The impact of money supply on the real sector during the Covid-19 pandemic: Evidence from OECD countries

Sinan Alçın¹  N. Merve Hamzaoğlu²  G. Derya Zayım³

¹Prof. Dr., Kırklareli University, Faculty of Applied Sciences Department of International Trade and Logistics, Türkiye, e-mail: sinanalcin@klu.edu.tr
²Asst. Prof. Dr., Istanbul Kültür University, FEAS, Department of Economics, Türkiye, e-mail: n.hamzaoglu@iku.edu.tr
³Res. Assistant, Istanbul Technical University, Department of Economics, Türkiye, e-mail: Izayim17@itu.edu.tr

Abstract

Declared as a pandemic on March 11, 2020, COVID-19 caused a “sudden stop” in the world economy, resulting in both supply and demand shock. Most of the countries responded by monetary expansion to tackle the global economic issue. In this study we aim to find the impacts of these economic policies during COVID 19 on global economy. Our sample includes 33 of OECD countries. We estimate the impact of monetary expansion on the real economy with a linear regression model. The results show that the monetary policy has positively and significantly impacted economic growth even after controlling for fiscal policies.

Keywords: Money Supply Shock, Health Crisis, Financial Markets, Real Economy, COVID-19, OECD countries

JEL codes: E44, I18, G01
1. INTRODUCTION

The Pandemic COVID-19 has generated a health crisis while posing a global threat to economic activity. The impact of Covid-19 on the economy was experienced precisely as a “sudden stop”: a sudden stop in production and consumption and a rupture in supply chains. As a result, since the beginning of 2020, monetary expansion policies exceeding $20 trillion have been implemented by the central banks of developed countries.

While the Pandemic is a common problem facing all humans, the level of economic devastation seems heterogeneous across countries. All nations have taken action to cope with the Pandemic and mitigate the financial risks on their economies. We see several measures, including containment policies, improving R&D in the health system, financial supports for all businesses, households, and actions to preserve employment (OECD, 2020a). Globally, we have seen nationwide quarantine periods starting in developed countries (mainly EU countries) and extensions of the state of emergencies in many countries (IMF, 2020). The preliminary international reports highlight the fact that the impacts would not be the same across the economies. The potential impact of the Pandemic may be worse than an economic shock, and it can damage emerging economies and low-income countries more severely (World Bank, 2020). Even though the Pandemic spread had been slowing down in Summer 2020, we see a sharp increase in case number and deaths during the second wave. Starting from October 2020, many countries have restarted applying containment measures to control the spread of the virus. As the Pandemic spread, lockdowns have become mandatory to restore the health system. Thus, the COVID-19 outbreak alarmed OECD countries and force them to take emergency actions to support the economy due to temporarily frozen economic activities and income losses. Because of public health consideration, starting from December 2020, vaccination has started worldwide, mainly in developed countries.

On the economic front, several fiscal packages were adopted. We see similar financial supports for businesses such as tax payment deferrals (OECD, 2020a). In many countries, work schemes were designed for short-time in order to preserve employment. Different type of supports for households were implemented like direct cash transfers to low and middle-income households in US; expansion of the degree and the amount of income supports in EU; active monetary measures rather than fiscal packages in developing countries (OECD, 2020a). As a fast response expansionary monetary policies were quickly adopted by several Central Banks (CBs) at the beginning of the Pandemic. Additionally, Elgin et al. (2021) found that more independent CBs adopt smaller cuts and larger fiscal and macro-financial packages.

As the Pandemic has dynamically been affecting the global economy, it is essential to work on efficient policy responses on the Covid-19 in the near future. OECD reports that fiscal action can aid in stimulating the economy where it is necessary. Furthermore, the report proposes “specific support for developing countries, including international coordination, financial support, and adaptation of tax rules”; it states that all options, including public finance and CB actions, will be necessary to restore the economy (OECD, 2020a), not the way around.

Fewer number of studies focus on the monetary policies of OECD countries in COVID-19. On the other hand, OECD (2020b) published several policy briefs reporting member countries’ new spending policies and immediate responses. Besides, studies are examining financial markets in specific countries, including OECD member countries. For instance, in Turkey, a limited number of studies analyze the impact of COVID-19 on the aggregate economy. We see Öztürk et al. (2020) conducting a sectoral analysis of the stock price index in the Pandemic. We see Çağmakli et al. (2020) analyze sectoral supply shocks utilizing teleworking and physical job proximity and sectoral demand shocks with credit card purchases by conducting a SIR-multi-sector-macro model. Moreover, Kartal et al. (2020) discuss the main changes in the stock exchange index in Turkey during the Pandemic.
Given the immediate monetary actions of CBs to combat the Pandemic, our motivation, in this paper, is to provide an exploratory study that evaluates the effectiveness of money supply growth on the real economy. Our main reason for working with OECD data is the leading role of OECD countries in policy development. Furthermore, one of the OECD’s main objectives includes “establishing evidence-based international standards and finding solutions to a range of social, economic and environmental challenges” (OECD). Therefore, OECD aims to provide an international standard for countries with different economic and geographical characteristics. Lastly, data availability can be problematic due to the dynamic nature of the Pandemic. For this reason, we chose OECD data sets as it offers researchers an opportunity to reach reliable data.

The structure of this study is as follows. The following section provides a literature review on monetary policies in a broad and wide range of studies focused on the economic impacts of COVID-19. Section 3 explains the data description, methodology, present econometric models, and discuss results. Lastly, in Section 4, we discuss our concluding remarks.

2. LITERATURE REVIEW

Monetary policies are commonly considered vital policy responses, especially in any downturn in the economy. In this regard, the monetary transmission mechanism showing the impact of monetary policies on the aggregate economy is worthy of attention. It can be in the form of different procedures, like monetary targeting of M3, inflation targeting, controlling interest rates (price control) (Juselius and Toro, 2005). As an unconditional monetary policy, quantitative easing (QE) is one of the standard tools that CBs apply to monetary expansion into the economy. It is noteworthy to mention that QE is not a newly discovered tool. We see that CBs used to apply it right after economic recessions like Fed in the 1930s, the Bank of Japan in 2001, the Bank of England, and the Fed after the recession in 2008 (Ricketts, 2011; Powell, 2002). As Haldane et al. (2016) denote, QE may have a significant macro-economic impact, and its effectiveness may vary over time. The vast literature on QE and monetary expansion also states them as one of the crisis causes. Furthermore, Horwitz (2012) already concludes that expansionary monetary policies formed a basis for the Great Depression. On the other hand, Krugman et al. (1998) recommended a monetary expansion policy as a solution in Japan’s case of the economic crisis.

In OECD countries, we see empirical evidence of monetary policy practices by adopting inflation targeting during the 1990s, as Divino (2009) states. Dedola and Lippi (2005) show evidence on heterogeneous effects of unexpected monetary policy shocks in 5 OECD countries’ industries (France, Germany, Italy, UK, and the USA). From another point of view, Ahrend (2010) discusses monetary ease in OECD countries between 2002-2005 and finds accommodating monetary policy as one factor behind financial imbalances triggering the 2009 recession.

In emergency cases, monetary policies may constitute a fast government response mechanism to any financial and economic threat. In the pandemic COVID-19, IMF has categorized the policy responses as monetary, fiscal, macro-financial, and exchange rate and balance of payment (ICMA, 2020). Indeed, COVID-19 has brought concerns on an upcoming crisis, and it is seen that 21 CBs announced QE programs on their local 10-year government bond yields right after the COVID-19 outbreak (Hartley and Rebucci, 2020). As Bonatti et al. (2020) state, the Pandemic caused stress on ECB’s conventional monetary policies, whereby we see exceptional monetary policies, whereby we see exceptional policies to smooth the impacts of such an economic crisis aiming to prevent an economic collapse. Moreover, they argue possible scenarios that the ECB may face regarding the exceptional monetary policies. As they denote, QE may be weaker in case of a rapid economic recovery. However, if any stagflation occurs, QE policy may be justified, but in case of a prolonged recession, ECB could face a dilemma supporting the debt of countries or causing a crisis in the euro area. The uncertainty of a possible hit by an impending economic crisis put CBs to announce for unconventional QE, but the situation could be problematic in the world economy in the long run. Zhang et al. (2020) discuss the unlimited QE
policies in the US and its impacts on financial markets. Bhar and Malliaris (2020) tackle the modeling of monetary policy and QE in the US. Finally, Benigno et al. (2020) focus on QE and its potential to support health and welfare expenditures and fiscal stimulus in emerging markets from a different perspective.

Literature covers a broad range of studies on COVID-19 and its impact on the economies. One branch of the literature deals with the pandemic-related consequences on the financial variables. For instance, drawing on the efficient market hypothesis, Narayan (2020) argues that pandemic-related shocks have a transitional effect on the Yen-US dollar exchange rate, which is the most affected asset price during the Pandemic. On the other hand, the stock market and exchange rate nexus are investigated by Narayan et al. (2020) for the Japanese economy. The paper’s main idea is that most firms in the Japanese economy benefit from the depreciation of YEN due to being more competitive and, therefore, stock market returns increase. Moreover, Haroon et al. (2020) suggest that under liquidity constraints, government interventions and flattening the curve seem to matter most for the emerging economies due to the aversion from uncertainty by investors. Finally, a refined analysis conducted by Pe et al. (2020) asserts that the impact of COVID-19 on the sectors such as transportation, mining, electricity & heating has been relatively more robust compared to manufacturing, information technology, education, and health care industries.

Due to the increased global risk, further studies investigate the impact of capital flows on the stock market prices in economies characterized by fragile financial markets (McKibbin and Fernando, 2020; Topçu and Gülal, 2020; Baker et al., 2020). For instance, Prabheesh (2020) points out the financial instability in Indian stock markets due to the reversal of portfolio records and provides evidence on the causality running from foreign portfolio investment to stock prices in the COVID-19 period. The situation seems alarming for financial markets, as indicated by Gil-Alana et al. (2020), who argues that shocks are long-lasting rather than temporary in selected Asian countries. Furthermore, Ozili and Arun (2020) mention the impact of fast policy responses by several governments and states, and they highlight that these fast responses may deepen the global recession soon.

Several studies look into the impact of the Pandemic on energy markets. It is seen that uncertainty poses cause of volatility in the energy markets (Salisu and Adediran, 2020), above a certain level of oil price volatility, both oil price news and infection cases are essential predictors of oil prices (Narayan, 2020). Pandemic occurrence and the oil market are also studied by Qin et al. (2020), who concluded that oil prices had been negatively affected by the Pandemic. Devpura et al. (2020) also supported a similar argument who claim that the pandemic and oil prices are directly related. Huang & Zheng (2020) highlights the relationship between investor sentiment and crude oil futures price and found a structural change during the first quarter of 2020. Iyke (2020) found US oil and gas producers’ heterogeneous responses to the Pandemic and stated that the Pandemic significantly triggered 28% of returns and 27% of return volatility. Similarly, Prabheesh et al. (2020) express that decreasing oil price is a negative signal for the stock market.

Moreover, Vidya et al. (2020) demonstrate to what extent the COVID-19 Pandemic deteriorates trade interconnectedness among the economies applying trade network analysis. From another perspective, studies are focusing on the impact of containment on economies and monetary transmission mechanisms –like supply and demand shocks, flight restrictions that limit the international mobility, social distancing, income per capita and consumption, emergency packages- (Baldwin and Tomiura; 2020; Thunström et al.; 2020; Ozili et al., 2020; Sumner et al., 2020; Bénassy-Quéré and Di Mauro, 2020).

3. DATA, METHODOLOGY, AND ECONOMETRIC MODELS

In this section, we firstly discuss data selection and methodology. Then econometric models and results are provided.
3.1. Data and Methodology

In this study, we used the pooled data of the OECD countries during the pandemic period. In the sample, we excluded Colombia, Iceland, Mexico, and Switzerland due to the lack of economic data for certain variables. Table A1 presents the list of sample countries. We exploited two databases to collect the data. First, we retrieved the selected macroeconomic variables from the leading economic indicators in the OECD database (OECD, 2020). We obtained Pandemic-related measures from Oxford COVID-19 Government Response Tracker (Oxford University, 2020). The economic variables that are used in the analysis are quarterly growth rate (g), industrial production index (IP), the money supply in domestic currencies (MS), interest rate (R), the exchange rate (EXC) And fiscal stimulus package (FIS). To include the health-related policies, we constructed containment index (C) and health index (H). They were using daily indicators from Oxford data. The selected indicators for containment index are school closing, workplace closing, cancel public events, restrictions on gathering, close public transport, stay at home requirements, restrictions on internal movement, international travel controls. For the health index, we exploited the indicators of public information campaigns, testing policy, contact tracing.

Fiscal stimulus package as a percentage of GDP entered into the equation with cumulative values. However, the rest of the variables are in quarterly frequencies for the 2020Q1-2020Q4 period. Except for economic growth and industrial production index, the remaining variables are available monthly and therefore converted to quarterly frequencies. As the growth rate and interest rates are in percentages and may take negative values, we use them in levels. For the rest of the variables, we used logarithmic transformations. In the Appendix, Table A2 shows the variable description and provides summary statistics.

The standard approach in empirical works to deal with the output effects of unanticipated monetary shocks is to apply Vector Autoregressive Regression (VAR) as the model allows for the endogeneity in macroeconomic variables. However, due to the short period in this paper, we proceed with the simple linear regression and weighted linear regression models. Furthermore, to avoid the potential endogeneity of policy responses and gross domestic product (GDP), we use quarterly changes in economic growth rather than using GDP in level as the dependent variable.

Following earlier studies, we included two important financial market prices for monetary transmission; short-term interest rate and exchange rate, namely, into our model as independent variables (Taylor, 1995). However, later studies have focused on the inadequacy of traditional Keynesian perspective and interest rate channel due to zero lower bound problem (Fahrer & Madigan, 1997; Krugman et al., 1998; Summers, 1991). Indeed, what we see during the global financial crisis (IMF, 2013) and the COVID-19 period (Dabrowski and Dominguez-Jimenez, 2020) as monetary responses are unconventional tools in the form of quantitative easing rather than the tools that the monetary transmission framework suggested. Therefore, we included financial stock as an explanatory variable and introduced a financial market quantity into our model. Furthermore, to control the fiscal responses and their potential impact on the real economy, we took the fiscal policy package indicator of COVID-19 Economic Stimulus Index (CESI) created by Elgin et al. (2020); fiscal packages of the governments are measured as a percentage of GDP.

Moreover, the industrial production index is taken as a proxy to represent the sectoral structure in each economy. Detailed sectoral analyses conducted by the International Labor Organization (ILO) (2021) state that the impact of COVID-19 on the sectors are uneven, and sectors such as construction and service have been affected to a greater extend. Therefore, we might expect a higher negative effect on real economies as long as they are more dependent on sectors outside the industry. Furthermore, to control for the various policy measures, we included containment and health indices using the indicators of Hale and Wester (2020). Lastly, country dummies are included to capture
unobserved heterogeneity, such as different institutional and social norms.

### 3.2. Econometric Model and Results

We estimate Equation 1 to investigate the effect of monetary shock on the economies’ short-run economic performance with OLS and feasible GLS. Our model is a simplified version of New Keynesian models (Gali, 2009; Fornaro et al., 2020), where output and employment are determined by aggregate demand. Our primary aim is to test whether the countercyclical monetary policy impacts aggregate demand and output in turn. The results appear in Table 1. In Model 1, we estimated the main equation with OLS and performed diagnostic tests to check for any potential misspecification. Added variable plots in Figure A1 demonstrate that the interest rate variable suffers from collinearity. Added variable plots decompose the multivariate relationship into a set of two-dimensional plots where $e_1$ is residuals from the regression of particular $X_i$ on all $X_{-i}$ and $e_2$ is residuals from the regression of $Y$ on all $X_{-i}$. The first residual, $e_1$, represents the nonlinear part of $X_i$ and the second residual, $e_2$, represents the information on $Y$ that $X_{-i}$ does not explain. Given this information, two extreme cases are essential. First, if the points are clustered through the $e_2$ axis, this implies perfect collinearity and the need to drop the variable, which is also the case for the interest rate variable in our model (Baum, 2006). Besides this technical explanation, we expect that the interest rate variable would not explain the variation in $Y$ in our model as Eurozone countries have the same interest rate level.

Moreover, in the short run, due to the stickiness of prices, policy-induced change in money supply is closely linked to nominal interest rate, and the deterministic relationship implies that describing monetary policy actions through the monetary base or nominal interest rate is equivalent (Ireland, 2005) and therefore, endogeneity concerns might prevail. Thus, we proceeded with a model excluding interest rates. Variance inflation factors presented in Table A3 show that no multicollinearity problems exist among the remaining variables. For additional check for model specification, we apply Ramsey’s RESET test, whose results are reported in Table A4. According to the results, we fail to reject the null hypothesis of the absence of omitted variable in the model. However, OLS estimates suffer from heteroscedasticity, as is shown in the Breusch-Pagan test in Table A5 in the Appendix. Therefore, we estimated Equation 1 (excluding interest rate) with the Feasible Generalized Least Square (FGLS) estimator. FGLS implements transformation in original data and runs a regression to the transformed data to deal with deviations from non-i.i.d errors (Baum, 2006). The logic behind FGLS is to give much weight to the residuals with fewer variances. Although in Model 1 and 2, we estimated the equation with heteroscedasticity robust standard errors, we also show FGLS results.

$$
g_{1,t} = \alpha + \beta_1 \log MS_{1,t} + \beta_2 R_{1,t} + \beta_3 \log EXC_{1,t} + \beta_4 \log FIS_{1,t} + \beta_5 \log IP_{1,t} + \beta_6 \log C_{1,t} + \beta_7 \log H_{1,t} + \sum_{i=8}^{44} \beta_i FE_i + \epsilon_i \tag{1}
$$

Our ex-ante predictions to have a statistically significant positive impact of money supply and fiscal stimulus package on the growth rate of real GDP suggested by countercyclical policy framework Krugman and Wells, 2009). Considering the open-economy macroeconomic model of Fleming (1962) and Mundell (1963), we expect a significant negative relationship between exchange rate and output through the channel that exchange rate appreciation depresses net export and output in the short run. Additionally, a positive relationship between industrial production and growth rate is expected by economic insight. Lastly, we anticipate a significant negative relationship with containment measures in the short run and a significant positive relationship with health measures. For Model 1, we predict an insignificant effect of interest rate on output growth following the discussion above.

Regarding the regression results, monetary policy positively and significantly affects quarterly economic growth in all specifications. The positive and significant coefficient estimate of the logarithm of money supply asserts that in the COVID-19 period, monetary easing positively contributes to the growth rate of real GDP. FGLS coefficient estimates state that a 1%
money supply increase results in a 0.27% increase in economic growth. As expected, the interest rate variable is insignificant. Curdia (2020) stated that conventional monetary policy has a limited policy space because of the zero lower bound, most notably in the USA. Even though this is not the scope of this paper, COVID-19 measures also cover financial packages across many countries (IMF, 2020). When we control the cumulative value of the fiscal packages and several controls, significant monetary policy effect still prevails. Our result is in line with earlier empirical findings regarding monetary policy effectiveness even though it does not provide a specific mechanism due to the short period (Bernanke & Blinder, 1992; Taylor, 1995; Christiano et al., 1998; Camarero et al., 2002; Sun et al., 2010).

Additionally, FGLS estimates show that a 1% increase in fiscal stimulus package results in a 0.43% increase in economic growth. In US, Castro (2020) investigated the potential fiscal channels and argues that unemployment insurance benefits can be considered as a crucial way in the stabilization of the economy. In an earlier study, Drautzburg et al. (2015) also provided a positive fiscal multiplier in the short run, where they studied fiscal policy in response to the American Recovery and Reinvestment Act (ARRA) of 2009. A statistically significant and positive result of the fiscal policy variable supports these studies.

The coefficient estimate of the exchange rate variable, on the other hand, stands negative and significant, which is also in line with our expectations and theory. In open economy macroeconomic models, a negative relationship

<table>
<thead>
<tr>
<th>Table 1. Regression Results</th>
<th>(Model 1)</th>
<th>(Model 2)</th>
<th>(Model 3)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OLS</td>
<td>OLS</td>
<td>FGLS</td>
</tr>
<tr>
<td>Growth rate (quarterly)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>log (money supply)</td>
<td>57.21***</td>
<td>56.47***</td>
<td>62.94***</td>
</tr>
<tr>
<td></td>
<td>(20.48)</td>
<td>(20.41)</td>
<td>(15.86)</td>
</tr>
<tr>
<td>interest rate</td>
<td>-0.979</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.300)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>log (exchange rate)</td>
<td>-58.98***</td>
<td>-63.12***</td>
<td>-63.00***</td>
</tr>
<tr>
<td></td>
<td>(18.59)</td>
<td>(17.72)</td>
<td>(15.59)</td>
</tr>
<tr>
<td>log (industrial production index)</td>
<td>28.07**</td>
<td>26.03**</td>
<td>27.84***</td>
</tr>
<tr>
<td></td>
<td>(11.42)</td>
<td>(11.07)</td>
<td>(9.990)</td>
</tr>
<tr>
<td>log (fiscal stimulus package)</td>
<td>89.53***</td>
<td>95.36***</td>
<td>101.5***</td>
</tr>
<tr>
<td></td>
<td>(29.72)</td>
<td>(28.62)</td>
<td>(25.23)</td>
</tr>
<tr>
<td>log (containment measure index)</td>
<td>-6.524***</td>
<td>-6.500***</td>
<td>-5.105***</td>
</tr>
<tr>
<td></td>
<td>(1.771)</td>
<td>(1.766)</td>
<td>(1.533)</td>
</tr>
<tr>
<td>log (health measure index)</td>
<td>3.461*</td>
<td>3.556*</td>
<td>1.520</td>
</tr>
<tr>
<td></td>
<td>(2.029)</td>
<td>(2.020)</td>
<td>(1.515)</td>
</tr>
<tr>
<td>Country fixed effects</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Observations</td>
<td>128</td>
<td>128</td>
<td>128</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.53</td>
<td>0.53</td>
<td>0.53</td>
</tr>
</tbody>
</table>

Robust standard errors in parentheses.
Significance levels: *** p<0.01, ** p<0.05, * p<0.1
postulates between the value of a domestic currency and net export or output levels (Fleming, 1962; Mundell, 1963; Dornbusch, 1976). Additionally, it is straightforward to expect a positive impact of the industrial production index on economic growth, not particularly for a pandemic period but regularly. We have this result in our model. Lastly, we find a negative and significant effect of containment measures and a positive and significant effect of health-related measures (only in FGLS, it is insignificant but still positive) on short-run economic growth. Recent study of Carlsson-Szlezak et al. (2020) claim that direct impact of social distancing measures was seen as reduced consumption of good and services, consumer confidence, and deteriorated production capacities. Mulligan (2020) states the cost of lockdown days and documents the offsetting effect of vaccine development and contract tracing. Our results also support these claims.

4. CONCLUSION

Since the beginning of the Pandemic, most governments have started to implement lockdown measures which caused a sudden and sharp decline in global production and supply chains, disrupted business activities, and an enormous uncertainty for the global economy. Concurrently, the COVID-19 outbreak depressed the aggregate demand due to quarantines, social life restrictions, and economic activities. As an immediate move, CBs around the world have reacted with similar responses. These are, in fact, the similar tools that the CBs used in financial turmoil in 2007-2009, even though the causes and the scopes were quite different.

In this study, we analyze the impact of monetary policy to stimulate the economy in the short run. We see a significant and positive impact of monetary policy on quarterly economic growth in all specifications. Our results justify QE measures of many CBs as sudden and immediate policy responses to the Pandemic (Bonatti et al., 2020) by documenting the positive contribution of money stock on the quarterly growth rate of real GDP. Even after controlling the fiscal stimulus, our results suggest that monetary policy served its purpose, but its magnitude is relatively weak. The negative and significant impact of the exchange rate on economic growth is in line with existing literature (Fleming, 1962; Mundell, 1963; Dornbusch, 1976). The positive and significant coefficient of the industrial production index highlights the more substantial impact of the Pandemic on emerging economies that are primarily dependent on the service sector. These economies are expected to be exposed to a sharper slowdown in economic growth due to containment measures, shutdowns and restrictions. Additionally, we see a negative impact of containment measures and a positive impact of actions such as testing, vaccination, and contact tracing.

The current study provides empirical evidence of monetary and fiscal policies on the short-run economic growth in a pandemic context. However, our preliminary results should be interpreted with caution despite the data constraints and the dynamic nature of the Pandemic. Therefore, we evaluate our results to contribute to the emerging literature that deals with macroeconomic policy effectiveness in the Pandemic era. Future studies may develop this model by adding different variables and extend the time horizon as long as more data becomes available. The study shows how vital investment in industrial production and quick policy responses in monetary and financial packages are for economic growth. For this reason, such policies may be recommended for underdeveloped economies in the short term.

Notes

1 In the OECD database, exchange rates are defined over the dollar value of the currencies, which means the exchange rate variable for the USA is 1.

2 In the data of Oxford Coronavirus Tracker, the variables are recorded on an ordinal scale in which higher values indicate higher strictness of the measures. We follow the index methodology of Hale and Wester (2020) and calculate daily indices using the equation $I_j = (v_i - 0.5(F_j - f_i)/N_j \times 100$ to normalize the indicators with different scales. In the formula, $I_j$ represents sub-index score for any given indicator at time $t$. $v_i$ denotes the original score of the indicator and has a scale of 0-2,0-3 or 0-4. $N$ is the maximum value that the indicator can take. $F$ is the binary flag variable that exists only for particular indicators and captures
the geographical scope of the measure. For example, when the variable has a flag, $F_j$, it takes the value of 1 and $f_j, t$ takes the value of 1 or 0 depended on whether the policy has been implemented over the whole country or targeted to a limited geographical area. However, instead of daily indices, we transformed the daily data to quarterly by simple averaging and got unique values for each sub-index at the country level.

REFERENCES


IMF. (2013). *Unconventional monetary policies - Recent experiences and prospects - Background paper*. International Monetary Fund.


OECD. (n.d.). *About the OECD*. OECD.org - OECD. https://www.oecd.org/about/


---

**Appendix**

**Table A1. List Of 33 OECD Countries in The Sample**

<table>
<thead>
<tr>
<th>Australia</th>
<th>Latvia</th>
<th>Denmark</th>
<th>Poland</th>
<th>Greece</th>
<th>Spain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>Lithuania</td>
<td>Estonia</td>
<td>Portugal</td>
<td>Hungary</td>
<td>Sweden</td>
</tr>
<tr>
<td>Belgium</td>
<td>Luxembourg</td>
<td>Finland</td>
<td>Slovakia</td>
<td>Ireland</td>
<td>Turkey</td>
</tr>
<tr>
<td>Canada</td>
<td>Netherlands</td>
<td>France</td>
<td>Slovenia</td>
<td>Israel</td>
<td>United States</td>
</tr>
<tr>
<td>Chile</td>
<td>New Zealand</td>
<td>Germany</td>
<td>South Korea</td>
<td>Italy</td>
<td>United Kingdom</td>
</tr>
<tr>
<td>Czechia</td>
<td>Norway</td>
<td>Japan</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table A2. Summary Statistics**

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quarterly growth rate</td>
<td>128</td>
<td>-0.560</td>
<td>7.405</td>
<td>-19</td>
<td>18.46</td>
</tr>
<tr>
<td>Money supply</td>
<td>132</td>
<td>133,688</td>
<td>555,341</td>
<td>15.66</td>
<td>3184353</td>
</tr>
<tr>
<td>(billion currencies)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exchange rate (USD=1)</td>
<td>132</td>
<td>74.89</td>
<td>243.7</td>
<td>0.757</td>
<td>1,220</td>
</tr>
<tr>
<td>Interest rate</td>
<td>132</td>
<td>0.205</td>
<td>1.938</td>
<td>-0.700</td>
<td>14.08</td>
</tr>
<tr>
<td>containment index</td>
<td>132</td>
<td>42.07</td>
<td>20.86</td>
<td>3.777</td>
<td>79.58</td>
</tr>
<tr>
<td>health index</td>
<td>132</td>
<td>69.10</td>
<td>22.83</td>
<td>8.791</td>
<td>100</td>
</tr>
<tr>
<td>Industrial production index (quarterly)</td>
<td>132</td>
<td>103.7</td>
<td>10.53</td>
<td>77.43</td>
<td>128.4</td>
</tr>
<tr>
<td>Fiscal stimulus (%of GDP) (cumulative)</td>
<td>132</td>
<td>14.16</td>
<td>6.897</td>
<td>3.780</td>
<td>42.20</td>
</tr>
<tr>
<td>Total number of cases per million (cumulative)</td>
<td>132</td>
<td>64,041</td>
<td>35,796</td>
<td>522</td>
<td>152,258</td>
</tr>
<tr>
<td>Country code</td>
<td>132</td>
<td>17</td>
<td>9.558179</td>
<td>1</td>
<td>33</td>
</tr>
</tbody>
</table>
**Figure A1. Added Variable Plots**

![Added Variable Plots](image)

**Table A3. Multicollinearity Test**

<table>
<thead>
<tr>
<th>Variable</th>
<th>VIF</th>
<th>1/VIF</th>
</tr>
</thead>
<tbody>
<tr>
<td>log (money supply)</td>
<td>3.49</td>
<td>0.286716</td>
</tr>
<tr>
<td>log (exchange)</td>
<td>3.41</td>
<td>0.293609</td>
</tr>
<tr>
<td>log (containment measure index)</td>
<td>2.26</td>
<td>0.442170</td>
</tr>
<tr>
<td>log (health measure index)</td>
<td>2.16</td>
<td>0.462912</td>
</tr>
<tr>
<td>log (fiscal stimulus index)</td>
<td>1.16</td>
<td>0.861384</td>
</tr>
<tr>
<td>log (industrial production index)</td>
<td>1.35</td>
<td>0.861384</td>
</tr>
</tbody>
</table>

**Table A4. Ramsey Reset Test Results For The Functional Form**

<table>
<thead>
<tr>
<th>Ho: model has no omitted variable</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model 1</td>
<td>0.2748</td>
</tr>
<tr>
<td>Model 2 (excluding interest rate)</td>
<td>0.2742</td>
</tr>
</tbody>
</table>
Figure A2. Residuals Normality

![Kernel density estimate](image)

kernel = epanechnikov, bandwidth = 1.5037

Figure A3. Residual Vs. Fitted Plot

![Kernel density estimate](image)

kernel = epanechnikov, bandwidth = 1.5037

Table A5. Breusch-Pagan / Cook-Weisberg Test For Heteroskedasticity

<table>
<thead>
<tr>
<th>Ho: Constant variance</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variables: fitted values of quarterly growth rate (model excludes interest rate)</td>
<td>0.0482</td>
</tr>
</tbody>
</table>