Do Monetary Policy Frameworks Matter in Low-Income Countries?*

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Our paper provides new empirical evidence about how the characteristics of the monetary policy framework affects the propagation of shocks in low-income countries (LICs). First, we analyze a cross-country panel dataset of 79 LICs over the period 1990 to 2015 to assess the impact of external shocks on real GDP growth, and we find highly significant differences between LICs where the central bank targets monetary aggregates or inflation compared to LICs that use the nominal exchange rates as the main nominal anchor. Second, we use difference-in-difference methods to assess the evolution of economic growth in sub-Saharan Africa (SSA) over the period from 1986 to 1994, and we find highly significant differences between 9 countries in the Central African Franc (CFA) zone compared to a control group of 12 other SSA countries. Our findings show that central banks in LICs can face policy tradeoffs similar to those which have been highlighted for more advanced economies, and our analysis underscores the key role of the monetary policy framework in fostering price stability and sustained economic growth in LICs.

JEL Codes: E02, E52, E58, O23

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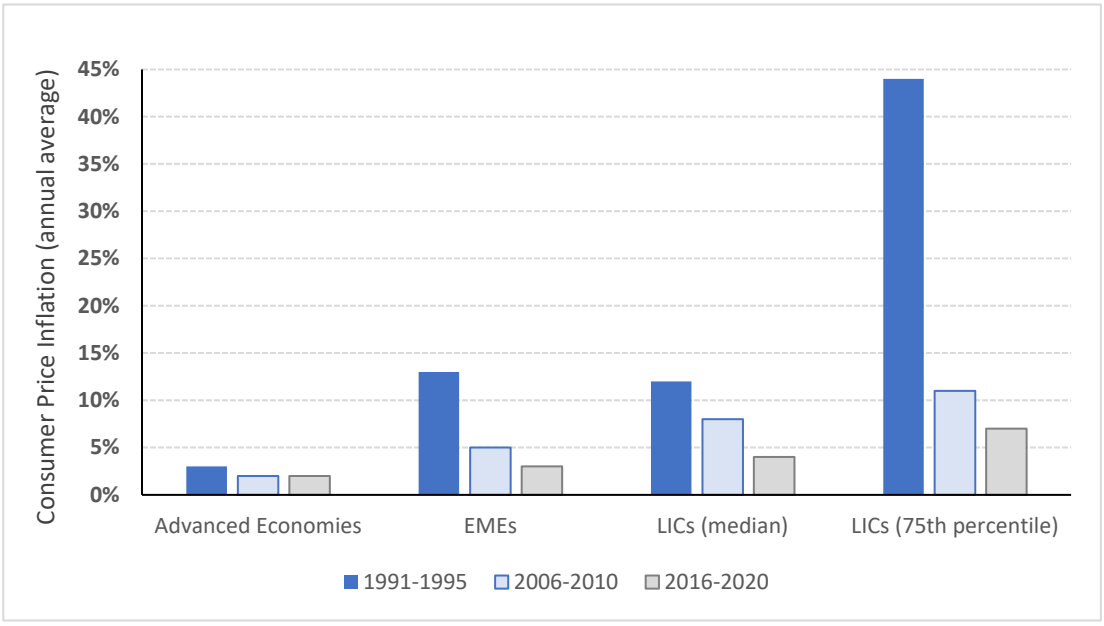
1. Introduction

In recent years, numerous low-income countries (LICs) have engaged in reforms to make their monetary policy frameworks more systematic, transparent, and forward-looking, often with technical support from the International Monetary Fund.[6] In particular, many LICs have been moving towards frameworks that foster price stability while allowing for greater exchange rate flexibility.

Not by coincidence, LICs have made extraordinary progress in bringing down inflation in recent years. Figure 1 shows the evolution of average annual CPI inflation in three distinct five-year intervals over the past three decades, across different groups of countries classified according to their level of development. Indeed, the shift in the median inflation rate for LICs has been broadly similar to that of emerging market economies (EMEs), and inflation outcomes are now just a notch higher than in advanced economies (AEs).

Figure 1
The Quiet Revolution in Monetary Policy



Source: World Bank online database.

[6] International Monetary Fund (2015).

Moreover, this success has been remarkably broad-based, as indicated by the changes in the 75th percentile of the distribution for LICS. That metric indicates that as of the early 1990s one-fourth of all LICs had inflation rates exceeding 40%, whereas three-fourths of all LICs now have single-digit inflation rates. These outcomes reflect structural and institutional reforms that have put fiscal policy onto a more sustainable path and significantly curtailed reliance on the central bank for financing budget deficits.

As many LICs have succeeded in taming inflation on a sustained basis, these countries now face more specific questions about the design of their monetary policy frameworks, analogous to the issues faced by central banks in AEs and EMEs. For example, should the central bank focus narrowly on stabilizing the price level *("strict inflation targeting")* or consider other objectives in setting the stance of policy *("flexible inflation targeting")*? What are the tradeoffs between stabilizing the domestic price level vs. the nominal exchange rate, and how do those choices affect the stability of economic growth? Moreover, in moving to a forward-looking monetary policy framework, analysis of the dynamic behavior of the economy and the propagation of shocks plays a key role in constructing economic forecasts and alternative scenarios.[7]

In this paper, we provide new empirical evidence about how the propagation of shocks in LICs is affected by the monetary policy framework. First, we analyze the response of real GDP to global shocks in a panel dataset of 79 LICs with annual data from 1990 to 2015, using the IMF AREAER classification of policy regimes that target the nominal exchange rate vs. policy regimes that target monetary aggregates or inflation. Second, we use difference-in-difference methods to assess the evolution of economic growth in sub-Saharan Africa (SSA) over the period from 1986 to 1994, and we find highly significant differences between 9 countries in the Central African Franc (CFA) zone compared to a control group of 12 other SSA countries. Both prongs of our analysis use reduced-form relationships to avoid relying on assumptions about the structure of the economy.

[7] The current inflationary shock seems to have affected LICs broadly similarly with other country income groups in 2021. While inflation has risen much higher in emerging and developing economies (which includes LICs), that could be explained in a large part. by much higher weights in the CPI basked for food and fuel, prices. Moreover, medium-term inflation forecasts (2027) for Sub-Saharan Africa LICs are consistent with the inflation rates observed by that group prior to the pandemic, as in other country-income groups (see July 2022 World Economic Outlook of the IMF), still pointing to well anchored inflation expectations.

Our findings illuminate monetary policy tradeoffs and highlight the role of monetary policy frameworks in fostering price stability and sustained economic growth in LICs. More specifically, our panel analysis examines the response of real GDP to surprises in global GDP, shifts in the terms of trade, and fluctuations in the price of oil. We find that the magnitude of those effects is significantly larger for policy regimes that target the nominal exchange rate compared to LICs that target monetary aggregates or inflation. Our analysis documents the robustness of these results across alternative regression specifications, including a sample limited to the lowest-income LICs, underscoring that monetary policy frameworks are as important in those economies as well as in the LICs that are approaching graduation to EME status.[8]

Our diff-in-diff analysis considers the evolution of real GDP growth of 9 CFA countries compared to a control group of 12 other SSA countries over the period 1986-94. At that time, the CFA was fixed to the French franc, which in turn was pegged to the German mark that served as the anchor of the European Monetary System (EMS). We verify the parallel trends assumption over the "pre-treatment" period of 1986-89; indeed, neither group exhibited a significant trend in growth over that period. Next, we analyze the impact of German reunification in 1990, which led to a marked tightening of French monetary policy to defend the French franc, and we find that this shock markedly reduced real GDP in the CFA zone but had no effect on the control group. Finally, after further economic developments in 1991-93, the CFA franc was devalued by 50% on January 1st, 1994, and during that year the CFA zone grew much faster than the control group.

Our paper makes a key contribution in highlighting how the specification of the monetary policy framework has significant consequences for the real economy in LICs. Our results can help inform policymakers' choices about specifying the nominal anchor in terms of the domestic price level, money aggregates vis-à-vis the nominal exchange rate, as well as the design of the central bank's policy framework (e.g., strict vs. flexible inflation targeting).

[8] Aguiar and Gopinath (2007) suggested that macroeconomic data for developing countries could be interpreted in terms of real business cycle (RBC) models driven primarily by productivity shocks, whereas García-Cicco, Pancrazi, and Uribe (2010) found that such a model could not explain key patterns in macroeconomic data for Argentina and Mexico. The notion that developing economies—where presumably economic and financial transactions are conducted in spot markets with flexible prices—could be reasonably approximated by RBC models imply that changes in money or nominal interest rates would be fully and quickly reflected in the domestic price level, while the determination of real economic activity would be unrelated to the choice of nominal anchor or other characteristics of the monetary policy framework (i.e., monetary neutrality). See Kydland and Prescott (1980) and Long and Plosser (1981).

Finally, it should be noted that our panel data analysis builds on the seminal work of Broda (2004), who analyzed the economic impact of terms of trade shocks using a panel dataset of 75 developing countries (including 30 LICs) over the period from 1973 to 1996 and found highly significant differences between regimes in output growth with fixed vs. flexible exchange rates.[9] The results of our dif-in-dif analysis are broadly consistent with the findings of Hoffmaister et al. (1998), who estimated a structural vector autoregression (VAR) for sub-Saharan African countries from 1971 to 1993 and found that external shocks contributed to greater output volatility in CFA vs. non-CFA countries. Our empirical approach is complementary but distinct from other recent studies that have used structural VAR models or dynamic stochastic general equilibrium (DSGE) models to analyze macroeconomic data for developing economies.[10]

The remainder of our paper is organized as follows. Section 2 describes the methodology of our panel data analysis, and Section 3 reports the results of that analysis. Section 4 presents our diff-in-diff analysis. Section 5 concludes.

[9] Edwards and Levy Yeyati (2005) analyzed terms of trade shocks in a larger panel dataset but did not report disaggregated results for LICs. Kose et al. (2003), Raddatz (2007) and Barrot et al. (2018) used panel data to analyze the influence of external shocks but did not assess the role of monetary policy frameworks. Calderón and Fuentes (2014) analyzed business cycles in advanced economies and EMEs, but their sample did not include any LICs. Rose (2014) studied the impact of the global financial crisis in a large panel dataset but did not report disaggregated results by level of development; see also Terrone (2020).

[10] For structural analysis of monetary transmission mechanisms in LICs, see Mishra and Montiel (2012), Portillo et al. (2016), Barajas et al. (2018), Berg and Portillo (2018), and Li et al. (2019). For structural analysis of the effects of government spending in LICs, see Shen et al. (2018)

Table 1: Low-Income Countries (LICs)

Afghanistan	Gambia	Nicaragua
Albania	Georgia	Niger
Angola	Ghana	Nigeria
Armenia	Grenada	Pakistan
Azerbaijan	Guinea	Papua New Guinea
Bangladesh	Guinea-Bissau	Rwanda
Benin	Guyana	Samoa
Bhutan	Haiti	São Tomé and Príncipe
Bolivia	Honduras	Senegal
Burkina Faso	India	Sierra Leone
Burundi	Kenya	Solomon Islands
Cambodia	Kiribati	Sri Lanka
Cabo Verde	Kyrgyz Republic	St. Lucia
Cameroon	Lao P.D.R.	St. Vincent and Grenadines
Central African Republic	Lesotho	Sudan
Chad	Liberia	Tajikistan
Comoros	Madagascar	Tanzania
Congo, Democratic Republic	Malawi	Timor-Leste
Congo, Republic of	Maldives	Togo
Côte d'Ivoire	Mali	Tonga
Djibouti	Mauritania	Uganda
Dominica	Moldova	Uzbekistan
Eritrea	Mongolia	Vanuatu
Ethiopia	Mozambique	Vietnam
	Myanmar	Yemen
	Nepal	Zambia

2. Panel Data and Methodology

Our analysis encompasses all countries that were classified as LICs at any point during the period 1990 to 2015. Table 1 reports the full list of 79 countries that are included in our sample. However, some countries (such as Afghanistan and South Sudan) have missing data during part of the sample period. Moreover, our panel only includes observations for years in which each country was classified as a LIC; some countries (such as India) graduated from LIC status and became classified as EMEs during the sample period. Consequently, the panel is not fully balanced, and its cross-sectional dimension evolves over time, e.g., there are 76 countries from 2003 to 2009 but only 69 countries as of 2015.[11]

Following the approach of Jordà (2005), we estimate the dynamic response of GDP growth to external shocks using a parsimonious single-equation specification. This approach is effective for

[11] See Appendix A for variable definitions and data sources.

capturing nonlinear dynamics while avoiding the need to impose *a priori* restrictions. In particular, we perform regressions as follows:

$$\dot{y}_{i,t+k} \;=\; \theta_{1,k}\, MP_{i,t}\, x_{i,t} \;+\; \theta_{2,k}\left(1 - MP_{i,t}\right) x_{i,t} \;+\; \alpha_{i,k} + \gamma_{t,k} + \varphi z_{i,t,k} + e_{i,t,k} \qquad (1)$$

where $\dot{y}_{i,t}$ denotes the real GDP growth of country *i* in year *t,* i.e., $\dot{y}_{i,t} = 100\left(y_{i,t} - y_{i,t-1}\right)$, and $y_{i,t}$ denotes the natural logarithm of real GDP. The binary indicator $MP_{i,t}$ denotes the monetary policy framework of country *i* in year *t*, i.e., $MP_{i,t} = 0$ if the nominal exchange rate is the main nominal anchor, and $MP_{i,t} = 1$ if the central bank targets monetary aggregates or inflation. The exogenous variable $x_{i,t}$ denotes the external shock to country *i* at year *t*. The country-specific and time-specific effects are denoted by $\alpha_{i,k}$ and $\gamma_{t,k}$, respectively, and the vector of control variables is denoted by $z_{i,t}$.[12]

We consider two distinct time horizons: $k = 0$ corresponds to the contemporaneous impact of the shock, while $k = 1$ corresponds to the lagged effect one year later. Since forecast error variance increases rapidly at longer horizons, specifications with $k > 1$ generally do not yield any statistically significant results.

Our main analysis is focused on assessing the impact of external demand shocks, i.e., for each country *i* and year *t*, $x_{i,t}$ denotes the innovation in trade-weighted real GDP of all other countries.[13] Parallel analysis of other shocks (the terms-of-trade and global oil prices) are provided in the appendices, and those results are fully consistent with our main findings.

In particular, the external demand shock to country *i* in year *t* can be expressed as follows:

$$x_{i,t} \;=\; \sum_{j \neq i}\left(\dot{y}_{j,t} \;-\; \mathrm{WEO}_{t-1}\left[\dot{y}_{j,t}\right]\right) \qquad (2)$$

where $\dot{y}_{j,t}$ denotes the real GDP growth of country *j* in year *t* for all other countries $j \neq i$, and $WEO_{t-1}\left[\dot{y}_{j,t}\right]$ denotes the forecast published in the IMF World Economic Outlook in the fall of the previous year.[14] We use this approach for computing forecast errors because the WEO covers

[12] Introducing lag domestic GDP growth as a control variable would reduce autocorrelation in the error term at the expense of making more difficult to disentangle the difference in the impact of the shock relative to the monetary policy framework. To account for the possibility of autocorrelation in residuals we used robust standard errors.

[13] Rand and Tarp (2002) find that shocks originating from OECD economies are critically important drivers of short-run output fluctuations in developing economies

[14] Over the period 1990 to 2015, WEO forecast errors for world GDP have a standard deviation of 1.1 percent and a range of -3.6 to +1.9 percent.

the entire global economy and reflects rigorous analysis as well as the expert judgment of Fund staff. An alternative approach would be to use forecasts generated mechanically by a statistical model such as a VAR, but such forecasts would necessarily rely on specific technical assumptions (e.g., linearity or stationarity).

Our classification of monetary policy frameworks is taken from the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER). This system uses a transparent and consistent methodology that incorporates judgments of the national authorities as well as Fund country teams.[15] We use the AREAER to distinguish two types of policy frameworks: (a) regimes that rely primarily on the exchange rate as the nominal anchor, and (b) regimes that target monetary aggregates or inflation.[16] For about one-third of the observations in our sample, the monetary policy framework is focused on targeting money or inflation; for all other observations, the monetary policy framework is focused on exchange rate stability.[17]

It should be noted that these regime classifications are potentially subject to two sources of endogeneity. First, a country's monetary policy framework at the start of the sample period may reflect intrinsic factors that are linked to its sensitivity to external shocks, e.g., countries with a high degree of trade openness might be more likely to have a regime in which the exchange rate serves as the nominal anchor. Second, a country may decide to switch to a different monetary policy framework, and that choice may hinge on the incidence of external shocks or other time-varying factors.[18] In light of those issues, our panel regressions include country-specific fixed

[15] Of course, this database may contain some misclassifications, which would add noise to our regime indicator and hence reduce the statistical significance of the results. Consequently, our analysis may be reasonably viewed as providing a lower bound for the true importance of monetary policy frameworks in LICs.

[16] Group (a) includes countries with hard pegs (no separate legal tender, currency boards and conventional pegged arrangements), soft pegs (stabilized arrangements, crawling pegs, craw-like arrangements, pegged exchange rates within horizontal bands, and other managed arrangements), and a few other countries where the exchange rate serves as the intermediate anchor of monetary policy. For group (b), it would be ideal to distinguish between monetary targets and inflation targeting, but only a single LIC (Ghana) initiated an inflation targeting framework prior to 2010.

[17] See Appendix B for detailed characteristics of monetary policy frameworks and exchange rate arrangements. For example, if the category of fixed exchange rate regimes was limited to Hard Pegs and Soft Pegs, that re-classification would only affect about 4 percent of the observations in our sample. We have verified that our results are robust to alternative specifications of the classification of monetary policy frameworks; those results are available on request from the authors.

[18] Of the 79 LICs in our sample, 25 countries never switched their monetary regime during the sample period, while 20 made a single switch (mostly departing from an exchange rate regime and adopting monetary/inflation targeting), and a number of other countries temporarily allowed greater exchange rate flexibility and then returned to a rigid exchange rate regime. Our regression analysis only includes observations in which the monetary policy framework of country *i* in year *t* was the same as in the preceding year *t-1*.

Table 2: Descriptive Statistics of Panel Dataset, 1990-2015

	Money / Inflation Target	Exchange Rate Target
Total Number of Annual Observations	575	995
GDP Per Capita *(PPP-Adjusted Constant Dollars)*		
All LICs	848	1,498
Lower-Income LICs *(less than $800)*	428	436
Trade Openness		
Exports *(percent of GDP)*	29	31
Imports *(percent of GDP)*	42	47
Capital Mobility		
Capital Inflows *(percent of GDP)*	6.1	5.3
Capital Outflows *(percent of GDP)*	2.3	2.7
Financial Development		
Financial depth index	14	25
Governance Indicators		
Corruption	2.1	2.3
Composite Risk	58.1	58.2
Economic Risk	29.8	31.0
Financial Risk	31.5	31.1
Political Risk	54.8	54.3
Central Bank Independence	0.5	0.4

Note: The financial depth index assesses the ratio of private credit to GDP and the ratio of deposit money bank assets to GDP. The governance measures of risk are taken from the International Country Risk Guide. The index of central bank independence is taken from Cukierman et al. (1992). See Appendix A for details.

effects and control variables, but we recognize that those adjustments may not fully eliminate these sources of endogeneity bias.

Our baseline specification includes country-specific and time-specific fixed effects, and we also control for the impact of military conflicts (as measured by the incidence of battle-related deaths), which have been associated with very large output fluctuations in some LICs.[19] In our sensitivity analysis, the set vector of control variables includes other country-specific characteristics that could be associated with the choice of monetary policy regime. Nonetheless, as shown in Table 2,

[19] In our parallel analysis of shocks to terms-of-trade and global oil prices (reported in Appendices C and D), the vector of control variables also includes our measure of shocks to external demand.

the mean values of these indicators are broadly similar across the two types of monetary policy frameworks. Our sensitivity analysis also excludes outliers using the studentized residual method.

We use Wald tests to assess whether the dynamic response of domestic output to a world GDP shock depends on the monetary policy framework. In particular, we test the null hypothesis that $\theta_{1k} = \theta_{2k}$ at each distinct time horizon (k = 0,1). The rejection of this null hypothesis can be interpreted as confirming that the design of the monetary policy framework indeed matters in LICs.

3. Impact of Global Demand Shocks

The results of our panel analysis are shown in Table 3. Evidently, shocks to global demand have markedly different effects on LICs with more rigid exchange rates compared to LICs with monetary frameworks that target monetary aggregates or inflation. In particular, an unanticipated 1 percent upward shift in world GDP boosts domestic output growth by about 0.5 percentage points in frameworks with more rigid exchange rates, and this effect is highly statistically significant in the year when the shock occurs as well as in the subsequent year. In contrast, the global shock has a negligible effect on LICS where the central bank targets monetary aggregates or inflation, and the differential impact compared to exchange rate-based frameworks is highly significant.

Indeed, these results are remarkably consistent with the implications of conventional models used in analyzing more advanced macroeconomies.[20] In such models, an unanticipated drop in global growth reduces exports and hence exerts downward pressure on money demand. In a framework with, say, an exchange rate peg, the central bank reduces the supply of money by a corresponding amount to keep domestic interest rates aligned with foreign interest rates, and that contraction in the money stock *magnifies* the impact of the external shock. Conversely, in a framework of monetary targeting or inflation targeting, the nominal interest rate declines and the nominal exchange rate depreciates, thereby *dampening* the impact of the external shock on domestic output.

In principle, such findings could differ according to relative income levels, and hence we consider the robustness of these results for a sub-sample of the lowest-income LICs. Such countries tend to have a large fraction of self-subsistence farmers and a relatively large informal sector, and hence prices and wages might be even more flexible than in LICs at somewhat higher levels of

[20] See the seminal contributions of Friedman (1953) and Obstfeld and Rogoff (1996).

Table 3: Response of Real GDP Growth to Global Demand Shock

MP Framework	*k* (horizon in years)	
	0	1
Sample: All LICs (79 countries, 1578 observations)		
Exchange Rate	0.49***	0.54***
	(0.1385)	(0.1252)
Inflation or Monetary Targeting	0.16	-0.09
	(0.1256)	(0.1441)
Difference	0.33*	0.63***
	(0.1859)	(0.1677)
Sample: LICs with GDP Per Capita below US$800 (62 countries, 870 observations)		
Exchange Rate	0.43**	0.86***
	(0.2053)	(0.2180)
Inflation or Monetary Targeting	-0.18	-0.03
	(0.1514)	(0.1594)
Difference	0.62**	0.88***
	(0.2679)	(0.2822)

*Note: Each regression is estimated using Panel Least Squares. The asterisks ***, **, and * denote statistical significance at the 1, 5, and 10 percent levels, respectively. In each regression, the dependent variable is the real GDP growth rate at time t+k , i.e., 100*log(GDP_{t+k}/ GDP_{t+k}), and the explanatory variables are as follows: (i) country fixed effects; (ii) forecast error of world GDP at time t, interacted with monetary policy framework dummy indicator (exchange rate vs. inflation/monetary targeting); and (iii) battle-related deaths.*

development, which could in principle reduce the relevance of the choice of monetary policy framework for the propagation of shocks. To examine this possibility, we consider the subsample of very low-income LICs, i.e., 62 countries (out of 79 LICs in our dataset) for which the PPP-adjusted level of real GDP per capita was less than US$800 as of 1990.[21] As shown in the lower panel of Table 3, the contrast between monetary frameworks is even stronger for this subsample than for the overall sample. For example, the impact of the shock in frameworks centered around more rigid exchange rates, is stronger by up to sixty percent in the year following the shock (horizon 1) than in the case of our entire sample of LICs, and the difference in impact among the two types of frameworks almost doubles in the year of the shock.[22]

[21] The country must remain below the threshold in 1990 and 1991 to be included in the subsample.

[22] The results hold including for the poorest LICs (with income below US$540.7), especially in the year following the shock. For countries above the median the results still hold, and the impact is stronger in the year of the shock; results available by request.

Table 4: Robustness of Panel Data Analysis

Sample: All LICs; *(79 countries 1552 observations)*		
Horizon	*k* (horizon in years)	
	0	1
Baseline, controling for outliers	0.19	0.66***
	(0.1502)	(0.1333)
Additional Controls:		
Trade Openness	0.20	0.60***
	(0.1517)	(0.1612)
Capital Openness (Inflows + Outflows / GDP)	0.19	0.62***
	(0.1570)	(0.1750)
Capital Openness (Ito's index)	0.20	0.48***
	(0.1518)	(0.1722)
Financial Depth (Bank assests / GDP)	0.17	0.52***
	(0.1529)	(0.1586)
Financial Depth (Credit to private sector / GDP)	0.14	0.59***
	(0.1502)	(0.1566)
Fiscal Policy	0.15	0.34**
	(0.1573)	(0.1550)

*Note: Each regression is estimated using Panel Least Squares, with outliers excluded using the studentized residual method. The asterisks ***, **, and * denote statistical significance at the 1, 5, and 10 percent levels, respectively. In each regression, the dependent variable is the real GDP growth rate at time t+k , i.e., 100*log(GDP_{t+k}/ GDP_{t+k}), and the explanatory variables are as follws: (i) country fixed effects; (ii) forecast error of world GDP at time t, interacted with monetary policy framework dummy indicator (exchange rate vs. inflation/monetary targeting); (iii) battle-related deaths; and (iv) the additional control variable as specified in the first column. Trade Openness refers to the ratio of total trade to GDP. Fiscal Policy refers to the ratio of the government deficit to GDP. See Appendix A for further details.*

The results are also robust according to a variety of methods and controls used. Table 4 reports the difference in coefficients for various monetary policy frameworks when controlling for various factors (outliers, and one control variable at a time, as follows). First, the difference in coefficients associated with the monetary policy framework remains significant at 1 percent when we use different ways to eliminate outliers. Second, the control variables are statistically significant and introducing these controls weaken the results somewhat: (i) the results at the impact of the shock (horizon 0) are now insignificant (they remain significant at 1-year horizon), and (ii) introducing the controls lower the impact of shocks at horizon 1 for financial depth and fiscal policy. This is in line with other results found in the literature.[23]

[23] Broda (2004) finds that trade openness is the only systematically significant control, and that introducing such a control makes the difference among regimes less significant.

The introduction of such control variables ensures that correlations between the monetary policy framework and other characteristics of that country are not captured by the monetary policy framework variable. A number of control variables are also included in the regressions, as commonly used in the literature: trade openness (the share of trade in the country's output, defined as the sum of nominal exports and imports divided by the nominal GDP), capital account openness (measured as the sum of capital inflows and outflows as a share of GDP), financial depth (measured as deposit money bank assets as a percent of GDP), and the overall fiscal balance for central government (also as a percent of GDP).

To summarize, we find strong and robust evidence—that holds even for the poorest LICs—that the effect on domestic output growth of unanticipated surprises to external demand depends on the monetary policy framework used and it is in line with notion that the exchange rate acts as a shock absorber.[24]

We have obtained broadly similar results by applying this empirical methodology to gauge the effects of other external shocks. For example, as reported in Appendix C, unanticipated shocks to the terms of trade have much larger effects on real GDP growth in LICs with rigid exchange rates compared to LICs that target monetary aggregates or inflation, and that difference is statistically significant at the 99% confidence level, consistent with the earlier findings of Broda (2003). Likewise, Appendix D provides parallel analysis for the impact of global oil price shocks on the real GDP growth of oil-exporting LICs. Those results provide further confirmation about the significant role of monetary policy frameworks in facilitating economic stability in LICs.

[24] Liquidity management is crucial in framework with fixed exchange rates; see El Hamiani and Veyrun (2019).

4. Difference-in-Difference Analysis

We now turn to difference-in-difference ("diff-in-diff") analysis of how German reunification affected the economic growth of LICs in sub-Saharan Africa (SSA) from 1990 to 1994.[25]
It might seem surprising that a geopolitical event in central Europe could have disparate effects on economies in SSA. The context for this "natural experiment" can be summarized as follows:

- Following independence, a number of former French colonies continued using a common currency—the Central African Franc (CFA)—that was rigidly fixed to the French franc; indeed, the exchange rate between the CFA franc and the French franc remained constant from 1948 until the end of 1993. [26] By contrast, other SSA countries established national currencies and conducted their own independent monetary policies.
- From 1987 onwards, the French franc was pegged rigidly to the German mark, which served as the anchor of the European Monetary System (EMS). Thus, when the Deutsche Bundesbank raised interest rates markedly in 1990 in response to German reunification, that triggered an even sharper tightening by the Banque de France (which was defending its peg against speculative pressures), and that tightening was transmitted directly to the members of the CFA zone.[27] By contrast, other SSA countries were not directly affected by German reunification.
- In early 1991, the start of the Persian Gulf war triggered a global economic slowdown.
- In 1991-93, CFA members adopted draconian fiscal measures to mitigate real exchange rate appreciation and restore external competitiveness, but those measures also damped economic growth.
- Following confidential consultations with the IMF and French authorities, the CFA franc was devaluated against the French franc by 50 percent on January 1, 1994.[28]

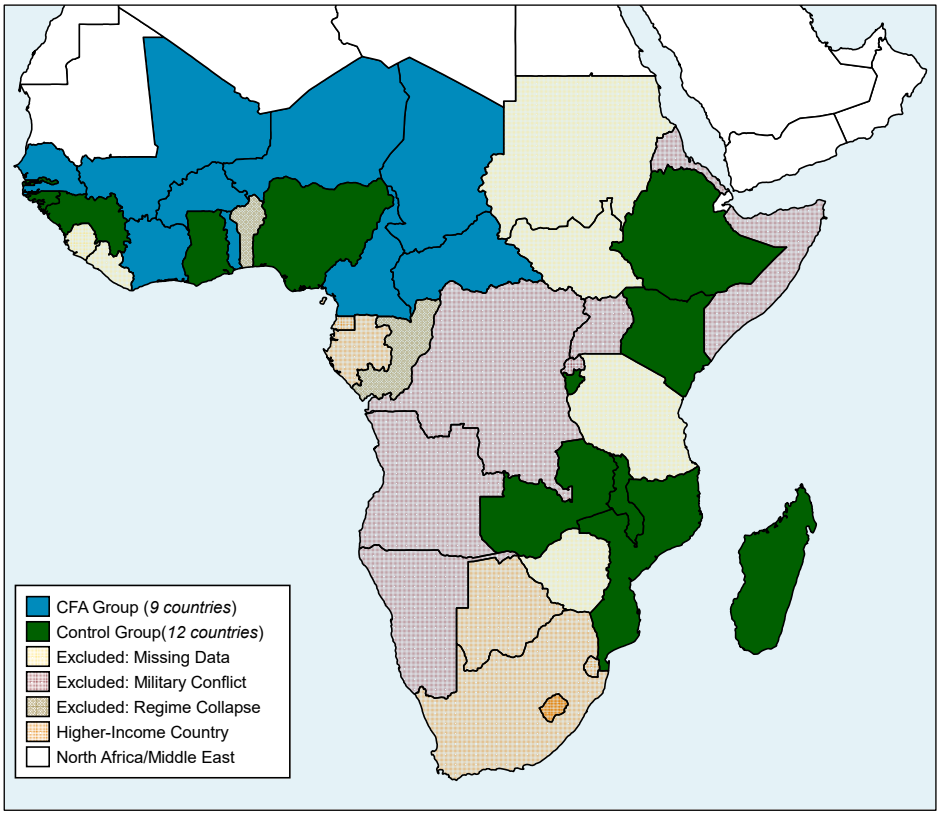
[25] See Callaway and Sant'Anna (2020) for methodology of Diff-in-Diff analysis with multiple time periods.

[26] The CFA zone encompasses the West African Economic and Monetary Union (WAEMU) and the Central African Economic and Monetary Community (CEMAC). Equatorial Guineau (a former Spanish colony) joined CEMAC in 1985. In 1997, Guineau-Bissau (a former Portuguese colony) discontinued its national currency and joined WAEMU. The nominal exchange rate between the CFA franc and the French franc was modified by a factor of 0.01 in 1960 when France removed two zeros from the denomination of its currency (henceforth referred to as the new franc).

[27] Such speculative pressures led several other European countries to depart from the EMS.

[28] As discussed by Beaudry and Sowa (1994), the experience of Ghana showed that currency devaluation could help reduce real wages and improve external competitiveness.

Figure 2: Sub-Saharan LICs, 1986-94



Our sample includes nine LICS that were in the CFA zone from 1986 to 1994 (Burkina Faso, Cameroon, Central African Republic, Chad, Cote d'Ivoire, Mali, Niger, Senegal, and Togo); this group excludes two countries whose Marxist-Leninist regimes collapsed in the early 1990s (Benin and Republic of Congo).[29] Our control group comprises 12 other SSA LICs (Burundi, Comoros, Ethiopia, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Madagascar, Malawi, Mozambique, Nigeria, Uganda, and Zambia) while excluding small island nations and other SSA countries with incomplete GDP data or that were severely affected by civil strife.[30] Notably, two control group countries (Guinea and Madagascar) used the CFA franc during the colonial era but established their own national currencies after gaining independence.

[29] The CFA zone also includes two higher-income countries (Gabon and Equatorial Guinea).

[30] Our control group excludes SSA countries outside the CFA zone that were severely affected by civil strife during the early-to-mid 1990s (Angola, Democratic Republic of Congo, Eritrea, Ethiopia, Namibia, Rwanda, Somalia, and Uganda), countries with missing or incomplete GDP data (Liberia, Sierra Leone, South Sudan, Tanzania, and Zimbabwe), small island nations (Cabo Verde, Comoros, Mauritius, Sao Tome & Principe, and Seychelles), and higher-income countries (Botswana, Eswatini, Lesotho, and South Africa).

Table 5: Diff-in-Diff Analysis of Annual GDP Growth in Sub-Saharan African LICs, 1986-94

Year	Real GDP Growth (%)		CFA Zone Treatment Effect	
	CFA Zone	***Control Group***	***No Covariates***	***With Covariates***
1990	-2.1 *(0.6)*	4.1 *(0.9)*	**-6.2** *** *(1.1)*	**-5.5** *** *(1.2)*
1991	3.0 (1.8)	1.9 *(1.4)*	1.0 *(2.3)*	1.7 *(2.4)*
1992	-0.6 *(1.4)*	-0.5 *(1.3)*	-0.1 *(1.9)*	0.6 *(2.1)*
1993	-3.4 *(2.5)*	4.1 *(1.6)*	**-7.5** ** *(3.0)*	**-6.8** ** *(3.2)*
1994	4.4 *(1.7)*	-0.1 *(1.5)*	**4.5** * *(2.2)*	**5.3** ** *(2.3)*

*Notes: For each year, the first pair of columns shows the mean annual real GDP growth rate of each country group (in %), and the second pair of columns shows the estimated treatment effect, i.e., the deviation of real GDP growth in CFA zone members compared to non-CFA countries. For the final column, the regression includes the following country-specific covariates: total population in 1989, the level of PPP-adjusted real GDP per capita (1985-89 average), the ratio of external trade to GDP, the ratio of domestic credit to GDP, and the ratio of fixed investment to GDP. Standard errors are enclosed in parentheses. Statistically significant treatment effects are shown in bold font, with p-values denoted as follows: *** = below 1%; ** = below 5%; * = below 10%.*

Our analysis begins by verifying the validity of the parallel trends assumption, which is crucial in conducting diff-in-diff analysis. Over the "pre-treatment" period of 1986-89, neither the CFA zone members nor the control group countries exhibited any significant trend in real GDP growth. Indeed, the point estimates for these trends are practically identical: 0.18% per year for CFA zone members and 0.15% per year for control group countries.[31]

As shown in the first pair of columns in Table 5, GDP growth in 1990 was about -2% among CFA zone members, sharply lower than in preceding years, whereas the control group's growth rate of 4% was very similar to its 1986-89 average. Both groups of countries experienced dampened growth during the global recession of 1991-92. The control group rebounded in 1993 and stagnated in 1994, whereas the CFA zone members experienced negative growth in 1993 and then a sharp acceleration in 1994. While not shown in the table, it should be noted that GDP

[31] Appnedix E provides charts of the annual GDP growth data for all of the individual countries over the sample period 1986-94.

growth in the two former French colonies (Guineau and Madagascar) was broadly similar to the rest of the control group throughout this period, providing further verification that the control group serves as a reasonable baseline for assessing developments in the CFA zone.[32]

Now turning to the diff-in-diff analysis, we consider the following set of regressions:

$$\dot{y}_{i,t} \;=\; \alpha_t + \beta_t CFA_{i,t} + \psi z_{i,t} + \epsilon_{i,t} \qquad (3)$$

where the dependent variable is the real GDP growth rate of country *i* in year *t*. The binary indicator $CFA_{i,t}$ is equal to 1 for CFA zone members and 0 otherwise. The regression also includes time-specific effects and a vector of control variables $z_{i,t}$. The treatment effects are denoted by the time-varying coefficients β_t.

As shown in the final pair of columns in Table 5, the German reunification shock (the "treatment") had large and persistent effects on the CFA zone compared to the control group:

- In 1990, real GDP growth in these countries was about 6% lower than in the control group. Even after adding a set of relevant covariates to the regression, the estimated treatment effect is about 5% and is statistically significant at the 99% confidence level.[33]
- In 1991-92, the CFA zone did not exhibit a substantial bounceback, reflecting the implementation of contractionary government budget measures as well as the global economic slowdown.
- By 1993, with increasingly draconian fiscal austerity, real GDP growth in the CFA zone was about 7% lower than in the control group.
- The January 1994 devaluation of the CFA franc was evidently effective in stimulating economic growth in the CFA zone, whose real GDP growth in 1994 exceeded that of the control group by about 5%.

[32] In 1990, for example, Guinea and Madagascar had real GDP growth rates of 4.3% and 3.1%, respectively; similar to the rest of the control group but far above the CFA zone's mean growth rate of -2.1%.

[33] The five covariates are total population, the level of PPP-adjusted real GDP per capita, the ratio of external trade to GDP, the ratio of domestic credit to GDP, and the share of fixed investment in GDP.

Table 6: Diff-in-Diff Analysis of Post-1989 Cumulative GDP Growth in Sub-Saharan African LICs, 1990-94

Year	CFA Zone Treatment Effect	
	No Covariates	***With Covariates***
1990	**-6.1** *** *(1.1)*	**-3.6** ** *(1.5)*
1991	**-5.1** ** *(2.6)*	-2.6 *(2.7)*
1992	-5.2 *(3.4)*	-2.6 *(3.7)*
1993	**-12.8** *** *(4.4)*	**-10.3** ** *(4.5)*
1994	**-8.3** ** *(4.2)*	-5.8 *(4.2)*

Notes: This table shows the estimated treatment effect when the dependent variable is $y_{i,t} - y_{i,1989}$ *. For each year, the penultimate column shows results for the specification with no control variables, while the final column shows results using the same covariates as described in the notes to Table 5. Standard errors are enclosed in parentheses, statistically significant effects are shown in bold, and p-values are denoted as follows: *** = below 1%; ** = below 5%; * = below 10%.*

Finally, as shown in Table 6, the post-1989 cumulative deviation in real GDP of the CFA zone relative to the control group exceeded 10% by 1993 but diminished markedly in 1994.

Thus, this "natural experiment" provides further evidence about the key role of the monetary policy framework, even in LICs with very low income levels (such as Chad and Niger). These results also underscore the challenges of maintaining external competitiveness in the context of a rigid exchange rate, consistent with a long literature that has highlighted the merits of exchange rate flexibility in fostering stable prices and sustained economic growth.

5. Conclusion

In recent years many LICs have been modernizing their monetary policy frameworks. The results of our paper provide strong empirical support for the importance of this progress. We overwhelmingly reject the hypothesis that monetary policy frameworks are irrelevant for LICs. In particular, we find highly significant differences in the response to external shocks on real output growth between LICs with monetary policy frameworks implemented through more rigid nominal exchange rates and LICs implementing monetary or inflation targeting. The countries that use exchange rate targeting to ensure price stability see a statistically larger response in real domestic output growth than countries targeting inflation or money. Moreover, these results are robust to various specifications—including shocks, control variables, and subsamples—and hold even for the poorest LICs.

Our empirical analysis reaches these conclusions without imposing a model or economic structure borrowed from advanced economies and our findings have broader implications for both the formulation of structural models of the monetary transmission mechanism and the design of monetary policy frameworks in LICs. In particular, they strongly suggest that the building blocks needed for a successful monetary policy framework in LICs must be very similar to the best practice for advanced economies and emerging markets (see IMF, 2015). Unsal and others (2020) have recently emphasized the joint relevance of *de jure* and *de facto* characteristics of monetary policy frameworks. Indeed, having a systematic and transparent monetary policy framework may become even more important as LICs face the aftermath of the COVID-19 pandemic and the inflationary outcomes associated with the economic supply-side disruptions and policies to support aggregate demand across the globe.

Appendix A: Definitions and Sources of Panel Data

Variable	Notation	Source	Transformation/Unit
Real GDP	*GDP*	WEO	In logs; 2005 = 100
World GDP	*WGDP*	WEO	In logs; 2005 = 100
Terms of trade	*ToT*	WEO / IFS	Unit value of exports / unit value of imports, in logs; 2005 = 100
Oil prices	*Oil*	WEO	In logs; 2005 = 100
Oil producing indicator	*OilExp*	IEA	Crude oil production exceeding 5% of NGDP
Wars	*War*	Uppsala Conflict Data / UN	Number of battle-related deaths / population
Nominal GDP	*NGDP*	WEO	
Trade Openness	*TO*	WEO	Exports + Imports (US$) / Nominal GDP (US$)
Capital Account Openness: flows	*FA*	WEO	Financial account inflows + outflows (US$) / Nominal GDP (US$)
Capital Account Openness: index	*CAI*	Chinn & Ito	*N/A*
Financial Depth: deposit money banks assets (percent of domestic currency GDP)	*BA*	Global Financial Development	*N/A*
Financial Depth: credit to the private sector (percent of domestic currency GDP)	*CPS*	Global Financial Development	*N/A*
Fiscal Policy: central government overall balance (domestic currency)	*CGBAL*	WEO	Percent of nominal GDP
International Country Risk Guide index and main subcomponents	*ICRG*	PRS group	*N/A*
Central bank independence index and subcomponents	*CBI*	Cukierman et al.	*N/A*

Appendix B: Detailed Information on Monetary Policy Frameworks in LICs, 1990–2015

Exchange rate regimes					
	Hard Pegs	**Soft Pegs**	**Flexible**	**Total**	**Monetary Policy Frameworks**
ER targeting	845	195	24	1,064	
Money targeting	0	82	472	554	
Inflation targeting	0	4	29	33	
Total	**845**	**281**	**525**	**1,651**	

Appendix C: Panel Data Analysis of Terms of Trade Shocks

Developing countries (which include LICs) tend to have growth strategies centered on integrating their economies into the global supply chain and developing through exports growth. Therefore, understanding the effects of a terms of trade shock[34] on domestic growth and how it varies with the monetary policy framework used is also very important.

To the extent that LICs are price takers in the commodity markets, the monetary policy framework affects the impact of a change in terms of trade on domestic output growth.[35] A rise in the value of a country's currency lowers the domestic prices of its imports but may not directly affect the prices of the commodities it exports. As some countries could be price makers, we expect weaker results than in the previous case of an external demand shock.

We use the same regression specification as in equation (1) of the main text, but the external shock $x_{i,t}$ is now defined as the forecast error for the terms of trade of country i in year t, i.e., the actual terms of trade minus the IMF WEO projection published in the fall of the previous year. We consider a typical shock size of 10 percent.[36] Such an unanticipated improvement to a country's terms of trade should expand its net exports and hence raise its aggregate demand. The intuition is similar as before. In the monetary policy framework centered around a fixed exchange rate, the rise in aggregate demand puts pressure on interest and exchange rates. Since the value of the exchange rate should remain fixed, the central bank would offset this effect. If we observe a distinct response of this shock in a monetary policy framework targeting money or inflation, it would be because the exchange rate would be able to adjust, *and* other prices do not adjust instantaneously.

The top panel of Table C1 confirms this intuition. In response to an unanticipated 10 percent shock to the terms of trade, there is a positive effect on domestic output growth (about 0.2 percentage points) mainly in frameworks maintaining price stability through more rigid exchange rates. This effect is statistically significant at the 5 percent level in the year when the shock occurs (horizon

[34] The terms of trade are the relative price of imports in terms of exports in domestic currency. An improvement of a nation's terms of trade benefits that country; it can buy more imports for any given level of exports.

[35] There are some cases where a particular country has a dominant role in the production of a specific commodity. For example, in 2012 Cote d'Ivoire produced about one-third of the world's supply of cocoa and Madagascar accounted for about one-fifth of the global supply of bourbon vanilla.

[36] The standard deviation of the forecast error of the terms of trade is about 15 percent.

0), and at 10 percent in the subsequent year. Moreover, there is a highly statistically significant difference between the effects in frameworks with less flexible exchange rate versus monetary or inflation targeting frameworks (1 percent at 1-year horizon).

The lower panel of Table C1 examines the robustness of these results when we eliminate the influence of outliers and control for other characteristics of the countries studied. Indeed, the precision and statistical significance of our key results is generally strengthened by doing so.

Our sensitivity analysis also highlights potential interactions between monetary and fiscal policy in determining the propagation of shocks. In principle, accommodative fiscal policy could offset restrictive monetary policy, in which case the effects of monetary policy framework might not be readily apparent from the reduced-form impact on economic growth. However, as shown in the final row of Table C1, such interactions are not strong enough to mask the difference in the growth impact of a global demand shock across monetary policy frameworks.[37]

[37] Catao and Chang (2015) show that when imported food price shocks are substantial, in the presence of sticky prices and incomplete international risk sharing, the real exchange rate and terms of trade can move in opposite directions and there are trade-offs between (monetary) policy rules.

Table C1: Effect of a 10 Percent Terms of Trade Shock on Domestic Output Growth

MP Framework	*k* (horizon in years)	
	0	1
Sample: All LICs *(76 countries, 1504 observations)*		
Exchange Rate	0.28**	0.16*
	(0.0134)	(0.0093)
Inflation or Monetary Targeting	-0.17	-0.16*
	(0.0108)	(0.0086)
Difference	0.45***	0.32***
	(0.0171)	(0.0121)
Sensitivity analysis: Difference in monetary policy framework coefficients		
Sample: All LICs *(76 countries, 1484 observations)*		
Baseline, controling for outliers	0.44**	0.29**
	(0.0151)	(0.0121)
Additional Controls:		
Trade Openness	0.44**	0.29**
	(0.0161)	(0.0124)
Capital Openness (Inflows + Outflows / GDP)	0.40**	0.27**
	(0.0169)	(0.0139)
Capital Openness (Ito's index)	0.47**	0.37**
	(0.0159)	(0.0151)
Financial Depth (Bank assests / GDP)	0.52***	0.37***
	(0.0164)	(0.0134)
Financial Depth (Credit to private sector / GDP)	0.45***	0.37***
	(0.0173)	(0.0137)
Fiscal Policy	0.13	0.04
	(0.0204)	(0.0139)

Note: The regressions are estimated using Panel Least Squares. The asterisks ***, **, * denote statistical significance at the 1, 5, and 10 percent levels, respectively. In the sensitivity analysis regressions, outliers are excluded using the studentized residual method. The regression variables are

Dependent: domestic real GDP growth rate at time *t+k,* (100*(log GDPt+k - log GDPt+k-1))

Independent: (i) country fixed effects, (ii) forecast error world GDP at time *t*, interacted with monetary policy framework dummy coefficients (exchange rate versus inflation or money targeting), (iii) battle-related deaths (*war*), and (iv) country specific external demand (to control for world GDP). Results available by request for introducing one additional control variable at a time, as in Table 2

Appendix D: Panel Data Analysis of Oil Price Shocks

This appendix considers the impact of oil price shocks on LIC oil exporters. In a monetary policy framework that targets inflation, a central bank would respond to such shock only to the extent that the second-round effects will push the expected inflation at the targeting horizon to deviate from the inflation target. As before, a difference in the impact on the domestic output growth according to the monetary policy framework used would be present only to the extent to which prices do not adjust immediately, and the exchange rate adjust to buffer the economy instead.

Previous research analyzing the effects of oil price shocks in LICs find that the effect of the most recent oil price shock (starting in 2014) on the output growth of oil importing countries has been muted; see Obstfeld et al. (2016) and Cerdeiro and Plotnikov (2017). One explanation is that most countries, especially the LICs, use oil price subsidies. Since their economy was somewhat insulated when the prices were high, then the aggregate demand did not expand when the prices collapsed, if they were importers. That is the case regardless of the monetary policy framework used.

We also find that the impact of a ten percent oil price shock (the shock defined as before, unanticipated surprises between the forecast of the prices at a year horizon and the actual price) does not differ across monetary policy frameworks for oil importing countries.[38] The results are not reported here but are available on request from the authors.

Thus, we focus our analysis on oil-exporting LICs in which crude oil production exceeds 5% of nominal GDP in at least one year of our sample (1990-2015). For such countries, an unanticipated increase in global oil prices tends to raise net exports and hence stimulate aggregate demand.[39] In the presence of rigidities and frictions, the exchange rate would adjust to buffer the economy from the shock, rather than the prices. As such, we expect a significantly different impact of such shock on domestic output growth across different monetary policy frameworks.

[38] Specifying the magnitude of the oil price shock at 10 percent is conventional in the literature. The forecast error of oil price varies in our sample between -60 and +40 percent, the median of the oil price forecast error is 12 percent.

[39] We converted the IEA measure (in metric ton) into barrels using the standard conversion factor of 7.33 bbl/ton, then we computed the US$ value of crude oil production by multiplying oil price, and then computed the ratio to nominal GDP. While this is a relatively low threshold, given the size of the sample, it is useful.

To analyze this hypothesis, we use the same regression specification as in equation (1), and we now define the external shock x_{it} as the surprise in the global oil price, i.e., the average oil price in year t minus the WEO projection published in the fall of the preceding year.

The regression results are shown in Table D1 and confirm the significant role of the monetary policy framework. In response to an unanticipated 10% shock to global oil prices, there is a positive effect on domestic output growth (by about 0.45 percentage points in the year of the shock and higher in the subsequent year) only in frameworks maintaining price stability through rigid exchange rates. The impact is statistically significant at the 99 percent confidence level, especially one year after the shock, and there is a statistically significant difference between the effects in frameworks with rigid exchange rate versus monetary or inflation targeting frameworks in the year after the shock.

These findings are robust to removing outliers and adding other control variables, especially in the year following the shock. These results are broadly consistent with the findings of Grigoli et al. (2017), who found that the 2014 oil price shock affected disproportionately the oil exporters targeting an exchange rate. This strong and robust statistical difference in the effect on domestic output growth of an oil price shocks for big oil exporters, implies that big oil exporters using a fixed exchange rate as a nominal anchor have a very volatile domestic output growth. They benefit tremendously when oil prices increase and suffer a lot when oil prices plunge.

Table D1: Effect of a 10 Percent Global Oil Price Shock on Domestic Output Growth

Sample: LICs big oil exporting *(9 countries, 183 observations)*		
MP Framework	*k* (horizon in years)	
	0	1
Exchange Rate	0.46**	0.69***
	(0.0220)	(0.0167)
Inflation or Monetary Targeting	0.62*	-0.03
	(0.0352)	(0.0150)
Difference	-0.16	0.66***
	(0.0482)	(0.0250)
Sensitivity analysis: Difference in monetary policy framework coefficients		
Sample: LICs big oil exporting *(9 countries, 183 observations)*		
Baseline, controling for outliers	0.30	0.71***
	(0.0311)	(0.0181)
Additional Controls:		
Trade Openness	0.32	0.71***
	(0.0349)	(0.0189)
Capital Openness (Inflows + Outflows / GDP)	0.24	0.66***
	(0.0325)	(0.0181)
Capital Openness (Ito's index)	0.27	0.87***
	(0.0396)	(0.0308)
Financial Depth (Bank assests / GDP)	0.28	0.62***
	(0.0328)	(0.0224)
Financial Depth (Credit to private sector / GDP)	0.29	0.68***
	(0.0220)	(0.0195)
Fiscal Policy	0.10	0.43*
	(0.0330)	(0.0238)

Note: The regressions are estimated using Panel Least Squares. The asterisks ***, **, * denote statistical significance at the 1, 5, and 10 percent levels, respectively. In the sensitivity analysis regressions, outliers are excluded using the studentized residual method. The regression variables are specified as follows:

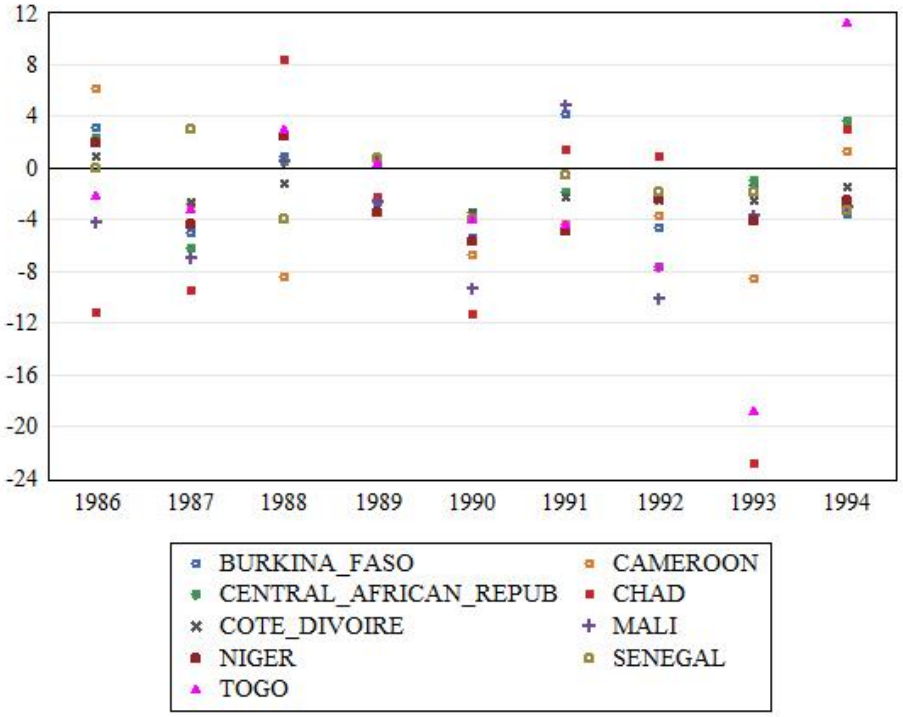
Dependent: domestic real GDP growth rate at time *t+k,* (100*(log GDPt+k - log GDPt+k-1))

Independent: (i) country fixed effects, (ii) forecast error world GDP at time *t*, interacted with monetary policy framework dummy coefficients (exchange rate versus inflation or money targeting), (iii) battle-related deaths (*war*), (iv) country specific external demand (to control for world GDP)

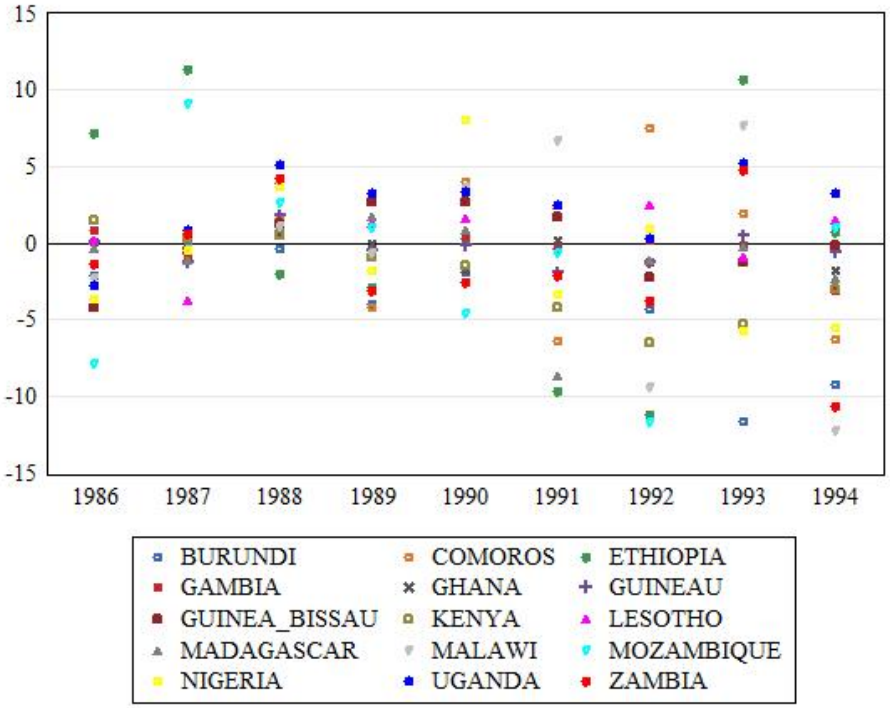
Big oil exporters: Angola, Cameroon, Chad, Rep. of Congo, Ghana, Mauritania, Nigeria, Sudan, and Yemen.

Appendix E: Annual Real GDP Growth in Selected Countries, 1986-94

CFA Zone



Control Group



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