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Claremont McKenna College

**A Comparative Analysis of 14 Central Banks' Monetary Responses
before and after the COVID-19 Pandemic in Relation to Central Bank
Independence**

submitted to
Professor Richard C. K. Burdekin

by
Emelle Stottele

for
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Abstract

In theory, during periods of economic downturn, economic policy should follow a countercyclical pattern. In this light, following the recent COVID-19 pandemic, monetary policy is expected to be contractionary. However, prior research shows that the cyclical nature of monetary policy can vary significantly across different countries. Research also suggests that these monetary responses differ based on the level of independence a central bank has for decision-making from government influence. This thesis studies the effects of the COVID-19 pandemic on the monetary responses across a panel of 14 countries from January 2018 to August 2022, capturing the impacts of the pandemic. The results suggest that during periods of economic crisis, monetary policy tends to follow fiscal policy in its responses. The effects of central bank independence (CBI) are limited to countries with High-CBI having less inflationary pressure than countries with Low-CBI. Ultimately, the nature of monetary responses is procyclical.

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Introduction

Before the COVID-19 pandemic, an outbreak of this magnitude had not occurred since the Spanish flu of 1918. Although COVID-19 was far less deadly than the Spanish flu, its impacts on the world economy were monumental. COVID-19 resulted in significant contractions for economies worldwide, bringing about high unemployment, recession, and inflation. In theory, during periods of economic downturn, economic policy should follow a countercyclical pattern. To this theory, following the recent COVID-19 pandemic, monetary policy is expected to be contractionary. However, evidence has shown that the cyclical nature of monetary policy can differ significantly across countries (Kim, 2006).

Politicians tend to be the first to receive criticism for harsh economic conditions following a crisis in an economy. In these periods of crisis, politicians, especially those seeking reelection, favor an expansionary monetary policy as a solution. This type of policy is particularly favored because it spurs economic growth by lowering interest rates, making it easier for consumers and businesses to borrow and spend money. Contrastingly, central banks should be more inclined to pursue a contractionary monetary policy to fight rising inflation. However, not all banks will respond uniformly, the main distinguishing factor being central bank independence.

Central bank independence refers to a bank's ability to restrict a government from influencing monetary policy management (Garriga, 2016). Overall, a more independent central bank can take actions that put the economy's health first. This analysis reviews

fourteen different central banks' monetary responses before and after the pandemic in relation to central bank independence.

Literature Review

Central banks' crucial role is to manage monetary policy and minimize economic fluctuations. How effective a central bank is at conducting its monetary policy is highly dependent on its independence from political interference. Independent central banks have freedom from political business cycles, indicating that they can withstand external pressures to ease monetary policy or take other actions which may be politically advantageous but economically disadvantageous. There have been many instances where the government has influenced an 'independent' central bank to pursue its political agenda. The Nixon-Burns case of 1972 is an example of this type of manipulation. Arthur Burns was appointed as chairman of the FED in 1970, and there is evidence of multiple documented phone calls from Richard Nixon repeatedly putting pressure on Burns to ease monetary policy (Burton, 2006). In a particular instance during an official policy meeting, Burns stepped out to take a phone call, returning energized and in favor of an expansionary policy. Research suggests that this move to pursue expansionary monetary policy in an already-inflationary environment was out of political pressure rather than out of conviction (Burton, 2006). Central bank independence has been a widely studied subject, where independence brings undeniable benefits such as lower inflation rates, more debt sustainability, and a reduced risk of fiscal crisis.

Maintaining price stability is a crucial goal of central banks. Since inflation targeting was introduced in New Zealand in 1989, it has become one of the most popular

monetary policy tools (Bernanke et al., 1999). The Taylor rule (1993) focused on interest rate targeting and is considered the optimal monetary policy rule. The Taylor rule outputs an optimal interest rate based on inflation rates and economic growth:

$$\text{Federal Funds Rate} = \text{Inflation} + 0.5(\text{Real Inflation} - \text{Target Inflation}) + 0.5(\text{Real Output} - \text{Potential Output}) + \text{Real Rate of Interest}$$

(Taylor, 1993).

As to the Taylor Rule, if the rate of inflation increases by 1% above the target rate set by central banks, it should raise Federal Fund Rates by 0.5%. However, it is worth noting that the Taylor Rule proves to be inapplicable in an economy during periods of significant inflation. As was evident in October 2021, due to supply shortages and higher costs resulting from the COVID-19 pandemic. In such situations, the federal funds rate will be lower than the Taylor Rule recommended. Despite this drawback, higher weights on inflation would indicate that central bank independence is also highly correlated with lower inflation rates. It is ideal to have quiet, predictable, and stable inflation within an economy because money can hold its value, and consumers and businesses can plan their spending. In addition to producing lower inflation rates, Burdekin et al. (2011) suggested that central bank independence can lead to more consistent policies and reduced levels of uncertainty.

Research has also shown that central banks can effectively maintain fiscal discipline in an economy depending on how independent they are. Having provided a measure for central bank independence, which is used in this analysis, Garriga (2016) suggested that there are many aspects in which a central bank can be independent,

including personal, financial, and policy independence. A central bank's financial freedom will allow them to maintain fiscal discipline because it can restrict the government's ability to fund its expenditures through significant bank loans (Garriga, 2016). In addition, a central bank can prevent the government from pursuing overly expansionary and inflationary policies (Bernholz, 2013). Bernholz argues that this is caused by the move towards monopolized bank notes to central banks and the lack of budget constraints. This move allowed governments to control the banks and induce them to produce as many letters as desired, threatening price stability. Based on this, Bernholz suggested that the only way to prevent these expansionary and inflationary policies from taking place is for central banks to be independent of national admirations (e.g., European Central Bank), the constitution (e.g., Swiss National Bank) or the law (e.g., Federal Reserve Bank) (Bernholz, 2013).

In addition, there is a significant adverse effect on the budget deficit arising from central bank independence when controlling for monetary base growth, output growth, unemployment, and time effects (Burdekin and Laney, 2016). Independent central banks produce smaller deficits because the government cannot guarantee that a central bank will buy its bonds. Therefore, an independent central bank is less likely to monetize government budget deficits, resulting in less inflationary deficits since governments will be less likely to have significant deficits (Sikken and de Haan, 1998). Analysis by Burdekin and Laney (2016) for a group of 14 Latin American countries during 1990 - 2012 suggested that reforms establishing independence can improve fiscal discipline in countries that previously had poor inflation performance. These findings are promising as they indicate that central bank independence will lead to monetary and fiscal stability.

Following periods of economic contractions, central banks must act to stabilize the economy. The recent COVID-19 pandemic caused principal economic contractions worldwide, and various research suggest alternate views on the type of monetary policy most suited to combat these challenges. According to the Keynesian economic model, optimal policy should be expansionary during periods of economic contraction and contractionary in periods of economic success. However, many researchers argue that this is sometimes not the case and that monetary policy is not always cyclical and differs across countries (Kim, 2006). Other research has shown that increasing interest rates during economic booms may lead to economic crises (Scularick et al., 2020). Although governments are more prone to pursuing expansionary policies following economic contractions, Elgin suggested that more independent central banks are likely to take on more minor cuts in the policy rate and reserve requirements (Elgin et al., 2021). On the other hand, central banks, which are more subject to political pressures from the government, have a history of employing conservative policies (Ismihan & Ozkan, 2004; Adam & Billi, 2014).

Based on past research, central bank independence is essential for a successful monetary policy. This thesis investigates the importance of central bank independence by conducting a comparative analysis of central bank behavior in response to central bank independence and other factors. Principal economic contractions such as those caused by the COVID-19 pandemic can provide insight into central banks' strength in ensuring economic and financial stability within a country. Specifically, this thesis aims to analyze how 14 different central banks around the world have been conducting their monetary

responses before and after the pandemic based on their level of central bank independence.

Data Methods

The data used in this analysis is a time-series panel data set that consists of central bank independence, budget balance, exchange rate, stock market index returns, monetary base, industrial production, inflation, and COVID-19 variables. The COVID-19 variables employed in this analysis consist of case data scaled by country population and a government response index. The panel includes 14 countries which provide a strong representation of central banks worldwide. These countries were selected to understand the behavior of central banks in less developed and economically weaker countries compared to those in more developed and economically strong countries. All variables are measured monthly, starting in January 2018 to August 2022, with 56 observations per panel.

The measure of central bank independence data was obtained from Garriga (2016). The CBI (central bank independence) Index is reported annually from 1970 - 2012. Garriga's index relies on the Cukierman, Webb, and Neyapti (1992) rules for coding central bank legislation. Central bank legislation is coded based on: CEO characteristics, policy formation attributions, central bank objectives, and central bank limitations on lending to the public sector (Garriga, 2016). Additionally, reforms that did not impact a central bank's level of independence were not included in constructing the index value. This analysis uses the most recently reported index of the unweighted average (LVAU) data series, similar to Garriga's weighted series. The index is measured

on a scale of 0-1, with zero representing no independence and one representing complete independence.

The government response index was obtained from the Oxford COVID-19 Government Response Tracker. This index is measured on a scale of 1 - 100, where 0 is the weakest and 100 is the strongest. The government response index explains how governments' responses have differentiated throughout the pandemic. It comprises an aggregate of the containment and health index, the stringency index, and the economic support index. The COVID-19 case data was downloaded directly from Our World in Data which scaled the data by population per 1 million people. This data was converted from daily to monthly for consistency with other variables.

The monetary base data was mainly obtained from the IMF and kept in domestic currency. Data for Argentina, Switzerland, and the UK were unavailable on the IMF. Switzerland's monetary base data was obtained from the Swiss National Bank. The UK monetary base data was obtained from the Bank of England. Argentina's monetary base data was obtained from the Central Bank of Argentina. India's monetary base data was unavailable, therefore, money supply (M1) data was downloaded from the Federal Reserve Economic Data (FRED).

All exchange rate data was downloaded from the IMF. The exchange rate data is reported as domestic currency to the USD. Inflation data is mainly obtained from the IMF. Data for Argentina was unavailable, so it is downloaded from the Argentina National Institute of Statistics and Census (Instituto Nacional de Estadísticas y Censo). Relevant stock index data was downloaded from Bloomberg for all 14 countries and were

converted to US Dollars for comparison purposes. The analysis includes the largest composite stock index by market capitalization for each respective country. These data variables were converted into percentage change or levels, making it possible to compare the countries.

Industrial production data were mainly obtained from Global Financial Data (GFD) measured as total volume. Data for Argentina, Korea, Mexico, and Switzerland were unavailable from GFD. Argentina's industrial production data was obtained from the Argentina National Institute of Statistics and Census. Korea's industrial production data were obtained from Statistics Korea. Mexico's industrial production data was obtained from the Mexico National Institute of Statistics and Geography (Instituto Nacional de Estadísticas y Geografía). Switzerland's industrial production data were obtained from the Swiss Federal Statistics Office.

The empirical analysis uses panel regressions for the 14-country sample. Lagged dependent variables were included in all regressions. Additional panel regressions will be undertaken to identify whether there are differences between the monetary responses taken by central banks in countries of different levels of development. The groupings are determined by whether the country is industrialized or developing. The groupings are shown below:

Table 1: Country Groupings - Industrial & Developing

<i><u>Developing</u></i>	Uruguay, Argentina, Mexico, India, Brazil, Thailand, South Africa
<i><u>Industrialized</u></i>	Switzerland, USA, UK, Sweden, Canada, Japan, South Korea

In addition, the empirical analysis undertakes further panel regressions to identify whether there are differences between the monetary responses taken by central banks of different levels of independence. The 14-country sample is split into High-CBI and Low-CBI groups. Since the CBI index is measured on a scale of 0 - 1, a country is considered to have Low-CBI when its index value is less than 0.5 and High-CBI when its index value is greater than 0.5. These regressions omit the CBI variable and are run with fixed effects. The groupings are below:

Table 2: Country Groupings - Low-CBI & High-CBI

<i><u>Low-CBI</u></i>	India, USA, Brazil, Canada, South Korea, South Africa, Sweden
<i><u>High-CBI</u></i>	Uruguay, Argentina, Mexico, Switzerland, Thailand, Japan, UK

The overall summary statistics for all variables are in the table below:

Table 3: Full Sample Summary Statistics

	Count	Mean	S.D.	Minimum	Maximum
budget_bal	752	-0.08203	1.407702	-28.4522	8.391304
xr_g	769	0.006801	0.369758	-0.13873	0.357013
infl	759	0.005449	0.010237	-0.02033	0.074062
ip_g	752	0.00122	0.045924	-0.335	0.559
mb_g	746	0.008036	0.0308	-0.1854	0.335608
market_g	784	0.002181	0.082578	-0.56337	0.478261
govt_res	784	29.01098	29.01988	0	100
cbi	784	0.488092	0.170753	0.16569	0.76688
covid_case	784	18.40812	298.4317	0	7701.311

Given that the data of the variables are reported as growth rates, the mean of the variables indicates their average growth rate over the sample period. Both the government response index and COVID-19 cases have the most significant average growth values. These high average growth rates are expected as COVID-19 spread rapidly over a short period, and the government response to these increases typically followed. The budget balance is the only variable that has a, on average, decreasing growth rate, indicating overspending or overlending. The CBI average value is approximately 0.5. The monetary base variable has a lower average growth rate and standard deviation in growth rate than the budget balance, indicating relatively less volatility for monetary policy than is true for fiscal policy. Exchange rates, inflation, stock market index returns, and industrial production had similar responses. The standard deviation indicates the level of volatility that these variables experienced. As expected, the government response index and the COVID-19 cases were the most volatile. The budget balance was also relatively volatile compared to other variables. This volatility in

budget balance is expected since it is a fiscal indicator similar to the government response variable. All other variables have experienced low volatility over the sample period.

A simple correlation matrix between these variables was also run, and this is shown in Table 4:

Table 4: Full Sample Correlation Matrix

	Budget Balance Growth	Exchange Rate Growth	Inflation Rate	Industrial Production Growth	Monetary Base Growth
Budget Balance Growth	1.0000				
Exchange Rate Growth	0.0367	1.0000			
Inflation Rate	0.0360	0.1871	1.0000		
Industrial Production Growth	0.0552	-0.0339	0.0588	1.0000	
Monetary Base Growth	-0.0327	0.1143	0.1492	-0.0381	1.0000
Stock Market Index Price Growth	-0.0097	-0.1458	-0.0016	0.0131	-0.0446
Government Response Index Growth	0.0280	-0.0273	0.0449	0.0437	0.0939
Central Bank Independence	-0.0110	0.0761	0.3302	0.0072	0.0783
Covid Case Growth	-0.0126	0.0092	-0.0457	-0.0184	0.0877

	Central Bank Independence	Covid Case Growth
Central Bank Independence	1.0000	
Covid Case Growth	-0.0379	1.0000

The negative correlation between CBI and inflation indicates that CBI may not meaningfully restrain monetary responses during this period. This is because it is expected that greater independence would require a lower inflation rate. The correlation between monetary base and government response indicates that fiscal and monetary

policy acted similarly during the pandemic. This is to be expected in periods of economic crisis. Positive correlations between monetary base and both exchange rate and inflation respectively, are consistent with procyclical policy. The negative correlation between monetary base and industrial production is also consistent with procyclical policy. The negative correlation between monetary base and the stock market indices are consistent with higher stock returns, which indicate overheating.

Empirical Analysis: Fiscal Policy Regressions

Fiscal policy regressions were run to understand the monetary policy reaction to fiscal policy. Budget balance growth is regressed on its lagged value, monetary base growth, industrial production growth, market returns growth, exchange rate growth, and inflation. The post-COVID-19 regressions include the monthly case growth variable in the regression. Unlike the monetary policy regression, the government response index growth is omitted as a fiscal variable is already included. The lagged dependent variable is included to allow for inertia. A significant positive effect of monetary base growth would be in line with the growing monetary base being able to finance deficits. A significant positive effect of exchange rate growth is in line with budget deficits rising due to a weakening currency. An increase in government spending drives inflation; therefore, a negative sign is considered for inflation. The faster the growth of industrial production implies that less expansionary fiscal policy is necessary to support economic growth, and therefore a negative sign would apply. Higher stock returns may indicate overspending, and a contractionary policy response would imply a positive sign. The baseline fiscal policy equation constructed is as shown:

$$BB_t = \delta BB_{t-1} + \beta MB_t + \beta IP_t + \beta R_t + \beta XR_t + \beta I_t \lambda CBI_i + \varepsilon \quad (1)$$

BB represents the country's budget balance growth. MB, the growth rate in the monetary base, P the growth rate in industrial production, R the growth rate in stock market price, XR the growth in the exchange rate, I the inflation rate, CBI the value of the central bank independence index, and ε the error term. The regressions between these variables when grouped by industrial/developing and pre/post-COVID-19 time periods are displayed in Table 5 below:

Table 5: Budget Balance Regression

Developing & Industrial, Pre & Post-COVID-19:

Table 5.1: Developing Countries Pre-COVID-19

VARIABLES	(1)
lag_bb	0.6753768 (0.06329)***
mb_g	0.6641195 (0.352935)*
ip_g	-0.1354986 (0.6769889)
market_g	0.1955555 (0.1468118)
cbi	-0.0860197 (0.0846142)
infl	2.480148 (1.661793)
xr_g	-0.3362323 (0.247744)
_cons	0.0126006 (0.039169)

Robust standard errors in parentheses

***p<0.01, **p<0.05, *p<0.1

Table 5.2: Developing Countries Post-COVID-19

VARIABLES	(1)
lag_bb	-0.14768 (0.0863781)
mb_g	-2.831179 (17.64189)
ip_g	13.51509 (8.461696)
market_g	5.923749 (5.503174)
cbi	0.4809919 (1.685424)
infl	13.96333 (77.00056)
xr_g	19.87818 (13.70079)
_cons	-0.7319984 (0.8861071)

Robust standard errors in parentheses
 ***p<0.01, **p<0.05, *p<0.1

Table 5.3: Industrial Countries Pre-COVID-19

VARIABLES	(1)
lag_bb	-.3852378 (0.06558441)***
mb_g	-1.431976 (0.6848512)**
ip_g	1.150354 (0.4236876)***
market_g	-0.5468112 (0.2705013)**
cbi	-0.2040357 (0.1654488)
infl	-0.643279 (2.54722)
xr_g	0.6401255 (0.803322)
covid_case	-0.0002566 (0.000143)
_cons	0.0779517 (0.0779517)

Robust standard errors in parentheses
 ***p<0.01, **p<0.05, *p<0.1

Table 5.4: Industrial Countries Post- COVID-19

VARIABLES	(1)
lag_bb	-0.2654273 (0.0737709)***
mb_g	-15.14864 (5.850884)**
ip_g	-0.2947566 (2.595668)
market_g	-2.051094 (1.510581)
cbi	-0.2337711 (0.5938569)
infl	17.99009 (19.83079)
xr_g	-0.3563027 (3.88715)
covid_case	8.36E-06 (0.000157)
_cons	0.1993666 (0.3144762)

Robust standard errors in parentheses

***p<0.01, **p<0.05, *p<0.1

The regressions studied are not run with fixed effects, as the effects of central bank independence are already fixed. Central bank independence was insignificant in all regressions. For the developing countries' pre-COVID-19 regression, there are two statistically significant variables: lagged budget balance growth (99% level) and monetary base growth (95% level). For every 1 percent increase in the monetary base growth rate, the budget balance growth rate will increase by 0.66 percentage points. An increase in the monetary base may positively impact the budget balance because it is associated with positive liquidity effects and a strengthened economy. However, the positive relationship between these two variables does not indicate that fiscal and

monetary policy were acting in line with each other pre-pandemic because a more robust fiscal balance implies smaller deficits and less expansionary fiscal policy.

For the developing country post-COVID-19 regressions, there is statistical significance for five variables: lagged budget balance (99% level), monetary base growth rate (95% level), industrial production growth rate (99% level), stock market returns growth rate (99% level), and COVID-19 case growth rate (90% level). A statistical significance of 90% for variables is a standard threshold. For every 1 percent increase in the monetary base growth rate, the budget balance growth rate decreases by 1.43 percentage points. This is consistent with increasing monetary base and expansionary fiscal policy going together. Both policies now tend to expand together as policymakers react to the pandemic in the post-2020 sample. The significant negative response to COVID-19 cases indicates a potential increase in government spending at the onset of the pandemic. This is unsurprising as offsetting the effects of the pandemic with expansionary fiscal policy was done by most, if not all, countries worldwide. The significant and negative response to the stock market returns growth rate further supports this point by indicating overspending. The significant positive response to industrial production on the budget balance is in line with previous assumptions. These results alternately imply that industrial production decreases were met with fiscal expansion consistent with the unique needs of the economy during the pandemic. The overall trend for developing countries is that expansionary fiscal policy was widely used once the pandemic hit.

For industrial countries, there are no statistically significant variables for the pre-COVID-19 regressions. Therefore, the comparison between monetary policy in developing and industrial countries cannot be made for the pre-COVID-19 period. However, the industrial country post-COVID-19 regressions show statistical significance for two variables: lagged budget balance (to the 99% level) and monetary base growth rate (to the 95% level). For every one percent increase in the monetary base growth rate, the budget balance decreases by 15.15 percentage points. Post-COVID-19, developing countries experienced an approximately 900% greater decrease in budget balance growth relative to industrial countries. This indicates that overspending and overall expansionary fiscal policy were utilized at a much grander scale in industrial countries over developing countries. Fiscal policy in industrialized countries was more reactive because industrialized countries had fewer funding constraints. This difference in funding constraints also suggests that countries with a weak fiscal stance were more vulnerable to the effects of the pandemic as they could not conduct expansionary fiscal policy to the same degree.

Empirical Analysis: Monetary Policy Regressions

Monetary base growth is regressed on its lagged value, budget balance growth, industrial production growth, market index price growth, exchange rate growth, and inflation. The post-COVID-19 regressions include the government response index and monthly case growth variables in the regression. The lagged dependent variable is included to allow for inertia. A positive effect of budget balance growth would align with monetary policy expansion when fiscal policy becomes tighter. An increase in exchange

rate growth means the currency depreciates, and a negative response would be considered with countercyclical policy. The same would be true concerning inflation rates. The fast growth of industrial production results in less necessary expansionary monetary policy to stabilize the economy. Therefore, a negative sign would be consistent with countercyclical policy here as well. Higher stock returns may indicate overheating and, once more, call for a negative response. The baseline monetary base equation constructed is as shown:

$$MB_t = \delta MB_{t-1} + \beta BB_t + \beta IP_t + \beta R_t + \beta XR_t + \beta I_t \lambda CBI_i + \varepsilon(2)$$

MB represents the country's monetary base growth, BB the growth rate in budget balance, IP the growth rate in industrial production, R the growth rate in stock market returns, XR the growth in the exchange rate, I the inflation rate, CBI the value of the central bank independence index, and ε the error term. The initial regression between these variables prior to grouping by the central bank independence values and pre/post-COVID-19 periods are displayed in Table 6:

Table 6: Monetary Base Regression

VARIABLES	(1)
lag_mb	-0.2035401 (0.0384962)***
budg_bal	-0.0009367 (0.0008312)
ip_g	-0.0299617 (0.0299617)
market_g	-0.003272 (0.0146689)
xr_g	0.1019001 (0.0329824)***
infl	0.4365774 (0.124607)***
cbi	0.0077157 (0.0077157)
_cons	0.0033404 (0.0033404)

Robust standard errors in parentheses

***p<0.01, **p<0.05, *p<0.1

This regression is not run with fixed effects because the effect of the central bank independence variable is already fixed. The budget balance and industrial production effects are insignificant in this initial regression. Stock market returns are insignificant as well. The significant positive responses to exchange rate growth and inflation imply procyclical rather than countercyclical responses. The lagged monetary base, exchange rate growth, and inflation rate all show high statistical significance to a greater than a 99% level. For every 1 percent increase in exchange rate growth, the monetary base will increase by 0.10 percentage points. For every 1 percent increase in the inflation rate, the monetary base will increase by 0.44 percentage points. Offsetting the depreciating currency and rising inflation rates requires a decrease in the monetary base by central

banks. These findings indicate procyclical policies in the fourteen countries over the sample period.

In order to obtain a more precise understanding of the monetary responses of central banks, further modifications are made to the initial regression. As with fiscal policy, the fourteen-country sample is split into two groups of seven, industrial and developing, to identify potential similarities and differences between central banks in different economies. In addition, the observations are split by date. Regressions are run pre-COVID-19 (Jan 2018-Dec 2019) and post-COVID-19 (Jan 2020-Aug 2022). For the post-COVID-19 regressions, the government response index and COVID-19 cases are added to our initial regression equation as dependent variables. January 2020 was determined to be the start of COVID-19 as this was the first month when countries reported observations for the COVID-19 variables used in the regression.

Monetary policy and growth in the monetary base tends to be expansionary during times of crisis, and COVID-19 case growth reflects the depression arising from the pandemic, and a positive response to this variable is expected. The government response index's sign depends on whether monetary policy is working against the fiscal policy or is supporting fiscal policy. In times of crisis, monetary and fiscal policy often go together; however, a more independent central bank may be less inclined to follow a supportive role. Therefore, if fiscal and monetary policy act together, we should expect a positive sign for the government response index but a negative response to the budget balance. Overall, four new regressions are run, and results are shown in Table 7 below:

Table 7: Monetary Base Regression

Developing & Industrial, Pre & Post- COVID-19

Table 7.1: Developing Countries Pre- COVID-19

VARIABLES	(1)
lag_mb	-0.0526663 (0.0935196)
budg_bal	0.0203872 (0.0138351)
ip_g	-0.085173 (0.1613748)
market_g	-0.0158583 (0.0355748)
cbi	0.0070203 (0.0200145)
xr_g	0.0682346 (0.0577035)
infl	0.1381041 (0.3992901)
_cons	0.0069518 (0.0092811)

Robust standard errors in parentheses

***p<0.01, **p<0.05, *p<0.1

Table 7.2: Developing Countries Post- COVID-19

VARIABLES	(1)
lag_mb	-0.3372493 (0.0615661)***
budg_bal	-0.103616 (0.00618)*
ip_g	0.0233758 (0.0399456)
market_g	-0.0279762 (0.0260634)
cbi	0.0243046 (0.0155697)
xr_g	0.1453503 (0.0762578)*
infl	0.3403236 (0.2395314)
govt_res	0.0005939 (0.0001354)***
covid_case	0.000033 (0.0000133)**
_cons	-0.33859 (0.0101302)***

Robust standard errors in parentheses
 ***p<0.01, **p<0.05, *p<0.1

Table 7.3: Industrial Countries Pre- COVID-19

VARIABLES	(1)
lag_mb	-0.2870589 (0.0814828)***
budg_bal	-0.0001497 (0.0004287)
ip_g	-0.1095712 (0.0430717)**
market_g	-0.0366225 (0.0271715)
cbi	-0.0102333 (0.0083908)
xr_g	0.0327794 (0.0689044)
infl	0.4157622 (0.3810386)
_cons	0.0103604 (0.004408)**

Robust standard errors in parentheses
 ***p<0.01, **p<0.05, *p<0.1

Table 7.4: Industrial Countries Post- COVID-19

VARIABLES	(1)
lag_mb	0.0706635 (0.0746686)
budg_bal	-0.0017761 (0.0009155)*
ip_g	-0.0979159 (0.0321815)***
market_g	0.0213986 (0.0193537)
cbi	0.0081728 (0.0075205)
xr_g	0.0492357 (0.04885522)
infl	0.5861198 (0.2459074)**
govt_res	0.0002146 (0.0000644)***
covid_case	5.16E-06 (1.95E-06)***
_cons	-0.0108175 (0.0050874)**

Robust standard errors in parentheses
***p<0.01, **p<0.05, *p<0.1

Focusing solely on the developing countries' regressions, there are no statistically significant variables for the pre-COVID-19 regression. The post-COVID-19 regression for the developing countries sample shows the lagged monetary base and the government response index, each statistically significant at the 99% level. The COVID-19-cases variable is also statistically significant at the 95% level, and the exchange rate growth and budget balance growth variables are statistically significant at the 90% level. All other variables (industrial production growth, exchange rate growth, central bank independence, and inflation) remain insignificant.

For every 1 percent increase in government response index growth, the monetary base increases by 0.00059 percentage points. This significant positive effect of

government response suggests that monetary policy expanded in developing countries to support moves from fiscal policy to tackle the impacts of the pandemic. It is also in line with the assumption that monetary and fiscal policies tend to act as a unit in times of economic crisis. The significant negative sign on the budget balance variable is also consistent with deficits and money growth rising together. The significant positive reaction to exchange rate growth is consistent with procyclical policy. A depreciating currency would require a reduction in the monetary base to offset. However, this is likely not possible in periods of economic crisis as the central bank has more important priorities than maintaining a strong currency. There is also a significant positive response of monetary base growth to COVID-19 case growth. This is expected, due to the sharp increases in COVID-19 cases at the onset of the pandemic, which may have prompted expansionary monetary policy.

There are statistically significant results for lagged monetary base growth and industrial production growth pre-COVID-19, which was not the case for developing countries. The significant negative response to industrial production is consistent with countercyclical policy. The post-COVID-19 regressions of industrial countries' samples show statistical significance for industrial production growth, the government response index, and COVID-19 case growth at the 99% level. The inflation rate is statistically significant at a 95% level, and budget balance growth is statistically significant at the 90% level.

Every 1 percent increase in the government response index growth results in a 0.0002 percentage point increase in the monetary base. This relationship between the

government response index and monetary base is consistent with the findings from the developing countries sample, where monetary policy also eased in movement with fiscal responses to the pandemic. The significant positive response to COVID-19 cases and significant negative response to budget balance growth is also consistent with that of developing countries. As the inflation rate increases by 1 percent, the monetary base increases by 0.059 percentage points. For monetary policy to offset the rise in inflation, it would have to shrink the monetary base. However, consistent with the depreciating exchange rate, keeping inflation low is not the most significant priority in periods of an economic crisis which is why this sign appears.

Essential takeaways from these findings are that monetary and government policies acted in the same direction, which is expected during an economic crisis. In addition, central banks will likely not prioritize maintaining a stable currency and keeping inflation low in periods of economic crisis like the pandemic.

Central bank independence was insignificant in all four regressions. This is likely due to the telescoped period and the extreme circumstances of the COVID-19 pandemic. Therefore, to further investigate if there was an impact of central bank independence, further monetary policy regressions were run where the countries were grouped by high-CBI and low-CBI. The CBI variable was omitted in these regressions, and standard fixed effects were used. The results are shown in Table 8 below:

Table 8: Monetary Base Regression
High-CBI & Low-CBI, Pre & Post- COVID-19

Table 8.1: Low-CBI Countries Pre- COVID-19

VARIABLES	(1)
lag_mb	-0.3009891 (0.0938001)***
budg_bal	0.0000973 (0.006963)
ip_g	-0.1153809 (0.0717787)
market_g	0.0271838 (0.0470147)
xr_g	0.0816698 (0.0861498)
infl	1.241261 (0.5666397)**
_cons	0.0067304 (0.0023424)***

Robust standard errors in parentheses
 ***p<0.01, **p<0.05, *p<0.1

Table 8.2: Low-CBI Countries Post- COVID-19

VARIABLES	(1)
lag_mb	-0.173323 (0.0782431)
budg_bal	-0.0009838 (0.0014503)
ip_g	-0.095654 (0.0482059)**
market_g	-0.0150113 (0.0339819)
xr_g	0.1385671 (0.0598841)**
infl	0.1337151 (0.3026369)
govt_res	0.0002219 (0.0001637)
covid_case	7.82e-06 (2.50e-06)
_cons	-0.006264 (0.0087102)

Robust standard errors in parentheses
 ***p<0.01, **p<0.05, *p<0.1

Table 8.3: High-CBI Countries Pre- COVID-19

VARIABLES	(1)
lag_mb	-0.0570544 (0.1003397)
budg_bal	-0.0004655 (0.0050618)
ip_g	-0.0187136 (0.1227387)
market_g	-0.0000177 (0.0303283)
xr_g	0.1578739 (0.1578739)***
infl	0.4389436 (0.3021162)
_cons	0.0042651 (0.0028907)

Robust standard errors in parentheses
***p<0.01, **p<0.05, *p<0.1

Table 8.4: High-CBI Countries Post- COVID-19

VARIABLES	(1)
lag_mb	-0.4229112 (0.0684795)***
budg_bal	-0.0061483 (0.0039347)
ip_g	0.042407 (0.0374564)
market_g	-0.0657193 (0.0287661)**
xr_g	-0.0919406 (0.1069465)
infl	0.6793574 (0.2097065)***
govt_res	0.0005403 (0.0002466)**
covid_case	-0.0001371 (0.0000386)***
_cons	-0.015477 (0.0125299)

Robust standard errors in parentheses
***p<0.01, **p<0.05, *p<0.1

Countries with low CBI before COVID-19 show statistical significance for two variables: lagged monetary base and inflation. The inflation rate is statistically significant at the 95% level and lagged monetary base is statistically significant at the 99% level. For every 1 percent increase in the inflation rate, the monetary base growth rate increases by 1.24 percentage points. To achieve their low and stable inflation goal, central banks should decrease the monetary base if the inflation rate rises. For low-CBI countries pre-COVID-19, the monetary base is growing at a rate faster than inflation promoting further inflationary pressures, potentially influenced by pressure from the government to pursue a more expansionary monetary policy in place of one that is contractionary. Low central bank independence in these countries could explain the relationship between these variables. The statistically significant lagged monetary base indicates strong upward and downward momentum. Post-COVID-19, countries with low CBI showed statistical significance for industrial production growth (95%), exchange rate growth (95%), and COVID-19 case growth (99%). The significant negative response to industrial production growth on monetary base growth is consistent with countercyclical policy. The significant positive response to COVID-19 cases is in line with the preliminary analysis of expansionary monetary policy being prompted at the onset of the pandemic.

Countries with high-CBI pre-COVID-19 showed statistical significance only for the exchange rate growth variable at a 99% level. Again, the significant positive response to this coefficient is consistent with procyclical policy and implies a depreciating currency. Monetary policy controls exchange rates indirectly, and to maintain a strong currency, a reduction in the monetary base would be necessary. Post-COVID-19, high-CBI countries showed statistical significance for five variables: lagged monetary

base growth (99%), market returns (95%), inflation rate (99%), COVID-19 case growth (99%), and the government response index (95%).

For every 1% percent increase in the inflation rate, the monetary base growth rate increases by 0.68 percentage growth. Contrary to countries with low-CBI pre-COVID-19, the monetary base is increasing slower than inflation, thereby not fueling inflationary pressures as much. The level of central bank independence could explain this difference. A central bank with high independence would be more likely to maintain low and stable inflation in the absence of government pressure. The significant negative response to stock market returns would help offset overheating. The significant positive effect of the government response index is consistent with previous findings. It indicates that monetary policy tended to support fiscal policy during the emergency regardless of central bank independence. Although this is consistent with the assumption that monetary and fiscal policy act together as a unit in periods of economic crisis, it is not consistent with the assumption that independent central banks acted freely of government influence at this time. The significant positive response of monetary base growth to COVID-19 case growth is consistent with prior results.

Apart from varying responses to inflation rates, there is limited evidence suggesting that central banks conduct different monetary policies depending on their level of independence during the pandemic. However, there are meaningful differences pre-pandemic.

Conclusion

The empirical analysis suggests that there are limited instances where central bank independence has influenced the monetary responses of central banks before and after the COVID-19 pandemic. However, this study shows that there is evidence of price stabilization behavior when it comes to inflation. When comparing between central banks with Low-CBI and High-CBI (refer to Table 7), we find that central banks with high independence have significantly lower inflationary pressures than economies whose central banks have low independence. Given that one of the primary responsibilities of central banks is to achieve price stability, these findings suggest that independence, at least to some degree, does influence monetary responses.

While limited findings suggest that central bank independence results in different monetary responses across central banks, the empirical analysis provides a concrete understanding of how monetary policy responds to a very particular type of economic crisis arising from a pandemic. Regardless of a central bank's independence, monetary policy tends to follow the lead of fiscal policy in times of economic crisis. In addition, concerns that under normal circumstances would be necessary to central banks, like maintaining a desired domestic currency level, seem to be less concerning. A central bank conducting procyclical responses and accommodating fiscal policy is favored over one which exercises more restraint during a pandemic. Central banks aim to achieve maximum sustainable employment and price stability. In the long-run, the markets adjust, people find jobs, and supply and demand stabilize prices. But as Keynes famously said, “in the long run, we are all dead.” Central banks have the responsibility to move markets

to the long-run equilibrium as smoothly as possible. In the case of COVID-19, this meant ensuring people's basic livelihoods. If a central bank were to conduct a countercyclical policy, there would likely be more significant harm than benefit. For example, constricting spending in a time where individuals and businesses are already struggling would not lead to desirable outcomes.

According to countercyclical policy, following the COVID-19 pandemic, monetary policy should have moved opposite to economic fluctuations and be contractionary. However, more often than not, the empirical analysis indicates that monetary responses have been procyclical during the sample period (2018-2022).

Although the empirical analysis primarily finds evidence of procyclical monetary responses with regard to inflation, this is likely due to the telescoped time period and the extreme circumstances arising from the COVID-19 pandemic. Given that the COVID-19 pandemic was the largest pandemic since the Spanish Flu (1918), these were unprecedented times, making it difficult to predict where economies are headed. Literature in this area needs to be improved, and there needs to be further research conducted to understand the stabilization policies of central banks following a pandemic. This makes it impossible to predict the projected countercyclical relationship between the variables in response to events as substantial as a pandemic.

Future studies could capture a larger sample period as monetary responses have not seemed to fluctuate significantly. Economies are still recovering from COVID-19, and perhaps the present is when differences between the monetary responses of central banks of different levels of independence would be more visible.

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