

Volume 36, Issue 4

The Classical Dichotomy fails in the Eurozone

Andrea Vaona

University of Verona, Department of Economic Sciences, and Kiel Institute for the World Economy

Abstract

By means of structural VARs we investigate the long-run nexus between inflation and output in the Eurozone under different identification schemes and model specifications. The Eurozone is an interesting case study due to its very low inflation rate and to the official adherence of its monetary authority to the classical dichotomy. We find a strong positive long-run connection between inflation and output, supporting recent theoretical models arguing that this might exist at low long-run inflation rates.

The author thanks an anonymous referee and Raoul Minetti for insightful comments. He also thanks Omar Bashar for helpful emails. The usual disclaimer applies.

Citation: Andrea Vaona, (2016) "The Classical Dichotomy fails in the Eurozone", *Economics Bulletin*, Volume 36, Issue 4, pages 2183-2191

Contact: Andrea Vaona - andrea.vaona@univr.it.

Submitted: July 14, 2015. **Published:** November 26, 2016.

1. Introduction

Many economists and economic policy makers believe in the classical dichotomy, namely the view that inflation and real economic magnitudes are unrelated in the long-run (Mishkin, 2007). This notwithstanding, some studies found that inflation and unemployment have a linear negative long-run connection (Furuoka, 2007; Furuoka et al. 2013). Moreover, recent theoretical models imply nonlinearities in the long-run level of output-inflation nexus. The level of economic activity – the level of output, in particular - and inflation are positively connected at low inflation rates, but negatively at high ones (Akerlof et al., 1996, 2000; Levin and Yun, 2007; Vaona, 2013; Snower and Tesfalessie, forthcoming. More specifically on the output level, Deveraux and Yetman, 2002; Vaona and Snower, 2008; Graham and Snower, 2008; Ahrens and Snower, 2014)¹. We here focus on testing the hypothesis of long-run non-superneutrality in the form that the inflation rate has no long-run effect on the level of output.

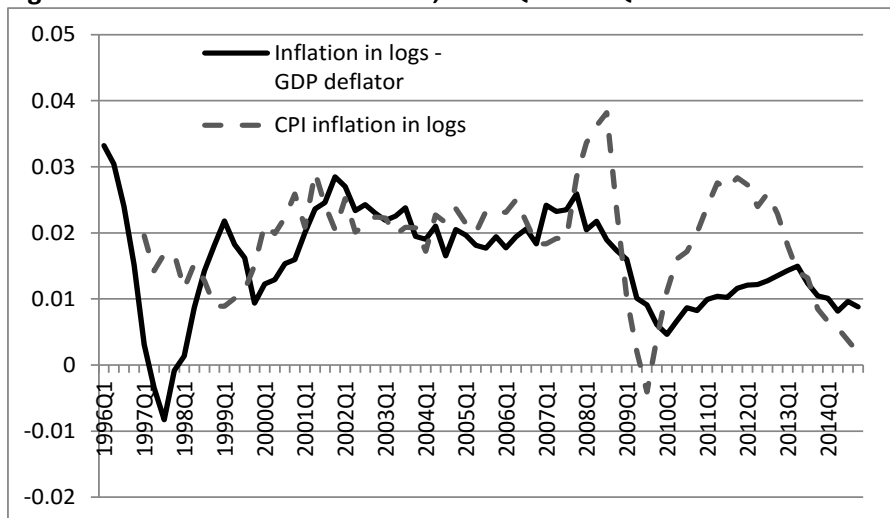
Low inflation rates – nonetheless subject to permanent shifts – are seldom observed for long periods of time (Dickens, 2001). Hence, high inflation observations might drive the results of cross-country studies (Ericsson et al., 2001). Nonetheless, Bullard and Keating (1995) find positive long-run nexuses between the long-run level of output and inflation in low inflation countries.

Under these respects, the Eurozone experienced very low inflation rates for about two decades. The purpose of the present note is, therefore, to shed further light on the above issues by focusing on the Euro area.

Next, we introduce our data and methods. Baseline results and robustness checks follow. Finally, we conclude by discussing our results in the light of the literature of reference, their policy implications and some limitations of our research strategy.

2. Data and Methods

Figure 1 – Inflation in the Eurozone, 1996Q1-2014Q4

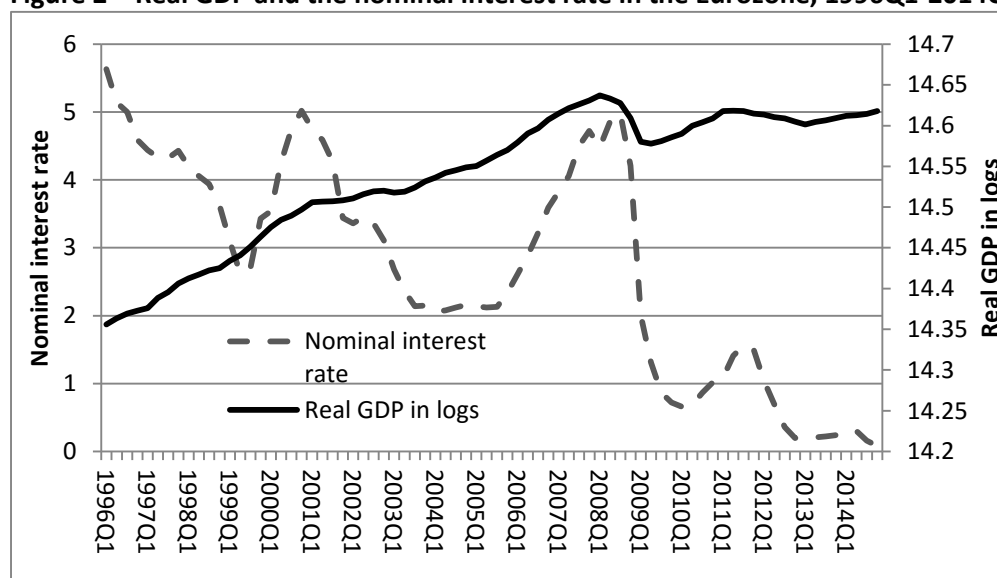


Data source: OECD

We consider OECD quarterly series concerning the GDP deflator and the GDP in 2005 prices from 1996Q1 to 2014Q4. Inflation is computed with reference to the same quarter of the previous year. Data are in logs. Robustness checks also consider data regarding the harmonized consumer price index (H CPI) and the short-term interest rate. Figures 1 and 2 show the series. The beginning and the end of the sample are characterized by some instability: a pattern to keep into account in the following of the analysis.

¹ It is worth noting that this stream of literature mainly stresses the role of the product and labor markets in the transmission mechanism of monetary policy (a brief review is offered in Vaona, 2016). The credit channel is mostly ignored notwithstanding its importance (Bernanke and Gertler, 1995; Gertler and Kiyotaki, 2010; Iacoviello and Minetti, 2008; Guerrieri et al. 2012). Therefore our empirical results might capture different mechanisms than those stressed by the contribution listed above.

Figure 2 – Real GDP and the nominal interest rate in the Eurozone, 1996Q1-2014Q4



Data source: OECD.

Regarding our methods, we start with unit root and (single equation) Engle and Granger cointegration testing. We use the Schwarz information criterion (SIC) to choose the lag length of all tests. For brevity sake, we here only report the Augmented Dickey-Fuller (ADF) and the Phillips and Perron (PP) tests, the latter based on a spectral OLS autoregressive approach. More unit root tests are available upon request.

If tests detect cointegration, we will resort to a VECM. If all variables turn out to be $I(1)$ but not cointegrated, we will resort to VARs in first differences after Davidson et al. (1978). We choose the lag length computing five criteria: the sequential modified likelihood ratio test statistic (LR), the final prediction error (FPE), the Akaike information criterion (AIC), the SIC, and the Hannan-Quinn information criterion (HQ). Next we follow the majority of the criteria. Furthermore, we use AIC to impose zero restrictions on the parameters of the included lags in baseline results, while robustness checks rely on HQ.

Estimation of bivariate structural VARs is widespread in the literature (Vaona, 2016). More specifically, we mainly rely on Blanchard and Quah (1989) decompositions (hereafter BQ), adopting a monetarist view, namely that, in the long-run, inflation is a purely monetary phenomenon (Roberts, 1993; Bullard and Keating, 1995; Rapach, 2003). Baseline results also include the identification approach by Cover et al. (2006) and Bashar (2011). Suffice here to say that this identification strategy assumes a vertical long-run aggregate supply curve, that can be shifted by movements of the demand curve, as demand shocks may induce more innovation and higher productivity. More technically, the approach by Bashar (2011) entails estimating an AB SVAR in output growth and inflation changes where the A matrix is $\begin{bmatrix} 1 & -\alpha \\ 1 & 1 \end{bmatrix}$ and the B matrix is $\begin{bmatrix} \cdot & \cdot \\ 0 & \cdot \end{bmatrix}$. Parameters to be estimated are denoted by dots. The value of α is derived from the identification assumption that demand shocks do not have any long-run real effect unless when shifting the supply curve.²

In baseline results we make use of accumulated structural impulse response functions (SIRFs) and forecast error variance decompositions (FEVD). To sum up, if, according to our unit roots tests, the acceleration of inflation and real growth are stationary, but inflation and the level of real output are not and if there is no evidence of cointegration, this will have two implications. In the first place, inflation acceleration and output growth will not have any long-run link. However, their accumulated impulse response functions in presence of identified shocks will detect permanent changes in the levels of inflation and output which are $I(1)$.

² Bashar (2011) diffusely compares BQ and Cover et al. (2006).

In robustness checks, we introduce an interest rate measure to move to a trivariate SVAR and we adopt the identification strategy by Rapach (2003), encompassing a monetarist view of long-run inflation and the assumption that, in the long-run, technological shocks do not influence the interest rate. While illustrating our robustness checks, for sake of brevity, we will focus on long term derivatives after, for instance, Rapach (2003). The long-run derivative of GDP growth with respect to inflation acceleration can be defined as

$$LRD_{GDP,INF} = \lim_{k \rightarrow \infty} (\partial GDP_{t+k} / \partial \varepsilon_{INF,t}) / (\partial INF_{t+k} / \partial \varepsilon_{INF,t}) \quad (1)$$

where INF denotes inflation and $\varepsilon_{INF,t}$ the identified shock to inflation acceleration. In other terms, under the stationarity and cointegration conditions stated above, $LRD_{GDP,INF}$ measures the long-run change in the level of output due to a theoretically identified change in inflation as a proportion of the effect that this shock has on the long-run level of inflation. This is because $LRD_{GDP,INF}$ coincides with the ratio of the values of the SIRFs of output growth and inflation acceleration as time goes to infinite.

Further note that, in a trivariate setting, as in Rapach (2003) the infinite horizon response of structural disturbances is

$$\lim_{s \rightarrow \infty} \begin{pmatrix} INF_{t+s} \\ R_{t+s} \\ GDP_{t+s} \end{pmatrix} = \begin{pmatrix} d_{11} & 0 & 0 \\ d_{21} & d_{22} & 0 \\ d_{31} & d_{32} & d_{33} \end{pmatrix} \begin{pmatrix} \varepsilon_{INF,t} \\ \varepsilon_{R,t} \\ \varepsilon_{GDP,t} \end{pmatrix} \quad (2)$$

where $\varepsilon_{R,t}$ and $\varepsilon_{GDP,t}$ respectively denote identified shocks to the change in the interest rate and output growth. Therefore $LRD_{GDP,INF} = \frac{d_{31}}{d_{11}}$. The application of this equality to the bivariate case is straightforward. For notational purposes, the infinite horizon response of structural disturbances of a bivariate SVAR in inflation acceleration and output growth with a monetarist identification assumption is

$$\lim_{s \rightarrow \infty} \begin{pmatrix} INF_{t+s} \\ GDP_{t+s} \end{pmatrix} = \begin{pmatrix} c_{11} & 0 \\ c_{21} & c_{22} \end{pmatrix} \begin{pmatrix} \varepsilon_{INF,t} \\ \varepsilon_{GDP,t} \end{pmatrix} \quad (3)$$

For most of our estimates we used JMulti after Lütkepohl and Krätzig (2004).

3. Baseline results

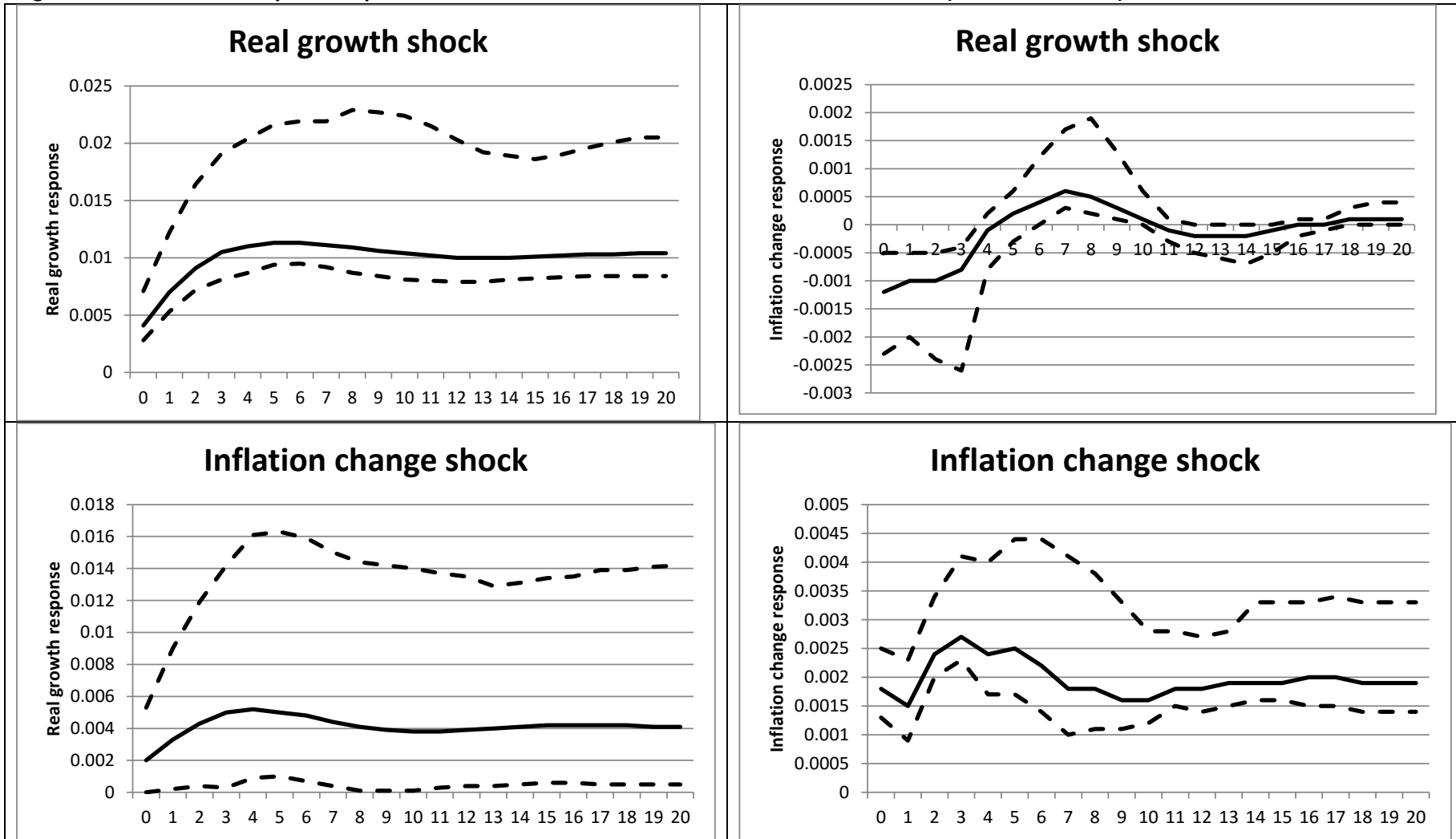
We start by running unit root and cointegration tests. Inflation and real output level are $I(1)$, but they are not cointegrated (Table 1). Inserting a linear trend in the test would not alter this result. Further unit root tests are available upon request.

Hence, we estimate a VAR in first differences for output and inflation in logs. Three lag length criteria (FPE, LR and AIC) point to 5 as the most suitable choice, the other two would point to a shorter lag structure. We stick to the majority of the criteria and we compute accumulated SIRFs (Figure 3). We find permanent effects of inflation on output. c_{11} is estimated to be 0.002 – with a bootstrapped t-statistic of 5.71 - while the estimated c_{21} is 0.004 – with a bootstrapped t-statistic of 2.08 - implying a value of $LRD_{GDP,INF}$ of 2. Bootstrapping returns results robust to departures from standard assumptions regarding error processes.

The effect of output growth shocks can be interpreted as the result of technological developments that raise output and reduce costs and inflation.

Figure 4 shows FEVDs: inflation acceleration shocks mainly drive changes in the inflation rate, while output growth shocks mainly output growth. Figure 5 shows SIRFs upon adopting the identification strategy à la Cover et al. (2006). Results are qualitatively similar those in Figure 3. Quantitatively they imply a larger $LRD_{GDP,INF}$ of 4.98. After about two years SIRFs hit their long-run value making a medium run identification approach, as in Lastrapes (1998), superfluous.

Figure 3 – Accumulated impulse-response functions to one standard deviation structural shock (BQ identification)



Notes. 95% Studentized Hall Confidence Bootstrapped Intervals based on 200 repetitions.

Figure 4 – Forecast error variance decompositions (BQ identification)

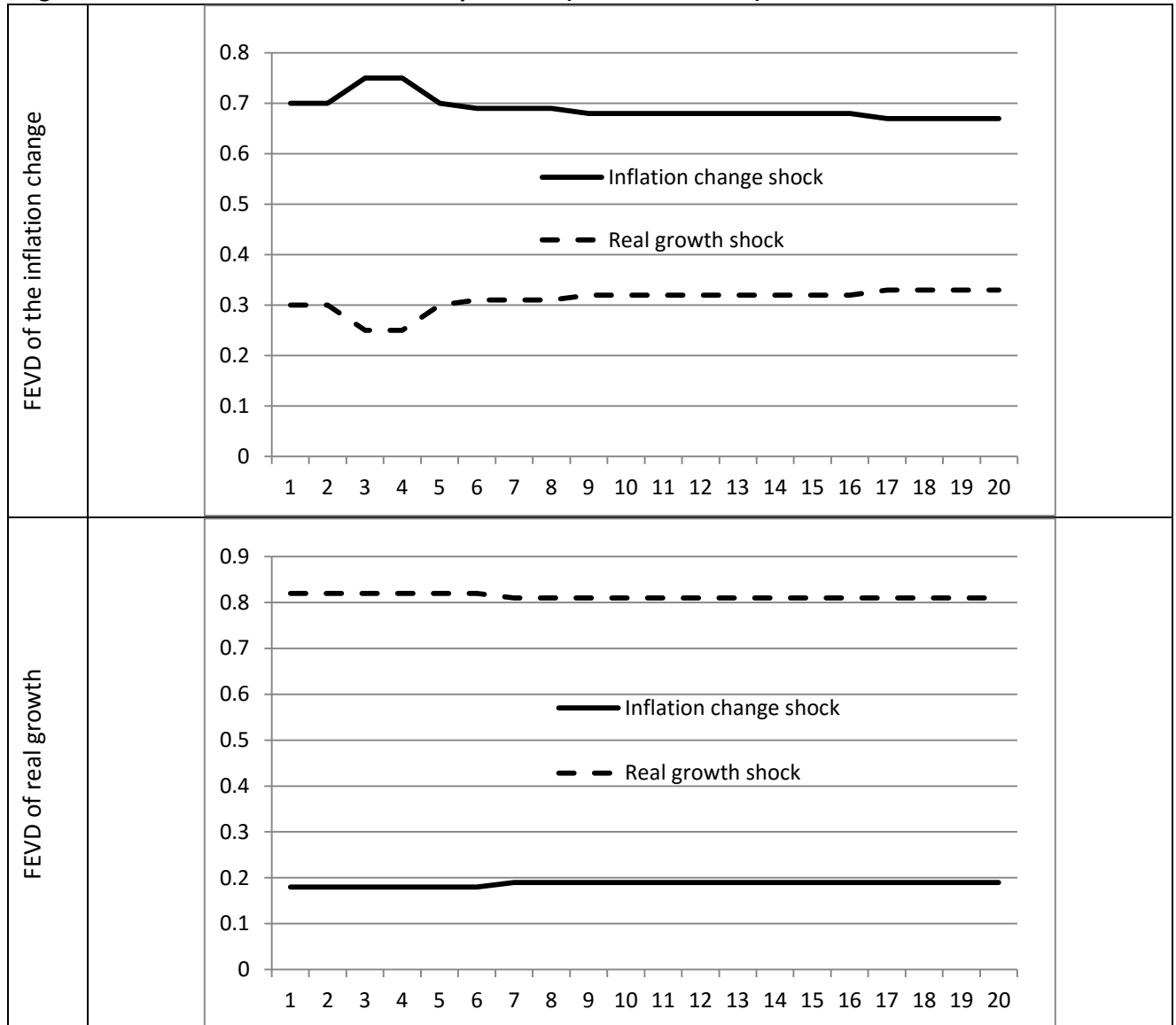
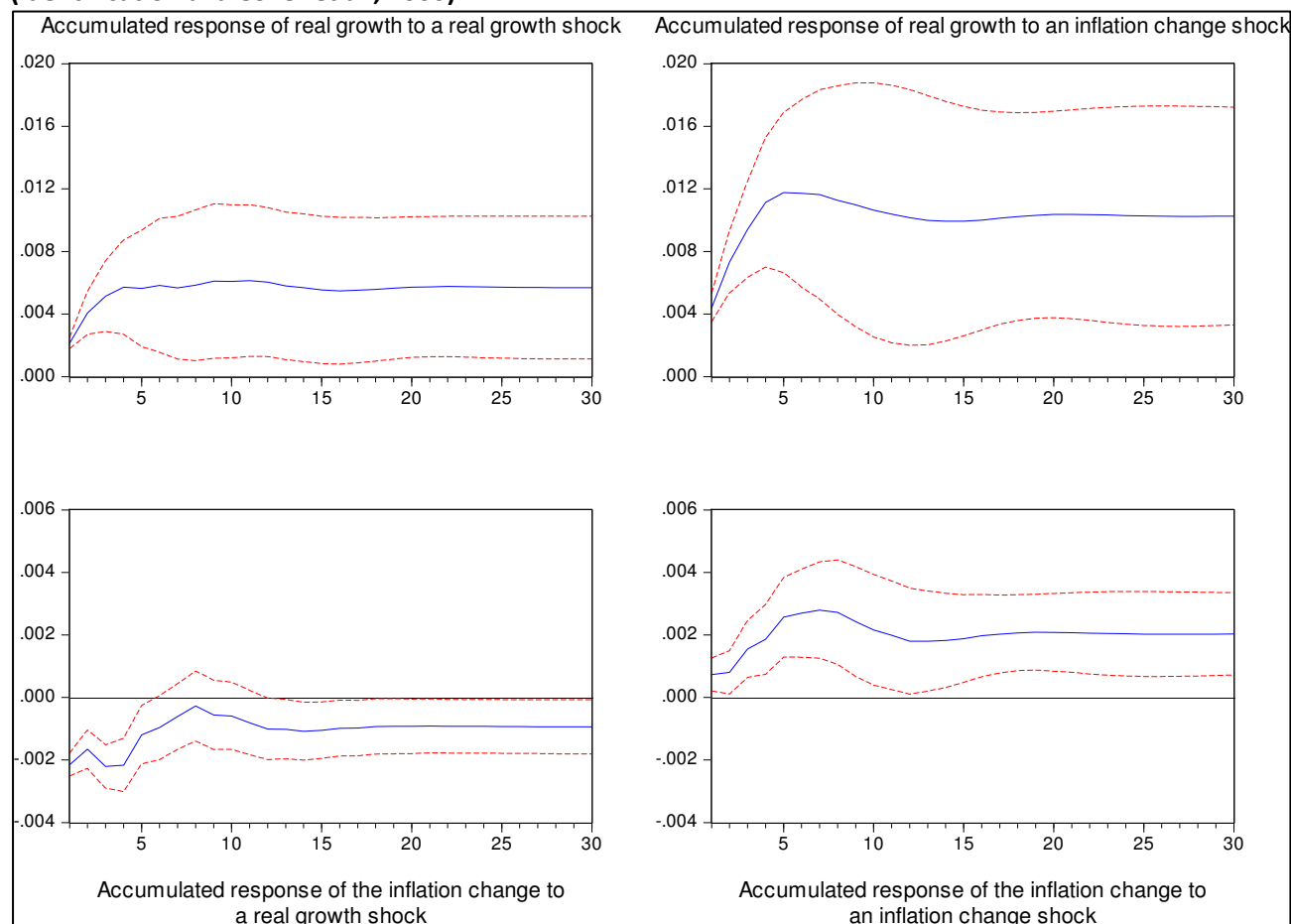


Table 1 – Unit root and cointegration tests (p-values)

Unit root tests				
	ADF		PP	
	Levels	First differences	Levels	First differences
Inflation	0.10	0.00	0.10	0.00
Real output level	0.22	0.00	0.20	0.00
Single equation cointegration tests (null of no cointegration)				
Inflation equation	0.35			
Real output level equation	0.87			

Note: the first difference of logged real output level is an approximation to the percentage growth rate of real output.

Figure 5 – Accumulated impulse-response functions to one standard deviation structural shock (identification à la Cover et al., 2006)



Note. Analytic response standard errors.

4. Robustness checks

Building on Figures 1 and 2, robustness checks start with subsample stability. We first drop observations before the introduction of Euro coins and banknotes and, then, we drop observations after the collapse of Lehman Brothers. In addition, we change our measure of inflation shifting from the GDP deflator to the HCPI. Finally, we run a trivariate SVAR.

Table 2 – Unit root and cointegration tests (p-values)

Unit root tests				
	ADF		PP	
	Levels	First differences	Levels	First differences
HCPI Inflation	0.23	0.00	0.07	0.00
Nominal interest rate	0.12	0.00	0.23	0.00
Single equation cointegration tests (null of no cointegration)				
Inflation equation	0.42			
Real output equation	0.34			
Nominal interest rate equation	0.12			

Both HCPI inflation and the nominal interest rate are $I(1)$, as Table 2 shows. In a trivariate setting no cointegration shows up. Therefore, we proceed applying the BQ decomposition. Table 3 shows results concerning lag-length criteria, the estimated values of the relevant parameters of the long-run impact matrix and the implied long-run derivatives. Results are broadly similar to those contained in the above section. $LRD_{GDP,INF}$ is larger in the more recent subsample, when inflation was

lower. Inserting the nominal interest rate, $LRD_{GDP,INF}$ halves but it is still positive and the significance of underlying parameters is not affected to a great extent.

Table 3 - Results of robustness checks

Robustness check	Lag length criteria	c_{11}	c_{21}	d_{11}	d_{31}	$LRD_{GDP,INF}$
Sample 2002Q1-2014Q4	5 ⁱ	0.0018 [3.4378]	0.0081 [1.9612]	-	-	4.5
Sample 1996Q1-2008Q3	5 ⁱ	0.0025 [3.6170]	0.006 [2.1162]	-	-	2.4
HCPI instead of GDP deflator	4 ⁱ	0.0043 [4.1094]	0.0112 [2.9078]	-	-	2.6
Trivariate VAR	1 ⁱⁱ	-	-	0.0052 [4.7001]	0.0053 [1.9583]	1.01

Notes. Bootstrapped t-statistics in brackets. i: chosen on the basis of LR, FPE and AIC. ii: chosen on the basis of FPE, AIC, SIC and HQ.

5. Conclusions

To conclude, we compare our results to those available in the literature, briefly infer some policy implications and discuss the limitations of our study.

Our estimates of $LRD_{GDP,INF}$ are larger than the significant ones available, for instance, in Bullard and Keating (1995), namely those for Austria, Germany, Finland and the UK. However, it is also true that from the early sixties to 1992 - their observation period - inflation yearly rates ranged from 4% in Germany to 8% in the UK. In our sample, the average inflation rate is 1.5%. Our results are likely to derive from the nonlinearities in the output-inflation nexus highlighted by recent theoretical studies. We cannot detect, though, the threshold after which the effect of inflation on output either disappears or turns negative, exactly because of low inflation rates throughout our sample.

Under a policy perspective, the ECB officially adheres to the classical dichotomy (ECB, 2011, 55). There could be advantages in fully recognizing that, at low inflation rates, this might not hold. Firstly, monetary policy making might turn less conflictual, gaining credibility. Secondly, more consciousness regarding the long-run effects of monetary policy might avoid either unnecessary delays in interventions or too restrictive stances. This could help fostering the implementation more symmetric macroeconomic policies within the monetary union (De Grauwe and Yi, 2013).

Three caveats are warranted regarding our research strategy. In the first place, Eurozone data are averages of those of its member countries, that have a greater degree of sovereignty than US member states. However, the Eurozone can be considered a closed economy. Extending the analysis to its single member countries, more similar to open economies, would entail different identification assumptions than those adopted below, hampering comparability. Furthermore, the data we used are taken into account by monetary policy makers when devising policies for the whole Eurozone.

The second caveat has a methodological nature. Recent sticky prices models incorporate a long-run dichotomy between nominal and real magnitudes and yet the former ones can have a persistent effect on the latter ones. Given the well-known problem of low power of unit root tests in finite samples, we might have captured persistent and not really long-run effects of inflation on the level of output.

Finally, as mentioned above, our results might stem from different mechanisms than our theoretical literature of reference, as this literature stresses the importance of the product and labor markets and neglects that of the credit market.

6. References

- Akerlof, G. A., W. T. Dickens and G. L. Perry (1996) "The macroeconomics of low inflation" *Brookings papers on economic activity* **1**, 1-76.
- Akerlof, George A., W. T. Dickens and G. L. Perry (2000) "Near-rational wage and price setting and the long-run Phillips curve" *Brookings Papers on Economic Activity* **1**, 1-60.
- Ahrens, S. and D.J. Snower (2014) "Envy, guilt, and the Phillips curve" *Journal of Economic Behavior and Organization* **99**, 69-84.
- Bashar, O. (2011) "On the permanent effect of an aggregate demand shock: Evidence from the G-7 countries" *Economic Modelling* **28**, 1374-1382.
- Bernanke, B. S. and M. Gertler (1995). "Inside the Black Box: The Credit Channel of Monetary Policy Transmission" *Journal of Economic Perspectives* **9**, 27-48.
- Blanchard, O.J. and Quah, D. (1989) "The dynamic effects of aggregate demand and aggregate supply disturbances" *American Economic Review* **79**, 655-673.
- Bullard, J. and J.W. Keating (1995) "The long-run relationship between inflation and output in postwar economies" *Journal of Monetary Economics* **36**, 477-496.
- Cover, J.P., Enders, W. and J.C. Hueng (2006) "Using the aggregate demand-aggregate supply model to identify structural demand-side and supply-side shocks: results using a structural bivariate VAR" *Journal of Money, Credit and Banking* **38**, 777-790.
- Davidson, J.E.H., D.F. Hendry, F. Srba and S. Yeo (1978) "Econometric modelling of the aggregate time series relationships between consumer's expenditure and income in the United Kingdom" *Economic Journal* **88**, 661-92.
- De Grauwe, P. and Ji Y. (2013) "From Panic-Driven Austerity to Symmetric Macroeconomic Policies in the Eurozone" *Journal of Common Market Studies* **51**, 31-41.
- Devereux, M.P. and J. Yetman (2002) "Menu costs and the long-run output inflation trade-off" *Economics Letters* **76**, 95-100.
- Dickens, W.T. (2001) "Comments on Charles Wyplosz's <<Do we know how low inflation should be?>>." stencil, The Brookings Institution.
- ECB (2011) *The monetary policy of the ECB*, European Central Bank: Frankfurt.
- Ericsson, N.R., J.S. Irons and R.W. Tryon (2001) "Output and inflation in the long-run", *Journal of Applied Econometrics* **16**, 241-253.
- Furuoka, F. (2007) "Does the "Phillips curve" really exist? New empirical evidence from Malaysia" *Economics Bulletin* **5**, 1-14.
- Furuoka F., M. Qaiser and H. Harvey (2013) "Does the Phillips curve exist in the Philippines?" *Economics Bulletin* **33**, 2001-2016.
- Gertler, M. and N. Kiyotaki (2010) "Financial intermediation and credit policy in business cycle analysis" in *Handbook of monetary economics*, by B. M. Friedman and M. Woodford, Eds., Elsevier, The Netherlands: Amsterdam, 547-599.
- Graham, L. and D. J. Snower (2008) "Hyperbolic Discounting and the Phillips Curve" *Journal of Money, Credit and Banking* **40**, 427-448.
- Guerrieri, L., M. Iacoviello, and R. Minetti (2012) "Banks, sovereign debt and the international transmission of business cycles" NBER working paper Number 18303.
- Iacoviello, M. and R. Minetti (2008) "The credit channel of monetary policy: Evidence from the housing market" *Journal of Macroeconomics* **30**, 69-96.
- Lastrapes, W.D. (1998) "International evidence on equity prices, interest rates and money" *Journal of International Money and Finance* **17**, 377-406.
- Levin, A. and T. Yun (2007) "Reconsidering the natural rate hypothesis in a New Keynesian framework" *Journal of Monetary Economics* **54**, 1344-1365.
- Lütkepohl, H. and M. Krätzig, Eds., (2004) *Applied time series econometrics*, Cambridge University Press: Cambridge, UK.
- Mishkin, F.S. (2007) "Monetary policy strategy: How did we get here?" in *Monetary policy strategy* Mishkin, F.S., Ed., MIT Press: Cambridge MA, 1-28.

- Rapach, D.E. (2003) "International evidence on the long-run impact of inflation" *Journal of Money, Credit, and Banking* **35**, 23-48.
- Roberts, J.M. (1993) "The sources of business cycles: a monetarist interpretation" *International Economic Review* **34**, 923-934.
- Snower, D. and M. Tesfaselassie (forthcoming) "Trend Growth, Job Turnover and Phillips Curve Tradeoffs" *Macroeconomic Dynamics*.
- Vaona, A. (2013) "The most beautiful variations on fair wages and the Phillips curve", *Journal of Money, Credit and Banking* **45**, 1069-1084
- Vaona, A. (2016) "Anomalous empirical evidence on money long-run super-neutrality and the vertical long-run Phillips curve" Kiel Working Paper, 2038, Kiel Institute for the World Economy, Kiel.
- Vaona, A and D. J. Snower (2008) "Increasing Returns to Scale and the Long-Run Phillips Curve" *Economics Letters* **100**, 83-86.