Government expenditure and inflation in the Euro Area

Much is said about the association between monetary policy and inflation, but the task of governments to keep inflation stable is of less debate. This paper suggests that the current level of real government spending per capita growth rate is negatively associated with the current inflation in the Euro Area by using a time series model. However, there are some concerns with reverse causality.

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I. Introduction

Many countries in the European Union have to deal with high levels of inflation nowadays. The Bureau of Statistics in the Netherlands for example stated that the inflation was 9.7 percent in March compared to the year before (Central Bureau of Statistics, 2022). Bloomberg (2022) reported that inflation has risen to top levels in the European Union. Inflation is an increase in prices and a fall in the purchasing power of money. Inflation can be fought by monetary policy and fiscal policy as it will be explained in the literature section. A nice feature of the countries of the Euro Area is the monetary policy does not differ across countries. Many economists, of which Keynes is the leading one, argued that government spending is essential to keep an economy stable in the short run. The government spending is the total amount of spending in the Euro Area in a given period by any level of government.

This research is about if the trend of the real government expenditure per capita tells us something about the future rate of inflation in the Euro Area. This leads to the question if government expenditure is a good predictor of inflation in the Euro Area. If this is the case, governments should know that their spending behavior is a factor of an increase in inflation. This means that they should adjust this behavior in order to keep inflation stable around the proposed two percent per year. This is so important, because stable prices are a solid basis for a stable and growing economy. Although, it is hard to state anything about causality, it can guide to some understanding of causality.

The hypothesis is supported in the literature that an increase in government spending leads to an increase in inflation. More government spending leads to more output and this will be compensated by a higher price level in the economy. More empirical research supports this hypothesis by looking at time series models. The data in this research contains the period from 2000 until 2019 on a quarterly basis. Also the interbank rate is used as a proxy for monetary policy. An Ordinary Least Squared (OLS) method is used allowing for lags of the dependent variable and independent variables. Thus, the ideal autoregressive distributed lag (ARDL) will be found. The results tell that the best model is where four lags of inflation are used and five lags of the real government spending per capita growth rate and the interbank rate. In this sample government expenditure is negatively associated with inflation. The most plausible reason for this sign is that government expenditure is merely procyclical. For a placebo test this research also examines the possibility of an AR model, but this model does not predict better

than the ARDL models using one and two exogenous variables by using a pseudo-out-of-sample test.

II. Literature

II.1 Theories about inflation

The theory of inflation is explained in the framework of aggregate supply and aggregate demand (Whitta-Jacobsen, Sørensen, & Jorgen, 2010). The aggregate demand represents an equilibrium in the goods market and in the money market. This curve represents a combination of the output gap and the inflation that keeps the goods and the money market in equilibrium where for both markets the real interest rate alters to keep a balance in both markets. The goods market can be approximated by a linear function of the deviation of the trend of consumption, government spending and investment on the deviation of the trend of output. All these deviations are transformed to a function where the real interest rate is a factor. This shows that the real interest rate is negatively correlated with aggregate demand for goods. The money market equilibrium is given by the Taylor rule and the constant money growth rule where in both cases the nominal interest rate is positively correlated with the output gap. By transforming the Taylor rule we get the association between the real interest rate and the aggregate demand for money. For certain combinations of inflation and the real interest rate exists an equilibrium on the goods market as well as on the money market. These combinations give existence to the aggregate demand (AD) function. This function is downward sloping, because a higher inflation induces the central bank to raise the real interest. The higher real interest rate will in turn lower aggregate demand on the goods and services. Part of the goods market is the deviation in fiscal policy of its trend. This means that government spending would increase till above its trend. A change in fiscal policy represents a movement of the aggregate demand line, because fiscal policy is taken as exogenous in this framework.

There is another crucial link between inflation and the output gap which is represented by the aggregate supply function. First of all, there is a trade-off between unemployment and inflation which was described by Philips. This trade-off means that when the expected rate of inflation is constant, there is a negative association between unemployment and inflation in the short run. On the long run there is no trade-off, because the unemployment tends to return to its natural level, because in the long-run expectations must be fulfilled. The expectations augmented Philips curve in combination with the derivation of the natural output, which is the output when unemployment is at its natural level, we derive the short-run aggregate supply (SRAS) function.

The SRAS is a function of inflation using the underlying inflation, the output gap and supply shocks as its determinants. The underlying inflation is the expected inflation determined by forward and backward looking factors. If these factors change, we see a shift of the SRAS-function, because the underlying inflation is given as exogenous. The short run aggregate supply curve is upward sloping due to a rise in output requires a rise in employment. Because of diminishing marginal return of labor, higher employment generates an increase in marginal cost which is translated into an increase in prices via the mark-up pricing behavior of firms. The long-run aggregate supply is a vertical line, because in the long-run the supply is solely determined by the level of natural unemployment. The full model is depicted in figure 1 where point A is the equilibrium. The equilibrium inflation of π_1 and output at its natural level.

Now, when the government spending is increasing the aggregate demand for goods and services will increase. This is represented by a shift of the function from AD to AD_1 which can be seen in figure 1. For every level of inflation, there is a higher aggregate demand for goods. This means that the economy is now in point B. There is now a higher inflation rate π_2 and a higher output gap y_2. This means that the inflation rate is greater than the underlying inflation. Due to the backward looking component of the underlying inflation, people realize that they made a mistake, so they think inflation will be greater the next time. So, the underlying inflation rises. This means that the short run aggregate supply function also moves from SRAS to $SRAS_2$. This brings the economy in point C where the inflation is now even higher than in point B with a lower output gap. If there is no reaction from the central bank and the government keeps spending above the trend, the SRAS will keep shifting upwards until the underlying inflation is equal to the actual inflation. If the increase in government spending is just temporary, the AD-curve will shift back. Eventually, the SRAS-curve will also shift back until the economy is back at point A.

If there is effective monetary policy, the central bank will try to move back the AD-curve by pursuing restrictive monetary policy. Doing so by restricting the money supply or by raising the policy rate. The central bank can also inform the public that the increase in aggregate demand is temporary. So that the inflation will soon be at its target level. Here, the central bank tries to activate the forward looking component of the underlying inflation to lower the inflation rate.

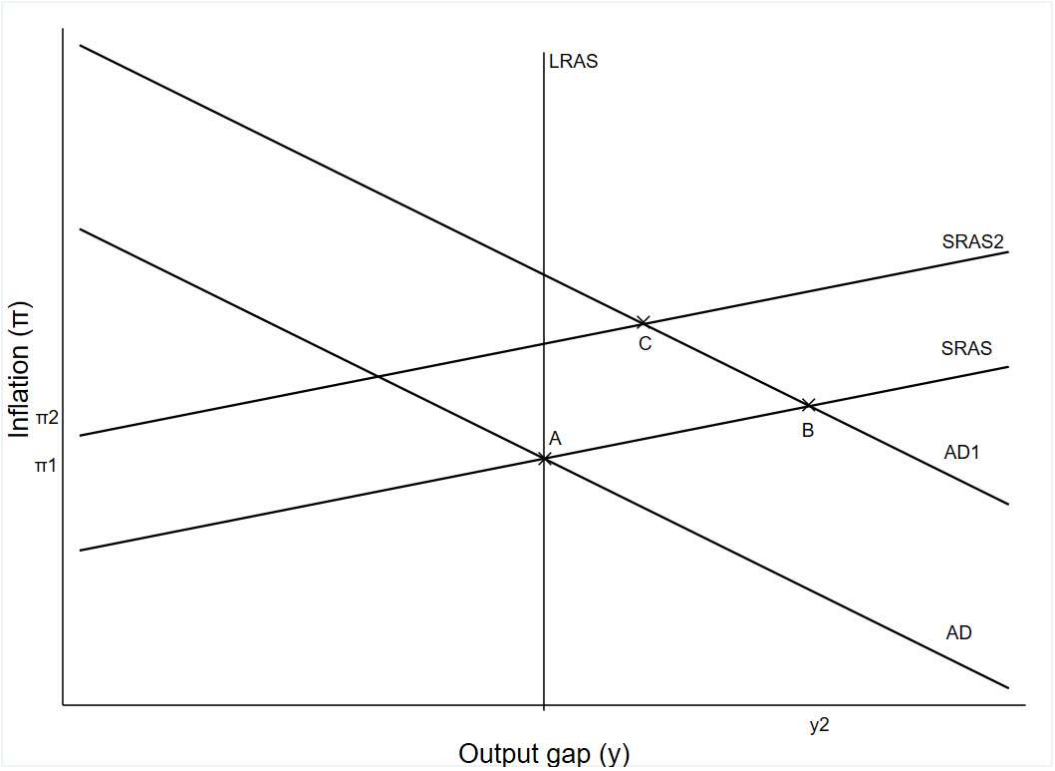

Figure 1: Graphical illustration of the AS-AD model

Notes: A graph of the short-run aggregate supply curve (SRAS) and the shifted one (SRAS2), of the aggregate demand curve (AD) and the shifted one (AD2) and the long-run aggregate supply curve (LRAS). On the y-axis the inflation is depicted and on the x-axis the output gap.

This framework makes clear that when a government increases government spending in existence of an effective central bank, the actual inflation rate as a result of the increase will ceteris paribus temporarily increase inflation. Now, the empirics will be pointed out.

II.2 Empirical evidence on inflation

Research in Great Britain by Eltis (1983) dives into two possible explanations for inflation. It looks at inflation patterns from 1957 till 1981. First, the money growth by financing budget deficits as a determinant of inflation. Here are some clues for this kind of inflation in Great Britain, although it is hard which type of money aggregate to look at. The other preposition concerns the increase in wages throughout the years. An increase in real net of tax wages will also lead to money growth which in fact can accelerate inflation. A slowdown of productivity growth or a faster increase in taxation will accelerate inflation. It is an somewhat dated research. Next, more recent research will be discussed.

Borio and Filardo (2007) point out that the inflation process is changing. They find that more global factors play a role in the inflation process rather than domestic factors. The main implication of the globe-centric model is that labor characteristics and capital mobility are such that factor input markets are closely integrated globally. This implies that there should not be looked at the excess demand in one country, but at the excess demand globally as a determinant of inflation. Borio and Filardo include various measures for global slack by using the extended Philips curve approach. This model tries to estimate the inflation correcting for the underlying rate to rule out the cyclical component of inflation. They indeed find that inflation does react less to the domestic output gap and that it is merely determined by the global economic slack. However, in the results they present, this is not exactly the case for the Euro Area. The coefficient for global economic slack is not statistically significant. This can point out that an effect for certain countries of the inflation and aggregate demand is hard to measure, but that this could be possible when looking at the Euro Area on itself. First, this could mean that the Euro Area is only affected by the internal determinants for inflation. Secondly, it could also mean that the Euro Area is just to big for this mode, because the Euro Area is then a determinant of global slack itself.

In Forbes (2019) the researcher acknowledge like in Borio and Filardo (2007) that due to globalization inflation is much more synchronized around the world. A comprehensive treatment of globalization can improve inflation models. Global factors are the main drivers of inflation. Think of commodity prices, world slack, exchange rates and global value chains. They find a strong global component in CPI inflation, while core and wage inflation flattened out. One of the explanations is that the commodity price volatility has increased. Domestic slack still plays a role for all the inflation measures, but due to globalization this effect has flattened out. This supports the idea that an effect can be found when looking at larger areas, like the Euro Area.

In another research Lim and Sek (2015) discuss the determinants of inflation. The countries in the data are separated into low inflation countries and high inflation countries. They estimate a model for inflation by using the monetary aggregate m4, national expenditure, imports and GDP growth. The model used is an ARDL model. The maximum lag length here is 1 for each variable. For low inflation countries the best model is one lag length for each variable. For high

inflation countries the ideal model only includes the monetary aggregate and the national expenditure which both are statistically significant.

On the short run, there are no effects of the independent variables on inflation for high inflation countries. For low inflation countries imports, monetary aggregate and GDP growth have a significant effect on inflation in the short run. On the long run, the monetary aggregate and national expenditure have a significant effect on inflation. For national expenditure this is a negative effect. For the low income countries, only GDP growth has a significant effect on inflation. The aim of this research was to find the important determinants of inflation. So that there should be price stability by controlling for these determinants. This paper contributes to this research in a way that it is tries to find a significant effect of government spending on inflation on a low inflation region. The Euro Area can not be compared to a regular country while this research focusses on specific countries. To add on that, the Euro Area is characterized by low inflation. Hereby, it can be investigated if the same rules apply for regions as for countries. If this is the case, it is unlikely that government spending has an effect on inflation.

II.3 Fiscal policy and inflation

In Lipsey (1982) the main hypothesis is tested that the government is responsible for the generation and the core of inflation (underlying inflation) as presumed then by many economists. Lipsey describes that a government can cause demand-side inflation by expansionary fiscal policy. Eventually, this will be countered by a rise in the interest rate as is described in section II.2. More interesting are the supply shocks. Because a government has to validate these shocks by choosing to react or not. When an unfavorable supply chock occurs the government has to stop the wage-price spiral by fiscal and monetary policies. An asymmetric property of inflation should be kept in mind. Which is that a rise in demand is mainly captured by a rise in inflation and a decrease in demand is mainly captured by a decrease in output. This paper is of a great theoretical character, but supported with some empirics. Now, there will be paid more attention to the empirics on fiscal policy.

Dikeogu (2018) investigated the relationship between public spending, which comprises public capital and recurrent public spending. This research is held in Nigeria which is characterized by high unemployment and high inflation, also called stagflation. The government spending in Nigeria is eye catching, because the fluctuating trend in Nigeria which makes it ideal for modelling. Doing this by using an ARDL model. The inflation is measured as a function of

public capital and recurrent spending, money supply and the exchange rate. The researcher found that capital public spending negatively affected inflation and public recurrent spending had no significant impact on inflation. The investigation promotes a more secure channeling of government expenditure by using the capital channel. Doing so by investing more in infrastructural projects. For this paper, there can not be made a distinction between the type of government spending. That means that this research can not guide the effect of government spending for this paper, but the paper can contribute to overall effect of government spending on the inflation of a region instead of a country.

II.4 Monetary policy and inflation

In Hossain (2014) inflation in Australia is investigated under different regimes during the period 1950-2010. Australia has had five different monetary policy regimes during this period. The study conducts a unit root test with a linear and non-linear specification whether inflation persistence has the characteristics of a unit root. This suggests that inflation is high but has no unit root which means that the inflation is stationary. This may suggest that it is hard to find an effect of government spending, because inflation is so stable. However, it is good to know that inflation is stationary for statistical purposes and monetary policy does not change this property.

As mentioned in section II.1 inflation targeting is a important tool to guard the forward looking component of inflation. Actually, this tool has been of great debate in past research to see the effects on inflation. In Gonçalves and Salles (2008) react to another research where inflation 'targeters' are compared to 'non-targeters' using a difference-in-difference design. Here it is found that there is no difference, but Gonçalves and Salles argue that there is selection bias in their research. This happened, because only developed countries were taken into consideration. Now, the paper will dive into 36 emerging economies, 13 of which have opted for inflation targeting. Using a difference-in-difference design they find that those countries opted for inflation targeting lowered the inflation and GDP growth variability. The ECB practices inflation targeting. This means that for the entire Euro Area the inflation variability will be lower, because they are bounded by the ECB.

II.5 Euro Area

In Galí, Gertler and López-Salido (2001) the European inflation dynamics are investigated by using the New Philips Curve (NPC). This has been done before for the United States. The researchers merely find the same results that inflation is mainly pushed by the real marginal

cost in the post-war period. For real marginal costs the real unit labor costs are used. Furthermore, they find that the forward-looking component of inflation is much stronger in the Euro Area than in the United States and labor market frictions has played a key role in shaping the behavior of marginal costs. Lastly, they find a substantial amount of price stickiness in the Euro Area. These findings can guide this paper towards using many lags, because of the price stickiness in the Euro Area. The patterns of inflation are hard to use, because they mainly describe cost-push inflation rather than demand-pull inflation. However, expansionary monetary policy drive up labor unit costs. This paper contributes to the fact that the central bank has a huge influence in the Euro Area which could mean that monetary policy can affect the inflation more than fiscal policy does.

In Pirovano and Van Poeck (2011), the researchers try to determine the inflation differentials between countries in the Euro Area. In the last and most informative part for this study, they investigate the determinants of inflation differentials by using a dynamic panel data model using the Arellano-Bond (1991) GMM panel estimator. Here, the dependent variable is estimated by the lagged dependent variable, the vector of independent variables and the error term which comprises the country fixed effect and an idiosyncratic shock. First of all, they found that the lagged dependent variable is positive and statistically significant. Two of the independent variables they include are government balance and government expenditure. These variables are measured as a percentage of GDP. Government balance has a positive association with the inflation differential. This means that more restrictive fiscal policy is associated with a higher inflation differential. Government expenditure has a negative correlation with the inflation differential. Both these associations are significant. Like the authors state, the signs of these correlations feel counterintuitive.

The authors concluded that inflation differentials are rather determined by country specific and persistent structural factors. A policy implication of this is that there should be structural reforms in product and labor markets. Fiscal policy can also play a huge role in attacking the inflation differentials. Also, it is desirable that the European Central Bank have more instruments to attack inflation in countries in high-inflation countries while not influencing low-inflation countries. It is questionable if the determinants of inflation differentials work in the same way as the total inflation of the Euro Area. It may be possible that the factors mentioned are solely effectuated due to the inflation differential. This paper contributes to the question if

determinants of inflation in the Euro Area work in the same way as the determinant of differentials of inflation in the Euro Area.

III. Data

III.1 Data sources

To answer the research question, panel data is used from Eurostat. Eurostat is an organization of the European Commission which produces and collects data on many subjects. Eurostat is the statistical office of the European Union. Eurostat collects data about the inflation, the interbank rate, government debt and government spending over an extensive period by cooperating with national statistical agency offices and other national authorities in EU member states. For the population size of each country data is used of the World Bank. The World Bank is an organization which works in every major area of development. They do this by providing a wide array of financial products and technical assistance. They also collect data from national and international statistical offices.

III.2 Variables and measurement

The data period for this research is 2000-2019 and is for the 19 Euro Area countries as of 2015 when Lithuania joined (European Union, n.d.). All these countries are also part of the data for the periods when they were not part of the Euro Area. It is assumed than even before they joined the Euro Area these countries were highly integrated with the existing countries. Thereby, the biggest and most important countries were part of the Euro Area since the founding on the first of January 1999.

The inflation is measured in percentage change over the previous period on a monthly basis, Harmonized Index of Consumer Prices. Thus, this inflation index measures the changes in prices of consumer goods and services acquired by households. This index is an aggregate for the Euro Area after it has been harmonized for every country. This variable will be transformed to quarterly data by compounding the inflation rate. The inflation is given as a percentage instead of a fraction.

Total government spending is only available on a yearly basis. In Eurostat multiple government levels are given. Here, total general government expenditure is used. This comprises general government units that have legal authority over other units in the economic territory for non-market production in the benefit of the community, units like corporations and quasi-

corporations which are government units, units as non-profit institutions recognized as independent legal entities for non-market production and are under control of the government and units as autonomous pension funds where there is a legal obligation to contribute to. Total spending comprises re-current spending as well as capital spending. Here after, the yearly government spending will be divided by the population size of the Euro Area. This step is now, because population is also only measured on a yearly basis. Then, the yearly data will be assigned to the corresponding quarter by general government debt. It is believed that debt and spending have a close relationship. Government debt grows when the government expenditures exceed the government revenue. This means that in this paper it is assumed that the real government revenue is stationary over time. Total consolidated general government debt at face value is used. The general government is the same definition as for the government expenditure. Government spending will be assigned to each quarter using a weighted average of government debt of each year. The final step is to transform the allocated government spending per capita into real terms. This means that all the quarters are compounded until the fourth quarter of 2019. Meaning that the allocated real government expenditure per capita (from now government expenditure or government spending) is measured in 2019q4 euros.

Furthermore, Eurostat provides the Euro Overnight Index Average (EONIA), the effective overnight reference rate for the euro, mentioned here after as the interbank rate. This rate is computed as a weighted average of all overnight unsecured lending transactions in the interbank market. This will be used as a proxy for monetary policy. This variable is measured as a percentage and is measured on a quarterly basis.

IV. Methodology

For this paper a time series model will be used. The ARDL model uses a combination of endogenous and exogenous variables. The ARDL model is an Ordinary Least Squares (OLS) method using heteroskedacity robust standard errors. The endogenous variable is the inflation rate and the exogenous variables are government spending and the interbank rate. Two models will be estimated The ARDL (p,q) model is denoted by:

(4.1)

$$\pi_t = \mu + \beta_0\pi_{t-1} + \ldots + \beta_p\pi_{t-p} + \delta_0 G_t + \ldots + \delta_q G_{t-q} + u_t$$

The ARDL(p,q,q) model is denoted by:

(4.2)

$$\pi_t = \mu + \beta_0\pi_{t-1} + \ldots + \beta_p\pi_{t-p} + \delta_0 G_t + \ldots + \delta_q G_{t-q} + \theta_0 IR_t + \ldots + \theta_q IR_{t-q} + u_t$$

Where π_t is the inflation at time t, G_t the government spending at time t, IR_t the interbank rate at time t, p the number of lags regarding the endogenous variable and q is the number of lags of the exogenous variables. It can be the case where the growth rate is used for one or more of the variables. These are denoted as $\%\Delta\pi$, $\%\Delta G$ or $\%\Delta IR$ and are all denoted as a percentage. For the sake of simplicity the same lags are used for the exogenous variables. The coefficient of interest is δ_q, which shows if current and/or past values of government expenditure have predictive power for the current inflation. The expectation is that this estimated coefficient has a positive sign as it is expected that expansionary fiscal policy leads to more inflation. If the governments spends extra real euros per capita the expected inflation increases. The coefficient θ_q is expected to be negative, because inflation in general decreases when the interest rate increases. A higher interest rate makes households postpone their consumption and so inflation decreases. u_t is the error term with an expected value given the possible predictors of 0. This is one of the assumptions of this model. This assumption will likely not hold, because there are some unobservables that are correlated with government spending and influence inflation. Furthermore, there can be reverse causality, because inflation can influence government spending by the reaction of governments to high levels of inflation for example. This violation is not problematic for the model. However, there can not be spoken about effects, only associations.

Next, all variables have to comply with the assumption of stationarity. This means that a variable will eventually will return to its mean. This will be tested in this paper by using a Dickey-Fuller test. This assumptions is important, because stationarity implies that each point is independent of another. This implies that the statistical properties do not change over time. The assumption is likely to be true for inflation, because this variable is already detrended when the percentage change is used relative to the year before. Although there is likely to be a structural factor in inflation, but this is not concerning, because it would be stationary around this structural component. Nevertheless, inflation will be tested for stationarity. For government spending and the interbank rate it is not sure that this assumption holds. These variables will be tested by the Dickey-Fuller test. If the variables do not comply, the growth rate can be tested and used. This is constructed by taking the difference between the current value and the first leg dividing by the value of the lag. Furthermore, the endogenous and

exogenous variables become independent as the lag of both variables become large. Lastly, large outliers are unlikely and there is no perfect multicollinearity. This is often not worrying with aggregate macroeconomic values.

The association between inflation and government expenditure is investigated. As well as the combined association of government expenditure and the interbank rate and inflation. This will be performed by using the OLS-method with Newey-West HAC heteroskedacity and autocorrelation-consistent standard errors and lag-length computed by the following formula:
(4.3)

$$p = 0.75T^{\frac{1}{3}}$$

The best time series model will be chosen by using two information criteria. This will be done by looking at the Bayesian Information Criterion (BIC) of different combinations of lag lengths of each variable. This will be done for two models. The first with one exogenous variable which is government spending and the second with both exogenous variables which are government spending and the interbank rate. The lower the BIC imply the model is closer to be the true model. The maximum lag length is 6. It is based on the log likelihood function defined as:
(4.4)

$$BIC(p) = -2\left(\frac{LL}{T}\right) + \frac{\ln(T)}{T} t_p$$

Where LL is the maximized log likelihood function for the estimated model. The t_p is the number of parameters in the model and T is the number of observations.

As a last step, an AR model will be estimated to check if a time series model, where only inflation is used, has predictive power. Now, we have three models: the AR(p), ARDL(p,q) and ARDL (p,q,q). A pseudo-out-of-sample test will be used to determine which model describes the actual data best. For this test the years 2018 and 2019 will be left out the test. Then the squared difference of each year will be computed to see if the models come close to the actual data. The model with the lowest squared difference is the best model when choosing between an AR model and an ARDL model. In this case two ARDL models.

V. Results

V.1 Visual inspection

To comply with the properties of a ARDL model, the stationarity of real government spending per capita and the interbank rate will be tested. Also, the visual inspection can guide us to a certain correlation between the investigated variables. A first visual inspection of inflation in figure 2 can tell us that there seems to be stationarity around a certain inflation rate. The structural component seems to have a value of around 0.50 percentage point. However, government spending seems to have a trend, government spending has increased substantially in these 20 years. This is also the case for the interbank rate. On first sight this variable seems to have a stochastic trend which is a violation of the assumption of stationarity. Later on, all the variables will be tested on stationarity. If this is the case, the first difference will be used. Around 2008 the inflation and government spending seems to move in opposite directions which can imply a negative correlation. However around 2012 government spending decreases substantially and inflation also decreases which can guide us to a positive correlation. The sign of the correlation is visually ambiguous. Around the years 2001 and 2006 the interbank rate and inflation seems to move in the same direction which can imply a positive correlation.

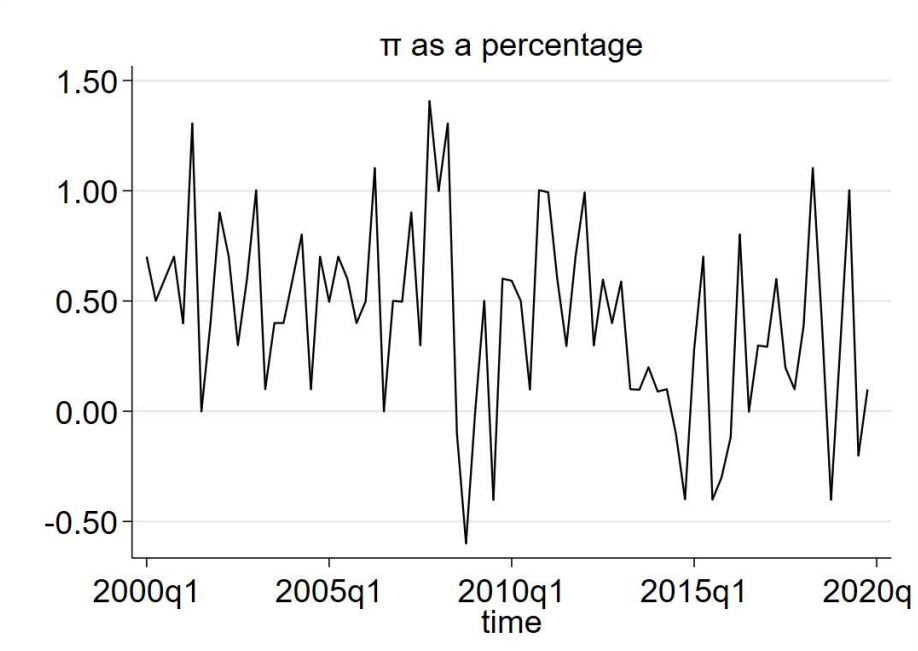

Figure 2: Euro Area inflation from 2000 until 2019.

Notes: The Euro Area inflation is depicted against time. The inflation is constructed from monthly inflation data by compounding and is represented as a percentage. Time starts at the first quarter of 2000 and ends at the fourth quarter of 2019.

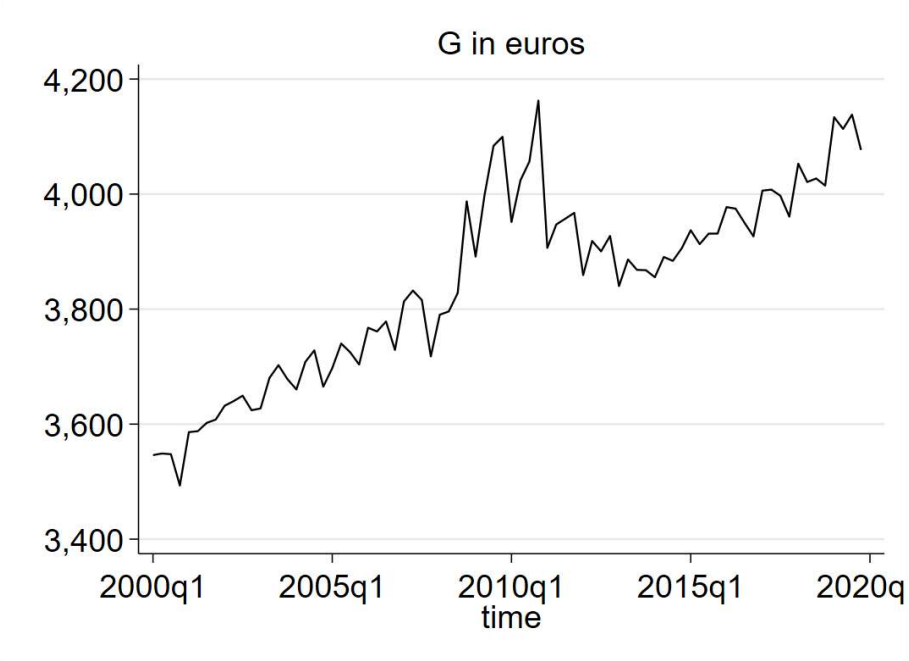

Figure 3: Euro Area government spending

Notes: The allocated real government spending per capita against the time is depicted starting at the first quarter of 2000 until the fourth quarter of 2019. The yearly spending is allocated on the basis of the quarterly government debt.

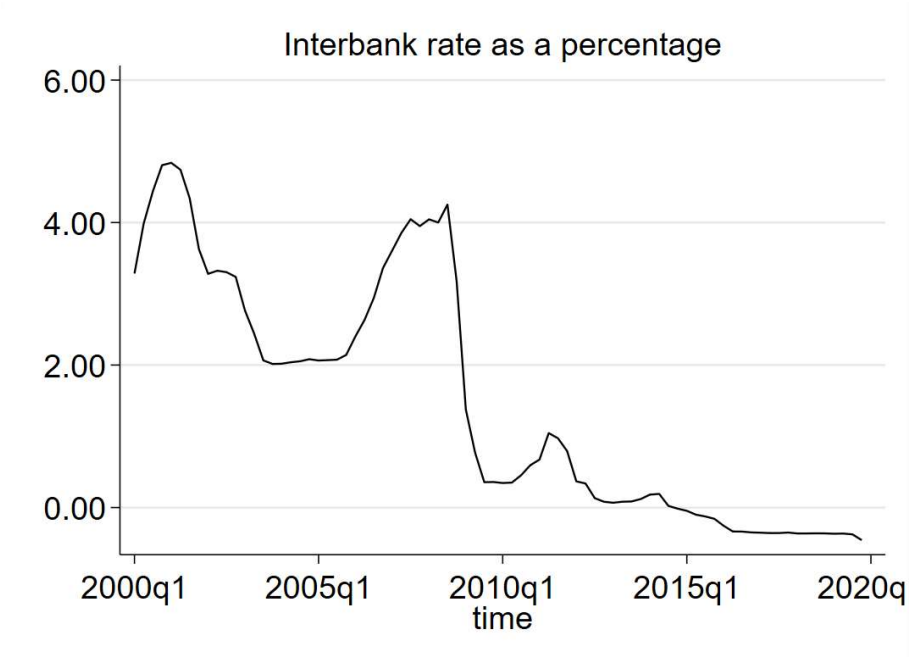

Figure 4: The interbank rate in the Euro Area

Notes: The interbank rate against time starting at the first quarter of 2001 until the fourth quarter of 2019. The interbank rate is a weighted average of the day-to-day rate.

V.2 Stationarity

Next, the Dickey-Fuller test will be performed for all variables. The null hypothesis of the Dickey-Fuller test is that the variable of interest contains a unit root, non-stationary. The results for the test are given in table 1. The first column confirms the assumption that inflation is stationary. The null hypothesis of non-stationarity can be rejected at a 5 % significance level. This means it can be assumed that inflation is stationary. Furthermore, the values for government spending and the interbank rate (G and IR) can not assumed to be stationary, because the null hypothesis can not be rejected. This guides the paper to the inclusion of the growth rates of these variables which also will be tested as can be seen in column three and five. This test reveals that stationarity can be assumed. This is because the null hypothesis of non-stationarity can be rejected at a 5 % significance level for the growth rate of government spending and interbank rate. All together, the variables inflation (π), government spending growth rate ($\%\Delta G$) and the interbank rate growth rate ($\%\Delta IR$) will be used.

Table 1: Dickey-Fuller test results

	π	G	$\%\Delta G$	IR	$\%\Delta IR$
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
Test statistic	-7.549***	-1.861	-12.832***	-0.768	-6.946***
5% critical value	-2.907	-2.907	-2.908	-6.946	-2.908

Notes: results of the Dickey-Fuller test without drift. In the first column it is performed on inflation. The second and third column contains the test without drift for government spending and the first lag difference of government spending respectively. The fourth and fifth column contains the test without drift for the interbank rate and the first lag of the interbank rate respectively. *10% / **5% / ***1% significance level.

V.3 Correlation between the exogenous variable and endogenous variables.

Then, we test for an association between the government expenditure growth rate and inflation using OLS with Newey-West HAC heteroskedacity and autocorrelation-consistent standard errors. This test is also done for the association between the government expenditure growth rate in combination with the interbank rate growth rate and the inflation. This section presents a formal test to support or object to the findings in section V.1 where a visual inspection is conducted. The results are given in table 2. It can be rejected that the estimated coefficient of the government spending growth rate is equal to zero at a 5 % significance level. The estimated coefficient has a negative sign which supports the first visual inspection as presented in the first

column. This result is somewhat counterintuitive, because an increase in government spending yields a higher inflation due to a higher aggregate demand. In the second column the interbank rate growth rate is added to the regression. Now, the point scatter for the government expenditure growth rate slightly decreases and is still significantly different from zero. This implies some minor negative bias in the first scatter in the first column. The interbank rate growth rate is not significantly different from zero which means nothing can be stated about the sign of the association. Both regressions tell that government spending and inflation are indeed associated. On average, 1 percentage point increase in government spending is associated with a 0.079 percentage point decrease in inflation in the sample in the Euro Area.

Table 2: regression results for association

	π	π
	OLS (1)	**OLS (2)**
%ΔG	-0.078***	-0.079***
	(0.018)	(0.018)
%ΔIR		0.001
		(0.001)
Constant	0.434***	0.431***
	(0.052)	(0.054)
Number of observations	79	79

Notes: in the first column the regression results, using OLS, are noted where inflation is regressed on government spending. In the second column inflation is regressed on government spending and the interbank rate. For both regressions 3 lags are used to calculate the Newey-West heteroskadicity robust and autocorrelation consistent standard errors which are calculated using formula (4.3). The Newey-West standard errors are given in parenthesis. *10% / **5% / ***1% significance level.

V.4 The best ARDL models

Next, we will estimate the ARDL(p,q) models and ARDL(p,q,q) models with multiple lag lengths. The judgement is made on the basis of the BIC criterion which two models should be used. This will first be done using only government spending. Here after also the interbank rate is added to the model. The ARDL models are estimated given by the formula (4.1) and (4.2). The model with the lowest BIC should be chosen, because that model predicts the inflation best. In table 3 the results of the first model are presented and in table 4 the models for the second

model are presented. For the model where only government spending is used for the distributed lag the best model is where 4 lags of inflation and 5 lags of government spending are used since the BIC-value is 85.899 which is the lowest of all predicted models. This model is denoted as ARDL(4,5). In the model where government spending and the interbank rate are used for the distributed lag, the best model is where 4 lags of inflation are used and 0 of the exogenous variables. This has a BIC-value 87.291 which is the lowest of the estimated models and thus results in a ARDL(4,0,0).

First of all, the similarity between the two models is that for both models 4 lags of inflation are used. For this reason, an AR model should also be tested to check if a model where inflation predicts itself predicts better. Second of all, in the first model 5 lags of government spending are part of the model, but when the interbank rate is added, suddenly the lags of government spending do not predict. This confirms the results obtained in section V.3 where the interbank rate showed no correlation with inflation. However, to conclude that the interbank rate only contains some minor omitted variable bias, the predictive power is tested in the placebo section and compared between the two models.

Table 3: BIC values for ARDL(p,q) using government spending

p / **q**	**1**	**2**	**3**	**4**	**5**	**6**
0	87.600	91.698	94.367	87.600	88.543	92.834
1	91.883	95.981	98.658	91.829	92.832	97.122
2	96.004	99.926	102.556	95.089	96.358	100.622
3	95.901	99.646	103.523	93.793	96.290	100.422
4	99.378	103.258	107.052	90.851	91.462	95.727
5	99.102	103.302	106.610	85.899	89.785	93.946
6	103.296	107.510	110.885	89.462	93.578	97.867

Notes: tale contains the BIC values for the estimated models. In the columns the number of lags are represented for the endogenous variable (p) inflation and the rows contain the number of lags of government spending (q). The BIC with the lowest value is the model with the most predictive power.

Table 4: BIC values for ARDL(p,q,q) using government spending and interbank rate

p q	1	2	3	4	5	6
0	90.515	94.699	96.987	87.921	89.746	93.982
1	98.870	103.048	105.449	96.501	98.177	102.426
2	103.161	107.374	109.970	101.473	102.501	106.783
3	105.324	109.446	113.528	102.835	104.981	109.269
4	112.749	117.015	121.056	103.989	104.200	108.485
5	112.831	116.947	119.541	95.211	99.005	102.957
6	119.643	123.684	126.193	101.234	105.466	109.748

Notes: tale contains the BIC values for the estimated models. In the columns the number of lags are represented for the endogenous variable (p) inflation and the rows contain the number of lags of the exogenous variable (q) government spending and interbank rate. The BIC with the lowest value is the model with the most predictive power.

In table 5 the estimated coefficients are presented for the ARDL(4,5) and ARDL(4,0,0). In the ARDL(4,5) in the first column of table 5 only the estimated coefficient of the fourth lag of inflation is significantly different from zero at a 5 % significance level. This means that the quarter exact a year ago has predictive power on the current level of inflation. The other lags are not significant. The sign of this association seems positive as the estimated coefficient of this lag has a positive value. Three out of the five estimated coefficients of government expenditure are significantly different from zero. The long run association of government expenditure is ambiguous looking at the model since the current value is positive and the fourth an fifth lag are negative. In other words a permanent change in government expenditure is given by the sum of expected coefficients dives by 1 minus the estimated coefficients of inflation which is -0.157. This means that on the long run a 1 percentage point increase in government expenditure results in a decrease in inflation of 0.157 percentage point. This sign is not in line with the hypothesis. One possible reason is that government expenditure reacts to inflation. This implies that governments recognize that inflation should be lowered when it is high and thus react by lowering government expenditure. However, this seems implausible, because governments are rather governed by political powers than by monetary motives. A government would increase government expenditure in times of high inflation to compensate its citizens for the high inflation. Another reason could be the procyclical component of government

expenditure. High inflation often correlates with high economic activity (high GDP). When GDP growth is high, some government expenditure lowers due to lower unemployment. When GDP growth is low, unemployment is high and so are unemployment benefits. This reasoning seams much more plausible.

In the second column the ARDL(4,0,0) is denoted. Here the same pattern is shown regarding inflation since only the fourth lag of inflation is significantly different from zero at a 5 % significance level. Past inflation values have a positive association with the current value. Since the BIC criterion awarded this model as the winner only the current values of government expenditure and the interbank rate will be used. Now, government expenditure has a small significant association with the current level of inflation. The sign of the estimated coefficient is negative. The short run association of government spending on inflation is -0.083 percentage point in the sample. The long run association is now -0.204 percentage point. The magnitude has increased compared to the model in column 1. A reason for this could be the positive association of the interbank rate with inflation. The interbank rate is significantly different from zero meaning it has some predictive power on inflation. Although the value is small. The long run association of the interbank rate is -0.005 percentage point. The negative sign can be explained by the effect that the interbank rate resembles the reaction by the central bank to an increase in inflation. A central bank that follows the Taylor Rule increases its policy rate in order to lower inflation. The interbank rate in this model is rather a consequence of the inflation than a fighter of inflation. This result raises the question if the interbank rate should actually be added to the model. This will be tested when we compare these two models and the AR model in the placebo section.

Table 5: ARDL model results

	π	π
	OLS (1)	**OLS (1)**
π		
L-1	0.070	0.145
	(0.107)	(0.131)
L-2	-0.006	-0.033
	(0.099)	(0.118)
L-3	0.022	0.093
	(0.105)	(0.114)
L-4	0.526***	0.388***
	(0.106)	(0.119)
%ΔG	-0.171***	-0.083**
	(0.039)	(0.033)
L-1	-0.086*	
	(0.045)	
L-2	-0.036	
	(0.040)	
L-3	-0.016	
	0.043	
L-4	0.147***	
	(0.049)	
L-5	0.101***	
	(0.108)	
%ΔIR		0.002**
		(0.001)
Constant	0.163	0.170*
	(0.108)	(0.101)
Number of observations	73	73

Notes: in the first column the regression results, using OLS allowing for lags using heteroskadicity robust standard errors, are noted where inflation is regressed on the lags of inflation and government spending using an ARDL(4,5) model. In the second column inflation is regressed on the lags of inflation, government expenditure and the interbank rate using an ARDL(4,0,0). Standard errors are given in parenthesis. *10% / **5% / ***1% significance level.

V.5 Placebo test

The derived models in section V.4 will be compared to a new constructed model which is an AR(4). This means that the current inflation will be predicted by the four past values of inflation only. Both of the derived models used four lags of inflation, bur differed regarding the number of lags regarding the exogenous variable. This raised the question if a model where inflation only predicted itself, is a better model than the other estimated models. The estimated coefficients are presented in table 6. The same pattern is shown which is that only the fourth lag of inflation is significantly different from zero at a 5 % significance level. These are all short run associattions.

Table 6: AR model results

	π
	OLS
	(1)
π	
L-1	0.135
	(0.152)
L-2	0.031
	(0.141)
L-3	0.036
	(0.123)
L-4	0.294**
	(0.134)
Constant	0.205*
	(0.112)
Number of observations	69

Notes: in the first column the regression results, using OLS allowing for lags using heteroskedacity robust standard errors, are noted where inflation is regressed in the lags of inflation using 4 lags. Standard errors are given in parenthesis. *10% / **5% / ***1% significance level.

Next, the models will be estimated again, but this time only before 2018. For the remaining period the forecasted values are calculated by using the ARDL(4,5), ARDL(4,0,0) and the AR(4) model. The sum of squared differences between the forecasted values and the predicted values are calculated for each model. The sum of squared differences for the ARDL(4,5) model is 1.221, for the ARDL(4,0,0) model 1.815 and for the AR(4) model 1.728 compared to the actual values of inflation for the years 2018 and 2019. Thus, the ARDL(4,5) predicts slightly better. This means that the model where lags of inflation are used and only government spending is the best predictor of inflation. This confirms the concern about the ARDL(4,0,0) where government spending and the interbank rate were significant, but only had minor values. This means that the a permanent increase of 1 percentage point in government expenditure is associated with a decrease in inflation of 0.157 percentage point.

VI. Conclusion

This research was focused on the inflation in the Euro Area, because a nice feature of this area is that the monetary policy is harmonized. All banks and institutions face the same interbank rate. As we have seen in the literature inflation has become a global phenomenon instead of a country specific system. To say something about inflation then, a measure was needed that took the size of the country into account. The Euro Area is because of these two reasons the perfect object to investigate the predictive power of government spending on inflation. By using the data of 2000 until 2019 a ARDL model was constructed to see if the real government spending per capita has predictive power on inflation. The data was transformed into quarterly data by using the quarterly total consolidated gross dent. Also the interbank rate was used to divide the predictive power into monetary and fiscal policy. The best model is where 4 lags of inflation are used and 5 lags of the government spending growth rate and the interbank rate growth rate. This model predicts better than a model where also the interbank rate is included and where only the lags of inflation are used to predict the current value of inflation. The null hypothesis that the government spending have positive predictive power on inflation can be rejected, because a negative long run association has been found. The long run prediction based on the government spending is that a percentage point increase in government spending will lower inflation by 0.157 percentage point on average in this sample.

As mentioned, there are two possible explanations for the sign of the association of government spending on inflation. The first is that governments react themselves to high inflation. This

implies that governments are fully aware of the consequences of expansionary fiscal policy. Taking that into account, they lower government spending as a response to high inflation. This explanation is not very plausible as a government is rather governed by political forces than monetary motives. The second and more plausible explanation is the cyclical component of government expenditure. High inflation is correlated with high levels of GDP growth (when there is no stagflation). At high levels of GDP growth unemployment is low meaning the payment of unemployment benefits decreases. This means government expenditure lowers when inflation increases.

As mentioned, there can not be spoken about a real effect, because there are several problems to speak about causality. The most important one is about reverse causality. This can be argued regarding government spending. Governments can choose to lower spending in order to lower the inflation when it is high. It can also be argued that inflation has an effect on the interbank rate, because central banks react by raising the policy rate due to high inflation In macroeconomics however it will always be hard to capture causal effects, because aggregate data is used.

VII. Discussion

VII.1 Government expenditure

One of the main problems by looking at the relationship between government spending and inflation is the availability of quarterly and secure data. For this research government debt is used which is besides spending of course heavily influenced by the revenues of the government. For better research it would be desirable that tax offices of the Euro Area countries collect quarterly data on government spending and multiple categories on this data. In this way there can be spent more attention to certain types of government spending and the association with inflation in the Euro Area. It is for example very interesting which types of government spending has predictive power on inflation. This can be compared to the research of Dikeogu (2018). This can also be a solution to reverse causality. Then, only categories should be investigated without a cyclical component in it. This excludes any category that contains socials securities.

Also the time measure can be wrong. It can be argued that a change in the underlying inflation is a time consuming process which is likely not to change in one quarter. An alternative way to investigate government expenditure and inflation is to look at a larger time period at a yearly

basis. In this way the underlying inflation can actually change and changes in government expenditure can take their time to be part of the inflation process. However, this is only problematic when taking not enough legs into account with using quarterly data.

VII.2 Monetary policy

One of the flaws of the interbank rate is that it is a consequence of inflation. It can be interesting to use interest rate that can cause inflation to change. Unfortunately, it is hard to think of an interest rate that is eventually not affected by the central bank. The mortgage rate for example is often a consequence of the cost of lending for commercial banks. Therefore, it is more helpful to look at monetary aggregates. Although they can be manipulated by central banks, the theoretical causal link to inflation is more clear. However, it can be argued that people react to high inflation by altering their consumption behavior. This causes the monetary aggregate to change. There is no clear solution to reverse causality regarding monetary policy. Tough, it could be helpful to look at multiple proxies for monetary policy.

VIII. References

Borio, C. E. V., & Filardo, A. J. (2007). Globalisation and Inflation: New Cross-Country Evidence on the Global Determinants of Domestic Inflation. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.1013577

Central Bureau of Statistics. (2022, April 7). Inflatie stijgt naar 9,7 procent in maart. Retrieved April 29, 2022, from https://www.cbs.nl/nl-nl/nieuws/2022/14/inflatie-stijgt-naar-9-7-procent-in-maart

Dikeogu, C. (2018). Public Spending and Inflation in Nigeria. *International Journal of Advanced Academic Research*, *4*(12), 52–66. https://ijaar.org/articles/Volume4-Number12/Social-Management-Sciences/ijaar-sms-v4n11-nov18-p82.pdf

Eltis, W. (1983). The Interconnection Between Public Expenditure and Inflation in Britain. *The American Economic Review*, *73*(2), 291–296. https://www.jstor.org/stable/1816857

European Commission. (2016, March 10). How the Economic and Monetary Union works. Retrieved April 29, 2022, from https://ec.europa.eu/info/business-economy-euro/economic-and-fiscal-policy-coordination/economic-and-monetary-union/how-economic-and-monetary-union-works_en#:%7E:text=Monetary%20policy,-Monetary%20policy%20for&text=The%20treaty%20lays%20down%20the,for%20promoting%20growth%20and%20employment

European Union. (n.d.). *Countries using the euro*. Retrieved June 27, 2022, from https://european-union.europa.eu/institutions-law-budget/euro/countries-using-euro_en

Forbes, K. J. (2019). Inflation Dynamics: Dead, Dormant, or Determined Abroad? *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3489524

Galí, J., Gertler, M., & López-Salido, J. (2001). European inflation dynamics. *European Economic Review*, *45*(7), 1237–1270. https://doi.org/10.1016/s0014-2921(00)00105-7

Gonçalves, C.E.S. & J.M. Salles (2006). Inflation targeting in emerging economies: What do the data say?. *Journal of Development Economics*, *85*, 312-318. https://reader.elsevier.com/reader/sd/pii/S0304387806001283?token=19263E4A16E0017770BCDC7B210F90F73B653EF67B11A78698D2F62D06618CAE3F87E7EC3A92781711D3F4CD48DA2192&originRegion=eu-west-1&originCreation=20220608131105

Hossain, A. A. (2014). Monetary policy, inflation, and inflation volatility in Australia. *Journal of Post Keynesian Economics*, *36*(4), 745–780. https://doi.org/10.2753/pke0160-3477360408

Lipsey, R. G. (1982). Government and Inflation. *The American Economic Review*, *72*(2), 67–71. https://www.jstor.org/stable/1802305

Lim, Y. C. & Sek, S. K. (2015). An Examination on the Determinants of Inflation. *Journal of Economics, Business and Management*, *3*(7), 678–682. https://doi.org/10.7763/joebm.2015.v3.265

Pirovano, M., & van Poeck, A. (2011, September). *Eurozone Inflation Differentials and the ECB*. https://repository.uaantwerpen.be

Randow, J. (2022, April 29). Euro-Area Inflation Hits Record, Raising Pressure on ECB [Press release]. https://www.bloomberg.com/news/articles/2022-04-29/euro-area-inflation-edges-up-to-record-raising-pressure-on-ecb

Whitta-Jacobsen, H. J., Sørensen, P. B., & Jorgen, H. (2022). *Introducing Advanced Macroeconomics* (2nd ed.). Oxford University Press.