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Monetary Policy and Economic Activity in Italy: A Structural VAR Approach

Introduction

In this paper, we are trying to find if monetary policy truly does affect the real gross domestic product of Italy. To do this, we are going to use a structural vector autoregression process to find the effect of monetary policy on real GDP growth. After doing the analysis, the data shows that monetary policy is effective in changing the real GDP growth of Italy, however it is in the opposite direction we would expect. Instead of an increase in short-term nominal interest rates lowering the real GDP growth, we see an increase in real GDP growth.

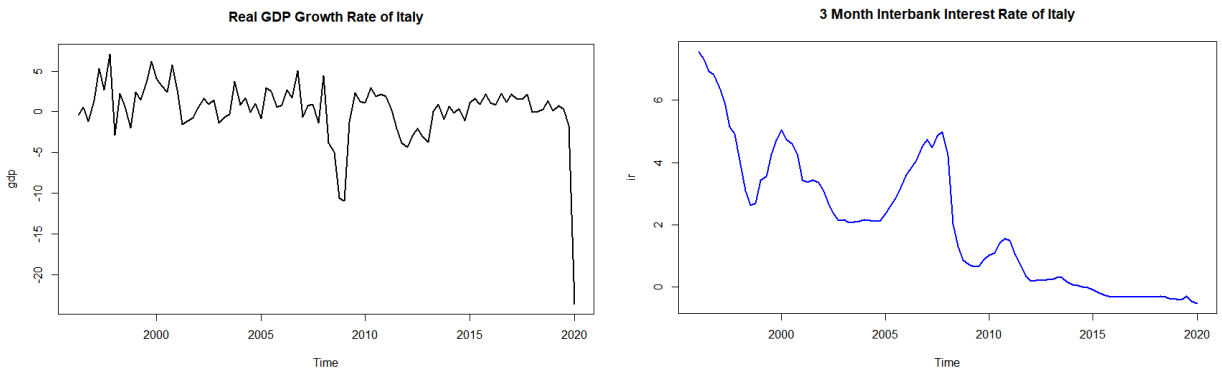
The Effectiveness of Monetary Policy

The theory behind why we would assume short-term nominal interest rates to have an effect on real GDP growth comes from the idea that if the central bank of a given country raises their interest rates, that would, in turn, affect the normal banks raising their interest rates, which causes borrowers to want to spend less and savers to utilize the higher interest rates by saving more, this causes a decrease in real GDP growth. However, if they lower interest rates instead, we would expect the opposite effect and see an increase in real GDP growth. Trying to find a causal between real GDP growth and short-term nominal interest rate can be quite difficult because there could be a case of reverse causality, meaning that it is not just nominal interest

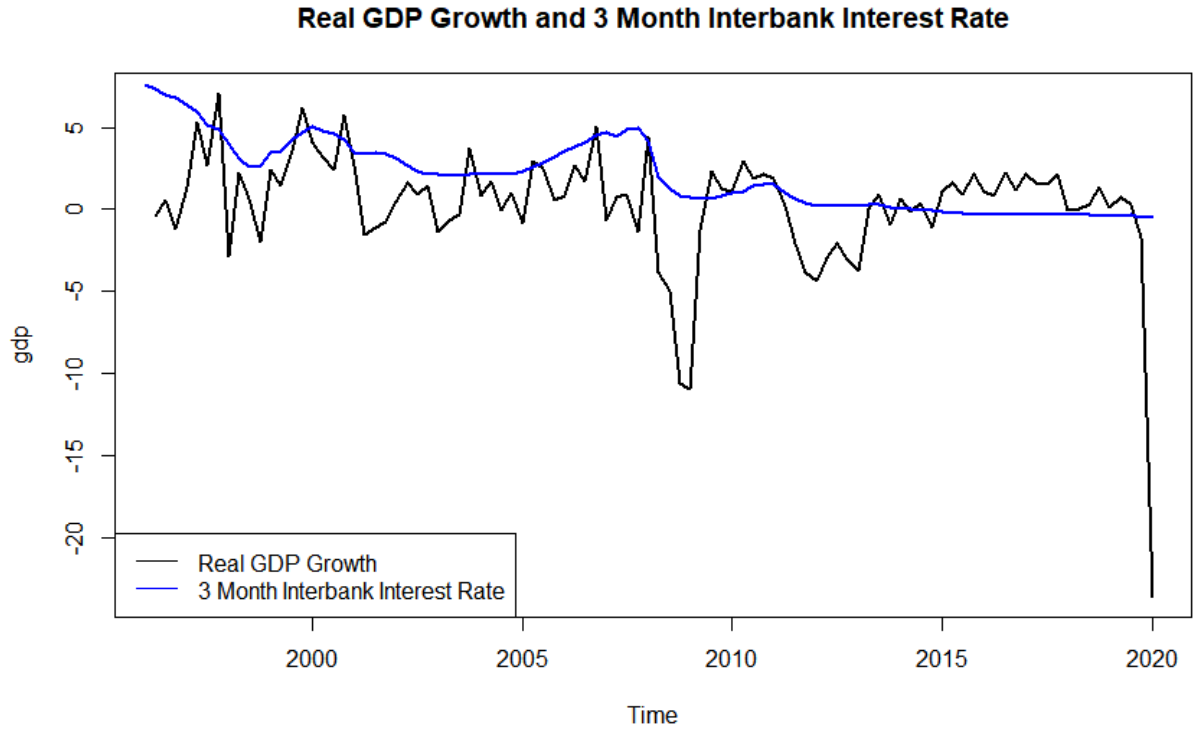
rates that influence real GDP growth, but real GDP growth could also influence nominal interest rates. To fix this, we are going to use a vector autoregression process and a solution proposed by Sims in 1980, to find the effect that short-term nominal interest rate has on real GDP growth. The solution proposed by Sims is to "triangularize" the matrix in the vector autoregression, in the context of this analysis that means to assume that the effect of short-term nominal interest rate on real GDP growth has zero effect at the current quarter, this is what allows us to measure the structural impulse response of how real GDP growth responds to a change of short-term nominal interest rate. This is a reasonable assumption because the true effects of the nominal interest rate will not be captured immediately by real GDP growth, it will take some time to change and continue to change in the future.

Preferred Specification

The datasets that will be used for this analysis are the Real Gross Domestic Product (Real GDP) of Italy and the 3-Month Interbank Interest Rate. First, we need to alter the data for the Real GDP of Italy to represent the Real GDP Growth of Italy. It is also important to note that the data has been selected to only include early 2020 data since the coronavirus pandemic has shown unprecedented effects on the economy and could harm the analysis. After that has been done, the data creates the following graphs:



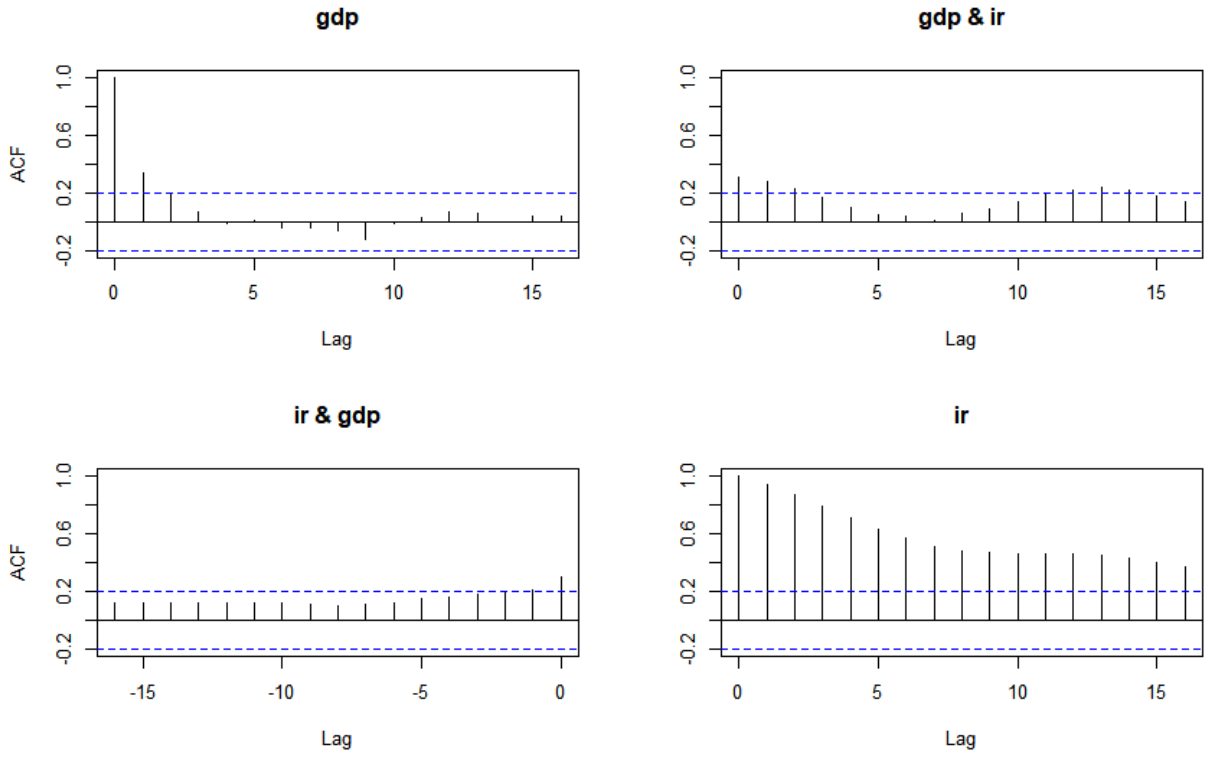
Left: Real GDP Growth of Italy. Right: 3 Month Interbank Interest Rate of Italy



Both Real GDP Growth Rate and 3 Month Interbank Interest Rate of Italy

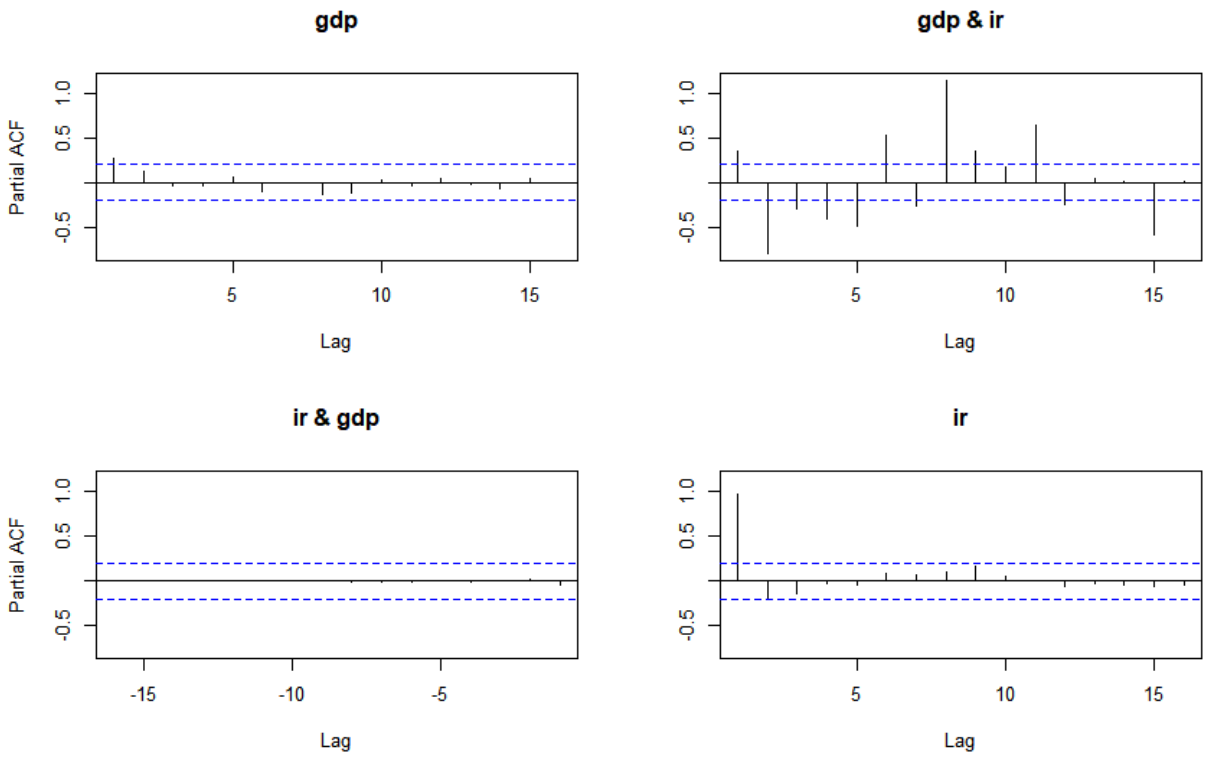
While it looks like the interest rate does seem to influence real GDP growth, it is not enough to make any claims. To find the specified model, we need to run a selection of vector autoregression criteria that will show us the best model to choose.

Before we start estimating the vector autoregression, we should look at the autocorrelation functions of the combined time series so that we can get an idea of what the results may show us later.



Autocorrelation Function of the Combine Time Series of Real GDP Growth and Interest Rates

The main part of the autocorrelation function that we are interested in are the cross correlation functions on the specifically the top right graph is what matters most for the analysis. What this graph attempts to convey is the cross correlation between a past interest rates and real GDP growth in the future. In this case, we see that there is a positive relationship between past interest rate and real GDP growth. This is already slightly alarming because that would mean that a positive and high interest rate could increase real GDP growth, but again this is not definitive yet.



Partial Autocorrelation Function of the Combined Time Series of Real GDP Growth and Interest Rates

Looking at the partial autocorrelation function could help us understand further the effect that the short-term nominal interest rate has on real GDP growth. Looking again at the top right graph, we see that there is still a correlation between interest rates and real GDP growth, even when past real GDP growth is accounted for. In fact, it seems to be relevant up to fifteen lags. While we should take this information with a grain of salt since fifteen lags is a lot, it still provides useful information in confirming that there is a correlation between the two variables we are analyzing.

	Order 2
AIC	-0.16443242
HQ	-0.04505459
SC	0.13332091
FPE	.84865195

Vector Autoregression Estimate for the Combined Time Series of Real GDP Growth and Interest Rates

The table above shows us our preferred specification for the vector autoregression order. The criteria in which to choose which order is best is dependent on the values given by the AIC, HQ, SC, FPE values. The lower the number the better fit the model is compared to other higher values. In the case above, since all the criteria shows that two is the lowest value relative to the others (a total of sixteen orders have been tested), it means that we should use an order two vector autoregression.

Is Monetary Policy Effective?

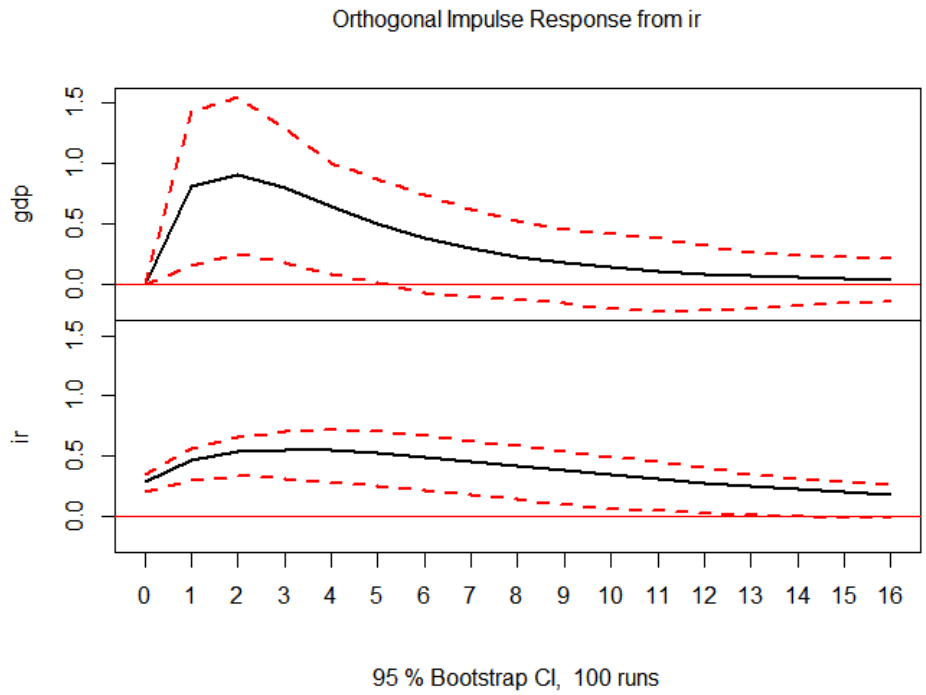
To see if the changes in short-term nominal interest rates have an effect on the real GDP growth of Italy, we need to analyze two sets of information given from the data. The first thing we can do is look at the coefficients that the vector autoregression process estimated and see if past interest rates affect the real GDP growth.

	Estimate	Standard Error	T-Value	Probability
GDP.L1	0.3807	0.1534	2.481	0.01496
IR.L1	2.8216	0.9970	2.830	0.00575
GDP.L2	0.1054	0.1465	0.720	0.47343
IR.L2	-2.4651	0.9584	-2.572	0.01177
Constant	-0.4798	0.4750	-1.010	0.31513

Estimation Results for the Equation of Real GDP Growth

Looking specifically at the two lags of the interest rates (denoted by IR.L1 and 2), we can see that the coefficients are large, and while the first lag is more statistically significant than the second lag, this does show that past interest rates lead to a change in real GDP growth. The interesting thing to notice is that the first lag is a higher value than the negative value of the second lag in absolute terms, which does lean into the fact that interest rates could have a positive relationship with real GDP growth like the autocorrelation function suggested, but there is still more analysis that can be done

The last thing to do is to find the structural impulse response function of the short-term nominal interest rate on real GDP growth. The first thing we need to show is that when we "triangularize" the matrix which is setting the alpha parameter that shows us how much real GDP growth is affected by short-term nominal interest rate at the current quarter to zero. Once we do that, we can plot the impulse response function.



Impulse Response Function of Real GDP Growth and Short-Term Nominal Interest Rate

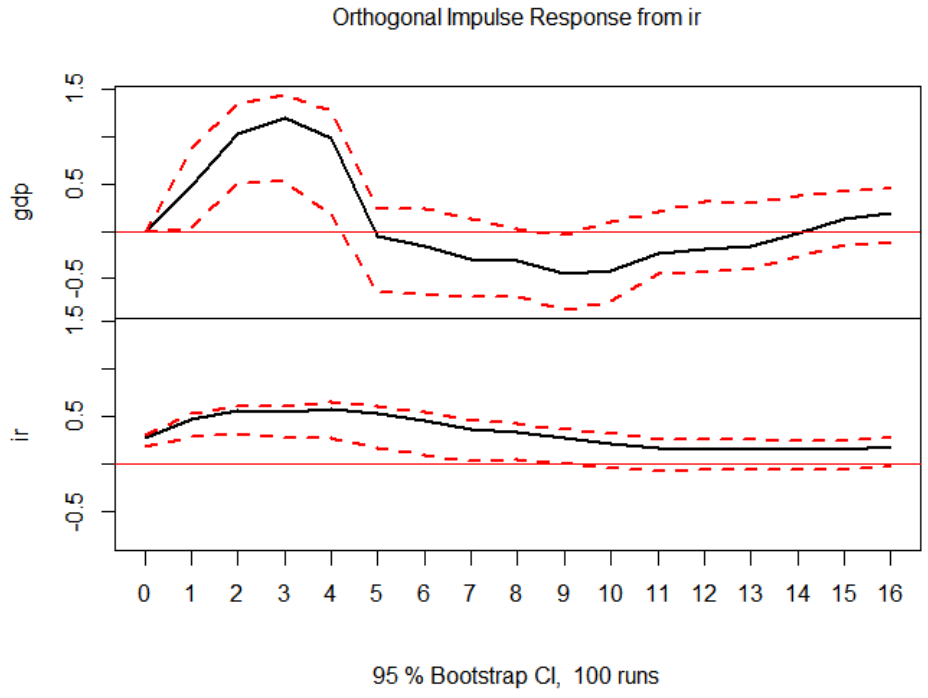
The graph above shows how a change in short-term nominal interest rates will affect real GDP growth in Italy in the future. The top graph represents that with a positive increase in the short-term nominal interest rates, that real GDP growth will also increase, the increase peaking two and three quarters ahead of the increase in short-term nominal interest rates. These results are surprising since it does seem to agree that monetary policy does have an effect on real GDP growth, however, it is the exact opposite of how the theory explained it to happen. The data shows that an increase in short-term nominal interest rates increases real GDP growth in Italy.

Limitations and Robustness

One of the biggest limitations holding this data back is the lack of data available for Real Gross Domestic Product for Italy. The best dataset I could find only started in the year 1996,

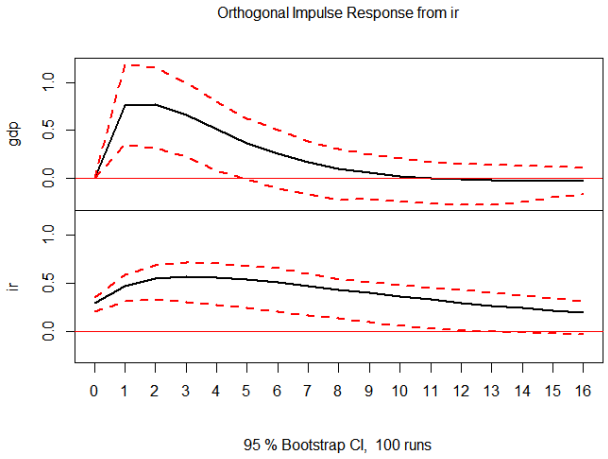
while the dataset for the interest rate started in 1976, this limitation in the data could be a limiting factor and a possibility as to why I got the opposite effect.

Another limiting factor was that we cut off the data during 2020, which could skew the data in a negative way. I've also done some robustness checks to see if there was anything different that could have been done differently to get a "normal answer." The first check I did was go further back a year and end the data on 2019 since the real GDP growth still shows a huge decline during the beginning of 2020. Once we do that and run the analysis as normal we get a new order for the vector autoregression, which is 6. Once we plot the impulse response function, we have this graph:

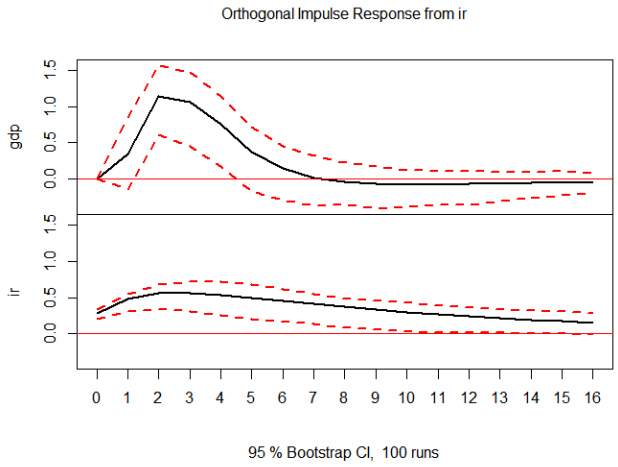


Impulse Response with Six Lags Excluding the Year 2019

While this still does show the same effect for the first few quarters, it does eventually show that the real GDP growth decreases starting at the fifth quarter in the future. However, since computing six lags seems like a lot, there were two other recommended orders for the vector autoregression: two and three. Once we do the normal analysis like before, we get the same results as before where the change in the interest rate increases real GDP growth:

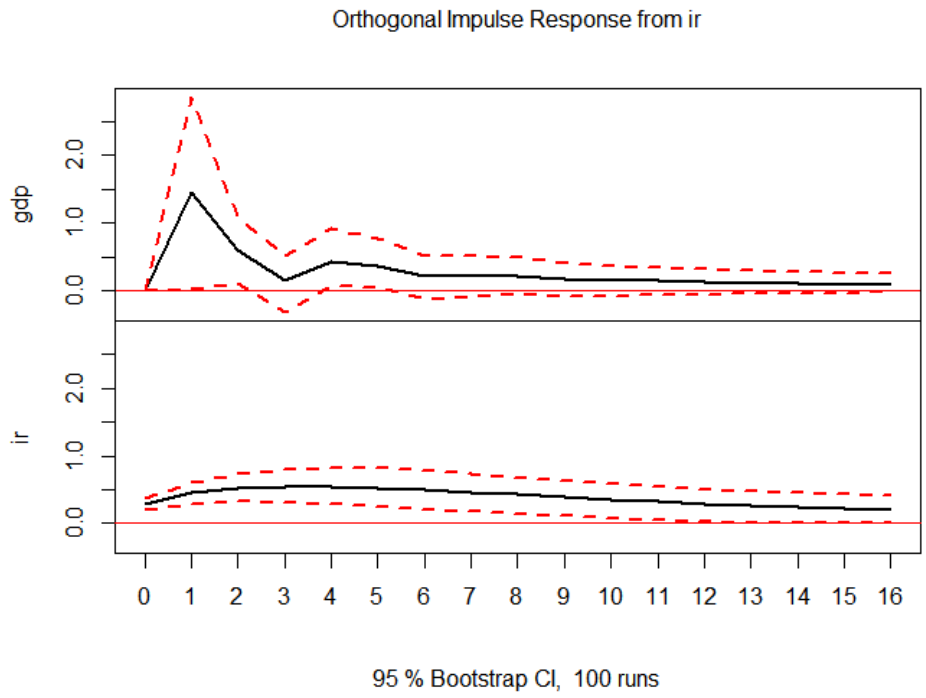


Impulse Response with Two Lags Excluding the Year 2019



Impulse Response with Three Lags Excluding the Year 2019

The next thing I wanted to try to see if I could get something different was to include the coronavirus pandemic. Even when that was done, it still showed the same result that I acquired in the previous section which is shown below. So even through all the different changes in orders of vector autoregression and time period selection of the data, we still see the positive relationship between short-term nominal interest rates and real GDP growth in Italy. This further analysis of other time periods makes it seem that it is just what the data shows and that it could be that an increase in interest rates truly does increase the real GDP growth of Italy.



Impulse Response with Two Lags Including the Year 2022