A Publication of
THE ETHIOPIAN ECONOMICS ASSOCIATION
(EEA)

VOLUME XXVIII NUMBER 2 OCTOBER 2019

Published: December 2020

Capital Flight and Fiscal Policy in Developing Countries: Evidence from Ethiopia

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Abstract

This study examines the effect of fiscal policy on capital flight in Ethiopia using time series data from 1970 to 2012, employing the Autoregressive Distributed Lag (ARDL) model. The results indicate that past capital flight, changes in debt, and government expenditure had no significant impact on capital flight in Ethiopia, while external debt, taxation, and expenditure practices under different political regimes did have a significant effect. The study details policy implications emerging from the empirical results.

Keywords: Fiscal Policy, Capital flight, Autoregressive Distributed Lag model, Ethiopia
JEL Code: K28, T56, G80

1. Introduction

Capital flight refers to wealth that is earned, transferred, or used, through by breaking a country's laws. It is illegal or illicit. It also refers to wealth whose origin is connected with illegal activity, such as corruption, the illicit production of goods, other forms of crime, or the concealment of a company's wealth from a country's tax authorities (The Service Centre for Development Cooperation, 2010). Capital flows are illicit if they involve illicitly acquired funds or are transferred abroad and held there without full disclosure to national authorities, or both (Ndikumana, 2015).

In past decades, many countries have experienced considerable capital flight with residents moving their wealth abroad, using different ways to accumulate foreign assets (Hermes and Lensink, 2014). Since the emergence of the Asian financial crisis of 1997–98, fiscal policy has gained considerable

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attention in the literature. At the center of this discussion has been the way fiscal policy influences economic variables, specifically the flow of funds across borders. While tax rates can be used to attract foreign capital and government spending can be used to stabilize and boost of economic growth, the extent of fiscal policy's impact on economic variables is still an open empirical question (Muchai and Muchai, 2016). The past decades have witnessed growing attention in academia and policy circles to the issue of capital flight from developing countries in general and African countries in particular. Researchers have been intrigued by the stunning paradox posed by large-scale capital flows both to and from Africa. While the continent receives a substantial amount of capital inflows in the form of official development assistance, external borrowing, and foreign direct investment, it also suffers heavy financial hemorrhage through capital flight (Ndikumana, Boyce and Ndiaye, 2014). Capital flight has become a major issue of concern for Africa because it reduces the continent's much needed investible funds.

In Ethiopia, capital flight is estimated at $31 billion over the 1970–2012 period. On average, the country lost around half a billion dollars annually under the 'Derg' regime (1974-1991). But this amount more than doubled to over 1 billion per annum during the EPRDF regime (1991-). The empirical evidence suggests that macroeconomic instability, the degree to which the financial market expanded and deepened, exports, the interest rate differentials, political instability, corruption, and debt-creating flows have been the most important determinants of capital flight from Ethiopia with the political environment also found to be crucial. Generally, capital flight was high before the violent regime changes and low in the subsequent periods, when the new regimes were in the process of establishing a firmer grip on power; after this, however, capital flight began to rise significantly again. The historical analysis points to potential causality running from political factors to capital flight. A strong improvement in economic and political governance would therefore be key to abating the problems of capital flight in Ethiopia (Alemayehu and Addis, 2016).

Despite the serious capital flight problem, few country-specific studies have investigated the size and determinants of capital flight in Ethiopia. The few that exist have generally focused on economic determinants (Alemayehu and Addis, 2016), and while several studies have explored the relationship between fiscal policy and capital flight in Africa (see for example., Muchai and Muchai 2016), no paper has systemically examined just how fiscal decisions influence capital flight. Whether these fiscal decisions influence capital flight or not remains an issue.

This study defines fiscal policy as combined government decisions regarding a country's revenue and spending. It therefore relates to government taxation and the expenditure decisions that lead to budget deficit or surplus. In this context, the study addresses the following questions as they affect the case of Ethiopia: What is the effect of government consumption on capital flight? Do taxation practices influence capital flight? How do political regimes affect capital flight?

2. Capital Flight and Fiscal Policy

There are few studies of developing countries that analyze the relationship between capital flight and fiscal policy variables such as taxation, government expenditure, and debt. Alesina and Tabellini (1989), for example, state that uncertainty about which political group will be in control in the future, and uncertainty about future fiscal policies, is one of the main reasons for over-accumulation of public debt and private capital flight. Boyce (1992), using time series data from the Philippines between 1962 and 1986, finds evidence for debt-motivated capital flight and suggests foreign borrowing causes capital flight by contributing to an increased likelihood of debt crisis, worsening macroeconomic conditions, and the deterioration of general investment conditions. Eaton (1987) argues that the expectation of increased tax obligations created by the potential nationalization of private debt generates capital flight. Ize and Ortis (1987) also show that when fiscal rigidities create difficulties for servicing foreign debt, private capital flight is encouraged by foreign borrowing as there is the expectation of higher domestic asset taxation to service future debt. Foreign borrowing also provides the resources for channeling private capital abroad.

Boyce and Ndikumana (2012) examine 30 sub-Saharan African countries and show that funds borrowed abroad are often re-exported as private assets. By comparing cumulative capital flight with private net external assets, they conclude that Sub-Saharan African countries are net creditors vis-a-vis the rest of the world. In the case of capital flight driven debt, capital flight forces governments to borrow from abroad since capital flight decreases national resources by lowering domestic savings and investment. In this case, capital flight provides the resources to finance loans to the same residents who export their capital, leading to a situation of ‘round-tripping’ or ‘back-to-back loans’, motivated by the desire to obtain government guarantees on foreign borrowing.

2.1 Capital Flight from Ethiopia

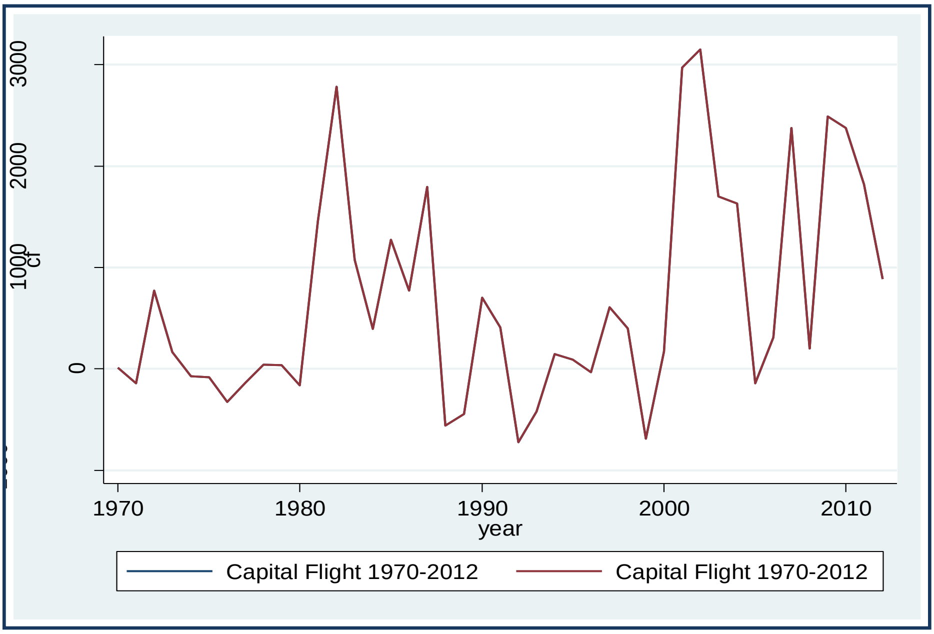
The capital flight from Ethiopian for the last 42 years is estimated and the results are summarized in Table 2 s. We find the total real capital flight during the period 1970 to 2012 to be USD 31 billion. On average, the country lost around half a billion dollars annually during the 'Derg' regime, with the amount more than doubled to over one billion per annum during the EPRDF regime. The reasons why capital flight accumulated more during the latter regime, despite being more stable and taking IMF and World Bank advice to create a more liberal market pro-private sector economy, deserves further research. Overall, capital flight amounted to about 50 percent of the country's average annual exports during the period.

Table 1: Capital flight from Ethiopia (1970-2012): in millions of real constant US Dollar (2012)

Year	Capital Flight 1970-90 The Derg Regime*	Year	Capital Flight (1991-2012) The EPRDF Regime
1970	10.7	1991	410.6
1971	-140.9	1992	-725.6
1972	771.6	1993	-420.5
1973	163.9	1994	145.6
1974*	-72.4	1995	91.9
1975	-84.5	1996	-33.3
1976	-324.7	1997	605.7
1977	-138.4	1998	398.3
1978	41.0	1999	-689.5
1979	37.6	2000	170.8
1980	-160.8	2001	2969.6
1981	1457.5	2002	3148.6
1982	2784.0	2003	1700.8
1983	1072.0	2004	1631.3
1984	392.1	2005	-144.5
1985	1272.1	2006	309.6
1986	771.4	2007	2376.2
1987	1794.8	2008	198.4
1988	-561.0	2009	2491.2
1989	-445.9	2007	2376.2
1990	702.2	2008	198.4
		2010	4096.3
		2011	1818.7
		2012	886.7
Total Capital Flight		9342.4	21437.1
Average Annual Capital flight		444.9	974.4
Grand Total (1970-2012) = USD 30779.5			
Average Annual Capital Flight (1970-2012) = USD 715.8			

Source: Alemayehu and Addis, 2017

Figure 1: Capital flight from Ethiopia (1970-2012)



Source: Own computation

The average annual capital flight during the Derg regime was half the amount that left under in the EPRDF regime, and the EPRDF regime also accounted for about 70 percent of the whole during the entire period under analysis. Under the Derg, capital flight reached its maximum point in the 1980s and then declined up to 2000. The highest level of capital flight was registered under the EPRDF in 2003. The overall shape of capital flight shows a cyclical pattern during the period under consideration.

3. Empirical Evidence on Fiscal Policy and Capital Flight

Much of the contemporary literature on African capital flight has focused, inter alia, on lessons from case studies on the causes and effects of capital flight (Ndikumana, 2016). Notably, the nexus between fiscal policy and capital flight in Kenya (Muchai and Muchai, 2016), determinants of capital flight in Madagascar (Ramiandrisoa and Rakotomanana, 2016) and Ethiopia (Alemayehu & Addis, 2016), capital flight and trade invoicing in Zimbabwe (Kwaramba et al., 2016) and capital flight in Cameroon connections between tax revenue and capital flight in Burkina Faso (Ndiaye and Siri, 2016) and the effect of capital flight on public social spending in Congo-Brazzaville (Moulemvo, 2016).

Muchai and Muchai (2016) noted capital flight has been an issue of concern for Africa because it has reduced the continent's much needed investible funds. Kenya lost US$ 4.9 billion in real terms from 1970 to 2010 through capital flight. Their study sought to provide fiscal evidence of capital flight from Kenya and the results established that previous capital flight, changes in debt, and government expenditure had no significant impact on capital flight from Kenya, though external debt, taxation, and expenditure practices under different political regimes did have a significant effect. The study also discussed policy implications emerging from their empirical results.

Alemayehu and Addis (2016 and 2017) focused on economic, institutional and political determinants to estimate the volume of capital flight, and its impact on growth and on poverty reduction in Ethiopia. With total capital flight (1970-2012) estimated at USD 31 billion, a simple ICOR-based growth model simulation found the average growth lost to capital flight to be about 2.2 percentage points per annum, between 2000/01-2012/13. Using the elasticity of poverty to income and inequality, we also found poverty would have been reduced by about 2.5 percentage points in the last decade had it not been for capital flight. We would also note that growth in Ethiopia in the last decade has been accompanied by rising inequality that wiped out the positive effects on poverty reduction. Had it not been for this inequality accompanying growth, the lost resources of capital flight would have led to around a 5-percentage point decline in poverty during the last decade.

4. Data and Methodology

The annual time series data for fiscal and control variables covering the period 1970–2012 uses figures obtained from the Ministry of Finance and Economic Cooperation, the National Bank of Ethiopia, and the World Bank's World Development Indicators. Capital flight was computed using the extended Balance of Payments residual method (Ndikumana and Boyce, 2010 and 2012). For this study, capital flight data from Boyce and Ndikumana (2012) were used.

Analysis in previous sections revealed a qualitative relationship between fiscal policy variables and capital flight in Ethiopia. Here, we undertake a quantitative analysis of the relationship between fiscal policy and capital flight. The fiscal policy variables included in the analysis are government expenditure, taxation, changes in the stock of debt, and external debt. For the proper specification of our model, the control variables presented in the literature are included. These are the exchange rate, which captures risk and returns on investment; political regimes; previous capital flight; financial deepening; and inflation, capturing the macroeconomic environment. To analyze empirically the fiscal policy variables that might induce capital flight in Ethiopia, we employed a regression model in the following form:

$$\boldsymbol{KF_t = \alpha_0 + \alpha_1 KF_{t-1} + \alpha_2 CD_t + \alpha_3 ED_t + \alpha_4 T_t + \alpha_5 EXP_t + \alpha_6 P_t + \alpha_7 FD_t + \alpha_8 INF_t + \alpha_9 ER_t + \varepsilon_t} \quad \textbf{(1)}$$

Where α1 to α9 are parameters to be estimated, t is time and e is the error term. Capital flight (KF): Capital flight/GDP. Change in the Stock of Debt (CD): CD /GDP. Financial Deepening (FD): M2/GDP. Inflation (INF): Annual average inflation rate (consumer price index). External Debt (ED): Total external debt/GDP. Exchange Rate (ER): Annual average exchange rate; Ethiopian Birr against the US dollar. Tax rate (T): Total taxes/GDP. Expenditure (EXP): Government Expenditure/GDP. Political Regimes (P): Dummy variable: 1 in regimes that demonstrated fiscal discipline relatively (EPRDF), 0 otherwise (Derg regime).

5. Results and Discussion

Since we are using time series data, the stationarity of the time series is important. Traditionally, the Augmented Dickey-Fuller (ADF) has been used to test for the stationarity of macroeconomic variables, and the results are presented in Table 1 below. However, this test does not consider the fact that the data in question could have structural breaks. To take into account the existence of structural breaks, the Clemente-Montanes-Reyes (1998) test was applied in this study.

The Clemente-Montanes-Reyes (CMR) approach has two models: an additive outlier model (AO) which captures a sudden change in the mean of a time series, and an innovative outlier model (IO) which allows for a gradual shift in the mean of the series of the model. We employed the CMR-IO test, which is considered superior to the AO model since it can identify the long-run impact of changes (Kinuthia and Murshed, 2015). Breusch-Godfrey serial correlation LM test is presented in Appendix A3.

The diagnostic test was run on the residuals of the long-run equation presented in Appendix 6; it indicated no evidence of Serial Autocorrelation; the Breusch-Godfrey with the null hypothesis of no Serial Autocorrelation was accepted; and the white test for Hetroskedasticity also indicated no evidence of Heteroskedasticity. The test for checking the model specification, the Ramsey RESET for model specification, was conducted and the result indicated that the model had no evidence of any misspecification.

UNIT ROOT TEST

Determining the stationarity of a time series is a key step before moving to any analysis. Customarily, the Augmented Dickey-Fuller (ADF) has been used to test for the stationarity of macroeconomic variables. Consequently, capital flight, external debt, change in debt, tax rate, government expenditure, exchange rate, and financial deepening are integrated of order (1) while inflation is integrated of order (0). Since seven (of eight) of the variables are I(1) processes, it is possible to run a long-run equation with our stationary variables.

Table 1: Stationarity result

Variables	Without constant and trend	With constant only	With constant and trend	Order of integration
DLNKF	-5.240*	-5.180*	-5.115*	I(1)
DLNCD	-4.323*	-4.246*	-4.219**	I(1)
DLNFD	-4.499*	-4.485*	-5.203*	I(1)
LNINF	3.026*	0.406	-1.269	I(0)
DLNED	-3.680*	-3.638**	-3.580**	I(1)
DLNER	-2.729*	-3.319**	-3.511***	I(1)
DLNT	-3.991*	-3.978*	-4.831*	I(1)
DLNEXP	-3.730*	-3.697*	-4.372*	I(1)

*- significant at 1%, **- significant at 5% and ***- significant at 10%

BOUND TEST FOR CO-INTEGRATION

Our estimated F-statistics is outside the critical value bounds at 90, 95, and 99 percent. We, therefore, reject the null hypothesis of no co-integration and no long-run capital flight equation. The ARDL bounds test, therefore, confirms the existence of a long-run capital flight equation presented in Table 2 below. The regression results are presented in Table 3.

Table 2: Bound co-integration result

Test Statistics	Value	Lag	Level of significance	I0 Bound	I1 Bound
F-statistic	5.352466	2	10%	1.95	3.06
			5%	2.22	3.39
			2.5%	2.48	3.7
			1%	2.79	4.1

Table 3: Long Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNT	-13.987043	3.297720	-4.241429	0.0003
P	-15.464325	4.581440	-3.375429	0.0027
LNINF	-1.162713	0.935439	-1.242960	0.2270
LNFD	8.921147	3.557880	2.507434	0.0200
LNEXP	3.616109	3.830957	0.943918	0.3555
LNER	8.932589	3.266884	2.734285	0.0121
LNED	-0.016644	0.479176	-0.034735	0.9726
LNCD	-0.079615	0.128959	-0.617371	0.5433
C	-16.019901	9.374833	-1.708820	0.1016

Cointeq = LNKF - (-13.9870*LNT -15.4643*P -1.1627*LNINF + 8.9211 *LNFD + 3.6161*LNEXP + 8.9326*LNER -0.0166*LNED -0.0796*LNCD -16.0199)

The finding that previous capital flight had no significant effect on the current capital flight implies that there has been no habit formation. The change in the stock of debt was also found to have no significant effect on capital flight in Ethiopia and that result confirms the results of Muchai and Muchai (2016) for Kenya, and Nyoni (2000) who focused on Tanzania, though it is inconsistent with the findings of other studies such as Hermes and Lensink (1992), Lensink et al. (1998), and Ndikumana and Boyce (2003).

External debt had no positive and significant influence on capital flight. This finding was inconsistent with the findings of Muchai and Muchai (2016) for Kenya, of Hermes and Lensink (1992), Lensink et al. (1998), and Ndikumana and Boyce (2003) but it was consistent with the findings of Nyoni (2000). Financial deepening, however, did have a positive and significant influence on capital flight.

Table 4: ARDL Co-integrating and Short Run Form

ARDL Co-integrating and Short Run Form

Dependent Variable: Log of capital flight

Selected Model: ARDL (2, 1, 1, 0, 2, 2, 2, 0, 0)

Co-integrating Form

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNKF(-1))	0.476432	0.186824	2.550164	0.0182
D(LNT)	-10.446250	5.011589	-2.084419	0.0489
D(P)	-3.530503	3.751813	-0.941013	0.3569
D(LNINF)	-1.988996	1.655245	-1.201632	0.2423
D(LNFD)	-7.208446	5.969921	-1.207461	0.2401
D(LNFD(-1))	-8.754956	3.528175	-2.481440	0.0212
D(LNEXP)	15.816610	5.087023	3.109208	0.0051
D(LNEXP(-1))	10.367885	3.739880	2.772251	0.0111
D(LNER)	27.958649	8.282047	3.375814	0.0027
D(LNER(-1))	-10.208636	4.565486	-2.236046	0.0358
D(LNED)	-0.028472	0.821374	-0.034664	0.9727
D(LNCD)	-0.136194	0.214934	-0.633656	0.5328
ECM	-0.710650	0.287751	-5.944904	0.0000

Tax has a significant coefficient, implying that taxation significantly influenced capital flight. This finding is consistent with the study of Muchai and Muchai (2016), Alam and Quazi (2003) but is inconsistent with Pastor (1990) Vos (1992), Schineller (1997) and Ndikumana and Boyce (2003). While the political regimes' variable had a significant effect on capital flight, the impact of government expenditure was insignificant.

6. Conclusions and Policy Implications

This study examined how fiscal policy affected capital flight in Ethiopia using time series data from1970 to 2012. It defined fiscal policy as decisions taken by the government regarding the country's revenue and spending. Econometric analysis was done to ascertain the effect of tax and public expenditure on capital flight. This revealed that taxes had a negative and significant impact on capital flight from Ethiopia while external debt was found to have a negative and insignificant effect, invalidating the revolving door phenomenon for Ethiopia.

Fiscal policy regimes were also considered in the study in order to explore the effect of political regimes on capital flight and the result established that political regimes which exercised some form of budgetary discipline experienced less capital flight. Furthermore, financial deepening and exchange rates had a significant and positive effect on capital flight though government expenditure and change in the stock of debt had an insignificant impact. There was no evidence of debt-fueled capital flight. The inflation rate has always been kept within tolerable levels for economic players and this probably explains its insignificance in the econometric results. Previous capital flight had a significant effect on the current capital flight, implying that there was some habit formation.

Based on the findings from this study, we can derive some policy implications. The government should be prudent in managing public resources as fiscal discipline is shown to be a significant factor in deterring capital flight. Taxation policies in Ethiopia should be implemented cautiously, and the government should cease from a directed focus on tax incentives, rather focusing on the general tax rate in the economy.

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Appendices

Appendix 1: ARDL Estimation Result

Selected Model: ARDL (2, 1, 1, 0, 2, 2, 2, 0, 0)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LNKF(-1)	-0.234219	0.179499	-1.304846	0.2054
LNKF(-2)	-0.476432	0.186824	-2.550164	0.0182
LNT	-10.44625	5.011589	-2.084419	0.0489
LNT(-1)	-13.48069	5.208154	-2.588382	0.0168
P	-3.530503	3.751813	-0.941013	0.3569
P(-1)	-22.92355	7.412287	-3.092642	0.0053
LNINF	-1.988996	1.655245	-1.201632	0.2423
LNFD	-7.208446	5.969921	-1.207461	0.2401
LNFD(-1)	13.71445	6.423568	2.135021	0.0441
LNFD(-2)	8.754956	3.528175	2.481440	0.0212
LNEXP	15.81661	5.087023	3.109208	0.0051
LNEXP(-1)	0.737173	4.990640	0.147711	0.8839
LNEXP(-2)	-10.36788	3.739880	-2.772251	0.0111
LNER	27.95865	8.282047	3.375814	0.0027
LNER(-1)	-22.88675	6.796683	-3.367340	0.0028
LNER(-2)	10.20864	4.565486	2.236046	0.0358
LNED	-0.028472	0.821374	-0.034664	0.9727
LNCD	-0.136194	0.214934	-0.633656	0.5328
C	-27.40445	15.54777	-1.762597	0.0919
R-squared	0.656537	Mean dependent var		-3.994351
Adjusted R-squared	0.375522	S.D. dependent var		2.821711
S.E. of regression	2.229827	Akaike info criterion		4.746025
Sum squared resid	109.3868	Schwarz criterion		5.540119
Log likelihood	-78.29351	Hannan-Quinn criterion		5.035190
F-statistic	2.336304	Durbin-Watson stat		2.355482
Prob(F-statistic)	0.030165			

Appendix 2: Lag length selection

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-78.66520	NA	8.876170	5.009440	5.409387	5.147501
1	-78.06862	0.852260	9.124594	5.032492	5.476877	5.185894
2	-72.96474	6.999607*	7.258143*	4.797985*	5.286809*	4.966727*
3	-72.78957	0.230216	7.661290	4.845118	5.378381	5.029200
4	-72.63322	0.196552	8.107191	4.893327	5.471028	5.092749
5	-72.60237	0.037029	8.654916	4.948707	5.570846	5.163469
6	-71.63651	1.103839	8.775189	4.950658	5.617235	5.180760
7	-70.70298	1.013544	8.932353	4.954456	5.665472	5.199899
8	-70.54661	0.160836	9.527952	5.002663	5.758118	5.263446

* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

Appendix 3: Breusch-Godfrey Serial Correlation LM Test

F-statistic	1.714259	Prob. F(2,20)		0.2055
Obs*R-squared	5.999919	Prob. Chi-Square(2)		0.0498
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
LNKF(-1)	0.179249	0.276551	0.648159	0.5243
LNKF(-2)	0.217664	0.222101	0.980023	0.3388
LNT	1.085257	5.106510	0.212524	0.8338
LNT(-1)	2.167350	5.234542	0.414048	0.6832
P	0.087684	3.715660	0.023598	0.9814
P(-1)	1.173019	7.308620	0.160498	0.8741
LNINF	0.196869	1.678308	0.117302	0.9078
LNFD	0.610024	5.915828	0.103117	0.9189
LNFD(-1)	0.910243	6.477481	0.140524	0.8897
LNFD(-2)	-1.053817	3.624339	-0.290761	0.7742
LNEXP	-1.156514	5.011650	-0.230765	0.8198
LNEXP(-1)	-3.101341	5.180925	-0.598608	0.5562
LNEXP(-2)	1.048366	3.790487	0.276578	0.7849
LNER	-2.307302	8.180237	-0.282058	0.7808
LNER(-1)	0.080981	6.606914	0.012257	0.9903
LNER(-2)	1.229632	4.673768	0.263092	0.7952
LNED	0.170081	0.831144	0.204635	0.8399
LNCD	-0.111616	0.232346	-0.480388	0.6362
C	2.976128	15.55519	0.191327	0.8502
RESID(-1)	-0.478782	0.351707	-1.361309	0.1886
RESID(-2)	-0.359583	0.321579	-1.118179	0.2767
R-squared	0.146339	Mean dependent var		1.55E-14
Adjusted R-squared	-0.707321	S.D. dependent var		1.653684
S.E. of regression	2.160778	Akaike info criterion		4.685364
Sum squared resid	93.37923	Schwarz criterion		5.563047
Log likelihood	-75.04997	Hannan-Quinn criter.		5.004968
F-statistic	0.171426	Durbin-Watson stat		2.158257
Prob(F-statistic)	0.999884			

Appendix 4: Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.410749	Prob. F(18,22)		0.9701
Obs*R-squared	10.31292	Prob. Chi-Square(18)		0.9212
Scaled explained SS	4.294299	Prob. Chi-Square(18)		0.9996
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	-17.81438	37.36595	-0.476755	0.6382
LNKF(-1)	-0.170420	0.431390	-0.395048	0.6966
LNKF(-2)	-0.430487	0.448994	-0.958781	0.3481
LNT	-8.229395	12.04435	-0.683258	0.5016
LNT(-1)	-2.004187	12.51675	-0.160120	0.8742
P	-5.547786	9.016729	-0.615277	0.5447
P(-1)	-14.90422	17.81394	-0.836660	0.4118
LNINF	-2.138080	3.978049	-0.537469	0.5963
LNFD	-0.573779	14.34751	-0.039992	0.9685
LNFD(-1)	11.00610	15.43776	0.712934	0.4834
LNFD(-2)	9.000142	8.479261	1.061430	0.3000
LNEXP	8.573388	12.22564	0.701263	0.4905
LNEXP(-1)	-7.810517	11.99400	-0.651202	0.5217
LNEXP(-2)	-13.41368	8.988051	-1.492390	0.1498
LNER	10.50339	19.90424	0.527696	0.6030
LNER(-1)	-7.704293	16.33447	-0.471659	0.6418
LNER(-2)	10.22373	10.97223	0.931783	0.3616
LNED	-0.092985	1.974007	-0.047105	0.9629
LNCD	0.175977	0.516550	0.340678	0.7366
R-squared	0.251535	Mean dependent var		2.667972
Adjusted R-squared	-0.360846	S.D. dependent var		4.593827
S.E. of regression	5.358942	Akaike info criterion		6.499710
Sum squared resid	631.8018	Schwarz criterion		7.293804
Log likelihood	-114.2441	Hannan-Quinn criter.		6.788875
F-statistic	0.410749	Durbin-Watson stat		2.246464
Prob(F-statistic)	0.970140			

Appendix 5: Functional form

Ramsey RESET Test

	Value	df	Probability
t-statistic	1.395729	21	0.1774
F-statistic	1.948060	(1, 21)	0.1774

F-test summary:

	Sum of Sq.	df	Mean Square
Test SSR	9.285845	1	9.285845
Restricted SSR	109.3868	22	4.972129
Unrestricted SSR	100.1010	21	4.766714

Unrestricted Test Equation:

Dependent Variable: LNKF

Method: ARDL

Date: 06/20/18 Time: 11:11

Sample: 1972 2012

Included observations: 41

Maximum dependent lags: 2 (Automatic selection)

Model selection method: Akaike info criterion (AIC)

Dynamic regressors (2 lags, automatic):

Fixed regressors: C

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LNKF(-1)	-0.453513	0.235744	-1.923758	0.0680
LNKF(-2)	-1.041138	0.444026	-2.344769	0.0289
LNT	-25.84933	12.07761	-2.140268	0.0442
LNT(-1)	-27.13816	11.03422	-2.459453	0.0227
P	-7.535996	4.661592	-1.616614	0.1209
P(-1)	-49.96695	20.69045	-2.414977	0.0249
LNINF	-4.279794	2.306617	-1.855442	0.0776
LNFD	-12.89054	7.123278	-1.809636	0.0847
LNFD(-1)	27.11312	11.47663	2.362464	0.0279
LNFD(-2)	18.17432	7.581473	2.397201	0.0259
LNEXP	35.54378	14.98590	2.371814	0.0273
LNEXP(-1)	2.030143	4.973499	0.408192	0.6873
LNEXP(-2)	-22.30722	9.305005	-2.397336	0.0259
LNER	59.74629	24.17553	2.471354	0.0221

LNER(-1)	-47.00820	18.51933	-2.538332	0.0191
LNER(-2)	20.49197	8.617761	2.377877	0.0270
LNED	-0.277127	0.823724	-0.336431	0.7399
LNCD	-0.164502	0.211422	-0.778072	0.4452
C	-55.95215	25.49699	-2.194461	0.0396
FITTED^2	0.140520	0.100679	1.395729	0.1774
R-squared	0.685694	Mean dependent var		-3.994351
Adjusted R-squared	0.401321	S.D. dependent var		2.821711
S.E. of regression	2.183281	Akaike info criterion		4.706094
Sum squared resid	100.1010	Schwarz criterion		5.541983
Log likelihood	-76.47494	Hannan-Quinn criter.		5.010479
F-statistic	2.411251	Durbin-Watson stat		2.485346
Prob(F-statistic)	0.026646			

*Note: p-values and any subsequent tests do not account for model selection.

Appendix 6: Diagnostic tests

The diagnostic test run on the residuals of the long-run equation presented in the table below indicates no evidence of Serial Autocorrelation; the Breusch-Godfrey with the null hypothesis of no Serial Autocorrelation is accepted; the white test for Hetroskedasticity indicates no evidence of Heteroskedasticity.

Breusch-Godfrey Serial Correlation LM Test: Serial Autocorrelation			
F-statistic	1.714259	Probability	0.2055
Obs*R-squared	5.999919	Probability	0.0498
White Heteroskedasticity Test			
F-statistic	0.410749	Probability	0.9701
Obs*R-squared	10.31292	Probability	0.9212
Ramsey RESET Test: Model Misspecification			
F-statistic	1.948060	Probability	0.1774
Log likelihood ratio	-76.47494	Probability	5.010479

As shown in the above table the test for checking the model specification, i.e. the Ramsey RESET, also indicates that the model has no evidence of any misspecification.

Inflation and Money Growth in Ethiopia: Is there a Threshold Effect?

Kibrom Gebrekirstos[1] and Zenebe Gebreegziabher[2]

Abstract

This study analyses money growth - inflation nexus in Ethiopia using annual datasets covering the period 1970-2009. This period was considered due to data limitations. A significant aspect of the study is that it tries to identify the optimal level of money growth using Two Regime Threshold Model. The result from the two-regime threshold model reveals that there is indeed a threshold effect in the relationship between money growth and inflation and the optimal level of money growth is estimated to be 17% which has an important policy implication. Here, money supply creates inflationary pressures only when it exceeds 17%. A percentage increase in money supply above this threshold value is expected to cause 1.47 percent increase in annual inflation indicating that monetary factors are valid sources of inflation in Ethiopia. The results imply keep the money growth below 17%. Hence, a specific monetary policy measures that could be envisaged is controlling broad money supply (M2).

Keywords: Inflation, money growth, two regime threshold model, Ethiopia
JEL Code: E3, E4, C4

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1. Introduction

Some view that moderate and stable rate of inflation promotes output growth, ensures return to savers, enhances investment, and accelerates economic growth. In general, price stability is an indicator of macroeconomic stability. People dislike price hikes because higher inflation rate reduces the purchasing power of their money making them unable to buy the same quantity and quality of goods and services as before, given their income. Thus, the public views inflation as detrimental to economic performance of a country. However, though majority of economists agree with the public, there are economists who argue that inflation is positive to economic performance.

Sharing the public's view, the obvious question that comes in mind is what determines inflation? Alternatively, what are the sources of inflationary pressures? However, the answer is different according to different schools of thought. For example, the Structuralist school emphasizes supply side factors as determinants of inflation. Inflation is determined by developments and bottlenecks on the real side of the economy. In this approach, monetary factors are given less emphasis as sources of inflation because the proponents assumed that price changes largely took place on the real side of the economy, not on the monetary sector. Thus, monetary authorities have to accommodate wage and price increases (Bernanke, 2005). In contrast, the monetarist approach emphasizes, "Inflation is always and everywhere a monetary phenomenon" in the sense that an increase in money stock eventually leads to a rise in prices in the same proportion. That is, there is a positive one-to-one relationship between monetary and price growth (see for example, Roffia and Zaghini, 2007).

Price stability is recognized as primary objective of central banks. Yet the role of money in the conduct of monetary policy to achieve the said stability is debatable. Many economists believe that inflation is monetary phenomenon in the sense that money growth in excess of the growth rate of the economy is inflationary. When the monetary authority increases the money supply at a rate that exceeds the demand for cash balances at the existing price level, the higher demand for goods and services triggers a rise in the price level as the public tries to convert its excess cash holdings in to real items. There are studies that confirm this hypothesis (Gerlach, Browne, and Honohan 2004; Nelson, 2008; Dawyer, Jr, and Hafer 1999, Kulakisizoglu and Kulakisizoglu, 2009).

There are also economists who argue that money growth does not help in predicting the dynamics of inflation because either their relationship is weak or inflation and money growth are unrelated. Turnovsky and Wohar (1984) found that the causality between money supply and aggregate prices in the United States is neutral and concluded that money and inflation are unrelated. De Gregorio (2004), for several low inflation countries with very rapid growth of money, finds that money growth does not necessarily cause inflation. Roffia and Zaghini (2007), for 15 industrialized economies found that it is only in approximately half of the cases they investigate that positive relation between inflation and money growth exists.

The above mixed empirical evidence may be attributed to the inherent nonlinearities between the two variables. For example, Milas (2007), using a Markov switching regression model for the United Kingdom, finds that money growth is inflationary if it exceeds 10% threshold level. Similarly, Bachmeier, Leelahanon, & Li (2007) using a fully nonparametric model and a threshold regression model find that nonlinear models are more successful at forecasting inflation than linear models.

In Ethiopia, empirical studies are very scant on this issue. Tafere (2008), using a monetarist and structuralist model, found that the sources of inflation in Ethiopia are different for food and non-food inflation and in the short run and log run as well. However, he only considered the period 1994/95 to 2007/08. A similar study conducted by Loening, Durevall, and Birru (2009) using error correction models found that money stock does not explain inflation in the short run its but growth does. However, their analysis focuses only on the period January 1999 to November 2008.

Thus, the study contributes to this debate empirically quantifying and testing the nature of the relationship between money growth and inflation using a Two-Regime Threshold Model over extended period (1970-2009). Particularly, the study estimates the threshold level of money growth above which additional money is inflationary which has an important policy implication.

2. Conceptual Framework

The building block for this study is the quantity theory of money (Friedman, 1956, 1968; Cagan, 1956), which links money supply, velocity, prices, and real income. The quantity theory of money is preferred for theoretical consistency as the study focuses on long-run behavior. The predictive power of monetary aggregates for inflation dynamics also appears to be stronger in the long-run as opposed to shorter time horizons (Assenmacher-Wesche and Gerlach, 2006; Bachmeier and Swanson, 2005; De Grauwe and Polan, 2005). This can be written as an identity:

$$MV = PY \tag{1}$$

where M stands for money supply, V velocity, P price level and Y represents real income. Money supply is assumed exogenous and income velocity of money is independent of the other variables in identity 1. Under these assumptions, identity 1 can be written as the theory of price determination as follows.

$$P = \frac{MV}{Y} \tag{2}$$

taking log of equation (2), yields

$$\log P = \log M + \log V - \log Y \tag{3}$$

differentiation (3) with respect to time yields the equation for inflation

$$\frac{1}{P}\frac{dP}{dt} = \frac{1}{M}\frac{dM}{dt} + \frac{1}{V}\frac{dV}{dt} - \frac{1}{Y}\frac{dY}{dt} \tag{4}$$

or in terms of growth rates

$$\Delta_P = \Delta_M + \Delta_V - \Delta_Y \tag{5}$$

Equation (5) shows that the rate of inflation (Δ_P) is determined by the growth in money supply (Δ_M), growth in velocity (Δ_V), and growth in real income (Δ_Y). As envisioned in the early versions of the quantity theory of money

(Fischer 1911), we assume that velocity is constant and its growth rate is zero. As could be obvious velocity changes when the institutions in the economy change. In Ethiopia, the financial system is underdeveloped and the use of different payment modalities such as credit cards is yet to flourish. Hence, our assumption is valid. Therefore, with constant velocity assumption equation (5) reduces:

$$\Delta_P = \Delta_M - \Delta_Y \quad \textbf{(6)}$$

Note that equation (6) suggests that the growth rate in price is proportionate to the growth rate in money supply in excess of output growth.

Besides the aforementioned variables, short run cost shocks such as an oil price shock or a change in the exchange rate (Gerlach, Browne, and Honohan 2004) affect inflation even though not in the long run. Therefore, considering budget deficit, oil price shock and incorporating annual rainfall as a proxy for supply side constraints, the basic model becomes:

$$Inf_t = \beta_0 + \beta_1 gm_t + \beta_2 gdpg_t + \beta_3 loilpr_t + \beta_4 lrain_t + \beta_5 bd_t \quad \textbf{(7)}$$

where gm is the growth rate of money supply, gdpg is the growth rate of real gdp, loilpr is the logarithm of oil price in US dollars, lrain is the logarithm of annual rainfall, bd for budget deficit and subscript t stands for time.

3. Econometric Models and Estimation Methods

Adding error term (μ_t) to capture effect of other variables, we specify the econometric model to analyze inflation in Ethiopia as:

$$Inf_t = \beta_0 + \beta_1 gm_t + \beta_2 gdpg_t + \beta_3 loilpr_t + \beta_4 lrain_t + \beta_5 bd_t + \mu_t \quad \textbf{(8)}$$

Since there is a particular econometric issue related to the estimation and inference in empirical models with threshold effects, the study employs the methodology developed by Hansen (2000) and Caner and Hansen (2004). In particular, these authors develop tests for threshold effects, estimate the threshold parameter, and construct asymptotic confidence intervals for the threshold parameter. Their basic idea in threshold estimation is that an exogenously given variable, called "threshold variable", is used to split the sample in two groups or regime, which can or cannot be a regressor. This method derives the asymptotic distribution of OLS or 2SLS estimates of the threshold parameter. Importantly, in addition to generating unbiased and consistent parameter estimates, it locates the thresholds, tests for their significance and constructs their confidence intervals.

Accordingly, a two-regime threshold autoregression can be formulated as:

$$y_t = \theta_1^{'} x_t + e_{1t} \qquad if \quad q_t \leq \gamma \tag{9a}$$

$$y_t = \theta_2^{'} x_t + e_{2t} \qquad if \quad q_t \succ \gamma , \tag{9b}$$

where qt denotes the threshold variable (in our case money growth), splitting all the observed values into two classes or regimes. The terms yt and xt are m vector dependent and explanatory variables, respectively. The eit, for i=1,2, is the white-noise or error term of property of iid (independently identically distributed) and γ denotes the threshold value or parameter. If we knew γ the model could be easily estimated by OLS. Since the threshold is unknown a priori so it should be estimated in addition to other parameters. Note that when the threshold variable is smaller than the threshold parameter, the model estimates equation (9a) and when the threshold variable is larger than the threshold parameter, the model estimates the equation (9b).

Defining a binary variable $d_t(\gamma) = \{q_t \leq \gamma\}$ where {.} is the indicator function, with d=1 if $q_t \geq \gamma$ or d=0 otherwise, and setting $x_t(\gamma) = x_t d_t(\gamma)$, then equation (9a) and (9b) can be written as a single equation as:

$$y_t = \theta^{'} x_t + \delta^{'} x_t(\gamma) + e_t \tag{10}$$

where, $\theta = \theta 2$, $\delta = \theta 1 - \theta 2$, and θ, δ , and γ are the regression parameters to be estimated. The residual sum of squares as a result of estimating the regression parameters can be written as follows:

$$s_1(\gamma) = \hat{e}_{1t}(\gamma)^{'} \hat{e}_{2t}(\gamma) \tag{11}$$

Caner and Hansen (2004) recommend estimating equation (10) using 2SLS (two stages least squares) technique. The easiest way to implement this procedure is through minimization of the sum of squared residuals as a function of expected threshold value. Hence, we can rewrite the optimum threshold value as:

$$\hat{\gamma} = \arg\min\ s_1(\gamma) \quad \textbf{(12)}$$

Conditional on $\hat{\gamma}$, the regression equation is linear in θ and δ', yielding the conditional 2SLS estimates of $\hat{\theta}(\gamma)$ and $\hat{\delta}(\gamma)$ by regression of dependent variable on explanatory variables.

Following the foregoing procedure, the linear equation in equation (7) can be specified as a nonlinear equation under a two-regime threshold autoregression (TAR) model as:

$$Inf_t = (\beta_{10} + \beta_{11}gm_t + \beta_{12}gdpg_t + \beta_{13}loilpr_t + \beta_{14}lrain_t + \beta_{15}bd_t)d[q_t \le \gamma] + (\beta_{20} + \beta_{21}gm_t + \beta_{22}gdpg_t + \beta_{23}loilpr_t + \beta_{24}lrain_t + \beta_{25}bd_t)d[q_t > \gamma] + \mu_t \quad \textbf{(13)}$$

From equation (13), the optimal threshold value can be determined by obtaining the threshold value that minimizes the residual sum of squares (RSS). Since the main objective of this paper is to investigate the inflationary threshold effects in the relationship between inflation rate and money growth in Ethiopia, the annual growth rate of inflation is employed as the threshold variable in the analysis.

The main question in equation (13) is, therefore, whether or not there is a threshold effect? This requires a careful scrutiny between the linear model, i.e., equation (7), vis-à-vis the two-regime model, equation (13). The null hypothesis of no threshold effect (H0: β1i= β2i) is tested against an alternative hypothesis where threshold effect is present (H0: β1i≠β2i). However, traditional procedures of hypothesis testing cannot be applied, because under the null hypothesis of no threshold effect exits, the threshold parameter γ will be unidentified. Hansen (1996) suggests a standard heteroscedasticity-consistent Lagrange Multiplier (LM) bootstrap method to calculate the asymptotic critical value and the p-value.

To do this, a test with near-optimal power against alternatives distant from H0 is the LR statistics.[3]

4. Data and Context

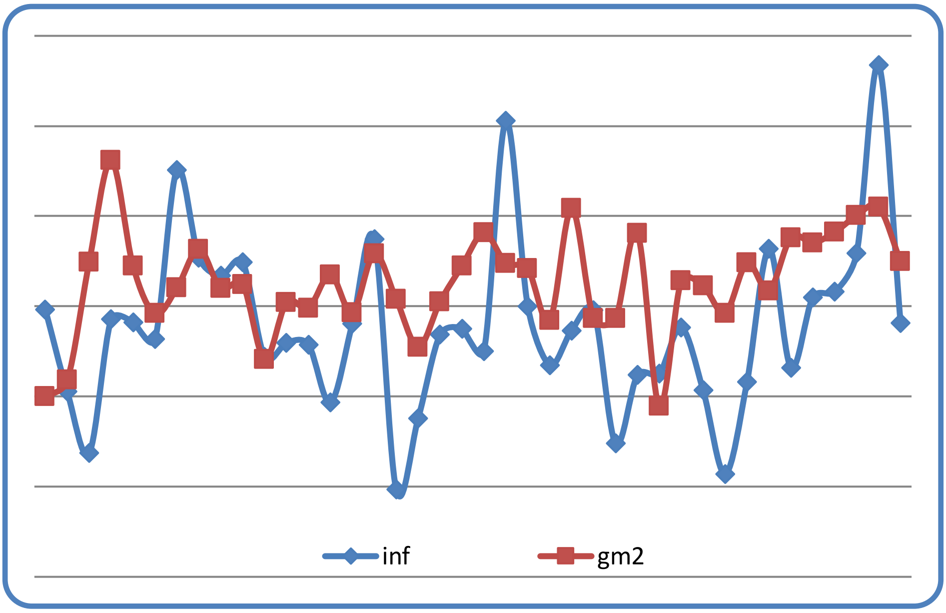
The study uses annual data for the period 1970-2009 collected from National Bank of Ethiopia (NBE), Ministry of Finance and Economic Development, Central Statistics Agency and International Monetary Fund. The period 1970-2009 was considered due to data limitations. In the endeavors directed towards achieving sustainable economic growth, the role of the monetary authority in Ethiopia is to maintain price and exchange rate stability. Hence, macroeconomic stability as proxied by price stability plays an important role in all economic decisions and fosters employment and economic growth. Moreover, exchange rate stability is meant to ensure the countries international competitiveness and to use exchange rate intervention as a monetary policy tool to influence both foreign reserve position and domestic money supply (NBE, 2009).

Specifically, the study use data on general price, money stock/supply, GDP (gross domestic product), budget deficit, oil price, and rainfall. There are different measures of money stock. However, since National Bank of Ethiopia uses broad money (M2) as a policy variable (see NBE, 2009), the study considered this variable in the estimation. Summary statistics of the variables considered is provided in the appendices (see Appendix A). The mean of inflation is about 7.7% while the mean of money growth is about 12.9%. While the standard deviation of inflation is 7.7, the standard deviation of money growth is 115.7 which is about 12 times that of the former. Further, their distribution is non normal as Jarque-Bera test rejects the null hypothesis of normality for both series.

A closer look at the behavior of the two variables- inflation and money growth during the period 1970-2009 reveals that both variables closely move together in the same direction (see Figure 1).

[3] See also Hansen (1999; 2000) and Hansen and Soe (2002) for details of the test.

Figure 1: Inflation and money growth (1970-2009)



Source: Authors' own analysis

The time series property of the data used in the study was also examined using ADF test due to Dickey and Fuller (1979, 1981), and PP due to Phillips (1987) and Phillips and Perron (1988). These tests are applied at level and at first difference of the variables. Test results are presented in the appendices (see Appendix B). The results show that the null hypothesis of unit root is rejected, at least at 5% level of significance, in both tests except for real GDP in the first difference. In ADF test, it turns out that real GDP is not significant even at 10% both at level and first difference. However, when PP test is applied real GDP become significant at 1% level at the first difference. Overall, these results suggest that the underlying variables are difference stationary.

Further, the test for cointegration was conducted using the maximum-likelihood test procedure established by Johansen and Juselius (1990) and Johansen (1991). Details of the test results are presented in the appendices (see Appendix C). The test shows that in the long-run, the variables are cointegrated; thus the existence of a meaningful long run relation. In the table below, the LR test indicates one cointegrating equation(s) at 5% significance level as the trace statistic 22.1195 is above the 5% critical value (29.68).

5. Empirical Results

As outlined in section 3, the initial step to see the existence of threshold effect is to estimate equation (13) using 2SLS as suggested by Caner and Hansen (2004) and computing RSS for different values of the threshold parameter. The optimal threshold level is the one that minimizes RSS. The test results are summarized in the following table.

Table 1: Test Results of Threshold Effects

Test Hypothesis	Optimal Threshold	LR test statistic	1% Critical Value	5% Critical Value	P-Value
H0: no threshold	17%	36.7 (LR0)	7.35	10.59	0.000
H0: one threshold		0.125 (LR1)	7.35	10.59	0.813

Source: Authors' own analysis

Applying Hansen's (2000) testing procedure, this study found evidence of one threshold in the relationship between money growth[4] and inflation. More specifically, the LR0 test statistic is 36.7, which is significant at 1% level with a bootstrap p-value of 0.000 indicating that the threshold exits. However, in an attempt to test for two thresholds, the LR1 test statistic is 0.125 which is well below the 5% critical value indicating that the null hypothesis of one threshold cannot be rejected significantly. Therefore, the test procedure implies one threshold and, thus, two regimes in the relationship between inflation and money growth in the country. The optimal threshold at which the residual sum of square is minimized is 17%. The results are similar to the findings of Milas (2007) except the magnitude of the threshold is higher in our case.

After estimating the threshold level using 2SLS and testing its significance, Caner and Hansen (2004) proposed the model parameters to be estimated by GMM. For comparison purposes, the first column in Table 2 presents estimates for a linear regression equation that ignore the threshold effect.

[4] All growth rates were calculated as the first difference of their logs. The interest rate is proxied by real lending rate, exchange rate by real effective exchange rate and credit by the total credit to the private sector.

Column two and three provide estimates of the two-regime threshold autoregressive model.

Table 2: Regression Results of Inflation Rate and Money Growth in Ethiopia (1970-2009) a

Dependent variable: Inflation

Variables	Linear Model	Threshold Model	
		Regime 1: ≤17%	Regime 2: > 17%
constant	35.61391	1.785103	-85.69495
	(129.3935)	(37.96798)	(118.2563)
Money Growth	2.194453	-0.4484866	1.472167*
	(4.345978)	(0.6849215)	(.7087817)
GDP Growth	0.0930879	0.4765417	0.0436404**
	(0.0799819)	(0.7707039)	(.0115594)
Budget Deficit	0.0038652	0.0018692	0.0019319
	(.0033405)	(0.0015056)	(0.0011776)
Oil Price	1.141137	5.63862	11.91485*
	(16.47499)	(4.437037)	(3.973082)
Rainfall	-12.94897	-8.535948	4.785771
	(26.65294)	(10.14296)	(21.7275)
N	38	29	9
R^2			0.91

a ** and * represent significant at 1%, and 5%, levels respectively while numbers in parentheses are standard errors. (Source: Authors' own analysis)

As the above table reveals, in contrast to the results obtained in the low money growth regime and in the linear specification, in the high regime model, money growth has a significant impact on inflation. More specifically, the impact of money growth on inflation is positive and significant at 5% level with a coefficient of 1.47. That is, an increase in money stock by 1% leads to increase in inflation by 1.47%. On the other hand, under low-inflation regime and linear specification, money growth does not have significant effect on inflation. The estimated non-linear relationship between inflation and money growth is **consistent with the empirical conclusion derived in previous studies such as** Bachmeier, Leelahanon, & Li (2007) and Milas (2007). That is, under high inflation regime, money growth has a positive effect on inflation.

In the high regime, a percentage change in oil prices is expected to change inflation by 11.9% indicating that oil shocks are important sources of inflation in the country (see Gerlach, Browne and Honohan 2004). Similarly, the coefficient on real GDP growth is positive and significant at 1% significance level. On average, this model predicts that a 1% increase in real GDP leads to a rise in inflation approximately by 0.04%. Finally, rainfall is insignificant in all specifications. Thus, according to our empirical result it appears that the monetarist view is valid in the context of Ethiopia.

6. Conclusions and Implications

In Ethiopia empirical studies money growth and inflation are very scant. The study contributes to the debate and shed light empirically quantifying and testing the nature of the relationship between money growth and inflation using annual datasets covering the period 1970-2009. This period was considered due to data limitations. The study employs a Two-Regime Threshold Model for the empirical analysis.

The following conclusions can be drawn from the foregoing discussion. First, the probe on the link between money growth and inflation revealed that their relationship is nonlinear. Particularly, the study found the existence of threshold effect in the relationship between inflation and money growth. Money growth is inflationary only when it is greater than 17%. Hence, an important policy implication is- ‘keep the money growth below 17%’. Second, as indicated by the significance of the coefficient of money growth, the monetarist view on the causes of inflation is valid in Ethiopia. Last but not least, our study analyzed the nonlinear effects of money on inflation using single equation model applying 2SLS. However, an interesting issue of further research could be employing Multivariate Threshold Vector-Autoregressive (MTVAR).

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Appendices

Appendix A: Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max	Skew ness	Kurto sis	Jarque-Bera	Prob
Inflation	40	7.7	9.4	-10.3	36.7	0.83	4.45	7.93	0.02
Money Growth	39	12.9	5.4	-1.1	26.1	-0.22	3.55	0.80	0.67
GDP Growth	39	25.2	115.7	-10.2	711.7	5.61	33.57	1723.17	0.00
Budget Deficit	40	-680.9	2388.1	3580.9	4815.0	-0.80	5.00	10.71	0.00
Oil Price	40	3.6	0.5	2.8	4.6	0.19	2.03	1.79	0.41
Rain Fall	40	4.6	0.2	4.1	4.9	-0.12	3.54	0.58	0.75

Appendix B: Results of Unit Root tests with ADF and PP a,b

Variables	Augmented Dickey-Fuller (ADF)		Phillips-Perron (PP)	
	At Level	First Difference	At Level	First Difference
Lcpi	-0.093	-3.710**	0.170	-4.915**
Lgdp	8.854	14.522	2.056	-6.233**
lm2	0.727	-4.049**	1.307	-5.983**
Loilpr	-2.208	-4.349**	-2.030	-5.115**
Lrain	-2.785	-7.906**	-3.949**	-11.792**

a The ADF and PP tests are based on the null hypothesis of unit roots.
b **, and * indicate significant at 1%, and 5% levels respectively, based on the critical t-statistics as computed by MacKinnon (1996).

Appendix C: Johansen tests for cointegration

Trend: constant			**Number of obs = 38**		
Sample: 1972 - 2009			**Lags**		
Max rank	**parms**	**LL**	**eigenvalue**	**trace statistic**	**5% critical value**
0	20	50.935417	.	128.9275	47.21
1	27	104.3394	0.93984	22.1195*	29.68
2	32	111.73297	0.32236	7.3324	15.41
3	35	115.33736	0.17280	0.1236	3.76
4	36	115.39915	0.00325		