102.8621	Hannan-Quinn criter.		-4.143008
F-statistic	3.958984	Durbin-Watson stat		1.652242
Prob(F-statistic)	0.001635			

The result of the short-run VEC model presented in table 6 is found credible following the appropriate diagnostic tests performed on the results. However, the result depicted that most of the variables are with insignificant coefficients. Hence, to produce a meaningful VECM, the parsimonious model is needed to be undertaken to generate a meaningful short-run relationships among the intended variables.

Coefficients Restrictions Wald Test and Adjusted R-Square Methods

Joint restrictions of the coefficients which are redundantly insignificant checked using both Wald-test Likelihood Ration approach and comparison of the adjusted R-square methods. While the adjusted r-square works in comparison of the two adjusted r-square of the pre (inclusive of all variables)-and-post estimation (excluding the redundant insignificant variables); if the later adjusted r-square is greater than the previous model, then the later result is preferable. In case of the Wald-test, the result is judged by the single or joint coefficient restrictions of the redundant insignificant variables.

Table 7: Wald-test result

Test Statistic	Value	df	Probability
F-statistic	0.497092	(9, 22)	0.8607
Chi-square	4.473824	9	0.8776
Null Hypothesis: C(2)=C(3)=C(5)=C(6)=C(7)=C(9)=C(10)=C(12)=C(13)=0			
Null Hypothesis Summary:			
Normalized Restriction (= 0)		Value	Std. Err.
C(2)		-0.050383	0.263712
C(3)		-0.367614	0.290525
C(5)		0.009349	0.277196
C(6)		0.018559	0.104598
C(7)		0.109392	0.102478
C(9)		0.050871	0.102385
C(10)		-0.037979	0.187158
C(12)		-0.058373	0.111582
C(13)		-0.107984	0.110345
Restrictions are linear in coefficients.			

The Wald Test coefficient restrictions reported above revealed that the probabilities of the coefficients jointly included in the test are above 0.05, meaning that the null hypothesis of the test which says that the roles of the coefficients are jointly zero is not rejected. Producing a green card for a coefficient restricted estimation

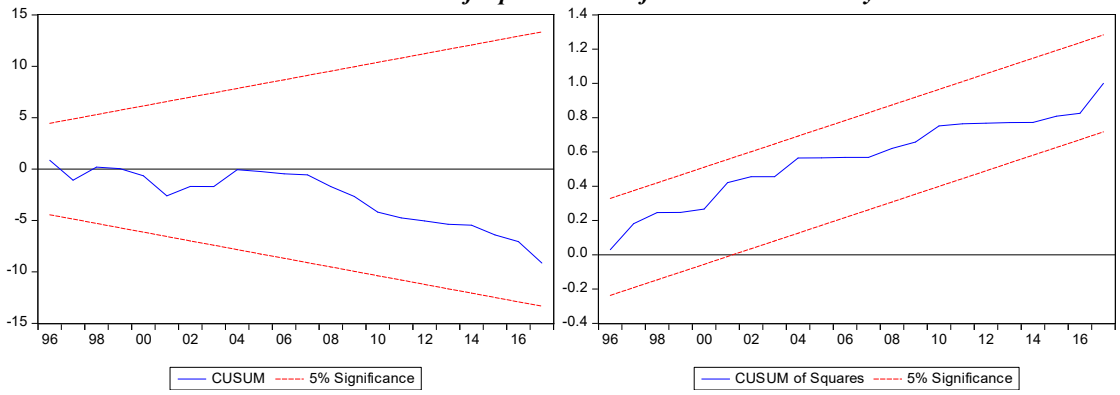
of the VEC model. Moreover, the result of the Wald test coefficient restriction could be reaffirmed by the evaluation of adjusted r-square result following the re-estimation. The re-estimated VECM is presented below.

Table 8: The Re-estimated VECM

Variables	Coefficients	Std. Errors	t-Statistics	Prob.
D(LINDY (-1))	0.926510	0.167685	5.525312	0.0000
D(LM2 (-1))	0.185026	0.164881	1.122179	0.2701
D(LCPI (-2))	0.084599	0.079078	1.069811	0.2927
D(LR)	0.270204	0.057401	4.707267	0.0000
D(LR (-1))	-0.156917	0.065064	-2.411747	0.0218
D(LER (-2))	-0.072755	0.070607	-1.030417	0.3105
ECT (-1)	-0.699293	0.237164	-2.948567	0.0059
C	-0.009115	0.008728	-1.044235	0.3042
R-squared	0.697969	Mean dependent var		0.030685
Adjusted R-squared	0.631899	S.D. dependent var		0.034859
S.E. of regression	0.021149	Akaike info criterion		-4.697576
Sum squared resid	0.014313	Schwarz criterion		-4.359800
Log likelihood	101.9515	Hannan-Quinn criter.		-4.575446
F-statistic	10.56417	Durbin-Watson stat		1.839488
Prob(F-statistic)	0.000001			

The logarithm of the current and one period lag of nominal interest rate, and one period lag of industrial output is found to significantly impact the short-run industrial productions of Ethiopia, while other variables remains insignificant at the conventional level of significance. The error correction term (ECT) came up with its expected sign, having a meaningful value. Ethiopian industrial economy is found to correct any distortions away from the equilibrium. An equilibrium distortion this period will be corrected by 70% in the next period, which is highly condensing behavior. The results reported above are credible based on the evaluations of the basic post estimation tests like serial correlation using Breusch-Godfrey Serial Correlation LM Test (Obs*R-squared=0.1247, (p-value=0.9395)), heteroskedasticity test using Breusch-Pagan-Godfrey (Obs*R-squared=7.18, (p-value=0.410)) and instability tests of Cusum and Cusum Square tests do not cross the 5 percent critical lines, showing the stability of parameters, as depicted below.

Cusum and Cusum of Squares Tests of Parameter Instability



Initial industrial income is found to be an important actor in the growth of the sector. Producers' investment in the construction and manufacturing sectors are highly fascinated with the returns and profits obtained in the late-business period. A one percent enhancement in the income of industrial businesses in previous period leads to more than 0.92 percent enhancement in the industrial income of the period at hand. Successive enhancement in the income of the industrialists is a bridging platform for the sector's flourishment. the coefficients of the current and one period lagged values of nominal interest rate is found to be the other important element in the short-run industrial growth prospects of Ethiopia, though their directions of influence varies. A percentage rise in the nominal interest rate while it induces industrial growth by 0.27 in the respective period, its one period lag reduces the growth by 0.15 percent. The policy impact of increasing the lending interest rate, through the market mechanisms, though it leads to the enhancement in the industrial outputs of Ethiopia, its effect after a fiscal year of enacting the policy came with the deterioration of industrial output. Meaning that, the economic agents after having justifiably enough periods for adjustment of their economic decisions, they will resort to cut borrowing, and hence investments in the sector fall, and this leads to the decline in the industrial productions of Ethiopia.

V. Conclusions

Ethiopia has enjoyed a successful growth registry despite the various heats that the economy faced. The rise in prices, foreign exchange crises and structural diversion of the economy towards inadvertent sector are among the main ones in the economic spheres. The dominance of the service sector at the expense of agriculture, keeping the industrial sector at its dormant stage, poses challenges and questions among the economic practitioners, various international organizations, and lately the government as well. Through the imperial regime to the contemporary government, there has been lots of policies and strategies directed to realize sustained growth in the sector, but in practice the required change become a mere wish in vain. The sector remains the lowest performer in growth and export contribution, employment generation and output shares. Especially what has happened in industrial sector is mainly explained by the construction subsector, manufacturing and other sub-sectors being the least performers.

This study tries to address the important roles that the monetary policy can play in the realization of Ethiopian industrial prospects. Monetary authorities, given its effective and efficient handling, can transform the structure of Ethiopian economy through adjustments of its macroeconomic tools and instruments. In addressing the problem, both the ADF and PP tests of stationarity have been undertaken on data obtained from various sources ranging from 1974-75 to 2016-2017. The result of both tests confirmed that the series are integrated of order one. The ARDL modeling cointegration approach used in this study traces to focus on the monetary framework, and it identified the long-run and short-run monetary policy estimates that have paramount importance in the industrial growth of Ethiopia. The technique proceeds with bound testing which identified the existence of long-run relationship among the variables. The test identified that there is cointegration among the variables, as the F-statistic of the test is greater than its upper bound critical values.

In the long-run, the growth in money supply, domestic inflation and the logarithm of nominal exchange rate determines the growth of Ethiopian industry. However, the exchange rate came with unexpected sign and that of the nominal interest rate remains unimportant, at least statistically. The study addresses the classicalists' arguments regarding the non-neutrality of money; in developing country, even on high value adding sectors like industry, monetary policy became effective in altering output growth. The negative and significant impact of inflation connotes the important monetary authority's roles of maintaining stability for the country's industrial surge. The exchange rate policy the country pursuing has posed challenges for the success of the industrial prospects, as a percentage rise in the nominal exchange rate is lowering the industrial output by 1.49 percent. The subsequent devaluation measures undertaken by the government, as well as the depreciation of Ethiopian currency is disfavoring the industrial growth, as the economy is import dependent and supplier of undersized quantity in the international market. This needs to recheck the policies in the perspectives of the country's industrial growth. Of course, the actual impacts of the policy in the rest of the sectors are still questionable, and this requires further empirical investigations. The weak financial integrations and string regulations makes the nominal interest rate more unresponsive. Moreover, the real interest rate is negative for long periods.

A one period lagged industrial output, the growth in domestic interest rate and its one period lagged value are an important determiners of Ethiopian industrial growth in the short-run. A percentage rise in the industrial output in the period enhances industrial growth of the subsequent period by more than 0.9 percent. Contradicting results have been observed across periods if we see the short-run estimates of the nominal interest rate in current and prior periods. A percentage rise in the nominal lending interest rate while it pushes up industrial growth by 0.27 percent, however its t-1 period impact reduces industrial growth by 0.16 percent. Though it boost growth at the period of the policy's enactment, it soon or later counteract with the stagnations of industrial outputs. This might necessitate the mobilization of domestic savings through enhancing the saving behavior, and facilitating the market mechanisms, especially the deregulations and expansions of the financial markets particularly at the corners of the country, where the majority dwells, to ease the lending rate and expand options for further investment and growth in the industry. The error correction term (ECT) has the expected sign with statistically significant coefficient. Almost 70 percent of the distortions in equilibrium will be corrected in the subsequent period. This is a good sign, given the stability of the model, confirmed by the post-estimation tests, for the possibility of controlling the distortions in Ethiopian industrial sector and to move the economy at its front.

Monetary policy is found to be effective in affecting Ethiopian industry both in the short-run and long-run. Industrial inertia is an important element for growth of industry both in the short-run and long-run, the policy directives has to give close attention for the stability and income sustainability in the sector. This might entail the need for appropriate taming of the policy frameworks and institutional setups of the industrial organizations required for attaining the goals of the sector. The non-neutrality of money, the important roles of exchange rate and domestic inflation borrow supports for the existence of the need for monetary authority's effective and efficient handling of the tools and instruments. It needs controlling domestic inflation to a desired level and managing the exchanging policy in line with the growth in industrial sector & the economy in large, as

their current stances are hampering the industrial growth in Ethiopia. Moreover, close interplay between the industrial organizations and the monetary authorities have to be created. Here, the need of considering the rearrangement of the intermediate monetary targets towards addressing the industrial goals might be necessitated, in reconsidering the structural paths of Ethiopian economy.

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