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Stefan Gerlach, Reamonn Lydon
and Rebecca Stuart

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Stefan Gerlach, Central Bank of Ireland and CEPR
Reamonn Lydon, Central Bank of Ireland
Rebecca Stuart, Central Bank of Ireland

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Centre for Economic Policy Research
77 Bastwick Street, London EC1V 3PZ, UK
Tel: (44 20) 7183 8801, Fax: (44 20) 7183 8820
Email: cepr@cepr.org, Website: www.cepr.org

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ABSTRACT

The Phillips Curve in Ireland: 1935 - 2012*

We study the determination of Irish inflation between 1935 and 2012 using a Phillips curve approach. We find that a simple backward-looking Phillips Curve that incorporates import prices is stable over the sample period and passes a number of diagnostic tests. We also consider the importance of UK and euro area inflation for Irish inflation. While UK inflation is significant in the period 1935 – 1979, and euro area inflation is significant in the period 1980 – 2012, we present evidence that suggests that these findings reflect common shocks.

JEL Classification: E3, E4 and N14
Keywords: historical statistics, import prices, inflation, Ireland and output gap

Stefan Gerlach
Central Bank of Ireland
PO Box 559
Dame Street
Dublin 2
IRELAND

Email: stefan.gerlach@centralbank.ie

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Reamonn Lydon
Central Bank of Ireland
PO Box 559
Dame Street
Dublin 2
IRELAND

Email: reamonn.lydon@centralbank.ie

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Rebecca Stuart
Central Bank of Ireland
PO Box No. 559
Dame Street
Dublin 2
IRELAND

Email: rebecca.stuart@centralbank.ie

For further Discussion Papers by this author see:
www.cepr.org/pubs/new-dps/dplist.asp?authorid=178440

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1. Introduction

This paper estimates a Phillips curve model to explain Irish inflation, using annual data for the period 1935 to 2012. The paper adds to a wide body of existing research that analyses the determinants of Irish inflation; see for example Geary and McCarthy (1976), Geary (1976), Flynn and Honohan (1986), Kenney and McGettigan (1997) and, more recently, Bermingham et al. (2012).

In contrast to the existing literature we study data spanning a much longer sample period, 80 years.[1] This period includes the three monetary policy regimes that have been in force since the foundation of the state: the parity link with Sterling to 1979, the European Monetary System (EMS) from 1980 to 1999, when monetary policy effectively operated under an adjustable peg regime, and Economic and Monetary Union (EMU) from 1999 onwards. To our knowledge, no other authors have attempted to explain Irish inflation under these different regimes using a unified framework.

Much of the existing literature assessing the Phillips curve in Ireland focuses on the period of, and just after, the parity link with Sterling. Bacon et al. (1982, p. 35) summarise the view of Irish inflation in this period:

"…Up to 1979, the dominant influence on inflation was the relationship between Ireland and the UK. This arose given: (i) the maintenance of a fixed exchange rate with sterling; (ii) that the UK is the dominant trading partner; (iii) exports and imports constitute such a large proportion of activity in goods and services; and (iv) demand patterns for non-tradeable goods and services tend to be somewhate similar for a variety of cultural and historical reasons."

This interpretation views Ireland as a small part of the UK economy during the period the Irish pound was fixed to Sterling. Despite the break with Sterling in 1979, the overriding view of inflation remained that of a small open economy where inflation pressures were largely externally determined with little or no role for excess demand in Ireland as captured by the unemployment rate or the output gap; see for

[1] With the exception of the Bermingham et al. paper, which studies the period from 1980 to 2011, most of the Irish empirical research tends to focus on a relatively short time period, typically around ten years.

example Flynn and Honohan (1986) and the summary in Kenny and McGettigan (1997).

Bermingham et al. (2012) use an extended sample period (1980-2012) and focuses on the more recent time period. Controlling for international factors, and using the short-run unemployment gap as a measure of slack in the domestic economy, the authors find a relationship between domestic economic conditions and inflation. They note that the effect is particularly strong during the recent financial crisis. This finding suggests that the relationship between the state of the macroeconomy and inflation can be detected more easily in longer sample periods, perhaps because the business cycle evolves slowly over time so that a long time period is required to find sufficient variation in the data.

In addition to explaining the determinants of Irish inflation since the 1930s, this paper adds to the literature that uses a long history of data to estimate the impact of measures of demand slack on inflation. This includes, of course, the original article by Phillips (1958), which examined UK wage inflation and unemployment from 1861 to 1913 (and subsequently fitted the curve to data from 1948 to 1957), as well as an extensive US literature, summarised in Gordon (2011).

Interestingly, prior to Phillips' paper, several other researchers studied the causality from unemployment (or some measure of demand slack) to (wage) inflation, with mixed results. However, as Humphry (1985) notes, the major difference between these "early" estimates of the Phillips curve, such as those by TinbergÌn (1936 and 1951) and Klein and Goldberger (1955) , and Phillips' later work was the latter's implicit emphasis on a long time time-span of data for studying the relationships. It could be argued that such a long time series is necessary to assess both causality and stability. In more recent work, Haldane and Quah (1999) examine the evolution of the UK Phillips curve since the 1950s, paying particular attention to the role of policy-makers' beliefs. Gruen et al. (1999) conduct a similar exercise for Australia,

paying particular attention to structural changes in the labour market and the role of import prices.

In this paper we study a sample period almost three times that of Bermingham et al. (2012) and show that there is strong evidence that the state of the Irish business cycle, as measured by the output gap, is an important determinant of domestic inflation. Furthermore, we demonstrate that the estimated relationship is stable over time and that dynamic out-of-sample forecasts provide good predictions of future inflation even during the recent financial crisis.

The remainder of the paper is structured as follows. In Section 2 we briefly review how the evolution of economic and monetary arrangements impacted on inflation between 1935 and 2012. Section 3 provides an overview of how the data are compiled and Section 4 briefly reviews our final data series. In Section 5 we study the unit root properties of the data, discuss our benchmark specification and present estimates of a simple backward-looking Irish Phillips curve that incorporates import prices. We show that the relationships are stable over the sample period and that the model passes a number of diagnostic tests. In Section 6 we analyse the role of UK inflation for the Irish Phillips curve the period 1935 – 1979, and in Section 7 turn to the role of euro area inflation in the period 1980-2012. While these external inflation rates are significant if incorporated in the simple model presented in Section 5, we present evidence that suggests that this finding reflects common shocks and is not structural. Section 8 presents out-of-sample forecasts for our preferred specification and Section 9 concludes.

2. Inflation and monetary regimes in Ireland since 1935

As noted above, monetary policy in Ireland operated under several different regimes between 1935 and 2012. Gerlach and Stuart (2013a, b) provide a VAR study of the Irish economy and estimate Irish money demand in this period. Here, we focus on explaining inflation trends since the 1930s.

Following independence, the monetary system was initially unchanged since the monetary arrangements appeared to function satisfactorily. Nevertheless, the old arrangements were not deemed suitable for an independent country and in 1926 the Government established a Banking Commission to review the monetary and financial system and propose changes. The Commission advised that the State should establish its own currency at par with Sterling and that a new Currency Commission should assume responsibility for the issuance of bank notes. These recommendations were included in the Currency Act of 1927 that introduced the Saorstát pound, which was fully backed by Sterling assets and redeemable in Sterling in London.

While these arrangements fell short of those in economies with a central bank, the Irish financial system functioned well and was closely integrated with the London money market. With the new currency fully backed and the Currency Commission's objectives limited to ensuring convertibility against Sterling, the credibility of the exchange rate parity was not in question.

Further impetus towards the creation of a central bank came following the Commission of Inquiry into Banking, Currency and Credit which reported in 1938, and which lead to the established of the Central Bank of Ireland (CBI) in March 1943. Kelly (2003) notes that the new central bank lacked some traditional banking functions, in particular the ability to restrict credit conditions, that implied that it was not in a position to set interest rates and to conduct an active monetary policy. Indeed, the functioning of the Currency Commission and the CBI, coupled with the fixed exchange rate against Sterling, implied that monetary arrangements in Ireland are best described as those of a currency board, at least until the early 1970s.[2] As a consequence, Irish inflation rates and interest rates followed closely those in Britain and were thus determined with little, if any, reference to domestic economic

[2] See Honohan (1995).

conditions although, of course, these were shaped by those prevailing in the United Kingdom.

The close link to Sterling was broken in 1979 when Ireland joined the European Monetary System as a founding member. While monetary policy remained focussed the requirement of exchange rate stability, the central rate of the Irish pound against the Deutsche Mark was realigned seven times by a total of 35.75% between September 1979 and January 1987.[3] The pound was devalued by a further 8% in January 1993, and the EMS bands were subsequently broadened to +/- 15% in the summer of 1993.

Finally, in January 1999 Ireland became a founding member of European Monetary Union. Irish interest rates and inflation rates were therefore again largely determined by developments outside of the domestic economy.

As this brief history suggests, Ireland experienced three monetary regimes in the period that we study: the 1922-1978 Sterling period that involved perfect fixity against Sterling; the 1979-1998 EMS period that involved repeated devaluations against the German Mark, and the 1999-2012 EMU period that involved membership in a hard currency area. Not surprisingly, these regimes are associated with quite different inflation behaviour. Table 1 shows that the annual inflation rate averaged about 6% in the two first periods, but less than 3% in EMU period.[4] Interestingly, while Irish inflation was lower than the rate of change of import prices in the Sterling period, it was higher than the rate of import price inflation in the EMS and EMU periods. One interpretation of these findings is that while inflation was largely externally generated in the Sterling period, a large part of inflation was generated domestically from 1979 onward.

[3] See Artis and Taylor (1994, Table 1).

[4] Furthermore, the standard deviation of inflation was much lower after 1999 than before.

3. The data

In this section we review the data used in our analysis. We use data on Irish and UK GDP and inflation and Irish import prices over a period of 80 years. Such long time series are not readily available from a single source; the data used here are compiled from a number of secondary sources.

We draw on Gerlach and Stuart (2013b) who discuss in detail the compilation of long time series from a number of sources. Briefly, the current vintage of data is used as far back as possible since it is assumed that it is subject to smaller measurement errors than older vintages. Older time series are then spliced in order to construct a single time series. Since, due to base year effects or definition changes the levels of the series are significantly different, the series are spliced together using growth rates. When more than one series was available, the decision of what series to use was based on a comparison of growth rates over overlapping periods.

3.1 GDP and the output gap

One of the main considerations in any Phillips curve estimation is the relevant proxy for excess demand. In its original form, the Phillips curve referred to the observed relationship between wages and unemployment. Over time, however, Phillips curve analysis has expanded to cover a wide range of theories of inflation which relates measures of economic activity or excess demand to inflation. As noted in Kenny and McGettigan (1997), excess demand measures fall into three broad categories: labour market measures, including employment growth, unemployment or the NAIRU; the 'gap' between actual and potential output; and capacity utilization measures. Our choosen excess demand measure is determined by the data: only real GDP is available for the entire period we are studying and we are therefore forced to use it.

Data on Irish real GDP are taken from Gerlach and Stuart (2013b). Data from 1935 to 1938 are taken from the Maddison website. The data are available on a per capita basis and population data from the census are used to calculate an aggregate figure.

Data from 1938 to 1947 are taken from official estimates of national income published in 1946 and 1951.[5] However, it is clear from the 1946 White Paper and the CSO's 1951 release that no data were collected in this period, and that these were estimates made in retrospect.[6] In both cases, the data are for total national income and are reported only in nominal terms. However, a retail price trend is also reported in both publications, and this is used as a deflator to obtain real GDP. Data on real GDP are available from the CSO from 1947 to 2012.[7]

The Maddison data are available for the entire period 1938 to 1947 for which CSO data are not available. However, the growth rates differ dramatically between the White Paper and CSO (1951) publication and the Maddison data. In contrast to the other two sources, the Maddison data indicate that the growth rate of GDP was (almost exactly) zero throughout the Second World War (Figure 1), which suggests that no data were in fact recorded for this period. As a consequence, we prefer the data originally published by 'official' sources for the time period that they are available.

In compiling data on UK GDP from 1935 until the end of the Second World War, three potential sources were considered: the Maddison website, Mitchell (2007) and data compiled in an article by Hills, Thomas and Dimsdale (2010). All three series exhibit similar growth rates, as can be seen in Figure 2, which is perhaps surprising given the data cover such a volatile period. However, there is a break in the Mitchell data in 1944/1945, for which no overlapping data is provided, and therefore no growth rate can be calculated. Furthermore, the Maddison data are available on a per capita basis, and we would therefore have to interpolate Census data to estimate

[5] See, White Paper (1946) and CSO (1951).

[6] The White Paper on National Income and Expenditure published in 1946, and containing data for the period 1938 - 1944, states that it *'inaugurates a series of official estimate of national income and expenditure… Heretofore the official statistical service has been unwilling to assume responsibility for statistics relating to national income through rough approximations have been made from time to time for departmental use'*.

[7] There are three breaks over this time period: in 1995 as data prior to 1995 exclude FISIM (the Financial intermediations sector indirectly measured), 1970 and 1959. Data from 1970 to 1995 are chain-linked annually and referenced to 2009; data prior to 1970 are at 1995 prices.

an aggregate GDP figure for this period. As a result, we use the data from Hills, Thomas and Dimsdale for this period. Data from 1948 to 2012 are available from the Office of National Statistics.

Euro area GDP is available from the ECB's Area-Wide Model database from 1970, and from the ECB and Eurostat from 1995.

To construct the output gap we compute a measure of trend output using the Hodrick-Prescott filter on the log of real GDP, where the smoothing parameter is set to 100, as is standard practice with annual data. We then calculate the output gap as the difference between the actual data and the trend. In the recent period, these measures are closely correlated with estimates of the output gap published by other institutions, such as the IMF and OECD.

3.2 Price series

A common question in the Phillips curve literature is whether a 'headline' or 'core' rate of inflation should be used. Core inflation excludes the energy and (unprocessed) food components of the CPI since these are highly volatile and since they are related to conditions in the international, rather than the domestic, economy.[8] In our case, the debate is moot as it is not possible to obtain a measure of core inflation for Ireland back to 1935. Instead we address the problem by including import prices which capture the cost of imported energy in our econometric model.

The Consumer Price Index (CPI) is available from the Central Statistics Office (CSO) for the period for the full period from 1935 to 2012. An import price index is available from the CSO beginning in 1930. UK CPI is available from the UK Office of National Statistics (ONS). The euro area Harmonised Index of Consumer Prices (HICP) is available from the European Central Bank's (ECB) Area-Wide Model database from 1970, and from the ECB from 1991.

[8] See the discussion in Montoya and Döhring (2011).

4. Review of individual time series

In this section we briefly review the the final data series that are plotted in Figures 3-6. In each plot, the vertical lines mark changes in the monetary regime, namely the establishment of EMS in 1979 and of the Eurosystem in 1999.

We begin by plotting Irish CPI inflation and the output gap in Figure 3. Note that their correlation depends on the nature of the shocks that hit the economy. Thus, shifts in aggregate demand will tend to raise both inflation and real GDP relative to trend, and thus generate positive comovements. By contrast, contractionary supply shocks tend to depress output relative to trend and raise inflation, generating a negative correlation between inflation and the output gap. From Figure 3, the correlation between inflation and the output gap does indeed seem to vary over time. Thus, during the period of the Second World War, inflation rose while the output gap turned negative, suggesting that a contractionary supply shock had occurred. Subsequently, however, the correlation turned positive. Following the establishment of the euro in 1999, however, the correlation has become much weaker than previously.

Figure 4 plots the annual change in the import price series and Irish CPI. Unsurprisngly, import prices are more volatile than CPI. While this is particularly the case during the Second World War and the first oil crisis in the middle of the 1970s, changes in import prices are also much larger than changes in the CPI through the late-1940s/early-1950s and the late 1980's/early-1990's.

Irish and UK inflation are plotted in Figure 5. As previously noted, Irish and UK inflation move together throughout the period prior to 1979. However, there are short periods where the series deviate from each other. Geary and McCarthy (1976), analysing annual inflation from 1951 to 1971, attribute these short-term deviations to differential fiscal policies between the two countries – specifically, indirect taxes and subsidies. However, the relationship between Irish and UK inflation becomes less close after 1979. Until 1999 the inflation rates are similar, with the exception of the

1991/1992 period during which the UK exited EMS. Following the introduction of the euro in 1999, the two series diverge.

Similarly, Figure 6 shows that the UK and Irish output gaps move closely together for almost the entire post-war period up to 1979. In the period thereafter, there are prolonged deviations between the series, notably the housing and construction boom of the 1990s and 2000s.

5. Econometric estimates

5.1 Unit root tests

Before estimating the econometric models, we first test whether the price and output gap series have unit roots. We perform Augmented Dickey Fuller tests and Phillips-Perron unit root tests on the annual changes in Irish and UK prices and on the output gaps (Table 2). The tests are conducted including a constant and a time trend, and the lag length is determined by the Schwarz information criterion (SIC) and the Akaike information criterion (AIC).

The Augmented Dickey Fuller tests indicate that when the lag length is determined by the SIC we can reject the hypothesis of a unit root in all cases, except for inflation (p-value = 0.10).[9] When the lag length is determined using the AIC, we fail to reject the null hypothesis for Irish and UK inflation. Using the Phillips-Perron test, we reject the null in all cases except inflation (p-value = 0.12) However, unit root tests are known to have low power and in what follows we therefore treat all variables as stationary.

5.2 Benchmark Specification

We use a standard Phillips curve model to explain Irish inflation. Whilst there has been much theoretical and empirical debate over the specification of the Phillips

[9] For UK inflation, the null is rejected at the 10% level (p-value = 0.07) irrespectively of which test is used.

curve relationship since the 1960s, it remains a central part of the toolkit of many policy makers and central bankers in particular.[10]

Our model holds that inflation, π_t, depends on its lagged value, proxying inflation expectations, the Irish output gap, G_t, and the rate of change of import prices (measured in local currency), ω_t. Since the lag structure is not known a priori, we allow for two lags of past inflation; and the current and two lagged values of the output gap and the rate of change of import prices to enter. Thus, the regression model can be written:

$$(1) \qquad \pi_t = \alpha_1\pi_{t-1} + \alpha_2\pi_{t-2} + \beta_0 G_t + \beta_1 G_{t-1} + \beta_2 G_{t-2} + \gamma_0\omega_t + \gamma_1\omega_{t-1} + \delta_2\omega_{t-2} + v_t$$

This model is deliberately overparametrised but will allow us to determine, for instance, whether inflation depends on the current or the lagged output gap, and the dynamic responses of inflation.[11]

5.3 Estimates

As a preliminary, we first estimate equation (1). Given that the price level data starts in 1933 and we have two lags, we use the sample period 1936-2007, leaving the period 2008-2012 for out-of-sample forecasts. The results in the first column of Table 3 show that lagged inflation and contemporaneous rate of change of import prices are highly significant, and that the lagged output gap much more significant than the current or twice-lagged output gap, despite the obvious multicollinearity.

"Reducing" this equation by removing insignificant variables and reestimating over the period 1935-2007 yields the results presented in the second column of that table. In this specification the lagged inflation rate, lagged output gap and the contemporaneous rate of increase of import prices are all highly significant as on

[10] For instance, a Phillips curve relationship has been used to explain why core inflation failed to decline and why unemployment rose so dramatically in the aftermath of the "Great Recession". Montoya and Döhring (2011) summarise the recent evidence.

[11] We performed a Johansen test for cointegration in the levels of consumer and import prices with two lags, but found none at the 5% level, either using the trace test or the Maximum Eigenvalue test. As a result, we do not include price levels in the regression equation.

would expect. The long-run passthrough of import prices is estimated to be $\frac{\gamma_0}{1-\alpha_1} = 0.64$ and thus somewhat below unity. Indeed, a Wald test rejects the hypothesis of a unit passthrough (p = 1.4%).

Before proceeding, we perform a battery of tests on this equation, looking, in particular, for evidence of instability. First we calculate a Bai-Perron test for one or several breaks at unknown points in time, trimming by 20% of the sample. Perhaps surprisingly, the test does not reject at the 1% level.[12] Such a test however has little power against a specific alternative. We therefore use a Chow test to explore whether a break occurred in 1979-80, when the fixed exchange rate to Sterling was abandoned. Perhaps surprisingly, the test does not reject (p = 91.1%). We also test whether a break occurred in 1998-99, when Ireland joined EMU. Since there are too few observations to estimate the equation reliably in the second sample, we use the forecast version of the Chow test. Again, we fail to reject the hypothesis of stability (p = 99.1%).

We also perform a test for heteroscedasticty of the White type and do reject the null hypothesis (p = 0.9%). While the estimated standard errors are similar to those constructed assuming homoscedasticity, following the suggestion in Stock and Watson (2011), we report White standard errors in Table 3. Finally, we test the hypothesis that the residuals do not display first-order serial correlation (p = 56.7%).

These findings indicate that the estimated Phillips curve model is stable and that it passes a number of diagnostic tests.

5.4 Subsample estimates

While we failed to find any evidence of instability, next we reestimate the equation for the two subsamples 1935-1979, when the Irish pound was linked to Sterling, and 1980-2007. The results in columns 3 and 4 of Table 3 show that while the parameter

[12] The critical value of the test is 19.82, the F-statistic is: 3.23 and the Scaled F-statistic is 12.93.

estimates for the two subperiods are very similar to those for the full period, the output gap is highly insignificant in the first subsample.

One interpretation of this finding is that Irish inflation was determined solely by international price developments in this period. However, the results in column 5 shows that if one controls for two outliers in 1943 and 1953, the t-statistic on the output gap rises from 0.93 to 1.96 (p = 5.7%). Thus, the finding that the output gap is insignificant in the first period seems sensitive to minor changes in the specification of the model.

6. Inflation in Ireland and in the UK, 1935-1979

Next we turn to the important of external inflation pressures. It is frequently noted that inflation in Ireland was very similar to inflation in the UK, at least until 1979. This fact is frequently interpreted as evidence that Irish inflation was largely, if not completely, determined by inflation in the UK during the period of the peg to Sterling. However, in the Phillips curve model presented above we used the rate of change of import prices as a forcing variable. While UK inflation will surely influence inflation in Ireland through import prices, it seems unlikely that there is an additional effect directly from consumer prices.

To test that hypothesis, we augment our preferred specification with the current rate of inflation in the UK.[13] Furthermore, since the relationship between Irish and UK inflation presumably was strongest during the period the Irish pound was pegged to Sterling than afterward, the sample period is 1935 to 1979.

The results, in Table 4, show that UK inflation is highly significant with a t-value of over 6. Furthermore, the Irish output gap is now insignificant. One interpretation of

[13] We performed a Johansen test on Irish and UK consumer prices with two lags, and found one cointegrating vector at the 5% level of significance using both the Trace test and the Maximum Eigenvalue test. We therefore included the logarithms of the lagged levels of Irish and UK consumer prices.

this result is that our earlier finding of a highly significant Irish output gap is simply due to the omission of an important determinant of Irish inflation, that is, UK inflation.

To explore the role of UK inflation in the Irish Phillips curve, we next replace it with its lagged value and the lagged UK output gap. Since these are important determinants of UK inflation, one would expect them to be signficiant in the regression. However, as shown in Column 2 of Table 4, they are not. Indeed, a F-test accepts the hypothesis that these variables are redundant (p = 86.3%). This suggests that the correlation between Irish and UK inflation, when controlling for import prices, is solely contemporaneous.

We go on the restimate the model in column 1, using lagged UK inflation and the lagged UK output gap as instruments. As the results in column 3 show, UK inflation is now highly insignificant. The fact that instrumental variables estimates are so different from the OLS estimates in column 1 suggests simultaneity bias that could arise as consequences of common shocks.[14] We therefore explore whether there is any evidence of such, using a Wu test. To implement the test, we regress UK inflation on a constant and lagged UK inflation.[15] The r-squared of this regression is 0.57 and the F-test yields a value of 12.70; lagged UK inflation is therefore a very good instrument for current UK inflation. Next we compute the fitted value of UK inflation from this equation and include it and actual UK inflation in the regression for Irish inflation. The estimates in Column 4 in Table 4 indicate that fitted UK inflation is significant at the 5% level, implying that the parameter in Column 1 is subject to simultaneity bias. We consequently conclude that the impact of UK inflation on Irish inflation occurs through import prices.

[14] Thus, some economic disturbance that increases Irish inflation simultaneously increase UK inflation, generating a positive correlation between the residual and one of the regressors in our simple PC model.

[15] This approach follows Greene (2011, Example 8.6, p. 276).

7. Inflation in Ireland and the euro area, 1979-2012

Since the argument regarding the role of UK inflation in determining Irish arises from the fixed exchange rate regime in place up to 1979, a similar question arises about the role of euro area inflation since Ireland joined EMS. We therefore perform the same analysis to that conducted for the UK to examine the role of inflation in (what has become) the euro area.

The results are presented in Table 5. We first include euro area inflation in our basic model. From column 1, we can see that it is highly significant and that the Irish price variables – both consumer inflation and import prices – are no longer significant.[16] This may be interpreted as indicating that Irish price movements are entirely determined by euro area inflation. However, when we include the the lagged inflation rate and the output gap as determinants of euro area inflation in the regression we find that, as with the determinants of UK inflation, they are not significant (Column 2). The F-test on their joint significance also indicates their redundance (p-value = 35.2%), and suggests that the correlation between Irish and euro area inflation is contemporaneous. Furthermore, when we restimate the model using lagged euro area inflation and the lagged euro area output gap as instruments, euro area inflation is insignificant, suggesting simultaneity bias.

We therefore perform a Wu test to address the possibility of simultaneity bias arising from common shocks. We obtain a fitted value of euro area inflation by regressing it on its lag and the lagged euro area output gap.[17] Including this fitted value alongside actual euro area inflation in our preferred equation, we find that it is significant at the 1% level (column 4), indicating simultaneity bias. We therefore conclude, again, that the significance of euro area inflation in Column 1 is the result of simultaneity bias and that the impact of euro area inflation on Irish inflation occurs through the

[16] We included the logarithms of the lagged levels of Irish and euro area consumer prices since a Johansen test with two lags indicates one cointegrating vector at the 5% level of significance. This result is the same using either the Trace test or the Maximum Eigenvalue test.

[17] The R-squared is 0.90 and the F-statistic for the regressors is 62.56, indicating that the instruments are valid.

prices of imports.

8. Forecasting inflation using the Phillips curve

Next we return to our preferred model in Column 2 of Table 3 and investigate its ability to provide dynamic out-of-sample forecast. Since the model is estimated in the sample 1935-2007, we can use it to provide forecasts of inflation, conditional on the observed behaviour of import prices and the output gap.

The forecasts are shown in Figure 7 together with a 95% confidence. Overall, actual inflation is within the confidence except in 2009 when prices in Ireland fell as a consequence of the massive financial crisis that hit the economy.

9. Conclusions

In this paper study the determination ofinflation in Ireland in the period 1933-2012. This sample spans a three different monetary regimes and a period of increasing economic development. We estimate a standard backward-looking Phillips Curve incorporating import prices to capture external price developments. Interestingly, we find that the estimated inflation equation is stable and that it passes a number of diagnostic tests.

Since it has often been asserted that Irish inflation is largely, if not completely, determined by inflation in the UK, we next attempted to quantify the effect of UK inflation on the Irish inflation over the period of exchange rate fixity from 1935 to 1979. We find that, although contemporaneous UK price movements appear to have a significant effect on Irish inflation, such estimates are subject to simultaneity bias, and we conclude that the results are the result of common shocks and are not structural. We draw similar conclusions on the role of euro area inflation over the period from the establishment of EMS in 1979 to 2012.

Using a reduced equation we next test the inflation forecasting power of the model. Our results indicate that, with the exception of 2009, the model produces good out-of-sample forecasts of inflation.

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Table 1

Mean and standard deviation of inflation, import prices and output gap in each monetary regime

Variable	Monetary regime	Mean	Standard deviation
Imflation	1935-1978	5.85	4.77
	1979-1998	6.06	5.57
	1999-2012	4.61	4.87
Import price inflation	1935-1978	6.34	9.83
	1979-1998	3.94	6.84
	1999-2012	2.77	6.14
Output gap	1935-1978	-0.06	2.37
	1979-1998	-0.88	3.16
	1999-2012	0.08	3.81

Table 2

Tests for unit roots, 1933-2012

	No trend			Trend		
Variable	Augmented Dickey-Fuller tests		Phillips-Perron test	Augemented Dickey Fuller tests		Phillips-Perron test
Choice of lag length	SIC	AIC		SIC	AIC	
Inflation	-3.12** [0.03]	-2.06 [0.26]	-3.05** [0.04]	-3.16 [0.10]	-2.10 [0.54]	-3.07 [0.12]
Output gap	-4.64*** [0.00]	-4.51*** [0.00]	-3.73*** [0.01]	-4.60*** [0.00]	-4.40*** [0.00]	-3.71** [0.03]
Import price inflation	-5.58*** [0.00]	-5.58*** [0.00]	-5.60*** [0.00]	-5.70*** [0.00]	-5.70*** [0.00]	-5.73*** [0.00]
UK inflation	-3.32** [0.02]	-2.62* [0.09]	-3.33** [0.02]	-3.36* [0.07]	-2.71 [0.24]	-3.33* [0.07]
UK output gap	-6.01*** [0.00]	-6.03*** [0.00]	-3.81*** [0.00]	-5.97*** [0.00]	-5.95*** [0.00]	-3.76** [0.02]

Notes: */**/*** denotes significance at the 10%/5%/1% level. p-values are in brackets. The exact sample period depends on the number of lags used. SIC and AIC denote the Schartz and Akaike information criteria.

Table 3: Estimates of the Irish Phillips curve					
Model	**1**	**2**	**3**	**4**	**5 Dummies: 1943, 1954**
Sample	1936-2007	1935-2007	1935-1979	1980-2007	1935-1979
Constant	1.26*** (3.10)	0.96*** (3.20)	1.02** (2.04)	0.85** (2.32)	1.00* (1.95)
Inflation, lagged	0.52*** (4.10)	0.61*** (11.44)	0.57*** (7.18)	0.67*** (7.54)	0.58*** (7.48)
Inflation, twice lagged	-0.04 (0.43)				
Gap	-0.01 (0.10)				
Gap, lagged	0.30 (1.53)	0.23*** (2.61)	0.18 (0.93)	0.20*** (2.77)	0.35* (1.96)
Gap, twice lagged	-0.02 (0.17)				
Import prices	0.24*** (7.38)	0.25*** (8.99)	0.26*** (8.52)	0.23*** (3.27)	0.26*** (8.98)
Import prices, lagged	0.07 (1.44)				
Import prices, twice lagged	0.04 (0.89)				
Adj. R-sq	0.83	0.83	0.79	0.90	0.83
DW	1.99	2.13	2.17	1.88	1.92

Notes: */**/*** denotes significance at the 10%/5%/1% level. Absolute value of t-statistics in parenthesis.

Table 4: Estimates of the role of UK inflation for the Irish Phillips curve, 1935-1979				
Model	**1**	**2**	**3**	**4**
	OLS	**OLS**	**2SLS**	**Wu test**
Constant	65.27*** (3.10)	39.5 (1.67)	34.59 (1.19)	37.59* (1.89)
Inflation, lagged	0.31*** (4.13)	0.55*** (4.19)	0.53*** (3.83)	0.46*** (4.72)
Import prices	0.13*** (4.13)	0.28*** (7.69)	0.29** (2.65)	0.10*** (3.18)
Gap, lagged	0.12 (0.99)	0.28 (1.49)	0.32* (1.70)	0.12 (1.07)
UK inflation	0.56*** (6.03)		-0.07 (0.20)	0.66*** (8.03)
UK inflation, lagged		-0.05 (0.38)		
UK gap, lagged		-0.05 (0.54)		
UK inflation, fitted				-0.42** (2.32)
Price level, lagged	-0.16*** (-3.13)	-0.10* (-1.74)	-0.09 (1.26)	-0.09* (1.93)
UK price level, lagged	0.16*** (3.28)	0.11** (2.04)	0.10 (1.61)	0.10** (2.24)
Adj. R-sq	0.92	0.86	0.84	0.93
DW	1.92	2.36	2.34	2.26
Notes: */**/*** denotes significance at the 10%/5%/1% level. Absolute value of t-statistics in parenthesis.				

Table 5: Estimates of the role of euro area inflation for the Irish Phillips curve, 1980-2012				
Model	**1**	**2**	**3**	**4**
	OLS	**OLS**	**2SLS**	**Wu test**
Constant	74.27*** (3.72)	98.55*** (3.18)	92.98** (2.50)	136.41*** (4.56)
Inflation, lagged	0.15 (0.97)	0.26 (1.56)	0.42** (2.75)	0.49*** (3.84)
Import prices	0.04 (0.69)	0.17*** (3.16)	0.18 (1.53)	-0.05 (0.73)
Gap, lagged	0.23*** (3.43)	0.37*** (4.00)	0.24*** (3.41)	0.18** (2.69)
EA inflation	1.11*** (3.50)		0.03 (0.04)	1.93*** (5.17)
EA inflation, lagged		0.33 (0.81)		
EA gap, lagged		-0.25 (0.96)		
EA inflation, fitted				-1.86*** (3.29)
Price level, lagged	-0.20*** (-3.98)	-0.23*** (3.08)	-0.21*** (3.00)	-0.32*** (4.85)
EA price level, lagged	0.23*** (3.89)	0.23** (2.76)	0.20*** (2.97)	0.34*** (4.95)
Adj. R-sq	0.91	0.87	0.87	0.96
DW	1.60	1.85	1.95	2.21
Notes: */**/*** denotes significance at the 10%/5%/1% level. Absolute value of t-statistics in parenthesis.				

Figure 1: Irish real GDP series

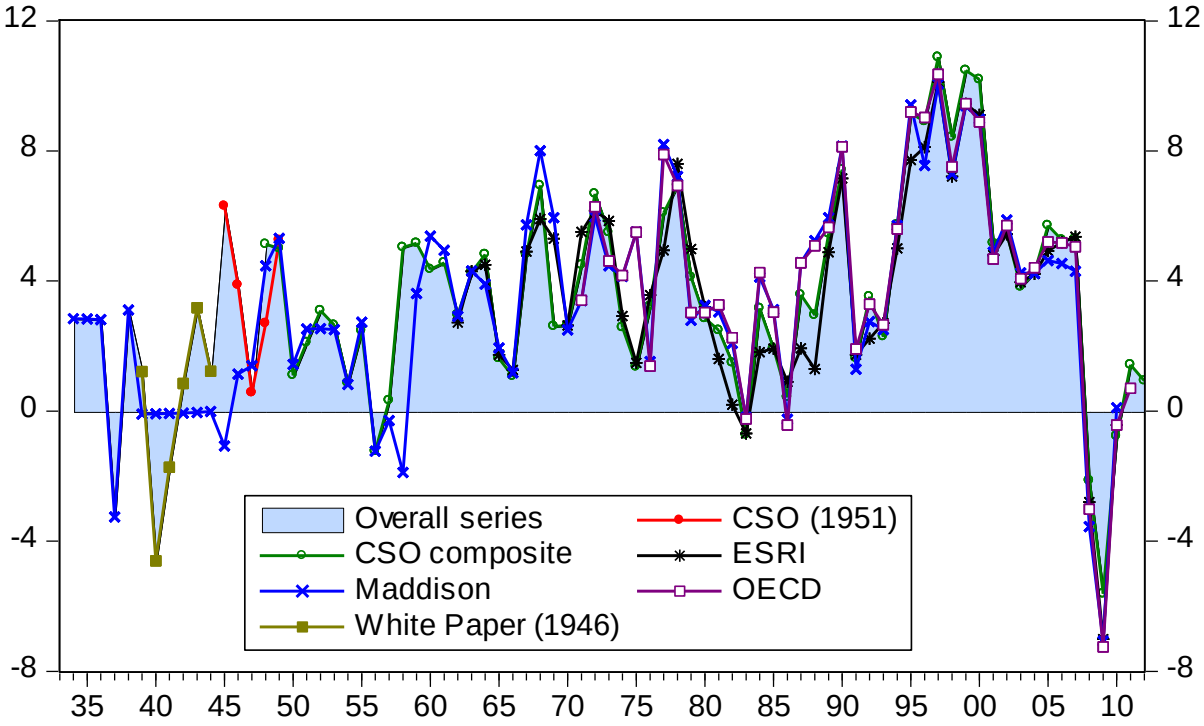

Figure 2: UK real GDP series

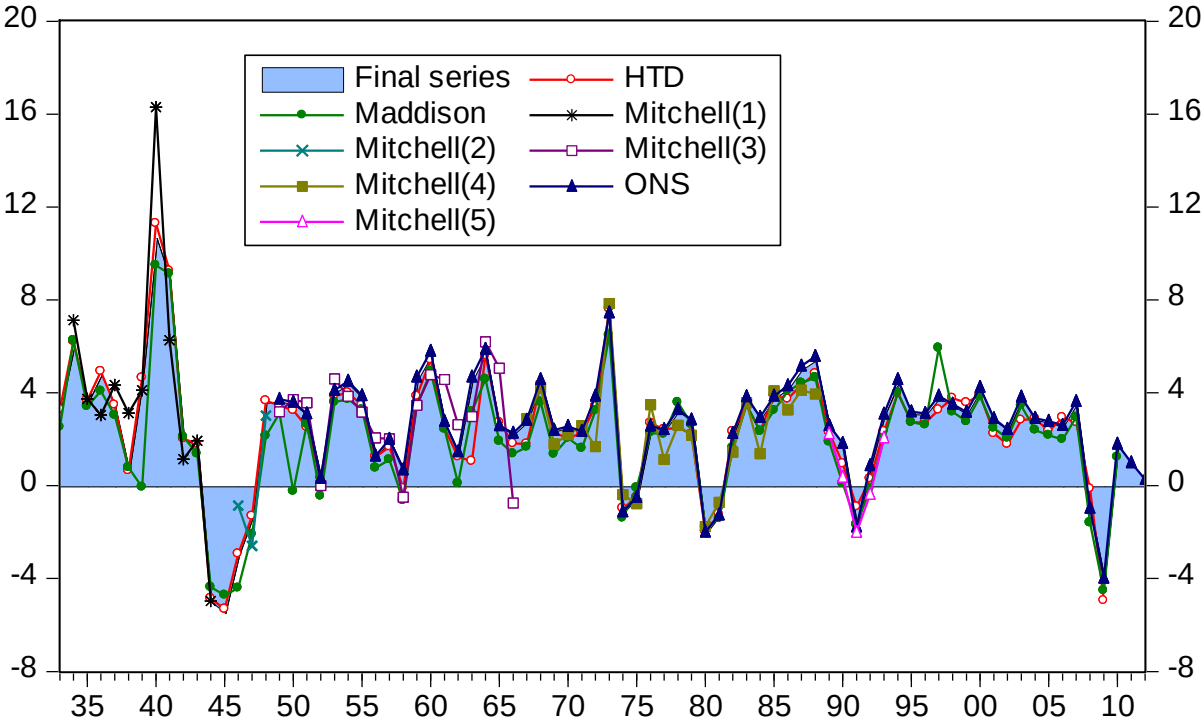

Figure 3: Irish inflation and output gap

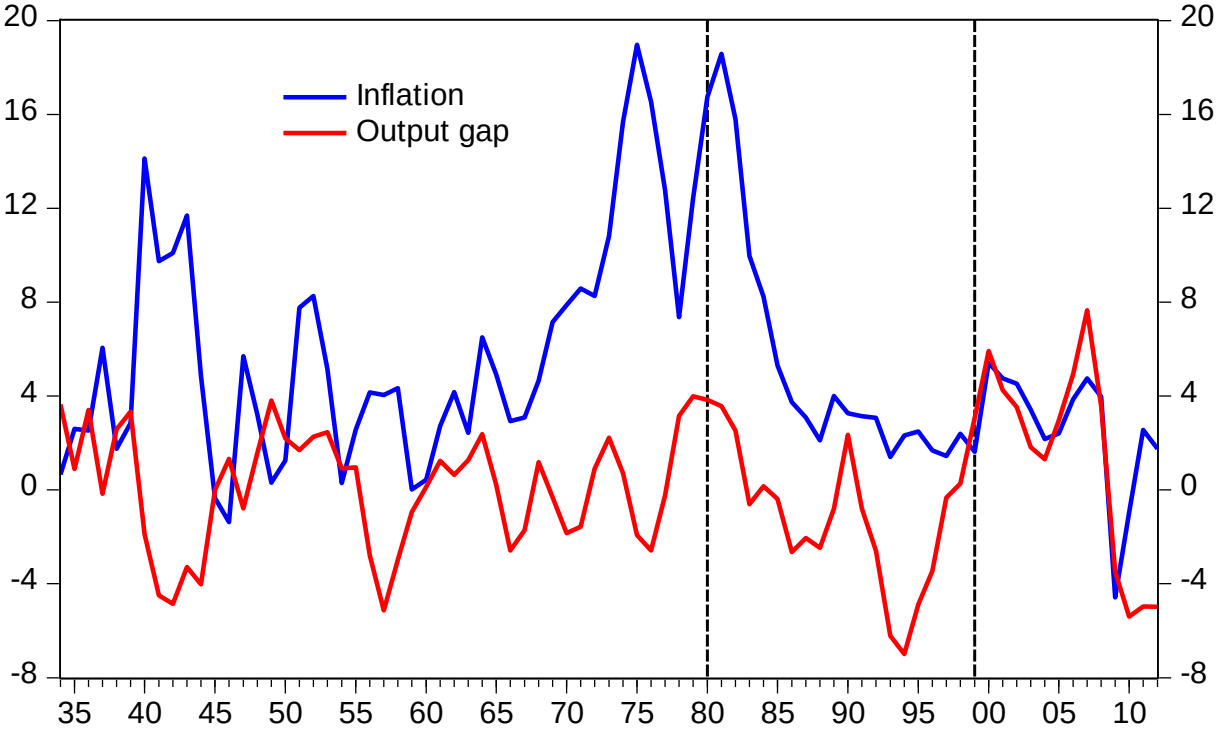

Figure 4: Inflation and changes in import prices

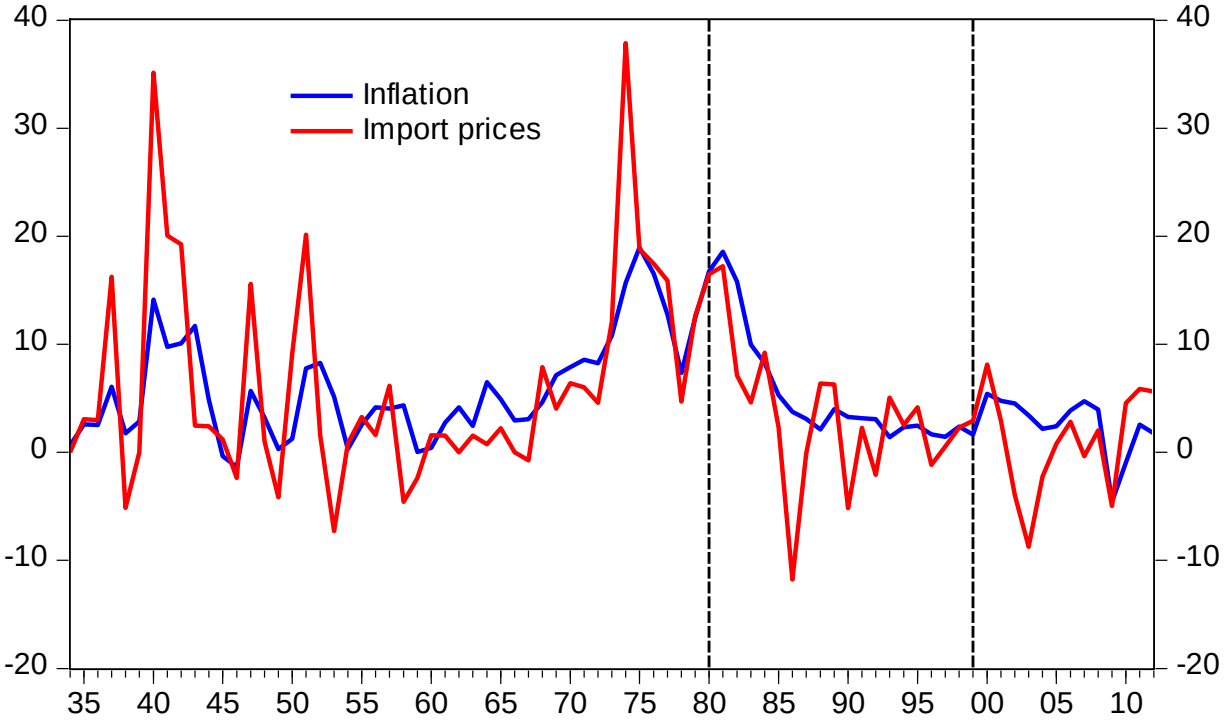

Figure 5: Irish, UK and euro area inflation

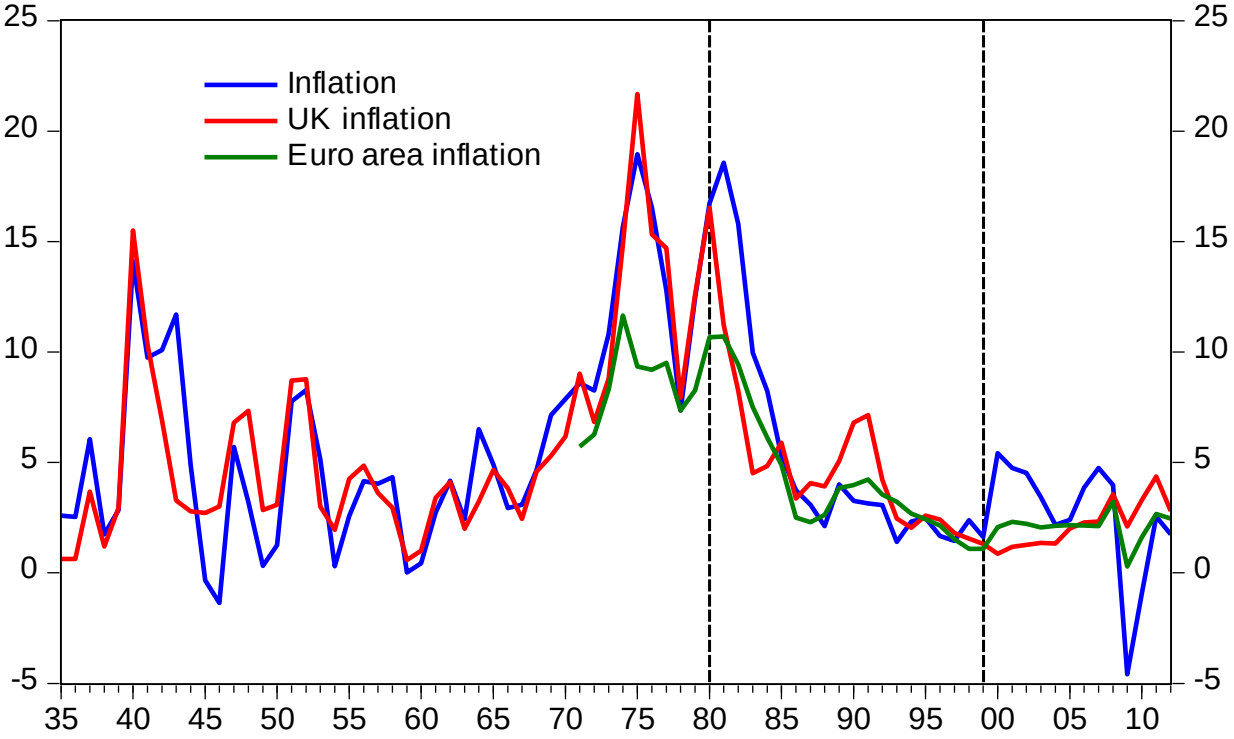

Figure 6: Irish, UK and euro area output gaps

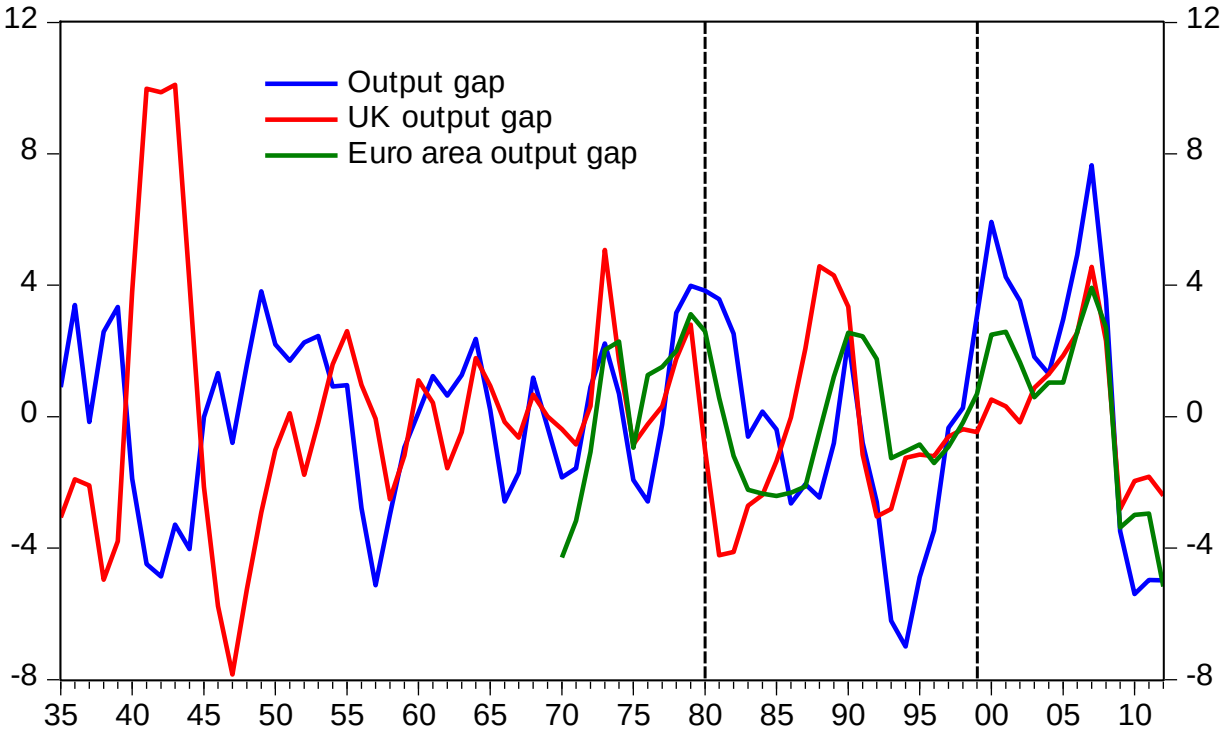

Figure 7: Dynamic forecast of the inflation rate