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The Impact Of The Interest Rate On Industrial Production During The 2008 Financial Crisis and the COVID-19 Pandemic

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Abstract

The impact of the real interest rate on industrial production growth in developed and developing countries was analyzed during the 2008 financial crisis and the COVID-19 pandemic. Panel data analysis was implemented for the monthly period between January 2002 and December 2020. The impact of the real interest rate on industrial production growth was negative for both developed and developing countries in all periods. Furthermore, for both developed and developing countries, the relationship between two factors was negative during the 2008 financial crisis. However, the effect of the real interest rate was stronger in developed countries. The real interest rate had a much greater effect on the expansion of industrial production during the COVID-19 pandemic than it did during the 2008 financial crisis. In developed countries, its impact was stronger. The result suggests that a drop in the real interest rate was essential in strengthening industrial production during the crisis and pandemic. Pulling the real interest rate down can be an effective tool for promoting growth and can lessen negative consequences in economic activities during COVID-19-like pandemics. Nevertheless, the low inflation rate in developed countries and the potential for currency depreciation in developing countries might restrict the implementation of expansionary monetary policy. Hence, other alternatives such as government intervention into economic activities by fiscal policy increase in importance beside monetary policy.

Keywords: 2008 financial crisis, COVID-19 pandemic, industrial production, interest rate, panel data analysis
JEL Codes: C5, E4, G01

2008 Finansal Krizi ve COVID-19 Salgını Sırasında Faiz Oranının Sanayi Üretimi Üzerindeki Etkisi

Öz

Gelişmiş ve gelişmekte olan ülkelerde reel faiz oranının sanayi üretimi üzerindeki etkisi, 2008 finansal krizi ve COVID-19 salgını döneminde analiz edilmiştir. Panel veri analizi Ocak 2002 ile Aralık 2020 arasındaki aylık dönem için uygulanmıştır. Reel faiz oranının sanayi üretimi üzerindeki etkisinin hem gelişmiş hem de gelişmekte olan ülkeler için tüm dönemlerde negatif olduğu sonucuna ulaşılmıştır. Ayrıca 2008 finansal krizi sırasında da bu iki değişken arasındaki ilişki hem gelişmiş hem de gelişmekte olan ülkeler için negatif bulunmuştur. Ancak gelişmiş ülkelerde reel faiz oranının etkisi daha güçlü olmuştur. COVID-19 salgını sırasında reel faiz oranının sanayi üretimi üzerindeki etkisinin 2008 finansal krizi dönemine kıyasla çok daha etkili olduğu sonucuna ulaşılmıştır. Bu etki gelişmiş ülkelerde daha belirgin olarak ortaya çıkmıştır. Sonuç olarak kriz ve salgın sırasında reel faiz oranındaki düşüşün sanayi üretimini canlandırmada önemli bir rol oynadığı görülmektedir. Reel faiz oranının aşağı çekilmesi, büyümeyi teşvik etmek için etkili bir araç olabilir ve COVID-19 benzeri salgınlar sırasında ekonomik faaliyetlerdeki olumsuz sonuçları azaltabilir. Fakat gelişmiş ülkelerde enflasyon oranı oldukça düşük olduğundan ve gelişmekte olan ülkelerde döviz kurunda değer kaybı riski ortaya çıkabileceğinden dolayı genişletici para politikasının uygulanabilirliği sınırlı kalmaktadır. Dolayısıyla para politikasının yanı sıra devletin maliye politikası yoluyla ekonomik faaliyetlere müdahale etmesi gibi diğer alternatif yöntemler önem kazanmaktadır.

Anahtar Kelimeler: *2008 finansal krizi, COVID-19 salgını, sanayi üretimi, panel veri analizi*
JEL Kodları: C5, E4, G01

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Introduction

The main aim of the research is to analyze the impact of the real interest rate on industrial production in developed and developing countries during the 2008 financial crisis and COVID-19 pandemic. Recently, the COVID-19 pandemic has become an important obstacle to economic growth. The developed and developing economies experienced negative growth, rising unemployment and deepening macroeconomic instabilities. This is a case of what can emerge during economic recessions. The 2008 financial crisis globally impacted on economic growth. These periods witnessed the use of a tool, the interest rate, to influence economic performance. In normal periods of economic growth, the market likes low real interest rate that can create investments. Furthermore, during low economic growth periods, the real interest rate plays a role in stimulating growth through consumption and production in the economy. To promote economic growth and reduce the effect of a crisis, a decrease in real interest can play a role until the economy returns to its potential growth path. Hence, to support industrial production, which is a strong dynamic behind economic growth, the real interest rate is an option to be used. To analyze this relationship, which might help many countries to think about the role of interest rate behind industrial production, especially in periods of great slowdown, two recent great economic collapses were considered for this analysis. These are 2008 financial crisis and the COVID-19 pandemic. It is assumed that the real interest rate in periods of economic slowdown can impact on industrial production. The main questions of this work are as follows: firstly, the impact of the real interest rate on industrial production growth during the 2008 financial crisis and the COVID-19 pandemic, and the difference in its impact between developed and developing countries, and secondly, whether the interest rate can serve as tool of monetary policy to assist growth. The article is going to answer these questions.

Table 1: List of Countries

Developed Countries	**Developing Countries**
Denmark	Brazil
Finland	India
France	Mexico
Germany	Russia
Italy	South Africa
Portugal	Turkey
Spain	
Sweden	
United Kingdom	
Canada	
United States	
Japan	

For the research, the countries which were chosen are listed in Table 1 and were separated according to their level of development. There are three reasons why these countries were taken into account. The first was their inflation levels, which can help in a comparative analysis between expansionary economic countries and those that follow more stable inflation policies. These countries were selected according to their inflation levels in the 2008 financial crisis. Average inflation was approximately 9% in the developing economies. Russia, South African and Turkey experienced above 10% inflation. The average inflation was around 3.1% in the developed economies.[1] The developed countries are categorized as a low inflation group, and the developing economies as a high inflation group. Thus, the effect of interest rates in these groups can be analyzed, and explored as to whether the real interest rate works better in high or low inflation countries in periods of economic slowdown. The second reason concerned data availability. These countries have data covering the time-periods concerned in the research. Having the latest data information was judged to be important for the analysis. The third reason is that the most of these countries have been impacted severely by the pandemic. For instance, the United States, Brazil, India, Russia, Spain, Mexico, South Africa, France, the United Kingdom, Italy and Turkey have had among the highest number of cases of COVID-19.[2] The countries are also leading economies, and cover a large part of the world with their economic power. Hence, including these countries in the analysis can answer our questions. In the future, these analyses can be examples for other economies that could not be included in the research due to technical limitations.

The variables considered for the research are the real interest rate and the industrial production index. The countries that were selected have market economies which allow interest rates to fluctuate, and have the power to influence industrial production. It can be expected that industrial production can be impacted by interest rate policy. Ahad et al. (2019) found there to be a cointegration between financial development, savings and industrial production in Pakistan for the period 1972 to 2014. Cruz-Garcia et al. (2019) estimated that expansionary monetary policy via reductions in interest rates in order to eliminate the effects of the crisis could also cause a negative impact on net interest margins. Furthermore, Aron and Muellbauer (2002) estimated that level of the real interest rate influenced output, which

[1]Source: OECD (Consumer price indices).

[2]Source: COVID-19 Dashboard by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University (JHU).

constrained growth in the 1990s. It was suggested that the ceiling on the interest rate must be reduced in order to make lower cost funds available to stimulate industrial production. The interest rate plays a key role in monetary policy. The main tool that is used for the central banks during economic crises is a policy of lower interest rates to promote growth and reduce debt levels (Buchner, 2020; Blanchard and Brancaccio, 2019; Dimsdale, 2009). This creates a bridge to channel funds into industrial production, and can also influence investment in a country. In a period of depreciation in the exchange rate, interest rates can be used to attract hot money to keep it stable. When there has been low domestic consumption growth, it has been implemented to stimulate domestic consumption in a country. It can directly support economic activities. Industrial production is a dynamic factor in economic growth. It can be affected by consumption in a country. It has been assumed that the relationship between the interest rate and industrial production is negative in periods of normal growth in an economy. Moreover, unexpected periods such as crises or pandemics can meet with a decreasing real interest rate to support industrial production. A high interest rate when a country experiences lower economic growth can increase economic costs. Therefore, a negative relationship is expected during crises or economic slowdowns to recover and revive economic growth. Nevertheless, the impact of interest rates can be different in developed and developing economies.

There are reasons why this topic was taken into account for the research. The COVID-19 pandemic had severe consequences for industries in the world's economies (Nicola et al., 2020; Altig et al., 2020). This is one of the researches that aims to find a way to mitigate the effect of pandemics. The countries experienced drops in economic growth, decreasing trade, and rising unemployment. This caused uncertainty for the future of economies. These countries were looking a way to reduce the effect of COVID-19 pandemic. However, the effect of the pandemic on economic activities could be different than that of economic crises. Hence, the 2008 financial crisis was considered for the comparison research because of its significant economic downturn and its proximity to the recent pandemic. In addition, throughout the 2000s, a majority of nations were increasingly interconnected via globalization and adopted comparable market-oriented economic strategies. Thus, it is presumed that all countries share a comparable economic narrative throughout certain timeframes, but the influence of the interest rate in the midst of the pandemic and crisis seems to diverge across developed and developing economies. The real interest rate was included in the analysis, because it is one of the first resources to directly influence economies and their industrial

production growth. This study is anticipated to serve as a model for governments on how to mitigate the impact of a pandemic in the event of future occurrences of such an outbreak.

In Section 2, the background of the research, and the current work are explained. In Section 3, assumptions and data collection are introduced. In Section 4, the model is laid out, and the empirical analysis is conducted. In Section 5, the political implications are discussed. The research is concluded in Section 6.

1. Previous Research and The Current Work

1.1 Previous Research

There are works that analyze the effects of interest rates or other closely related variables on industrial production and other economic activities. Some of these works seek to explain the role of monetary policy during a recession. Albonico and Tirelli (2020) divided EU countries into peripheral, called PIIGS, and core countries for the rest of euro area. The DSGE model was implemented for quarterly data between 1992Q2 and 2013Q3. It was found that the output response to the financial crisis was caused by asymmetric shocks. The demand shocks were more important in the core countries than in the others. However, interest rate shocks played a lesser role in both regions. Colombo and Paccagnini (2020) implemented a Smooth Transition VAR model using monthly data between January 1973 and December 2018 to analyze the effect of exogenous credit supply shock on macroeconomic variables. It was estimated that a credit supply shock identified as an excess bond premium created asymmetric effects on macroeconomic variables, and the variance of industrial production, employment and inflation was larger during recessions caused by the shocks. Yazdanfar and Öhman (2020) implemented multiple OLS and dynamic panel data to analyze five industrial sectors between 2008 and 2015. It was pointed out that the financial crisis and the interbank interest rate influenced the cost of debt. Small industries were more likely to pay more to borrow debt capital. Irandoust (2020) estimated the impact of the real interest rate on real output growth using quarterly data between 1987Q1 and 2019Q2 for Sweden, Norway, the UK, the US, New Zealand, Australia, Denmark, Switzerland and Canada. It was pointed out that expansionary monetary policy has a weaker impact on positive output growth than on negative output growth. Egea and Hierro (2019) analyzed the effectiveness of monetary policy and its transmission channel before and after the financial crisis, using a VAR model for the US and the Eurozone. It was suggested that to influence production growth, there should be quantitative easing that is not in the form of loans to financial institutions, because the second measure can be useful in stabilizing the financial system. Honda and Inoue (2019) assessed

the effects of the negative interest rate policy that was implemented in 2016 for Japan. It was found that this negative interest rate policy had a depreciation effect on the exchange rate. Moreover, there was a correlation between the appreciation in yen and decreasing industrial production. Overall, this policy helped support the real economy in Japan. Cachanosky and Hoffmann (2016) analyzed the effects of changes in interest rates on production in European countries during the 2000s. The paper found that the low interest rate policy of the European Central Bank influenced the allocation of resources across industry. Aristei and Gallo (2014) analyzed interest rate pass-through between interbank and retail bank rates in the euro area, using a Markov-switching vector autoregressive model based on monthly data for the period 2003-2011. It was shown that during the financial crisis, short-run transmission between the money market and retail banks was weak, but the responsiveness of loan rates to deviations increased in the long-term. It was pointed out that monetary policy was limited because of credit tightening in the financial crisis. Hristov et al. (2014) implemented a panel VAR model for quarterly data between 2003Q1 and 2011Q4 in the Euro area to analyze interest rate pass-through during the financial crisis. It was estimated that the pass-through effect was complete before the financial crisis. Abbassi and Linzert (2012) used daily data between 10 March 2004 and 31 December 2009 to analyze the effectiveness of monetary policy during the financial crisis by explaining the relationship between interest rates via an expectations hypothesis for the euro area. It was concluded that the central banks played important roles in conducting monetary policy during the financial crisis because non-standard policy measures helped decrease Euribor rates. Karagiannis et al. (2010) examined interest rate transmission for the Eurozone and the US by implementing a disaggregated general-to-specific model, and discussed monetary policy after the financial crisis. The periods used were non-identical, and were between January 1994 and September 2007 for the US and between January 1998 and September 2003 for the Eurozone. It was assumed that any change in the central bank rate impacted on retail interest rates, which influence consumer and business lending rates. This process affected aggregated domestic demand and output. To restore the efficiency of the monetary transmission mechanism, it was advised that the central banks should properly organize to channel liquidity.

The COVID-19 pandemic is still new for the world's economies. There are some works that have tried to explain how to mitigate the impact of the pandemic on economic activities. Bhar and Malliaris (2020) used a Markov switching econometric model, using monthly data for the period 2002-2015. Unconventional monetary policy during the financial crisis was

evaluated to mitigate the financial impact of the COVID-19 pandemic on US households and business. It was pointed out that an unconventional monetary policy was intended to implement quantitative easing with the aim of driving down longer-term interest rates to stimulate economic activity. It was found that the policy of the FED to reduce long-term interest rates was associated with a decrease in unemployment between 2009 and 2015. It was suggested that an unconventional monetary policy can help to mitigate the impact of the COVID-19 pandemic. Zhang et al. (2020) aimed to map the patterns of country-specific risks and systemic risks in the global financial markets. To that end, the top countries that were impacted by COVID-19 pandemic were listed. As a result, it was found that using a zero-interest rate policy and quantitative easing can cause further uncertainty and long-term problems. Qiu et al. (2020) used the triple-bounded dichotomous choice contingent valuation method to assess perceptions of the risks posed by the tourism industry, and estimated the willingness of residents to pay to mitigate health risks. It was found that respondents were willing to pay for risk reduction. Oravský et al. (2020) applied a linear panel regression between 2001 and 2017 to find way to reduce the negative consequences of the COVID-19 pandemic on economic activities in European countries. It was estimated that interest rates grew in at-risk countries but fell in the group of countries that appeared to be safe for investors.

1.2 The current work

In contrast to previous works, this research consists of data that was collected after the spread of the virus, when it was acknowledged as a pandemic. Thus, this research seeks to create implications by considering the situation. To understand the role of the real interest rate, the work took into account developed and developing economies that had low and high inflation, respectively. In particular, it analyzed in which country group industrial production showed a more significant response to the real interest rate. The research included the main countries that faced the pandemic, and examined the situation using panel data analysis. Most of the research was limited solely to interest rate policy and its pass-through effect, in the main, considering variable in the area of the financial market. Nevertheless, the impact of interest rates on industrial production also needs to be researched. This is a study that creates a direct relationship between the two variables. The work includes a large number of countries, analyzed in the periods of the 2008 financial crisis, and the COVID-19 pandemic. The impact of the real interest rate during the crisis is also examined. Regarding the effects of interest rate

policy, the differences between the periods of the 2008 financial crisis and the COVID-19 pandemic are interpreted for developed and developing economies. This shines a light on measures to mitigate the effect of a pandemic. Hence, the analysis presents an opportunity for the world's economies to construct policies which take the real interest rate into account.

2. Assumptions and data collection

During periods of potential economic growth, when monetary policy is free to respond to market conditions, it is assumed that the real interest rate can be a tool for stimulating growth. In periods of recession, it is assumed that a falling real interest rate can assist economic recovery from a crisis (Gertler and Gilchrist, 2018; Kuttner, 2018). In that sense, interest rates can provide a strong stimulus for industrial production (Munir, 2018). Thus, lowering the real interest rate can help revive markets in times of economic crisis. Furthermore, understanding the effect of interest rate policy can influence other policies, such as unconventional monetary policy, in support of economic activities. Following such a policy can also change expectations in the private sector and thus reduce the effects of financial crisis (Doh, 2019). A lower real interest rate is considered necessary for developing economies to achieve a higher growth rate (Shaukat et al., 2019; Ma, 2017). In that respect, a high real interest rate can negatively impact on economic growth. A lower interest rate policy can promote industrial production. First, it can lower the debt burden on industries that need to invest for their production processes. Second, expansionary monetary policy can provide lower cost credits and thus stimulate domestic consumption. This promoting policy can increase production. Hence, it can be one of the main tools for mitigating the effects of economic crisis. Nevertheless, there might be variations in interest rate policies across distinct groupings of countries. Whereas some countries need more stimulus from interest rate policy, for others, a slight change in this monetary policy can be enough to eliminate the negative impact of declining production. In particular, it becomes a reality that a falling real interest rate in developed economies may naturally have a higher impact on industrial production due to their stages of development. In other words, a slight lowering of interest rates can have a more significant impact on industrial production in developed economies than that in developing ones.

Various sources were used to collect monthly data between January 2002 and December 2020. It was challenging to collect data for all countries from same source. In particular, finding standard interest rate data was difficult. To increase the number of countries tested in the analysis, familiar data that can be accepted as a standard interest rate was utilized. Most of

the data was derived from the OECD to increase standardization for the research. For the developed countries in Table 1, OECD data was used to obtain interest rates, the industrial production index and the consumer price index (CPI). Consumer prices and industrial production data was released as the 2015=100 index, and the interest rate was designated as the long-term interest rate. For developing countries, different sources were used. For all developing countries, the CPI was derived from the OECD. For Brazil, the industrial production index was derived from the OECD, and the interest rate was collected as the discount rate from International Financial Statistics, IMF. For India, both interest rates as discount rates and the industrial production index released as 2010=100 were collected from International Financial Statistics, IMF. For Turkey, interest rates as discount rate was collected from International Financial Statistics, IMF and industrial production index was derived from OECD. For Russia, the industrial production index was derived from the OECD, and the interest rate as the call money/interbank rate was collected from the Federal Reserve Bank of St. Louis. For Mexico, the interest rate as the money market was derived from International Financial Statistics, IMF and the industrial production index was collected from OECD. For South Africa, OECD sources were used to collect all data. The CPI was used to derive the real interest rate for all countries.

3. Empirical analysis

The empirical model of panel regression analysis is explained as follow:

$$ipg_{it} = \alpha_i + \beta rir_{it} + \gamma_1 D_{it}^{2008} + \gamma_2 D_{it}^{Covid} + \gamma_3 D_{it}^{C} rir_{it} + \gamma_4 D_{it}^{2008} rir_{it} + \gamma_5 D_{it}^{Covid} rir_{it}$$
$$+\gamma_6 D_{it}^{C} D_{it}^{2008} rir_{it} + \gamma_7 D_{it}^{C} D_{it}^{Covid} rir_{it} + e_{it} \qquad i = 1,2,\cdots,N$$
$$t = 1,2,\cdots,T$$

Where,

ipg_{it}: Industrial production growth rate (year-on-year)

rir_{it}: The real interest rate

$$D_{it}^{2008} = \begin{cases} 1 & for\ i^{th}\ country\ in\ the\ 2008\ global\ crisis\ periods \\ 0 & otherwise \end{cases}$$

$$D_{it}^{Covid} = \begin{cases} 1 & for\ i^{th}\ country\ in\ the\ 2020\ COVID-19\ crisis\ periods \\ 0 & otherwise \end{cases}$$

$$D_{it}^{C} = \begin{cases} 1 & for\ the\ developed\ countries \\ 0 & otherwise \end{cases}$$

Different periods were taken from country to country in the dummy variables defined for global financial and pandemic crises. The error term e_{it} is independently, identically distributed over i and t, with mean zero and variance σ_e^2, N is the number of countries, and T

is the number of observations for each time period. For the applicability of the variables to the model, unit root tests and cross-section dependency tests were implemented.

3.1 Unit root tests and cross section dependency tests

The unit root null hypothesis can be rejected for both industrial production growth and the real interest rate at a 1% significant level. According to the unit root tests in Table 2, the integrated orders for these variables at level are zero. Therefore, panel regression can be implemented for estimating only a short-run relationship between the variables.

Table 2: Panel Unit Root Test

	Industrial production growth rate		Real interest rate	
	Test Statistic	p-value	Test Statistic	p-value
Im, Pesaran and Shin W-stat	-12.1	0.0000	-2.6	0.0042
ADF - Fisher Chi-square	237.8	0.0000	58.7	0.0097
PP - Fisher Chi-square	284.5	0.0000	60.5	0.0064

The Hausman test was implemented to decide whether to use random or fixed effects for the model. The Chi-square statistic of the Hausman test for correlated random effect is calculated as 65.44 ($p< 0.01$). According to the results of the Hausman test, the random effect null hypothesis can be rejected at a 1% significant level. This result shows that coefficient estimates from the random effects model are biased and inconsistent and, hence, that a fixed effects model is preferable.

Table 3: The Results of Cross-Section Dependence Tests

Test	Statistic	p-value
Breusch-Pagan LM	4888.7	0.0000
Pesaran scaled LM	270.7	0.0000
Bias-corrected scaled LM	270.7	0.0000
Pesaran CD	61.9	0.0000

Table 3 shows the results of cross-section dependency tests. According to the test results, null hypothesis, no cross-section dependence, can be rejected at a 1% significant level. These results show that there is contemporaneous correlation between cross-sections. Therefore, cross-section SUR (seemingly unrelated regression) was implemented to compute robust standard errors.

3.2 Panel regression analysis

The results of the panel regression analysis are displayed in Table 4. According to the table, while the coefficient of the real interest rate is statistically significant at a 10% level, the

coefficients of the other variables are statistically significant at a 1% level. The results show that there was a statistically significant difference between the coefficients of the intercept term and slope. This proves that the relationship between the real interest rate and industrial production growth causes structural changes in periods of crisis. Moreover, during the financial crisis and the pandemic, the impact of the real interest rate on industrial production growth indicates significant differences between developed and developing countries. The impact of the 2008 financial crisis shrank industrial production growth by 9.69 units in mean. Similar to the financial crisis, industrial production growth decreased approximately by 9.30 units during the COVID-19 pandemic.

Table 4: The Results of Panel Fixed Effect Model

Variable	Coefficient	t-Statistic	p-value
Constant	4.0201	11.1897	0.0000
rir_{it}	-0.0541	-1.8426	0.0655
D_{it}^{2008}	-9.6898	-16.9377	0.0000
D_{it}^{Covid}	-9.2971	-12.0885	0.0000
$D_{it}^{C} rir_{it}$	-0.3090	-3.5650	0.0004
$D_{it}^{2008} rir_{it}$	-0.5604	-6.9431	0.0000
$D_{it}^{Covid} rir_{it}$	-0.6557	-4.5453	0.0000
$D_{it}^{C} D_{it}^{2008} rir_{it}$	-0.5896	-3.2823	0.0010
$D_{it}^{C} D_{it}^{Covid} rir_{it}$	-2.2443	-4.3219	0.0000
Trend	-0.0130	-4.7910	0.0000
Fixed Effects (Cross)			
Denmark	-0.8576	Brazil	0.1762
Finland	-0.1264	India	3.2362
France	-1.2339	Mexico	-0.6663
Germany	0.0149	Russia	2.0812
Italy	-1.2602	South Africa	-0.9260
Portugal	-1.5493	Turkey	5.3450
Spain	-1.2275		
Sweden	-0.2729		
United Kingdom	-1.4476		
United State	0.0403		
Japan	-0.9944		
Canada	-0.3319		
R-squared=0.56 F-statistic=185.48 (p-value=0.0000)			
Estimation method was Pooled EGLS (Cross-section weights) Cross-section SUR was selected for correcting heteroskedasticity and contemporaneous correlation.			

One of the important reasons behind this difference is that the COVID-19 pandemic gave rise to strict regulations for social activities. Not only were manufacturing industries affected by decreasing demand but also service industries were deeply impacted by lockdown. Restricted

social life significantly slowed economic activities. The main difference between two periods is that the financial crisis did not constrain social activities. Governments usually try to increase social and economic interactions that can stimulate consumption and production when there is an economic crisis. Nevertheless, the pandemic prompted governments to implement policies that had an influence on the market. Intervention in economic activities deepened the recession, causing a large effect as in the period of the financial crisis.

Table 5 shows the marginal effects of the real interest rate on industrial production growth in the developed and developing countries. The table clearly indicates the differences between the two groups of countries in periods of recession. In addition, it gives information about how to follow interest rate policy in the two groups when economic slowdowns emerge. The table shows that in a normal period of growth, in developing countries, the real interest rate had a significant negative impact on industrial production. A one unit increase in the real interest rate caused a 0.05-unit negative change in industrial production. For the developing countries, real interest rate policy is sensitive to creating investment and consumption. These countries need investments to keep traction on the growth path. Nevertheless, in a period of crisis, it is expected that there will be a recession in economic activity. In other words, industries will avoid investment, and people will not consume products. This will slow down interaction between production and consumption in economic activities. To revive industrial production growth, the real interest rate policy becomes important. To effectively boost industrial production, it is necessary to reduce the real interest rate. As a consequence, the connection between the two variables becomes negative.

Table 5: The marginal effects of the real interest rate on industrial production growth

	All Samples	2008 Global Financial Crisis Period	COVID-19 Crisis Period
Developed Countries	-0.3630	-1.5131	-3.2631
Developing Countries	-0.0541	-0.6145	-0.7098

For developed countries, in all of the samples, the impact of the real interest rate on industrial production was negative. It was assumed that these countries had reached a technological frontier. Their growth rates slowed down. These countries need to pull interest rates down to stimulate industrial production. However, there is not much space for central banks to focus on interest rate policy. In other words, these economies become less sensitive to the interest rate, as their inflation rate is already very low. Although the effect was small, one unit increase in the real interest rate caused a 0.363-unit decrease in industrial production growth. In periods of recession, the interest rate policy gains more importance in developed countries

than in developing countries. Their economies become more vulnerable to interest rate policy. In the 2008 financial crisis, the impact of interest rate policy was significantly higher in developed countries than in developing countries. A one unit decrease in the real interest rate led to a 1.5131 unit increase in industrial production growth. This impact was 0.6145 units in the developing countries. Moreover, during the COVID-19 pandemic, interest rate policy became more crucial for economic activities in both developed and developing countries compared with the period of the financial crisis. When the interest rate decreased by one unit, it increased industrial production growth by approximately 3.26 units in developed countries and 0.71 units in developing countries. The table is an indication that interest rate policy can work to stimulate industrial production growth in developed countries more effectively than in developing countries during the pandemic.

As a consequence, it is reasonable to anticipate that the influence of interest rates on industrial production will be greater in developed countries than it would be in developing ones. The marginal effect of a one unit drop in the real interest rate on industrial production was more substantial in developed countries. This is due to the fact that developed countries have established economic markets and have had very low inflation. Thence, when they decrease the real interest rate by one unit, its impact on industrial production growth becomes more effective. Developing economies have more power via nominal interest rates to stimulate growth, as these countries experience higher inflation with higher interest rates.

4. Political implications

The COVID-19 pandemic had become a major challenge for world economies since it started in Wuhan. China locked down the entire city at the beginning of 2020, but this did not stop the spread of the virus to the rest of the world. Finally, COVID-19 was acknowledged as a pandemic in March 2020. The rapid spread of the virus caused many countries to impose strict rules on economic life. Universities, schools, tourist areas, restaurants, shopping malls and other public places were strictly controlled and locked down. These measures decreased the mobility of people and increased risk perception in the economy, which impacted on consumption and production. In spite of this draconian response, the number of cases of COVID-19 significantly increased. The virus cost thousands of lives, shut down industries and negatively influenced the financial sector. It seems clear that the restrictions imposed to eliminate the spread of virus impacted on economic activities, and, thus, on the financial sector. This caused a larger reaction in the economy than occurred during other pandemics because of the strict implementation by governments seeking to limit social and – and thus

economic – interaction (Baker et al., 2020). In the future, it can be expected that a pandemic that is comparable to COVID-19 would most likely take place. Therefore, it may be deduced that industries would continue to face obstacles. Their potential for growth might progressively decrease, which could limit economic development or inhibit future growth in the long term, increase unemployment rates, and contribute to rising macroeconomic instability and social problems.

This work shows that interest rate policy could be implemented as a tool for mitigating the negative effects of the COVID-19 pandemic on industrial production. It is possible that the effect of interest rates during a pandemic would be more significant than it was during the financial crisis that occurred in 2008. Its potential as a stimulator of growth was great for both developed and developing countries. Nevertheless, its impact on industrial production was lower in developing countries than in developed countries. In normal periods of economic growth, developed countries need to stimulate industrial production. However, their low inflation rates remain a challenge to the use of this tool of monetary policy. In developing countries, which experience high inflation rates, central banks can take initiatives to utilize interest rates. This gives rise to a number of political implications. In particular, to lessen the negative economic effects of the COVID-19 pandemic, interest rates could be decreased to a level that could raise industrial production. A low interest rate policy also could serve as a means of stimulating consumption during lockdown. The significance of reducing interest rates is greater for advanced countries due to their expansive economy and sophisticated industries, which were susceptible to the adverse impacts of the pandemic. The low real interest rate had a favorable impact on industrial production in developing countries. Furthermore, these countries should adopt low real interest rate policies to support industrial production during periods of economic recession. The primary significance of this work is that adopting policies that reduce real interest rates is an efficient method of stimulating output, therefore aiding economies in navigating the challenges posed by a pandemic.

5. Conclusion

This work investigates how to reduce the negative influence of the COVID-19-like pandemic by using the tool of interest rates. The effectiveness of interest rate policy has been analyzed for both the 2008 financial crisis and the COVID-19 pandemic, considering both developed and developing countries. The data was examined by panel regression analysis covering monthly periods between January 2002 and December 2020. The results indicate that for all of the data samples, the impact of the real interest rate on industrial production growth was

negative for both developing countries and developed countries. As most developed countries experience relatively low economic growth, their economies need to pursue lower interest rate policies in order to promote economic activity. This is because developed countries have more advanced industries in a low inflation environment. However, the low inflation rates that these countries experience makes following low real interest rate policies a challenge. For this reason, some countries, such as Japan, continue to keep their interest rates at negative levels, which may be of some assistance to any economic activity. The developing economies still need more advanced industries that can begin to match those in developed countries. Therefore, any decrease in real interest rates will help industrial production growth during normal growth periods. It is also estimated that during recessions, these countries experienced a negative relationship between the real interest rate and industrial production growth. In general, real interest rate policies have a greater impact on developed countries. As governments intervened in economic activities through strict regulation of social activities, the influence of the COVID-19 pandemic on industrial production deepened, and its impact had been larger than was the 2008 financial crisis. Following low real interest rate policies could help reduce the negative effects of the pandemic on industrial production. In the developed countries, because of low inflation level, the nominal interest rate remains very low. Hence, in periods of recession, the impact of the nominal interest rate can have limited effects on economic activities. As a consequence, this can lessen the contribution of the real interest rate to economic growth. In contrast, in developing countries, which experience high inflation rates, the nominal interest rate can be decreased further, which can promote growth in periods of crisis. Nevertheless, expansionary monetary policies can increase pressure on exchange rates. The risk of depreciation in currency can distress central banks pursuing flexible policies to promote economic activity. In both developed and developing countries, these limitations pose challenges in implementing expansionary monetary measures via interest rate policies during periods of economic downturn or pandemics. Government action in the market via fiscal policy may be necessary to bolster monetary policy.

Compliance with Ethical Standards

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Not applicable.

Conflict of interest

The authors declare that they have no conflict of interest.

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Various sources were used to collect data for the analyses. Each source of data and materials has been available and pointed through the paper.

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Genişletilmiş Özet

Araştırmanın temel amacı, 2008 finansal krizi ve COVID-19 salgını sırasında gelişmiş ve gelişmekte olan ülkelerde reel faiz oranının sanayi üretimi üzerindeki etkisini analiz etmektir. COVID-19 salgınının ekonomik büyümenin önünde önemli bir engel haline geldiği görülmüştür. Gelişmiş ve gelişmekte olan ekonomiler negatif büyüme, artan işsizlik ve derinleşen makroekonomik istikrarsızlıklar yaşamıştır. Bu olumsuzluklar, ekonomik durgunluklar sırasında da ortaya çıkabilecek bir durumdur. 2008 finansal krizi küresel olarak ekonomik büyümeyi negatif yönde etkilemiştir. Bu türden dönemlerde, ekonomik performansı tekrardan artırabilmek için faiz oranı gibi bir aracın kullanılması önemli bir politika olarak uygulanmıştır. Normal ekonomik büyüme dönemlerinde piyasa, yatırım yaratabilecek düşük reel faiz oranını benimsemektedir. Ayrıca, düşük ekonomik büyüme dönemlerinde, reel faiz oranı ekonomide tüketim ve üretim yoluyla büyümeyi teşvik edici bir rol oynamaktadır. Ekonomik büyümeyi teşvik etmek ve krizin etkisini azaltmak için, ekonomi tekrardan potansiyel büyüme oranına dönene kadar reel faizlerin düşürülmesi yoluna gidilebilir. Dolayısıyla, ekonomik büyümenin arkasındaki güçlü dinamik olan sanayi üretimini desteklemek için reel faiz oranı kullanılabilecek önemli bir seçenektir. Özellikle derin yavaşlama dönemlerinde faiz oranının sanayi üretiminin arkasındaki rolünü incelemek ve

faizin bir politika aracı olarak uygulanabilirliği hakkında birçok ülkeye yardımcı olabilecek bu ilişkiyi analiz etmek için yakın zamanda yaşanan iki büyük ekonomik çöküş ele alınmıştır. Bunlar 2008 finansal krizi ve COVID-19 dönemleridir.

Tablo 1: Ülkelerin listesi	
Gelişmiş Ülkeler	**Gelişmekte Olan Ülkeler**
Danimarka	Brezilya
Finlandiya	Hindistan
Fransa	Meksika
Almanya	Rusya
İtalya	Güney Afrika
Portekiz	Türkiye
İspanya	
İsveç	
Birleşik Krallık	
Kanada	
Amerika Birleşik Devletleri	
Japonya	

Araştırma için seçilen ülkeler Tablo 1'de listelenmiş ve gelişmişlik düzeylerine göre ayrılmıştır. Bu ülkelerin dikkate alınmasının üç nedeni vardır. Bunlardan ilki, göreceli olarak yüksek enflasyon yaşayan ülkeler ile daha istikrarlı enflasyon politikaları izleyen ülkeler arasında karşılaştırmalı bir analiz yapılmasına yardımcı olabilecek enflasyon seviyelerine sahip olmalarıdır. Bu ülkeler 2008 finansal krizindeki enflasyon seviyelerine göre seçilmiştir. Gelişmekte olan ekonomilerde ortalama enflasyon yaklaşık %9 olmuştur. Rusya, Güney Afrika ve Türkiye %10'un üzerinde enflasyon yaşamıştır. Gelişmiş ekonomilerde ise ortalama enflasyon %3,1 civarında gerçekleşmiştir. Gelişmiş ülkeler düşük enflasyon grubu, gelişmekte olan ekonomiler ise yüksek enflasyon grubu olarak sınıflandırılmıştır. Böylece, bu gruplardaki faiz oranlarının etkisi analiz edilebilecek ve ekonomik yavaşlama dönemlerinde reel faiz oranının yüksek veya düşük enflasyonlu ülkelerde daha iyi çalışıp çalışmadığı araştırılabilecektir. İkinci nedeni ise veri mevcudiyeti ile ilgilidir. Bu ülkeler araştırmanın ilgili olduğu zaman dilimlerini kapsayan verilere sahiptir. En güncel veri bilgilerine sahip olmanın analiz için önemli olduğu düşünülmüştür. Üçüncü neden ise bu ülkelerin çoğunun salgından ciddi şekilde etkilenmiş olmasıdır. Örneğin, Amerika Birleşik Devletleri, Brezilya, Hindistan, Rusya, İspanya, Meksika, Güney Afrika, Fransa, Birleşik Krallık, İtalya ve Türkiye en fazla COVID-19 vakasının görüldüğü ülkeler arasında yer almıştır. Bu ülkeler aynı zamanda önde gelen ekonomiler arasında yer almaktadır ve ekonomik güçleriyle dünyanın büyük bir bölümünü kapsamaktadırlar. Dolayısıyla bu ülkelerin analize dahil edilmesi sorularımıza global anlamda cevap verebilir. Ayrıca gelecekte bu analizler, teknik kısıtlar nedeniyle araştırmaya dahil edilemeyen diğer ekonomiler için de örnek teşkil edebilir ve bu ülkeler için de uygulanabilir.

Bu çalışmada, faiz aracını kullanarak COVID-19 salgınının olumsuz etkisinin nasıl azaltılabileceğini araştırılmıştır. Faiz politikasının etkinliği hem 2008 finansal krizi hem de

COVID-19 salgını için hem gelişmiş hem de gelişmekte olan ülkeler dikkate alınarak analiz edilmiştir. Veriler, Ocak 2002 ile Aralık 2020 arasındaki aylık dönemleri kapsayan panel regresyon analizi ile incelenmiştir. Sonuçlar, tüm veri örnekleri için, reel faiz oranının sanayi üretimi büyümesi üzerindeki etkisinin hem gelişmekte olan ülkeler hem de gelişmiş ülkeler için negatif olduğunu göstermektedir. Çoğu gelişmiş ülke nispeten düşük ekonomik büyüme yaşadığından, ekonomik faaliyetleri teşvik etmek için ekonomilerinin daha düşük faiz oranı politikaları izlemesi gerekmektedir. Bunun nedeni, gelişmiş ülkelerin düşük enflasyon ortamında daha gelişmiş sanayilere sahip olmasıdır. Ancak bu ülkelerin yaşadığı düşük enflasyon oranları, düşük reel faiz oranı politikalarının izlenmesini zorlaştırmaktadır. Bu nedenle, Japonya gibi bazı ülkeler, ekonomik faaliyetlerinin artmasına yardımcı olabilecek negatif faiz oranlarını sürdürmektedir. Gelişmekte olan ekonomiler hala gelişmiş ülkelerdeki sanayi sektörleriyle rekabet edebilecek daha ileri sanayi gücüne ihtiyaç duymaktadır. Bu nedenle, reel faiz oranlarındaki herhangi bir düşüş, normal büyüme dönemlerinde sanayi üretiminin büyümesine yardımcı olacaktır. Dahası durgunluk dönemlerinde bu ülkelerde reel faiz oranı ile sanayi üretimi büyümesi arasında negatif bir ilişki olduğu tahmin edilmektedir. Ayrıca daha gelişmiş endüstriyel bir güce sahip olduklarından dolayı gelişmiş ülkeler reel faiz oranı politikalarından daha fazla etkilenmektedir. Hükümetler sosyal faaliyetlerin sıkı bir şekilde düzenlenmesi yoluyla ekonomik faaliyetlere müdahale ettikçe, COVID-19 salgınının sanayi üretimi üzerindeki etkisi derinleşmiş ve bu etki 2008 finansal krizinden daha büyük olmuştur. Bunun için salgından etkilenen ülkelerin düşük reel faiz politikası izlemesi bir politik tavsiye olarak uygulanabilecek reçeteler arasına girebilir. Bu nedenle düşük reel faiz politikalarının izlenmesi gelecekte ortaya çıkabilecek benzer bir salgının sanayi üretimi üzerinde olumsuz etkisinin azaltılmasına yardımcı olabilecektir.

Gelişmiş ülkelerde, düşük enflasyon seviyesi nedeniyle nominal faiz oranı çok düşük kalmaktadır. Bu nedenle, durgunluk dönemlerinde nominal faiz oranının ekonomik faaliyetler üzerindeki etkisi sınırlı olabilir. Sonuç olarak, bu durum reel faiz oranının ekonomik büyümeye katkısını azaltabilir. Buna karşılık, yüksek enflasyon oranlarına sahip gelişmekte olan ülkelerde nominal faiz oranı düşürülebilir ve bu da kriz dönemlerinde büyümeyi teşvik edebilir. Ancak bu aracın kullanılmasıyla izlenen genişletici para politikaları döviz kurları üzerindeki baskıyı artırabilir. Para biriminde değer kaybı riski, ekonomik faaliyeti teşvik etmek için esnek politikalar izleyen merkez bankalarını sıkıntıya sokabilir. Hem gelişmiş hem de gelişmekte olan ülkelerde bu sınırlamalar ve ortaya çıkabilecek riskler, mevcut bir salgın sırasında faiz oranı politikası yoluyla genişletici parasal önlemlerin alınmasını zorlaştırmaktadır. Para politikasını desteklemek için hükümetin maliye politikası yoluyla piyasaya müdahalesi gerekebilir.