Irish Inflation: An Econometric Analysis

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Recently the EU Commission issued a censure of what they called "an expansionary Irish budget". Were they right? Michael King conducts an econometric investigation into some possible determinants of Irish inflation, such as British inflation and Irish government expenditure. He rejects the Commission's link between Irish government expenditure and Irish inflation, concluding that British inflation is more important.

Introduction

There's only one place where inflation is made; that's in Washington

\- M. Friedman, 1977

Unfortunately for once, we can rule out the Americans in attributing blame for the current bout of Irish inflation. With no control over monetary policy and Ireland now seen as the prototype modern small open economy, the cause of Irish inflation can draw little from the historical theories of inflation. We are subject to a different array of influences to the traditional price setting economy. Based on the inflation transmission mechanism, McAleese (1995) cites three principle sources.

1. EU inflation rate - of greater importance with the advent of a fixed exchange rate.

2. British inflation and Euro Pound exchange rate (the influence of the former may be dampened by Pound depreciation)

3. Prices of international factors of production.

So where does the EU reprimand on Irish fiscal policy come in to it. Assuming the Commission's problem is with Irish fiscal policy, rather than our market distorting corporate tax regime, is there significant evidence to back their criticisms?

The aim of the project is to use the ordinary least squares model to gain a contemporary understanding of the forces explaining Irish inflation. The X variables have been chosen to represent the different elements highlighted by McAleese (1995). Oil prices reflect the changing costs of international factors of production. British inflation represents to some extent the imported inflation view (recognising that exchange rate appreciation/depreciation may in fact at times contribute more significantly). Secondly, Irish government expenditure, as a percentage of GDP, evaluates the validity of the commission's criticism. Allied to these, seasonality will be factored in an attempt to identify whether it is seasonally induced.

The Econometric Model

$$Y = \beta 0 + \beta 1 \text{ (oil prices)} + \beta 2 \text{ (British inflation)} + \beta\, 3 \text{ (Govt. expenditure as \% of GDP)} + \beta 4 \text{ (} 2^{nd} \text{ Quarter)} + \beta 5 \text{ (} 3^{rd} \text{ Quarter)} + \beta 6 \text{ (} 4^{th} \text{ Quarter)}$$

Variables

Dependent variable Y

Irish consumer price quarterly index data is taken from the CSO publication economic series. Due to the unavailability of a continuous index from 1988 to 2000, some re-basing was necessary. The data is used as a continuous series with 1989 quarter 4 as base quarter.

First Independent variable X1

The first explanatory variable is the average international crude oil prices taken from the International Energy Agency Oil Information Publication since 1984. The figure that will be used is the average export price from the seven-principle oil exporting regions in the world. Due to the delay in the transmission from higher oil prices into domestic inflation a lag as a result of reserve buffering, of 1Q, 2Q and 3Q's will be used to see if the correlation is more significant.

Second Independent variable X2

The British quarterly consumer price index, obtained from the UK national statistic organisation is the second independent variable.

Third Independent variable X3

The final principal explanatory variable that I have chosen quarterly issues, as a percentage of the GDP figure for the year the issue takes place, with the exception of 2001Q1 where the figure of 1999 is used for simplicity. These figures are also taken from the CSO economic series and CNP and Government expenditure is measured in current prices for each period.

Seasonal Variables

In common with most time series data, Irish inflation exhibits regular oscillatory movements or seasonal patterns. In order to identify these movements a dummy variable is used. If there is a seasonal pattern present the estimated differential intercepts β_4, β_5, β_6, are statistically significant. In order to avoid multicollinearity 3 dummy variables are used to isolate the effects of the 4 seasons. In this regression the final three quarters are regressed with respect to the first quarter. Quarter 1 is thus, used as the benchmark with a dummy value of 0, D2 has a value of 1 for the 2^{nd} quarter and 0 for all the other quarters and so forth.

Omitted Variables

In attempting to replicate reality any model, will omit variables and this model is no different. From the open economy school of thought the two key variables omitted are EU inflation and the appreciation/depreciation of the Euro, the Punt prior to 1998 against the Pound Sterling. Others include wage inflation and credit expansion.

Expectations

I expect to see a positive and significant relationship between with oil prices and British inflation but I am unsure as to the nature of the relationship between Irish inflation and governmental expenditure as a percentage of GDP. In terms of seasonality, I suspect that the final quarter will show the highest seasonal fluctuations.

Procedure

There are many econometric models available that can be used to estimate the correlation between variables. Through the Microfit software programme, I will use the ordinary least square model to estimate the population parameters. From the estimates I will construct a line of best fit.

The OLS model will yield a relationship between the variables by estimating the size and sign of β_0, β_1, β_2, β_3, β_4, β_5, and β_6.

Evaluation

The evaluation shall deal first with the multiple regressions, followed by an examination of individual regression result. After lagging X1 for 1Q, 2Q and 3Q's it was found to make no difference, hence no lag was used.

Multiple Regression

The OLS line of best fir is as follows:

Y = 41.1288 - 0.906X1 + .5049X2 – 0.0032X3 – 0.4798D2 + 0.0295D3 + 0.1577D4

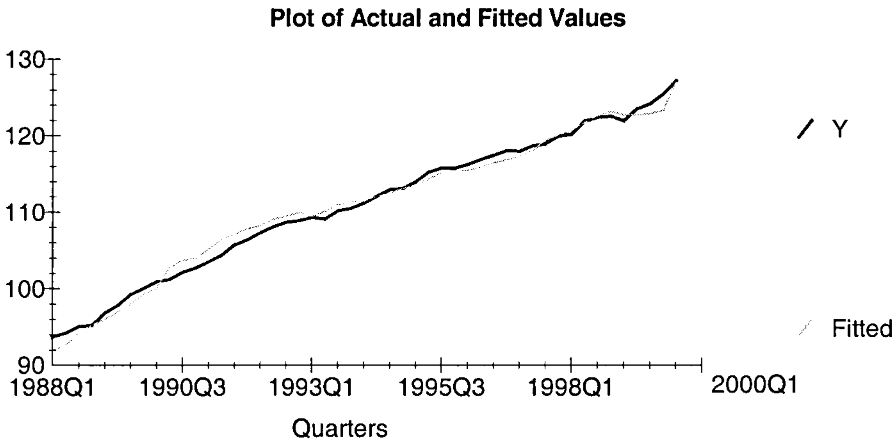
Independent Variable	Coefficient	T-Statistic	Probability
A	40.3659	12.5824	[.000]
X1	-0.024923	-0.53327	[.596]
X2	0.50714	39.5866	[.000]
X3	-0.10175	-0.51388	[.610]
D2	-0.04798	-1.1536	[.255]
D3	0.295	0.070724	[.944]
D4	0.1577	3.2486	[.002]

Analysis of Explanatory variables

The R^2 value of the multi-regression model is very close to the upper boundary of 1. It stands at 98.821% and indicates that the model is a very good fit. The adjusted R^2, R-bar squared is a less biased measure than R^2 in this case is still a very high 98.65%. In terms of structure, I will consider firstly the principal explanatory variables before discussing seasonality. X2 is the only explanatory variable that is in the multi-regression that is significant at the 1% or 5% levels. As for the coefficient on each X variables, there is as expected a positive and large correlation with British inflation. Counter intuitively there is a negative yet minimal relationship with crude oil prices which is significant at the 10% level. Regarding X3 we find a negative and minimal relationship but this relationship is not statistically significant at any level.

Seasonality

The β-coefficients indicate the direction the final 3 quarters inflation take with respect to the first quarter. We can see that inflation is lowest empirically in the second quarter rising to a peak in the pre-Christmas fourth quarter. Christmas consumer spending may explain this but so to might traditionally significant higher government expenditure in the final quarter, but in the context of the results of the model this can only be described as conjecture. Only the 4th quarter is significant at any level of significance, whereas an R2 of .0698 (when the seasonal dummies are regressed alone) indicates that seasonality is not overall in any way significant in explaining changes in Irish inflation.



Single regression.

It appears that there exists high overall explanatory powers in the model. However, it is important to evaluate what individual explanatory powers X1, X2, X3 have in case multicollinearity has undermined the high R^2.

Analysis

From these results it is clear that British inflation has a more significant effect on my Y variable than X1 and X3. The simple regression indicate that X2's British inflation is the only explanatory variable within the 10% significance levels, significant at the 1% level. Interestingly the R^2 for the single regression of X2 is only marginally less than for the multiple regression at 98.396%, indicating that British Inflation can claim most of the models explanatory powers.

Independent Variable	Coefficient	T-Statistic	Probability
A	110.3308	16.7484	[.000]
X1	0.0325	0.089543	[.929]
Independent Variable	Coefficient	T-Statistic	Probability
A	38.522	28.3548	[.000]
X2	0.51134	53.7015	[.000]
Independent Variable	Coefficient	T-Statistic	Probability
A	152.4019	21.7343	[.000]
X3	-5.2347	-5.9797	[.000]

Multicollinearity

Multicollinearity is always a possibility in multiple regression analysis. It refers to the existence of more than one exact linear relationship among some or all the explanatory variables in the regression model. In the multi-regression model, significant multicollinearity is indicated by the high R^2 allied with insignificant β coefficients. To investigate this further I regressed each of the X variables on each other. Intuitively there should be significant collinearity between oil prices and British inflation with negligible collinearity between these and Irish government expenditure.

When I regressed X1 or X2 I found R^2 to be .527, quite high and anticipated. X1 and X3 yielded on R^2 of .00147, almost no collinearity. Interestingly a strong negative relationship was found between British inflation and Irish Government expenditure as a percentage of GDP. Thus multicollinearity undermines the results from the multi-regression.

Although my OLS estimators are still best linear unbiased estimator (BLUE), the existence of multicollinearity between X1 and X2 will result in those independent variables having very large variable and covariances, which makes precise estimation more difficult. My predications for each of the three coefficients were as follows.

Predictions vs. Results

Variables	Prediction	Result
Y and X1	Positive, possibly lagged	Slightly greater than 0, but not significant
Y and X2	Positive & significant	Positive and significant
Y and X3	Unsure	Negative and significant
Y and Seasonal Dummies	4th Q of greatest positive influence	4th Q of greatest positive influence

Statistics

The t-statistic measures the ratio of the parameter estimate to the standard error: 'an estimate of a parameter is statistically significant if the t-statistic associated with it causes us to reject a particular significance level, the hypothesis test'. It allows us to test the hypothesis that the coefficients equal to zero.

$$\mathbf{H0: \beta1=0, \beta2=0, \beta3=0, \beta4=0, \beta5=0, \beta6=0}$$
$$\mathbf{H1: \beta1\neq0, \beta2\neq0, \beta3\neq0, \beta4\neq0, \beta5\neq0, \beta6\neq0}$$

In the multiple regression, only X2 was found to be significant at the 10% 5% and 1% but this allows us to reject the null hypothesis, as all coefficients don't equal zero. In terms of the single regressions, both X1 and X3 are significant at the 1% level. Hence H0: $\beta1=0$, and H0: $\beta3=0$ can be rejected but H0: $\beta2=0$ must be accepted. Of the seasonal dummies only D3 is significant and only at the 10% level.

F-statistic

The F-statistic evaluates the combined significance of all explanatory variables. The F-statistic for this model is F (3,45) = 586.69 with negligible probability hence the null hypothesis can again be rejected. The overall model is significant.

Autocorrelation

If the assumption that the disturbances μ are random or uncorrelated is made, the problem of auto-correlation arises. There are several methods for the detection of autocorrelation, of which the Durban Watson statistic is the most celebrated. It measures whether each observation is statically dependent on the previous term. In this model the Durban-Watson statistic is 0.458. As I have 45 and 6 variables the critical values for the model are to a 5% significance level:

dl = 1.189 and du = 1.895

The band of inconclusiveness is small because of the number of observations. Since my DW statistic is below the lower limit, there is very definite evidence of auto-correlation or serial correlation. This is not an unusual occurrence in this type of time serial data. Although my OLS estimation remains unbiased in the presence of auto-correlation, it is not efficient. Thus, the t and F tests of significance are less legitimate and other tests may be required.

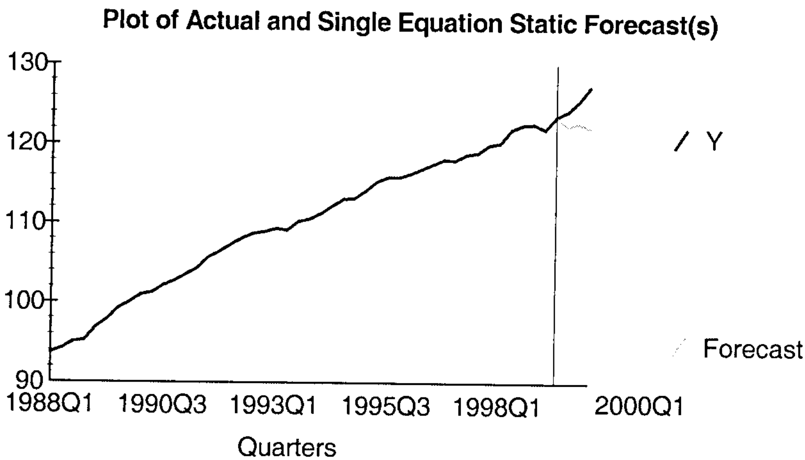
Hetroscedasity

If the assumption that all disturbances μ have the same variance is not satisfied there is hetreroscedasity. Hetrroscedasity does not destroy the unbiasedness and consistency properties of my OLS estimator but it would no longer be minimum variance or efficient. Unfortunately with a 29.2%, statistic, I cannot rule its existence to a 90% or 95% confidence level.

Forecasting

A desirable quality of such a model is the ability to forecast the future direction of ones variables. In order to test my model, I omitted the last 3 quarters data and re-ran the regression. The results that I obtained for the multiple regression model were very poor underestimating greatly. However when I omitted the seasonal dummies the forecasting improved significantly. This indicates that seasonal factors in 2000 will be of greater irrelevance. The results omitting the seasonal dummies are as follows:

Observation	Actual	Prediction	Error	S. D. of Error
1999Q3	124.16	122.3067	1.8533	1.0852
1999Q4	125.41	122.7332	2.6768	1.1158
2000Q1	127.18	122.1166	5.0634	1.193



As the model forecasts further into the future, it increasingly underestimates Irish inflation. The principle reason for this may be the Euros depreciation against the pound and the dollar over this period. Thus the main causes of inflation over this 2 periods and to the end of 2000 is omitted form the model. The model predicts negative inflation from 1999Q2 to 2000Q1, thus current Irish inflation, which began in this period, appears to be unexplained by the model.

Summary and Policy Recommendations

Firstly, the model suffers from auto-correlation and hetroscedasity may also be a feature. The model seems to be a very good fit but further investigation uncovers multicollinearity between British inflation and Oil prices and surprisingly British inflation and Irish Government expenditure as a percentage of GDP. Multicollinearity will always undermine econometric analysis, in particular with highly integrated macroeconomic data, nevertheless important conclusions can be drawn.

Independently, British inflation largely influences Irish inflation, government expenditure as a percentage of GDP has no significant correlation, and most surprisingly oil prices have a negative relationship that is statistically significant at the 10% level. Although the period of analysis ends in 2000Q1 the Commission had made overtures to the Department of Finance about fiscally generated inflationary pressures prior to this. From my model, it can be claimed that there was no basis for this and this is unlikely to change into till the end of 2000 and into 2001. Thus rendering unfounded the current arguments against the expansionary nature of Budget 2001.

Seasonally, Irish inflation peaks in the final quarter, but this is not to be believed to be a result of any of the used variables, most likely increased consumer spending. The model forecasts a slight reduction in consumer prices in 2000, I believe this is a result of the omitted variable of Pound/Euro appreciation. Future considerations of Irish inflation should firstly consider, foreign inflation and Euro depreciation, before any analysis of fiscal policy and international factor prices, given the permanent nature of our fixed exchange rate with Europe and an interest rate out of our control.

In order to avoid the problem of auto correlation, which is generally associated with macro-economic aggregates, I would consider using the change in each series as my variables.

Bibliography

Gujarati, Damodar. (1995) *Basic Econometrics.* New York; London: McGraw Hill International.

Keenan, Brendan. (2001). *Irish Independent Feb. 1st* Dublin: Independent Media Group.

Mandala, G.S. (1977) *Econometrics.* London: McGraw Hill

McAleese, Dermot. (1995) *Secondary Policy Objectives* Dublin: Gill & Macmillan

McAleese, Dermot. (1997) *Economics for Business.* London: Prentice Hall Europe.

Quinn, T. et al. (1999) *Inflation Analysis* Dublin: Central Bank

Quinn, T. &, A. Mandsley (1996) *Forecasting Irish Inflation.* Dublin: Central Bank

Stewart, Jon. (1998). *Econometrics.* London: Prentice Hall Europe.