INFLATION IN IRELAND: THEORY AND EVIDENCE

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Abstract

The purpose of this paper is to address some important questions surrounding the determinants of Irish inflation. As a backdrop, the international theoretical literature on inflation is selectively reviewed, with a view towards assessing its relevance to Ireland. Subsequently, the relevant Irish empirical literature is assessed in order to highlight the main outstanding areas of disagreement surrounding the determination of Irish inflation. This is contrasted with the widespread agreement which prevailed prior to our entry into the EMS. Following on from this, an empirical model of aggregate Irish inflation is formulated with a view towards specifically addressing the roles of (i) the exchange rate, (ii) wages and (iii) foreign factors in the determination of Irish inflation. Our overall results, obtained using the Johansen multivariate cointegration technique, highlight the long-run interrelationships between Irish prices, wages and the nominal effective exchange rate. In addition, it is shown that the purchasing power parity model is an acceptable long-run framework within which to consider price determination in Ireland. However, the results also support the view that excessive wage pressure, or domestic inflationary impulses in general, can exert upward pressure on Irish prices as long as the exchange rate is free to move.

1. INTRODUCTION

The main objective of the Central Bank of Ireland is to "safeguard the integrity of the currency".[1] For practical purposes, this is taken to mean the maintenance of low inflation in Ireland. Unfortunately, considerable controversy exists over the way in which Irish inflation is determined and there is, as yet, no model of inflation which is generally accepted by Irish economists. This paper will examine the determinants of Irish inflation from both a theoretical and an empirical perspective. It is hoped that, by carrying out this exercise, the overall inflationary process in Ireland, together with the scope for its control, will be better understood.

The layout of the remainder of the paper is as follows. In Section 2 we briefly review the main economic theories of inflation with a particular emphasis on how they relate to price determination in a small open economy. Section 3 of the paper critically reviews the Irish empirical research on inflation. It emerges quite clearly from this review that there are at least three specific areas of disagreement among Irish economists. In particular, there is a lack of agreement in regard to i) the role of the exchange rate in determining Irish inflation, ii) the relationship between wage and price inflation and iii) the strength and the source of foreign inflationary impulses in Ireland. In Section 4 of the paper an econometric model of aggregate consumer prices in Ireland is estimated in order to specifically address these issues. Section 5 summarises and concludes.

2. THEORIES OF INFLATION[2]

Reflecting its central importance to economic policy makers, there exists a voluminous international literature on the causes of inflation. No attempt will be made here to describe *in toto* the detailed evolution of this complex research.[3] Instead, three of the primary "component parts" in the literature are examined with a view to assessing, *inter alia*, which factors are likely to affect the inflation process in Ireland. Specifically, we outline some of main features of Phillips curve analysis, international monetary theories and also the Scandinavian model. In each case, a heavy emphasis is placed on the short- and long-run implications for price determination and inflation. It should also be noted that our chosen categories are not mutually exclusive. As will become clear, monetary explanations do not rule out Phillips curve analysis and elements of monetarism and the Phillips curve have been incorporated into the analytics of the Scandinavian model. Furthermore, this classification is evidently not exhaustive. Little or no reference is given to some other "theories" of inflation (e.g. sociological).[4]

Phillips Curve Analysis

The "Phillips curve" does not refer to a single "theory" of inflation but rather to a number of different formulations relating economic activity and inflation which have been developed over time. In its original form, the Phillips curve refers to a simple relationship between inflation and unemployment. The possibility of such a relationship has interested economists for several centuries.[5] However, the work of Phillips (1958) brought the relationship between inflation and unemployment to centre stage. Phillips' seminal paper provided empirical evidence, using UK data over the period 1861 - 1913, on the existence of an inverse relationship between the rate of change in nominal wages and the unemployment rate.[6] The primary implication drawn from this relationship was that policy-makers had a choice between low unemployment and low inflation. This early analysis did not seek to distinguish clearly between the short and long run. However, the trade-off was generally interpreted as being long-run in nature - one could achieve a permanently lower rate of unemployment by engineering a higher rate of wage inflation through expansionary policy. This approach was the main framework for analysing inflation in the 1960s.

The absence of any role for price expectations in the original Phillips curve ultimately led commentators such as Friedman (1968) and Phelps (1967) to question its long-run validity. The basic rationale underlying the incorporation of expectations was that wage contracts are agreed on the basis of expected changes in the cost of living. Thus, it is the expected real wage which should enter the equation and not nominal wages. Proponents of this new, expectations augmented, Phillips curve, argued that unexpected price increases would cause firms to expand employment to take advantage of the resultant lower real wage. Accordingly, unexpectedly higher prices would be associated with lower unemployment. However, as soon as workers realised that their real wage had been reduced, they would bid up their nominal wage to compensate and the reduction in unemployment would disappear. Only by further increasing prices, again in an unexpected manner, can unemployment be reduced (again only temporarily). Accordingly, it is only at the cost of ever-increasing inflation that unemployment can be kept below the so-called *non-accelerating inflation rate of unemployment* (NAIRU).[7] This insight has transformed the policy implications of the Phillips curve beyond recognition. The alleged long-run trade-off between the level of unemployment and the rate of wage/price inflation was overturned. Instead, it was argued that, if a government attempted to peg unemployment below the natural rate, it would face accelerating rather than merely higher inflation. Thus, the long-run Phillips curve was posited to be vertical at the natural rate of unemployment.[8] However, insofar as the unemployment rate could deviate from its natural rate temporarily, some trade-off continued to exist in the short run.

A key ingredient in any application of the Phillips curve is the choice of an excess demand proxy. Much research has assumed that the natural rate of unemployment is constant over time. On the basis of this assumption, researchers have employed the actual rate of unemployment as a measure of labour market disequilibrium. Other work has turned to a parallel measure of excess demand in the goods market, i.e. the gap between actual and potential output (Gordon, 1985) or a capacity utilisation series (e.g. Chadha, Masson and Meredith, 1992). The expectations augmented Phillips curve has, accordingly, been renamed, more generally, the *expectations excess demand hypothesis*. Unfortunately, all of these theoretical excess demand variables are themselves estimated with error, giving rise to important econometric issues. However, regression analysis has generally been successful in establishing an empirical link between several excess demand measures and the rate of change of consumer prices in the short run (e.g. Gordon, 1985, McElhattan, 1985).

Any empirical application of the Phillips curve also necessitates a choice in regard to how expectations are formed. Earlier work either ignored expectations or, like Phelps and Friedman, assumed that expectations were formed adaptively on the basis of past expectational errors. Under adaptive expectations, the expected rate of inflation could be accommodated empirically using a distributed lag specification of all past rates of inflation. The assumption of adaptive expectations permitted a short-run trade-off between inflation and unemployment to hold. However, some authors found difficulty with the notion that the public could be systematically fooled. Following on from the earlier work of Muth (1961), authors such as Lucas (1973) and Sargent (1973) replaced adaptive expectations with the assumption of rational expectations and, in so doing, altered the fundamental implications of the Phillips curve once again. Proponents of rational expectations argued that economic agents could not make the persistent systematic forecast errors that were implied by the earlier adaptive expectational assumption. Since agents were assumed to no longer continuously make errors regarding the expected rate of inflation, even in the short run the systematic trade-off between excess demand and inflation collapsed.[9] According to this view, any anticipated attempt by the authorities to generate excess demand will be doomed to failure, even in the short run, and will merely result in higher prices. The formulation of a particular expectations generating process also allowed the Phillips curve to be explicitly extended to an open-economy setting. Parkin (1973), for example, models the expected wage as a weighted sum of the price of internationally traded and domestically produced goods. Cross and Laidler (1975), who also directly incorporate foreign effects, cite the exclusion of foreign effects as a reason why so many studies do not find a coefficient of unity on the expected inflation term.[10]

Several key points can now be made in regard to the relevance of Phillips curve theory in an empirical study of Irish inflation. Any analysis of Irish inflation should bear in mind the almost unanimous rejection, on both theoretical and empirical grounds, of a long-run relationship between inflation and unemployment.

Furthermore, according to the Lucas/Sargent rational expectations version of the Phillips curve there is no systematic short-run relationship between these two variables either. Stopping short of this extreme position, leads us to accept the proposition that such short-run relationships may exist. Consequently, excess demand may be an important short-run or proximate determinant of variations in Irish inflation. However, since it does not endogenise demand, the Phillips curve does not provide us with an understanding of ultimate inflationary impulses. In an open economy context, the Phillips curve relationship may be even less useful in analysing inflation. Even if excess demand is related to short-run inflation, the external and internal components of this demand would need to be further investigated for a more complete understanding.[11] Thus, while Phillips curve theory may provide us with a behavioural relationship which has reasonably high explanatory power, it cannot be used to answer structural questions concerning the weight which should be attached to domestic as opposed to foreign inflationary impulses.

International Monetary Theories

Monetary theories of inflation can perhaps be viewed as formulating the inflation question at this deeper level of endogeneity. If we argue that money affects output, then excess money creation can generate excess demand which can in turn fuel inflation. The role of the supply of money relative to its demand is central to monetary theories of inflation. Put simply, monetary theories of inflation imply that any increase in the money supply greater than that which is warranted by the growth of productive potential will give rise to inflation. The *quantity theory of money* provided the general framework within which this link can be established.[12] In its most basic form, the quantity theory can be expressed as a simple identity of the following kind:

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where M is the stock of money, V is the velocity of money (or the amount of times it is turned over in the time period under discussion), P is the average price level during the period, and Y is real income.[13] On its own, this simple accounting relationship does not constitute a theory of inflation. However, under certain assumptions it can be manipulated to yield a simple theory where any change in the money supply over and above that warranted by real income will eventually be reflected one for one in the price level. The quantity theory thus provides a way of looking at long-run persistent changes in the price level in terms of the money supply. Accordingly, the quantity theory underlies Friedman's often quoted remark that inflation is always and everywhere a monetary phenomenon. Empirical work has largely borne out this proposition. In particular, it is true that countries which have

high money stock growth rates have generally been found to have concomitantly high inflation. For example, in a recent cross-country study, McCandless Jnr. and Weber (1995) report a correlation coefficient of 0.95 between monetary growth and inflation. Furthermore, this near perfect correlation is shown to hold across several definitions of money.[14]

The role money plays in the inflationary process remains, nonetheless, a highly controversial issue. As already discussed, it is widely agreed by economists that inflation must be accompanied by excessive monetary growth in the long run.[15] No such agreement exists, however, on whether money growth causes inflation or merely accommodates it.[16] Friedman himself argues that causality runs from excessive monetary growth to inflation; in Friedman (1987), however, he argues that this is "only the beginning of an answer to the causes and cures for inflation. The deeper question is why excessive monetary growth occurs" (p. 261). Excessive monetary growth may occur if a central bank deliberately decides to loosen policy in an attempt to stimulate activity, in which case it is truly exogenous. On the other hand, money growth may merely be accommodative, responding to inflationary pressures which arise elsewhere in the economy. For instance, the monetary authority may be accommodating excessive fiscal deficits. Alternatively, extraneous factors such as increased militancy on the part of unions or commodity price shocks, may result in a wage-price spiral which may also lead to central bank monetary accommodation.

The causative/accommodative controversy, noted above, has motivated an extensive analysis of the lead-lag structure in the relationship between money growth and inflation. If money growth could be shown to lead inflation then this might be taken as evidence against a purely accommodative role. However such inferences can never be completely justified. It is a fallacy to conclude that because one thing (monetary growth) precedes another (inflation) the former is a cause of the latter. Obviously, there may be some other factors involved.[17] In an interesting study of the lead-lag structure in the money-price relationship, Cassese and Lothian (1983) have examined the issue from the point of view of a highly open economy. In their assessment, the interpretation of the lead-lag structure as evidence of causal role for money becomes increasingly fraught with danger the more open the particular economy under investigation.

The monetary theory of inflation has also been used to explain the transmission of inflation in a world of fixed exchange rates.[18] In general, the international transmission of inflation has been analysed in terms of the response of domestic prices to changes in the reserve currency country (RCC) money supply. A flow chart analysis of four possible transmission channels, as identified in Lothian (1992), is provided in Figure 1. Lothian suggests that adjustment will take place through reasonably direct channels and also through more indirect mechanisms. In the former category, an increase in foreign demand for domestic goods would be expected to follow directly from an exogenous monetary impulse in the RCC. This would

eventually lead to an increase in the domestic price level *via* a Phillips curve type effect. This transmission mechanism, termed the *absorption* channel, is depicted as channel (1) in Figure 1. The law of one price also implies a direct *price arbitrage* channel (2) where domestic prices rise as a result of foreign price increases which emanate from a rise in RCC money supply. Obviously, both of these direct channels could be expected to operate with a greater degree of potency in very small open economies. Lothian (1992) also suggests the *price-reserve-flow* (3) and the *portfolio balance* (4) channels which involve reserve flows and, hence, adjustment of relative money supplies.[19] Under the former mechanism, the relative increase in the RCC traded goods prices (again emanating from an increase in the RCC money stock) gives rise to a current account surplus in the domestic economy. In the latter case, adjustment takes place through the capital account. The reserve currency country monetary expansion exerts downward pressure on world interest rates and, hence, a capital inflow into the domestic economy.

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KEY: M_w - RCC Money Stock, P_w - RCC Prices, P - Domestic Prices, r_w - RCC interest rates, AD^* - Foreign Aggregate Demand, M - Domestic Money Stock.

It is clear from Figure 1, that the two direct channels ((1) and (2)) imply a purely accommodative role for the domestic monetary stock in the domestic inflationary process. In contrast, domestic monetary growth precedes the rise in domestic prices under the two more drawn out mechanisms. Thus channels (3) and (4) imply a proximate causal role for domestic money.

The basic point to be made in relation to the international transmission of inflation, however, is that there are many possible lead and lag structures implied by the monetary approach to the balance of payments (MABP). In this regard, Cassese and Lothian (1983), stress that the relaxation of some basic assumptions gives rise to dramatic changes in the predictions of the MABP for the nature of the adjustment process and the timing of monetary and price changes. Empirical evidence on these alternative transmission mechanisms has been more difficult to pin-down. Since money and prices are highly correlated, regression analysis will find it very difficult - if not impossible - to distinguish the various mechanisms. To the extent that there is an international transmission process - and there undoubtedly is for an open economy with a rigid exchange rate - it is perhaps impossible to distinguish between competing channels empirically.

Although the above analysis only strictly applies to a fixed exchange rate regime, many of its implications may be carried over to pegged or quasi-fixed systems. A small open economy can only achieve monetary independence to the extent to which it is prepared to allow its exchange rate to float. Blejer (1979) and Blejer and Leiderman (1981) extend the analysis of the monetary approach to situations where the exchange rate is not rigidly fixed.

The above international monetary theories of inflation can shed much light on the issue of the determinants of Irish inflation. The long-run cross-country evidence on the role of money in the inflation process is convincing. However, one of the primary implications of the international monetarist approach is that the analysis of inflation must be extended beyond the role of the domestic money supply. In particular, international theories suggest that if Ireland maintains a rigid exchange rate with most of its primary trading partners, then the dominant role of foreign money and prices must be taken on board. Any study which does not examine the possible role of foreign variables will therefore be at best partial. At worst, such studies could lead to misleading or perhaps dangerous implications for policy. International monetary theories have also suggested several different channels of transmission. Unfortunately, since it is most likely that such channels operate in a simultaneous manner, it may be beyond the scope of regression analysis to distinguish between them empirically.

The Scandinavian Model

The Phillips curve is virtually silent concerning any role the structure of an economy might play in the inflation process. International monetary theories imply that economic structure may be of significant importance: i.e. the more open an economy, the greater the immediate impact of foreign money and prices on domestic prices. In contrast, by introducing a two sector dichotomy, the Scandinavian model makes explicit the role that economic structure may have in analysing inflation. The two sectors considered are the traded sector and the non-traded sector which differ insofar as only the former is exposed to international competition. We discuss below

the analytical structure of a basic Scandinavian model and proceed to a more general discussion of empirical work which has evolved from it.[20]

As formulated in Aukrust (1977), the Scandinavian model is a highly stylised model which seeks to describe the influence of world prices on prices in a SOE which operates under a fixed exchange rate regime. The model can also be used to explain why the inflation rate of such a SOE might deviate from the world rate even in the long run. The traded sector is assumed to be made up of industries producing goods which are either exportable or importable.[21] Under the assumption of smallness (price-taking behaviour in the traded sector), traded price inflation will necessarily be determined by world traded inflation adjusted for any change in the exchange rate. In the Aukrust (1977) formulation of the model, this is imposed as *both* a short- and a long-run constraint. Thus traded inflation can never deviate from that prevailing abroad if the exchange rate is assumed to be fixed. Wage increases in the traded sector are then assumed to be determined by the given traded price increases and the rate of productivity growth in the traded sector. Using the assumption of homogenous labour markets, or solidarity in wage movements, wages will be equalised across sectors. In the non-traded sector, no external constraints on price determination are assumed to exist. Non-traded inflation is modelled as arising from mark-up behaviour over wages adjusted for exogenous productivity growth. It can be easily shown (see Lindbeck, 1979) that under these circumstances the rate of growth of the aggregate price level (P) will be given by[22]

$$P = (P^* + e) + (1 - a)(q^T - q^N) \qquad (2.2)$$

where P* represents foreign traded inflation, e the proportional change in the exchange rate, "a" the share of the traded sector in national output and q^T, q^N refer to traded and non-traded productivity growth.[23] Thus domestic inflation can differ from foreign inflation, even in a fixed exchange rate regime. This arises if productivity differentials between the traded and non-traded sectors are larger in the domestic economy than elsewhere[24].

One of the main shortcomings of the basic Scandinavian model is that its predictions are long-run in nature and demand is assumed to play no independent role in the inflation process. In short, demand is taken to be purely accommodating. The basic model, however, can incorporate demand effects by augmenting it with a Phillips curve. For example, in a short-run extension of the basic model, Lindbeck (1979) includes an expectations augmented Phillips curve mechanism in his wage equation. Lindbeck contrasts the implied adjustment mechanism in the Scandinavian model with some monetarist models in which prices are "pulled-up" by way of excess demand due to real balance effects emanating from a current account surplus. In the Scandinavian model, prices for non-tradables are "pushed-up" due to higher unit labour costs resulting from the equalisation of wage rates across both sectors. Again, while each model implies different types of short-run mechanisms, there is no reason

why in terms of the actual transmission of inflation, each mechanism could not be operating simultaneously in a mutually-supportive manner.

For our purposes, at least two key inferences can be drawn from equation (2.2).[25] First, it is clear that, even under a fixed exchange rate, and even for very small open economies, such as Ireland, differential rates of productivity growth between the traded and the non-traded sectors (i.e. $q_r > q_{NT}$) can give rise to persistent deviations in the domestic rate of inflation from the world rate of inflation. Thus, the basic Scandinavian model predicts that countries with relatively large inter-sectoral productivity differentials will have higher rates of inflation relative to the rest of the world.[26] To contrast it with the "imported inflation" represented by the first component $(P^* + e)$ in (2.2), Lindbeck refers to the second component, i.e. $(1 - a)(q_r - q_{NT})$, as "structural inflation". Second, even though P can differ from $(P^* + e)$, the basic model implies that any change in world traded prices and the exchange rate will be transmitted one for one to domestic inflation (under the assumption that all of the right hand side variables can be taken as exogenous).

Summary

A highly stylised summary of the main theories identified in this brief outline of the international literature is given in Figure 2. The chart is a useful means of summarising some of the most important observations on the international literature which we have made.[27] For the sake of simplicity, the chart abstracts from any change in the exchange rate. Hopefully, the preceding discussions have served to clarify the individual relationships which are depicted in the chart. We will not, therefore, comment on each of the arrows connecting the various boxes. However, as emphasised in Rowlatt (1992), the inflation process is perhaps best thought of as a systematic spiral with extensive interrelations among the relevant economic variables existing at various levels.[28] This systematic nature of the inflation process is quite clearly evident from the flow chart. In fact, in the above representation of the various theories, there is no variable (apart from the productivity and "Other" variables) which is completely exogenous within this system, i.e. there is no box which does not have an arrow pointing towards it. From a methodological point of view, this suggests that the empirical economist can at best characterise the determinants of inflation in terms of a set of variables which can be assumed to be exogenous from the point of view of a small open economy.

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Such exogeneity assumptions might be justified on both theoretical and empirical grounds. Furthermore, very little support was found in the review for a simple causal role for wages in the inflationary process. Accordingly, the chart does not include wages as an exogenous cost-push inflationary impulse. Instead, at the centre of the inflation spiral, domestic wage inflation (adjusted for productivity) and price inflation are represented as trending together in the long run with no assumptions being made concerning the direction of causation. This is because any of the variables which are deemed to exert a significant influence on prices must also be considered as having a potentially significant effect on wages. The diagram also clearly illustrates the potential interdependencies which exist between the separate theories which have been identified in this review. For example, it is quite clear that the Phillips curve analysis of inflation, captured by the unemployment (U), the aggregate demand (AD) and the expected inflation (P^e) boxes, are themselves potentially dependent on world inflationary pressures.

3. IRISH EMPIRICAL RESEARCH ON INFLATION

Like their international counterparts, Irish economists have invested a lot of effort in attempting to unravel the manner in which inflation is transmitted. Much of the Irish work in the area has directly reflected developments in the policy arena. As a result, despite several frequently recurring themes, there has been quite an evolution in the way in which Irish inflation has been analysed over the last 25 years. In order to clarify what has and has not been achieved, i.e. the current state of "play", the main branches of Irish research are reviewed below. For heuristic reasons, the work is divided into papers analysing inflation both before and after Irish participation in the EMS.[29]

Evidence on the pre-EMS Period[30]

Prior to entry into the EMS in 1979, Ireland maintained a fixed exchange rate with a larger neighbouring economy (the UK) with which it conducted by far the most significant proportion of its trade.[31] Not surprisingly, *most* of the research into the determinants of inflation in Ireland directly reflected this reality. In particular, empirical evidence emerged in support of the central implication of international monetary theories that, in the long run, Irish inflation would converge to the rate of inflation of its main trading partner(s), i.e. the UK. Only in the short run, it was agreed, could Irish inflation deviate from this externally determined rate.

An Accounting View

In a symposium on inflation in the early 1970s, Geary (1974) remarked that discussions of inflation in Irish policy circles rarely took place within the internationally accepted small open economy fixed exchange rate framework at all. Instead, a fallacious "cost-accounting view" predominated, in which external influences entered only as a cost item, i.e. *via* import prices. Table 2 in the Inflation section of the Spring Bulletin of the Central Bank of Ireland 1974 decomposed the CPI into "sources of increase". The domestic component - represented by incomes, profits and taxes - is by far the largest. Accordingly, the Bulletin stresses the need to "restrain the domestic causes of inflation, which include an excessive rate of expansion of public expenditure and credit as well as money incomes". Putative support for this view was also found outside the Central Bank. Geary, Henry and Pratschke (1970), employed an input-output model to show that domestic wages were an important determinant of Irish inflation. While the Central Bank gave a large weight to domestic impulses, reference was also certainly made to external influences. The steady growth in the external sources of inflation is quite clearly displayed in the above-mentioned table: the import price "account" grew from 15 per cent of the CPI in 1969 to 44 per cent in 1973. However, it would appear that this influence was constrained to be no greater than the weight attaching to various

factors in the input-output tables (oil and raw materials being among the most relevant).

What is missing in the above discussions is any clear distinction between short-run proximate determinants of inflation and long-run equilibrium forces. Since an input-output analysis of inflation does not make use of these key distinctions, it can give rise to some misleading implications for policy. The above analysis seems to suggest that a small open economy can use domestic wage controls to permanently lower its long-run rate of inflation even if it maintains a fixed exchange rate with most of its trading partners. In the long run such actions are simply not possible, as outlined by Geary (1974). Furthermore, even if they were, they would lead to quite bizarre outcomes, as discussed in Honohan (1982, p. 364).

The SOE model: Equilibrium and Adjustment

Subsequent empirical research, which clearly distinguished in a meaningful way between the short and long run, emerged in support of what we shall loosely term the SOE model.[32] In a Phillips curve analysis, Geary (1976a) employs a version of the Parkin (1973) wage-price model. The long-run equilibrium restrictions implied by the SOE model are accepted when the UK Retail Price Index (RPI) is used as a measure of "world prices" over the period 1953-1974. In particular, the evidence on the UK price series points to an extremely recursive version of the wage-price model in which UK inflation directly determines Irish inflation rather than working through the labour market. As would be expected, less conclusive evidence emerges when the OECD consumption deflator is employed. Furthermore, Geary's analysis shows no statistical significance for the unemployment rate in either wage or price equations. He interprets this result as lending little support to the view that Irish wage or price inflation is determined by domestic excess demand. In an earlier paper, Geary and Jones (1975), despite allowing for the structural characteristics of the Irish labour force, report a similar finding.

Other, more atheoretical analysis, strengthened the case in favour of the long-run implications of the SOE model. In particular, an investigation of the lag structures between domestic and foreign price measures suggested that external influences fed one-for-one into Irish inflation. The only remaining controversy surrounded the question of "when" rather than "whether" full feed-through occurred. One important finding in Geary (1976b) is that the lags in the transmission of the UK RPI to Irish inflation were quite long and not necessarily geometrically declining. The analysis shows that it took at least eight quarters for UK inflation to be transmitted to the Irish economy. This finding lent greater substance to the idea (expressed in Kennedy, 1974) that the welfare implications of short run deviations, given that they can persist for quite long, should not be disregarded. However, Geary's long lag structures are subsequently refuted in Bradley (1977) who found almost no "attenuation" in the transmission of the long-term and annual components of the UK RPI into the Irish CPI. In assessing the light which the above papers shed on the

inflation debate, it is important to note that neither is intended as a structural analysis of inflation. Both studies should really be viewed as assuming rather than testing for the long-run implications of the SOE model. In particular, the explanatory power of the UK RPI is not tested in the presence of other possible domestic inflationary impulses. Other evidence supporting the assumptions of the SOE model is provided in Browne (1983). For the period 1961-1977, he applies a framework developed in Applebaum (1979) and finds evidence in favour of the SOE price-taking hypothesis for Irish importers. The evidence in this paper for price-taking on the part of Irish exporters is less clear-cut. However, Browne (1982) employs a different methodology using the same data and produces strong support for price-taking on the part of Irish exporters.

The insignificant unemployment rate in Geary (1976a) cast doubt on the appropriateness of the Phillips curve as a tool for analysing Irish inflation. Furthermore, the analysis of lag structures in Geary (1976b) and Bradley (1977) implied only a direct commodity arbitrage transmission channel. However, theories on the international transmission of inflation suggested several more complex channels. In a more monetarist approach, Browne (1984) attempts to assess the relevance of competing channels of transmission. In particular, he posits a strong role for foreign money which gives rise to capital flows into the SOE, ultimately leading to inflation. He thus challenges the standard interpretation of the MABP which sees the transmission of inflation taking place only *via* current account balances or direct commodity arbitrage. For the sterling link regime, Browne claims his results validate the SOE model. He cannot reject the hypothesis that UK monetary policy, operating through both the current and capital account, has a long-run one-for-one effect on the Irish rate of inflation. In contrast, while he finds domestic monetary policy to have a significant short-run effect, long-run neutrality cannot be rejected after about six months. As a result, this analysis provides strong support for the basic restrictions of the SOE model. However, there are problems associated with the structural conclusions drawn by Browne. Browne's transmission equation contains a very large number of right-hand side variables which one would expect to be endogenous and/or highly correlated.[33] As a result, the strict identification of the estimated parameters on certain regressors with particular transmission channels may not be valid. More fundamentally, in our view, the capital flow transmission channel cannot be separately identified from the popular current account channel, which is a central objective of the paper.

Domestic Causative Factors

Not surprisingly, while the SOE model has received wide-ranging support, there have been dissenting opinions on its applicability. Many of the above Irish papers which purport to validate the long-run implications of the SOE model during the pre-EMS period find wages to be significant as explanatory variables in price equations. Both Geary (1976a) and Browne (1984), for example, had found wages to be significant in some of their empirical formulations for the pre-EMS period. Some

have interpreted the significance of wages as evidence of *cost-push* inflation in a mark-up model which is contrary to the assumptions of the SOE model. Other empirical evidence of a cost-push nature is provided in Hackett and Honohan (1981). The empirical evidence reported shows that 75 per cent of the variation in the Irish CPI can be explained by import prices and wages together with lagged dependent variables. However, the estimated coefficient on the wage term appears to be unacceptably high. Consequently, the authors argue against any conclusion that control of domestic wages is a suitable means of maintaining stable prices in a small open economy.

We would largely concur with this assessment of the results of the mark-up model. The significance of wages in an Irish price equation does not, on its own, constitute evidence of domestic cost-push inflation. In a small open economy it is not possible to assume that wages are exogenous, i.e. determined independently of the world at large. Furthermore, it would be most surprising if, abstracting from productivity effects, wages and prices did not move together in the long run. Thus, the high positive correlation between wages and prices in many of the above Irish studies could largely be due to a common external exogenous factor, e.g. world prices. Consequently, we cannot conclude on the basis of the significance of wages in these equations that domestic cost-push factors are relevant in the long run. Some evidence on the exogeneity of Irish wages with respect to world inflationary impulses would also be required. It is unlikely that this type of exogeneity assumption could ever be supported and, consequently, we refer to the above erroneous interpretation of the wage parameter as the *wage significance fallacy*.

In a Scandinavian-type approach, Cassidy (1982) examines the relevance of domestic variables in equations for both traded and non-traded prices. Cassidy's study, applied over the 1955-1972 period, attributes a significant role to UK price inflation in the explanation of changes in both traded and non-traded prices. However, the size of the effect is much smaller in relation to the price of non-traded goods and services. Even more interesting, is the finding that wages are significant in the non-traded price equation but not in the case of traded prices. The results are interpreted by the author as casting doubt on the rigid price-taking assumptions of the SOE model, at least in the short run. Moreover, in both cases, a proxy for domestic excess demand is found to be significant. Consistent with the subsequent analysis in Mellis (1993) for the UK, and the adjustment path suggested by Lindbeck (1979), Irish traded prices are also found to be significantly related to Irish non-traded prices. These results are largely consistent with some of the main predictions of the Scandinavian model. One troubling feature in Cassidy's study, however, is the relatively low R^2 on both price equations.

Other research which suggested a role for domestic variables was conducted in a monetarist vein. Geary (1981) had found statistical evidence of a role for domestic monetary policy. While the author cautions against any structural conclusions, it is our view that the results at least cast doubt on the extreme monetary approach

whereby the domestic money stock is viewed as being fully endogenous with respect to externally determined domestic prices. As the analysis of Browne (1984) makes clear, however, a significant role for the domestic money stock may constitute a proximate analysis of a transmission mechanism where the ultimate long-run determinants are foreign. In a similar vein, Honohan (1982) notes that these correlations are between endogenous variables and as such must be interpreted with caution. Both variables could have been "caused" by an omitted exogenous variable such as foreign inflation. Thus, the same logic which applied in the above arguments relating to the wage significance fallacy also applies here. Geary (1981) did not, for example, test for the significance of domestic money in the presence of any foreign alternative. We would, therefore, advise against any causative interpretation of these results. Instead, they constitute an analysis of the "information content" of various variables in terms of how they can explain price movements.

<u>Evidence on the EMS Period</u>

If it was a reasonable approximation of the way inflation was transmitted to the Irish economy, the SOE model had both an upside and a downside. If, on the one hand, Ireland fixed its exchange rate vis-à-vis a low and stable inflation economy, it too could be expected to reap the benefits of price stability. On the other hand, if the economy to which Ireland was linked showed signs of being prone to frequent bouts of inflation, Ireland would have to suffer the unavoidable consequences. The decision to break the link with sterling in 1979 in favour of entering the ERM can be viewed as a policy choice in favour of the former scenario. Accordingly, this change in exchange rate policy constituted a very strong real world example of policy being influenced by the so-called SOE model. However, somewhat paradoxically, this decision created an environment in which the Irish rate of inflation could deviate from that of the countries to which it was tied.[34] The new regime was, for example, far short of a complete monetary union. The exchange rate, while confined to narrow ERM bands, was no longer rigidly fixed. Thus, there was always the possibility of adjusting the parities within the system and economic agents would take this into account in formulating their price expectations. Furthermore, since the UK stayed outside the ERM, the Irish pound began to float vis-à-vis the economy with which it conducted a large proportion of its trade. Ireland could, for example, avoid "importing" UK inflation by allowing the Irish pound/sterling exchange rate to appreciate.[35]

In summary, these new realities (and the same forces are essentially at play today) required a re-appraisal of the manner in which the determinants of inflation could be assessed. In particular, it was no longer true that a model of pure long-run external price determination would necessarily hold fully for Ireland. Accordingly, a proper understanding of the role of the exchange rate in such a regime is vital if the inflation forces in Ireland are to be properly understood. This is even more true since the wider ±15 per cent bands were introduced into the ERM in August 1993.

<u>The Role of the Exchange Rate</u>

As noted above, under the new monetary arrangements, the role of actual and possible exchange rate changes would have to be included in the analysis of inflation. The SOE model implies that - from a position of equilibrium - any permanent change in the exchange rate will feed through one-for-one into domestic inflation.[36] The model therefore implies that no long-run competitive gain can be reaped from a devaluation. Flynn (1986), in a simulation exercise analysing the effect of a 10 per cent devaluation, shows that this adjustment does indeed take place. In particular, a very fast response of import prices, export prices, output prices and raw materials prices is reported. Most of the adjustment takes place within four quarters. However, complete adjustment of wages and consumer prices takes about 16 and 18 quarters respectively. These basic findings are supported in a subsequent study by Flynn and Honohan (1986) who estimate import price, consumer price and wage equations over the period 1972-1984. The error correction mechanism (ECM) employed in the CPI equation implies that while wages have a significant short term effect, they do not prevent convergence of domestic prices to foreign prices, provided there is no change in the exchange rate. However, the authors appear to assume rather than test for this ECM specification. Flynn and Honohan (1986) also provide a theoretical analysis of the new exchange rate regime. They argue that the EMS regime may give rise to an inherent lack of stability. A once-off shock to prices can be converted into persistent inflation and this effect may be magnified the greater the tendency to adjust the exchange rate.

In contrast to the above studies, a subsequent analysis by O'Connell and Frain (1989) argued that changes in the exchange rate may not be fully reflected in the domestic rate of inflation (p. 4). The authors apply the Himarios (1987) variant of the Bruno (1979) model to Irish data over the period 1973 – 1987.[37] While two separate versions of the model are estimated, the basic conclusion is that only half of the change in the exchange rate is passed through to domestic prices. This conclusion is based on the fact that the sum of coefficients on the lagged exchange rate is approximately 0.5. The authors claim that their study casts doubt on the ECM specification in the Flynn and Honohan (1986) study since purchasing power parity between domestic and foreign prices may not be a binding long-run constraint. However, this criticism is only strictly valid if the two or three lags on the foreign price and exchange rate terms are an acceptable definition of the long run. When further lags of the exchange rate are used by the authors (i.e. 6, 7 & 8 lags) the hypothesis of 100 per cent pass-through cannot be rejected (see Table 2, p. 21). In addition, the O'Connell and Frain (1989) analysis of the relevant variables is conducted in first differences, thereby omitting long-run information contained in the data. In section 4, it is argued that the proper analysis of the exchange rate coefficient must be undertaken using a cointegration analysis of the relevant variables in levels.

From the above discussion, it is clear that the role of the exchange rate in the price determination process in Ireland depends crucially on the validity - or otherwise - of purchasing power parity as a long-run hypothesis. In general, the evidence provides only tentative support for the proposition. Among those studies which do not support the proposition, Leddin (1988) carries out a simple test using Irish, German and UK prices and bilateral exchange rates. The hypothesis of PPP is rejected. Thom (1989), employing both unit root and cointegration tests on 8 years of ERM data, rejects PPP using Irish/US wholesale prices (also used in the other tests described in this paragraph), and finds mixed results for both the Irish/UK and Irish/German data sets. Wright (1993) confirms that the Irish/UK and Irish/German real exchange rates are non-stationary. Nevertheless, he specifically highlights the drawbacks associated with the use of short data sets (his sample runs for just over 11 years) and, as an effort to partly overcome this problem, Wright employs a method proposed by Cochrane (1988) for quantifying the non-stationarity in a series. The results of this test suggest that the non-stationarity in the Irish/German real exchange rate is small, although the results for the UK are more ambiguous. Furthermore, he suggests that "longer data may provide even stronger evidence for mean-reversion in real exchange rates" (p. 118).

The above papers serve to highlight the econometric problems associated with short data runs when analysing PPP. One way of overcoming this is to extend the period covered. Leddin and Hodnett (1995) employ a data set covering the 1922 to 1994 period for Ireland and the UK and from 1960 to 1994 for Ireland and Germany. Unfortunately, the UK sample period was split in the paper into 1922-1939, 1939-1974 and 1975-1994 subperiods, to take account of structural change. Evidence in support of PPP between Ireland and the UK was found for the 1939 to 1974 period, although it was rejected for the other (shorter) periods. No support could be found for PPP using the shorter Irish/German dataset. In contrast, however, two other recent studies have uncovered more clear-cut support for PPP. Wright (1994) finds strong evidence of PPP in both the UK and German cases using multivariate cointegration techniques, when the system is supplemented with short-term interest rates. More recently Kenny and McGettigan (1996b), in a study which focuses specifically on EMS data, decompose the Irish CPI into its traded and non-traded components. The traded component, which comprises over seventy per cent of the total, enters into a strict PPP relationship with the nominal effective exchange rate and a measure of world traded prices. There is also some tentative evidence supporting a similar relationship for the aggregate CPI. In contrast, the strict

version of PPP is unambiguously rejected in the case of the non-traded component of the Irish CPI.

External Factors: The Reserve Currency Country

Prior to joining the ERM, external inflationary pressures had largely originated in the UK (abstracting from world commodity price shocks). Membership of the EMS, as the above studies on PPP make clear, required a redefinition of the external influences on the Irish economy. Since Germany was the hegemonial economy in the system, the role of German prices and monetary policy had to be assessed. In an early empirical study, Browne (1984) found little evidence of a strong role for Germany as the reserve currency country (RCC) of the ERM over the period March 1979 to October 1983. Variations in the German money stock were found to have no significant role in determining Irish inflation. Browne cites the day-to-day variation and periodic re-alignments in the IR£/DM exchange rate as the main reason why this result is to be expected. Perhaps more significantly, Browne also finds that for the EMS regime - in contrast to the earlier sterling link period - domestic monetary policy has an enduring effect on prices.

Browne's analysis was, however, restricted in its use of an admittedly small data set. More recent studies, with a longer run of data, have found greater evidence of a long-run role for German influences. Callan and Fitzgerald (1989) examine the determination of prices in the Irish manufacturing sector.[38] Within a cointegrating framework, the hypothesis of a long-run equilibrium relationship between Irish and UK prices and Irish and German prices (both converted to Irish pounds) is tested. The evidence relating to the period 1975-1987 suggests that Irish prices may not be cointegrated with either UK or German prices separately. The authors do, however, find that Irish prices may cointegrate with a weighted average of both UK and German prices. Furthermore, the role of German prices is much more significant when the post-EMS regime is considered on its own. These contentions are also borne out by the studies of Wright (1994) and Kenny and McGettigan (1996b), both of which find evidence in support of versions of the PPP hypothesis vis-à-vis Germany.

Domestic Factors Revisited

The changing environment associated with membership of the ERM has produced further empirical evidence on a persistent role for domestic variables in determining Irish inflation. Browne (1984) found that changes in domestic monetary policy as proxied by the domestic component of the monetary base had an enduring effect on Irish inflation in the post EMS period. O'Connell and Frain (1989) also attribute a significant role to a measure of domestic excess money creation in explaining Irish CPI inflation. In their summary table, the authors claim "domestic demand" accounts for approximately 26 per cent of Irish inflation between 1977 and 1985. One question surrounding this number is whether it can be interpreted as a short- or long-

run effect. We would argue that it can only be interpreted in a short-run sense since the regressions are run in first differences and only one lag of the excess money variable is included in the estimated equation. In an atheoretical VAR analysis, Howlett and McGettigan (1995) find some role for domestic monetary aggregates in predicting future Irish inflation. However, the authors do not interpret this as implying causation. A key issue which arises in all of these studies is whether domestic money growth can be considered to be exogenous with respect to changes in foreign (e.g. German) prices and monetary policy. Intuitively, for an SOE with such a large traded sector, this assumption of strict exogeneity may not be absolutely binding.

Wage growth continues to receive attention as a domestic determinant of inflation. As an alternative to their open economy specification, Callan and Fitzgerald (1989) consider the role of wages in a closed economy model of price determination. Only a short-run role for wages is allowed in their chosen specification. However, a long-run wage effect is observed in two individual industries in the manufacturing sector.[39] In a recent contribution, Fountas, Lally and Wu (1995) make use a framework developed in Mehra (1991) to consider the relationship between inflation and wage growth. They report a long-run equilibrium relationship between prices, wages and an output gap variable as evidence in favour of a cost-push theory of inflation. The coefficient on the wage term in the cointegrating vector is unusually large (3.445), however. In their short-run analysis, the authors find that wages Granger-cause prices and not *vice-versa*. However, the exogeneity of this "wage-push" with respect to external inflationary pressures is not tested. The strong conclusion in favour of long-run domestic causative impulses would appear, therefore, not to be fully justified. The significance of the output gap variable, and the high coefficient estimate (6.97), in a cointegrating relationship with the level of the consumer price index is also a surprising result. Under the Phillips curve approach, the output gap would only be expected to be related to the rate of change in the CPI. On empirical grounds, the inclusion of the output gap might be justified since it is found to be non-stationary. However, the deviation in output from capacity, i.e. the cyclical component in output, is generally thought to be stationary (see, for example, Canova, 1993). The finding of non-stationarity in the output gap measure may, therefore, be due to the detrending procedure employed in its construction. Another shortcoming of this study is that the analysis is biased in favour of domestic factors. External influences enter only *via* import prices and energy costs.

Summary

Some of the main findings/conclusions in the papers reviewed above are summarised in Table 1.[40] In general, prior to 1979, researchers uncovered a reasonable amount of evidence which was consistent with the long-run implications

Table 1 Explaining Irish Inflation both before and after EMS Membership

	P^{UK}	P^{GR}	P^M	P^X	P^O	Y	Y^W	M*	M	C	r	R^W	W	U	E
Pre-EMS Period															
Geary, Henry and Pratschke (1970)													✸		
Geary (1976a)	✸												✸	X	
Geary (1976b)	✸		✸	✸	✸										
Geary and McCarthy (1976)			✸	X									✸	X	
Bradley (1977)	✸		✸	✸	✸										
Browne (1984)	✸					✸	X	✸	X				✸	✸	
Hackett and Honohan (1981)			✸										✸		
Geary (1981)									✸						
Leddin and Hodnett (1995)	✸														
EMS Period															
Browne (1994)	✸	✸	✸	✸	X		X	✸					X		✸
Flynn (1986)			✸		✸								✸		✸
Flynn and Honohan (1986)			✸										✸		✸
Leddin (1988)	✸	✸													✸
O'Connell and Frain (1989)			✸						✸						✸
Callan and Fitzgerald (1989)	✸	✸											X		✸
Thom (1989)	✸	X													✸
Leddin and Hodnett (1995)	X	X													
Howlett and McGettigan (1995)			✸	✸		X		X	✸	X	X				
Wright (1993)	✸	✸													✸
Wright (1994)	✸	✸									✸	✸			✸
Fountas, Lally and Wu (1995)			✸		✸								✸		
Kenny and McGettigan (1996b)	✸	✸											✸	X	✸

KEY: P^{UK} - UK Prices, P^{GR} - German Prices, P^M - Import Prices/Unit Values, P^X - Export Prices/Unit Values, P^O - Output prices/Wholesale Prices, Y - Domestic Output Variable/Output Gap, Y^W - World Output Variable, M* - Foreign Money Stocks, M - Domestic Money Stock(M1, M3), Excess Money, C - Domestic Credit Series, r - Domestic Interest Rate Variable, r^W - World or Foreign Interest Rate Variable, W - Wages/Unit Wage Costs, U - Unemployment Rate, E - Exchange Rate. A ✸ indicates that the variable was generally found to be significant. In contrast an **X** indicates that while the variable was considered it was not a significant determinant/predictor of inflation.

of the SOE model. Accordingly, while short-term deviations were permitted, the prominent role of UK and import prices in determining the long-run rate of inflation in Ireland was stressed. The table clearly illustrates the pervasive finding that UK prices were an important determinant of Irish inflation during this period. However, in the period since Ireland joined the ERM, while wages and import prices continued to be frequently cited as significant, the role of UK prices has been less pervasive, as one would expect given the new regime. The new exchange rate regime has in fact produced significantly less agreement in relation to (a) the impact of exchange rate changes, (b) the nature of the foreign effect and (c) the role of domestic causative factors. While there is certainly agreement that the exchange rate is a significant determinant of Irish prices, the size of the effect of exchange rate changes is far from agreed. Estimates on the degree of pass-through currently range from 50 to 100 per cent.

Furthermore, some studies of the post-EMS regime, which stress the role of external factors, are restricted insofar as they appear to have assumed rather than actually tested the long-run restrictions of the SOE model. Other studies, which emphasise the role of domestic factors such as domestic money and wage push, fail to address the endogeneity of such factors both with respect to Irish prices themselves and with regard to foreign factors. The significance of domestic "demand" conditions is found to be mixed, with some support for the role of output, but no role being found for unemployment.

4. AN ECONOMETRIC ANALYSIS OF IRISH INFLATION

Overall, as the above review makes clear, there now exists considerably less agreement on the causes of Irish inflation than was the case prior to joining the EMS. Accordingly, it is the aim of this section to provide answers to some of the unresolved issues which have arisen, i.e. whether Irish inflation has been primarily influenced by internal or external factors, the role of the exchange rate and the importance of wages in the inflation process. In particular, we analyse what long-run equilibrium relationships exist between the variables of interest and also how each of the variables react given disturbances which result in a significant deviation from equilibrium.[41,42]

Methodology

The econometric methodology employed here is in the spirit of the general to specific modelling approach advocated by Hendry (1995) and Doornik and Hendry (1994). This involves an intensive statistical analysis in order to uncover both the long- and short-run relationships among a selected set of variables. To proceed with the analysis of the determinants of prices we need to define an appropriate set of variables to be analysed. At a minimum, the chosen dataset must be able to shed some light on the key questions concerning the role of wages, the exchange rate and foreign prices in the inflation process. However, when choosing which variables to

include, it is inevitable that we confront a trade-off between the benefits of keeping the model simple and the potential costs of misspecification due to certain variables being excluded.[43] In light of this consideration, we employ a five variable dataset which includes a measure of the domestic consumer price level (P), a measure of foreign prices (P*), the exchange rate (E), domestic wage costs (W) and a time trend to proxy for productivity effects (t):

$$\{ P, P^*, E, W, t \} \qquad (4.1)$$

A brief explanation of the reasons for including a time trend is warranted. On the basis of economic priors, we believed that there should possibly be two stable long-run relationships among the data in (4.1). The first possibility is that of some type of purchasing power parity relationship between domestic prices, foreign prices and the exchange rate. The second is that of a long-run equilibrium relationship between wages and prices. It would, however, be necessary to allow for long-run productivity effects in this latter relationship. As a result a time trend is included to proxy for its effect and thus allow for the observed upward movement in the real wage over time.[44]

As we shall see, the econometric analysis of (4.1) can be loosely viewed as testing the long-run validity of i) a pure wage mark-up model, ii) a pure SOE model or iii) a hybrid model which fuses elements of i) and ii). Callan and Fitzgerald (1989), in a previous analysis, consider a similar information set for Irish manufacturing output prices. Like us, they propose this vector of variables as a general specification which combines price mark-up elements with long-run purchasing-power-parity. However, they did not include a time trend to account for the potential impact of productivity. Another significant difference is our use of the "Johansen procedure" which allows for the possibility of more than one long-run relationship in the data.

This procedure is a multivariate estimation technique which attempts to uncover long-run stationary equilibrium relationship(s) among sets of non-stationary data.[45]

Data

The measure of world prices employed in this study is a weighted average of the UK and German wholesale price indices taken from the IFS databank. Such a proxy reflects the traditional trade links which exist between Ireland and both the UK and Germany. Wholesale prices are chosen since both the German CPI and the UK RPI are likely to contain sizeable non-traded elements. As in previous studies, e.g. O'Connell and Frain (1989), the nominal effective exchange rate (as calculated by the Central Bank of Ireland) is employed as the relevant exchange rate measure. An index of average weekly earnings in manufacturing, obtained from the CSO, is employed as a proxy for economy-wide earnings. Since this proxy for the possible impact of Irish wages on Irish prices is not adjusted for productivity it justifies the

inclusion of the time trend. The question of which domestic price measures to employ also needs to be addressed. Given its traditional importance - and central policy significance - a consumer price based measure would seem the most obvious choice. Accordingly, we choose an underlying measure of aggregate consumer prices (again obtained from the CSO) which nets out the effects of changes in the mortgage interest sub-index. The analysis is applied using quarterly data over the period 1979:Q1 - 1995:Q3.

Identifying Long-Run Relationships

In our testing procedure, we first confirmed how many stable long-run economic relationships exist among the five variables in (4.1). As noted above, this was undertaken using the well-known "Johansen procedure" which simultaneously estimates the long-run relation(s) in a system of equations which incorporates the endogenous interaction among each of the variables. The preliminary Johansen results provide strong support for the existence of two long-run relationships among the five variables under consideration.[46] The Johansen procedure provides unrestricted estimates of these two relationships. Such unrestricted long-run relationships are, however, not necessarily meaningful or interesting from an economic point of view. This is, of course, the classic identification problem, which must be overcome if we are to reach meaningful conclusions.[47] In order to identify the economic content of the data, it is necessary to impose restrictions - motivated by economic arguments - on the long-run equations, such that each is unique. These identifying restrictions can be formulated as likelihood ratio tests which are asymptotically distributed as χ^2. These test statistics, together with the estimated coefficients on the long-run relationships, are reported in Table 2.

Table 2 Estimated Long-run Relationships

Hypot -hesis	PPP Vector	Wage Vector	Test Statistic
1.	P = -0.357E + 1.080P*	W = 1.352P + 0.001t	$c^2(2) = 1.77$ **
2.	P = -0.432E + 1.113P*	W = P + 0.003 t	$c^2(3) = 2.54$ **
3.	P = -E + P*	W = P + 0.005 t	$c^2(5) = 11.90$ †

*NB: ** implies the joint hypothesis is acceptable with a probability value above 0.10 and †
with a probability value above 0.01*

The first row in Table 2 tests the least restrictive joint long-run hypothesis that i) some linear combination of P, E and P* is stationary and ii) W and P are stationary about a linear deterministic productivity trend. As is clearly evident from the low value for the χ^2 statistic, this hypothesis is easily accepted by the data. Furthermore, the estimated parameter values appear reasonable.[48] There is an implied positive long-run relationship between domestic prices and foreign prices. The negative sign on the exchange rate in the PPP vector implies that an appreciation of the currency exerts deflationary pressure on prices. The second row in Table 2 tests the more restrictive hypothesis that the wage relationship is a trend stationary real wage, i.e. it imposes unitary coefficients on the price term which implies full indexation of nominal wages in the long run. This hypothesis is also strongly accepted by the data. Finally, row three tests the most restrictive hypothesis that the PPP vector has coefficients of unity on both the exchange rate and foreign price level together with the previous restriction on the wage vector. This PPP vector would imply that any *permanent* change in the exchange rate or foreign prices feeds through fully into domestic prices in the long run. The test statistic in row 3 is, however, almost significant at the 5 per cent level. As a result, the evidence in favour of this strict PPP relationship is necessarily tentative. One possible explanation for this is the presence of non-traded goods in the CPI.[49] Another is the relatively short span of the dataset. Previous studies such as Froot and Rogoff (1995) have underlined the difficulty inherent in uncovering PPP relationships using datasets which only span a limited number of years. Finally, it is interesting to note that the estimated slope coefficient on the trend term is 0.5. This implies an annual average productivity growth rate of about 2 per cent.

Dynamic Adjustment to the Long Run

As has been argued above, the analysis in this paper can be largely viewed as testing the validity of i) a pure wage mark-up model ii) a pure SOE model or iii) a hybrid model fusing elements of i) and ii). It is imperative to point out, however, that - despite the interesting nature of the long-run results given above - the consistency (or otherwise) of the data with either of these models of price determination requires some knowledge of how each of the variables reacts given a disturbance which pushes the system away from equilibrium. For example, if it was found that the PPP relationship was enough to determine the adjustment of each of the variables in the system then this would constitute evidence in support of the pure SOE model. On the other hand, if the real wage relationship was all that was needed to explain the adjustment of the system back into equilibrium, then this would be suggestive of a strong role for wages in accord with the wage mark-up model. Lastly, if *both* long-run relationships simultaneously explain the adjustment of the system following a disturbance from equilibrium, then this would constitute evidence in favour of a hybrid model.

We can examine these important dynamic issues by analysing a system of equations in error correction form. The long-run relationships, identified in Table 2, are employed as error correction terms. In order to allow for the potential interdependence of domestic prices, wages and the exchange rate, we focus on a three equation system. The foreign price variable is treated as being determined outside the system and, as a result, no equation for foreign prices is included in the analysis. This gives rise to a three equation system for the rate of change of consumer prices, wages and the exchange rate conditional on the identified long-run structures. Below, we consider the dynamic behaviour which results from the estimation of the aggregate price system.

Table 3 reports the estimated adjustment coefficients from the conditional wage-price-exchange rate system described above. Also reported in the table are diagnostic statistics for residual autocorrelation and normality, both of which confirm that the system is well specified.[50] As can be seen, each equation includes both lagged and contemporaneous terms of the variables in first difference form. To preserve space, the estimated coefficients on such terms are not reported. The interested reader is referred to Kenny and McGettigan (1996b) for further details. In order to decide which variables to omit from the model, standard conditional inference techniques are employed: variables are dropped from the system if they are not significant and if their removal does not generate undesirable properties in the residuals (autocorrelation problems etc.).[51] The system was originally estimated by including *both* the long-run PPP relationship and the trend stationary real wage as error correction terms in each equation. Such error correction terms were, however, only retained in a particular equation if they were found to have significant t-statistics.

Several features of Table 3 warrant commentary. First, in the equation for aggregate consumer prices, the adjustment coefficient to the long-run PPP relation implies significant adjustment at approximately 6.8 per cent per quarter. Since this is the strict version of PPP, it implies complete long-run pass-through from any permanent change in the exchange rate or world traded prices into domestic traded prices. If all of the adjustment back to equilibrium is effected through consumer prices themselves, this implies a half-life of deviations away from PPP of approximately 11 quarters.[52] It is also interesting to note that the cointegrating real wage relation enters significantly into the equation for consumer prices with a positive sign.[53] The positive coefficient implies that any increase in real wages greater than that which is warranted by productivity growth feeds through to consumer price inflation. This finding suggests that there is a long-run role for wages in determining consumer prices in Ireland. Accordingly, the results are more consistent with a "hybrid model" where, although there is complete PPP, wages can still influence the domestic rate of inflation because the exchange rate is not rigidly fixed.[54] This evidence on the hybrid model implies that outcomes in both the goods and foreign exchange markets (captured by PPP term) as well as in the labour market (captured by the real wage term) together determine the inflation rate for consumer prices in Ireland. Recently, Dennis (1995) has argued that the assumption that only a single error correction term

enters the equation for a particular variable is too restrictive since it implies that any market disequilibrium affects only one market directly. The above findings on the hybrid model can be viewed as providing evidence in support of the contention that several disequilibria can affect the inflation rate directly.

Table 3 Short-run Dynamic Specification

Inflation Equation:

$$\Delta P_t = a_P + \sum_{i=0}^{n} b_{Pi}\Delta P_{t-i} + \sum_{i=0}^{n} l_{Pi}\Delta W_{t-i} + \sum_{i=0}^{n} q_{Pi}\Delta E_{t-i} + \sum_{i=0}^{n} d_{Pi}\Delta P^*_{t-i}$$
$$- \underset{(-3.03)}{0.068}\,[P + E - P^*]_{t-1} + \underset{(3.47)}{0.108}[W - P - 0.005t]_{t-1}$$

Wage Change Equation:

$$\Delta W_t = a_W + \sum_{i=0}^{n} b_{Wi}\Delta P_{t-i} + \sum_{i=0}^{n} l_{Wi}\Delta W_{t-i} + \sum_{i=0}^{n} q_{Wi}\Delta E_{t-i} + \sum_{i=0}^{n} d_{Wi}\Delta P^*_{t-i}$$
$$- \underset{(-3.56)}{0.108}[P + E - P^*]_{t-1}$$

Exchange Rate Equation:

$$\Delta E_t = a_E + \sum_{i=0}^{n} b_{Ei}\Delta P_{t-i} + \sum_{i=0}^{n} l_{Ei}\Delta W_{t-i} + \sum_{i=0}^{n} q_{Ei}\Delta E_{t-i} + \sum_{i=0}^{n} d_{Wi}\Delta P^*_{t-i}$$
$$- \underset{(-3.56)}{0.197}\,[P + E - P^*]_{t-1}$$

Vector AR(1 - 4): $F(36,95) = 0.7756\ [0.8049]$

Vector Normality: $\chi^2(6) = 4.894\ [0.5575]$

Turning next to the wage equation in Table 3, the adjustment of nominal wages to the strict PPP relation, at 10.8 per cent per quarter, is even more rapid than the adjustment of consumer prices. This finding suggests that an overvalued real exchange rate has a *direct* disinflationary impact on Irish wages. While not specifically modelled here, this effect could also occur *indirectly* via a quantity adjustment in the labour market: it could, for example, result in higher unemployment which would ultimately exert downward pressure on wages. The significance of the PPP relationship in the equation for wage inflation highlights the long-run endogeneity of wages with respect to both foreign (P*) and domestic (E, P) variables. Accordingly, this finding implies that the overall competitiveness of the

economy has a strong impact on the outcome of wage negotiations and constitutes a strong rejection of the hypothesis that wages could ever be viewed as an *exogenous* cost-push factor in Ireland. Somewhat surprisingly, the real wage equilibrium does not enter significantly into the wage equation.

Turning our attention to the exchange rate equation, the coefficients on the estimated equation also accord well with economic intuition. As might be expected in a small open economy, the purchasing power parity equilibrium on its own is sufficient to explain the long-run movement in the nominal effective exchange rate. Deviations from the PPP equilibrium are closed via reasonably swift adjustment of the exchange rate. The estimated adjustment implies (assuming only the exchange rate is adjusting) a half-life of deviations from PPP of just over 3 quarters. Compared with the slower adjustment of consumer prices themselves (half life of about 11 quarters noted above), this constitutes empirical evidence in support of the standard assumption in economics that asset market adjustment is significantly quicker than goods market adjustment.[55] Somewhat surprisingly, the real wage equilibrium does not enter significantly into the exchange rate equation. There is therefore no direct depreciating effect of excessive wage pressure on the exchange rate. Such an effect does, however, operate via the goods market where excessive wages can lead to higher consumer prices with a resultant depreciating effect on the exchange rate

Response to a Price Shock

The estimated adjustment coefficients discussed above are only partial in nature. As a result, it is not at all apparent how long it takes the system to return to equilibrium following a disturbance to one or other of the variables. This issue can, however, be examined using a set of impulse response functions which plot the reaction of each endogenous variable to a one standard error shock in a particular variable. Figure 1 depicts the behaviour of prices, the exchange rate and wages following a disturbance to prices themselves. As can be seen from the graph, the immediate effect of the shock is to raise prices above their equilibrium with nominal wages. Wages adjust upwards, however, and it can be seen from the graph that over time the full real wage equilibrium is re-established. The percentage deviation from equilibrium remaining after N quarters can be calculated using the impulse response functions and it is given in Table 4 towards the end of this section. From the table it can be seen that, after 20 quarters, over 90 per cent of the deviation from real wage equilibrium has been corrected.[56] The shock to prices also gives rise to an overvalued real exchange rate. As a result, it can be seen from Figure 1 that the nominal exchange rate depreciates dramatically. Indeed, consistent with the swift asset market adjustment noted above, the exchange rate exhibits a significant degree of volatility and initially overshoots its long-run equilibrium value. From Table 4, it can be seen that after about 24 quarters only 10 per cent of the deviation from PPP remains. Eventually the exchange rate settles down at its new long-run equilibrium value which is consistent with purchasing power parity.

Figure 1
Responses to Price Shock
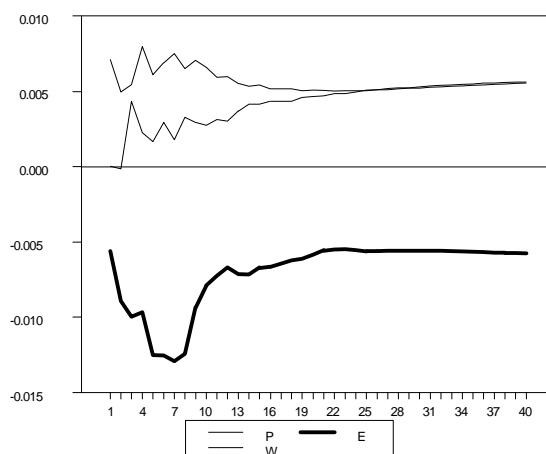
Response to a Wage Shock

The dynamic response of each of the variables following a positive shock to wages is depicted in Figure 2. The effects are, in general, rather similar to the case of a shock to prices. Again, both the real wage and the PPP relationships are eventually restored over time. The positive impact on prices due to excessive wage pressure emerges clearly from the graph. Following the wage shock, prices are gradually "pulled" up in order to bring about a restoration of the equilibrium real wage paid to workers. Looking again at Table 4, it can be seen that this is a reasonably drawn out process with full adjustment taking about 20 quarters. Interestingly, in contrast to the case of a price shock, the initial shock to wages is amplified within the system and wages end up significantly above the level to which they were originally shocked. This response is suggestive of a wage-price spiral being initiated by excessive wage pressure. It underlines the potential inflationary costs associated with unrealistic and uncompetitive wage agreements. As can be seen from Figure 2, the wage shock also has the effect of bringing about a substantial weakening of the exchange rate, such that PPP is restored in the long run. Again, however, despite the reasonably swift exchange rate response, it takes a significant length of time before full PPP is re-established. From Table 4.3, it can be seen that, following a wage shock, close to 90 per cent of the deviation has been corrected after about 20 quarters. These findings highlight the long-run endogeneity of the nominal exchange rate with respect to domestic inflationary pressures (for given foreign prices). As a result, our analysis shows that excessive inflationary pressure in the domestic economy, as proxied here by wages, can ultimately undermine exchange rate policy, i.e. the commitment to a nominal peg.[57]
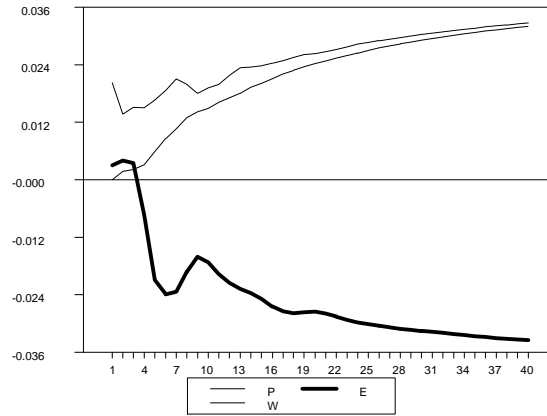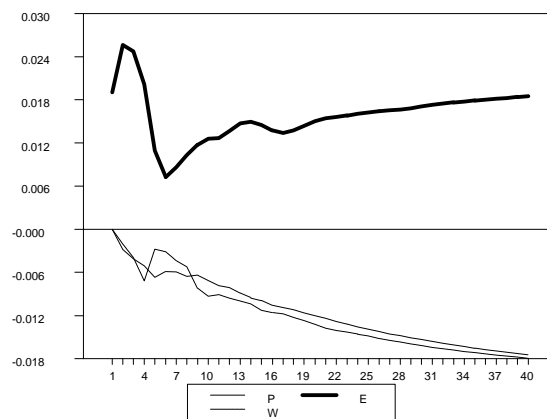
185

Figure 2 Response to Wage Shock

Figure 3 Response to Exchange Rate Shock

Response to an Exchange Rate Shock

The responses following a sudden appreciation of the exchange rate are depicted in Figure 3. The shock to the exchange rate, like the shock to prices, gives rise to an overvalued real exchange rate. As could be seen in the analysis of the equations in Table 3, this has a deflationary impact on both wages and prices. From the graph, it can be seen that prices and wages move fairly quickly into line with one another, but take a considerable length of time to settle at their new "equilibrium" levels.

Indeed, on the basis of the evidence in Table 4, a significant deviation from real wage equilibrium is only maintained for about 12 quarters. This suggest that, over the period of our analysis, the real wage norm has been rigidly adhered to with

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workers ensuring that nominal wages are brought quickly back into line following a shock. Again, the system responds so that in the long run PPP is re-established. Deviation from PPP are, however, of a significantly longer duration that deviations from equilibrium in the labour market. From Table 4, it can be seen that it takes approximately 32 quarters for about 90 per cent of the market disequilibria to be corrected. Finally, note that even though full PPP holds in the long run, an exchange rate shock of 10 per cent need not necessarily give rise to a 10 per cent change in domestic prices. Given that the exchange rate is endogenous in this model, the original shock may be either dampened or amplified. As depicted in Figure 3, the interaction among the variables is such that the effect of the shock is dampened over time, i.e. the exchange rate ends up marginally below the level to which it was originally shocked. Such a dampening of the original shock may not always occur, however. In particular, the Lucas critique would suggest that any persistent attempt to vary the exchange rate would eventually alter the structural parameters of the model. In addition, it should be noted that Figure 3 models the effect of a positive exchange rate shock, i.e. an appreciation. Any assumption that a negative shock to the exchange rate, i.e. a devaluation, has symmetric effects may not be justifiable.

Implications of the Analysis for a Single Currency Area

A number of implications can be drawn from the above analysis in relation to the determination of Irish inflation in Economic and Monetary Union. First, our analysis confirms that PPP represents a good long-run framework within which to analyse the evolution of Irish prices. This finding should apply *a fortiori* in a single currency regime. Under a single currency Irish inflation should replicate - on average - that prevailing elsewhere in the Euro area with the nominal exchange rate falling out of the equation.[58] This abstracts, of course, from possible long-run real influences, such as the Balassa-Samuelson effects outlined earlier. For instance, if Irish growth rates continue to outstrip those of our European partners, and the Balassa-Samuelson predictions hold, our inflation rates may end up being slightly higher than those prevailing in mainland Europe. Such differential inflation would not be problematic from a competitive viewpoint and would indeed be warranted by our stronger real growth performance.

Table 4
Percentage deviation from Real Wage Equilibrium remaining after N Quarters

N	Price Shock	Wage Shock	Exchange Rate Shock
4	-71.78	79.32	29.04
8	-49.69	34.82	-25.56
12	-49.50	21.43	15.82
16	-15.49	13.69	9.25
20	-8.78	7.70	9.70
24	-1.36	6.50	7.15
28	1.26	4.37	5.63
32	1.58	3.40	4.70
36	1.90	2.75	3.53
40	1.49	2.13	2.87

Percentage deviation from Purchasing Power Parity remaining after N Quarters

N	Price Shock	Wage Shock	Exchange Rate Shock
4	-21.09	58.17	74.75
8	-90.70	32.32	36.46
12	-11.69	20.42	40.91
16	-28.91	20.38	23.65
20	-13.97	11.78	20.27
24	-10.05	11.07	15.58
28	-7.94	8.74	11.03
32	-5.19	6.53	9.43
36	-4.59	5.52	7.23
40	-3.41	4.37	5.75

Although PPP will remain useful as a framework within which to analyse Irish inflation, it was also shown in our analysis that deviations from PPP are rather long-lived following nominal shocks. While the adoption of a single currency and the strengthening of the single market may serve to speed up such adjustments, it is quite possible that inflation differentials in the Euro area may be quite long-lasting following such shocks.[59] Such deviations from equilibrium could have competitiveness implications which would need to be addressed by policy-makers. Structural policies to free up the flexibility of the domestic economy in the face of shocks would, therefore, become a priority. There will also be a potentially enhanced role for fiscal policy in the short run, although this too will have to operate within the constraints imposed by the Stability and Growth Pact recently agreed.

It was also seen in our analysis that domestic wages have had a long-run influence over Irish inflation since joining the ERM in 1979. Such an effect operated through corresponding long-run movements of the exchange rate. Accordingly, with the introduction of the single currency, there will no longer be any room for domestic wage claims to affect Irish inflation in the long run. Medium-term inflation (and competitiveness) repercussions will probably continue to exist, but beyond this the only impact of excessive wage pressure would be higher unemployment (which would in turn lead to a consequent dampening of such wage pressures).

5. SUMMARY AND CONCLUSIONS

Background

The main objective of the Central Bank is to maintain low inflation in Ireland. It is, accordingly, very important that the inflationary process be understood, and that a well-defined model of its underlying causes be formulated. Although there is widespread agreement that both foreign factors and the exchange rate have important roles to play in the determination of Irish inflation, it is fair to say that, at present, there is no clear consensus among economists on the nature of the price determination process in Ireland. The purpose of this paper is to attempt to shed further light on some of the unresolved issues. Given that Ireland is viewed as being a classic case of a small open economy, the principal issues we address are the main causes of Irish inflation and whether these are externally determined and beyond our control, or whether domestic factors have some role to play. In this context, we investigate in some depth the argument of many commentators that domestic wage costs are an independent long-run cause of Irish inflation.

Before formulating our underlying empirical model, the main literature in the area was critically reviewed with a view towards assessing the contributions the various theories could make to an understanding of the inflationary process in Ireland. In the international review, the role of aggregate demand and unemployment were highlighted in our discussion of the Phillips-curve, as was the absence of any long-run relationship between such variables and inflation. In addition, the international review highlighted the role of money, both foreign and domestic, in the inflationary process. Finally, the Scandinavian approach, which emphasises the importance of productivity differentials between the traded and non-traded sectors of the economy, was discussed. Overall the review of the international literature served to highlight the extensive interrelationships among the economic variables driving the inflation process and the potential dangers associated with treating any particular

variable as being independently determined. As such, any attempts to uncover a monocausal explanation of the inflationary process is doomed to failure.

In parallel with the international literature, the Irish research on inflation has undergone a number of distinct phases. Until the early 1970s, even though the Irish pound was pegged to sterling, a cost accounting view of inflation prevailed in which various factors were held to "cause" inflation in proportion to their weight in an input-output table. This fallacious perspective was superseded by the small open economy view, whereby it was held that Irish inflation was fully determined abroad (i.e. in the UK) and that domestic factors had, at most, a transient role to play. In the 1980s, after our entry into the EMS, a quasi-fixed exchange rate regime, several papers emerged suggesting that domestic factors had a more important role in the inflationary process than envisaged by the small open economy (SOE) model. There is still disagreement over whether domestic factors have anything more than a short-run role in determining Irish inflation and also over the extent to which exchange rate changes feed through to the domestic rate of inflation.

Empirical Findings

The econometric analysis in section 4 attempted to model the price determination process in a small open economy using a dynamic system of equations and a set of stable long-run relations. The analysis, which covers the period 1979:Q1 - 1995:Q3, is an attempt to add to current understanding of the inflationary process which has been a topic of considerable controversy since the break with sterling. The data-based, general-to-specific, modelling approach which was employed can be viewed as testing the long-run validity of i) a pure wage mark-up model, ii) a pure price-taking small open economy model or iii) a hybrid model which fuses elements of i) and ii).

Our results highlight the purchasing power parity (PPP) paradigm as a valid long-run framework within which to consider the evolution of Irish inflation. The PPP equilibrium was shown to be highly significant in an equation for Irish consumer price inflation, thus confirming the strong role played by both the nominal effective exchange rate and foreign prices in the determination of Irish inflation. The analysis also uncovered a stable relationship between Irish wages, adjusted for productivity, and aggregate consumer prices. The results also suggest that when there is excessive real wage pressure, i.e. in excess of productivity growth, and when there is exchange rate accommodation, there is a long-run positive impact on Irish prices. As a result, our analysis is consistent with a hybrid model of consumer price determination in Ireland. Another feature of Irish price determination which also emerges quite clearly from the econometrics is the bi-directional nature of the feedback between wages and prices over the long term. Hence, talk of wage pressure as being an exogenous source of Irish inflation is misplaced. Finally, the

empirical section concluded with a tentative assessment of the implications of our findings for participation of Ireland in a single currency area.

Concluding Remarks

Our overall results support the use of purchasing power parity as an appropriate framework within which to analyse the determination of Irish prices in the long run. As such, the paper provides backing for the primacy currently accorded to the exchange rate in the formulation of monetary policy. However, our analysis also underlines the fact that the exchange rate cannot be treated in isolation from domestic policies. In order for the exchange rate to be used successfully in the pursuit of price stability, other domestic policies must ultimately be in harmony with it.

Footnotes

1. See Central Bank of Ireland Act, 1942, Section 6(1).
2. This section and the next are based on Kenny and McGettigan (1996a).
3. More comprehensive surveys are given in McCallum (1990) and Laidler and Parkin (1975).
4. An important and related issue, which is left aside for the purposes of this paper, is the subject of house and general asset price movements.
5. For early examples of such work see Humphrey (1986), pp. 91-98.
6. A simple model where output prices are expressed as a mark-up on wages adjusted for productivity growth allowed the original wage change equation to be transformed into a price change relationship.
7. It should be stressed that the NAIRU or "natural" rate can be affected by structural supply-side policies. The natural rate hypothesis simply argues that unemployment cannot in the long run be reduced below it natural rate by expansionary monetary policy.
8. According to Humphrey (1986) (p. 94), the view that the so-called Phillips curve was vertical was put forward by John Stuart Mill as early as the 1820s!
9. Short-run trade-offs may exist under the assumption of rational expectations where excess demand shocks are invoked by the government. Generating such shocks to temporarily lower unemployment would not, however, appear to be a sensible course of action for a government to undertake under such circumstances.
10. The unitary coefficient on the expected inflation term implies that in long-run equilibrium, i.e. when there are no price surprises, there will be no trade-off between inflation and unemployment.
11. Nickell (1990) has demonstrated that the two way trade-off between inflation and unemployment that may hold in a closed economy context is transformed into a three way trade-off including trade balance for an open economy. Excess demand which leads to low unemployment may result in a worsening of the trade balance rather than an increase in inflation.
12. Like the Phillips curve, the quantity theory has had a long history. See, for example, Humphrey (1986), pp. 1-18. For an excellent overview of the quantity theory, see Friedman (1987).
13. An alternative identity, upon which the quantity theory may be based, is Irving Fisher's equation of exchange, where Y, real income (final) transactions, is replaced by T, *gross* transactions (i.e. each step in the chain of production is included in the calculation of T, while only the value added of each transaction is incorporated into Y). Given the difficulties of measuring T accurately, economists have tended to use the income version presented above.
14. It has, however, been widely noted that the velocity of money became very unstable in the 1980s and 1990s, thus leading to a breakdown in many previous stable relationships between money and prices. See, for example, Federal Reserve Bank of New York (1990).

15. One way in which long run inflation can result without excessive money growth, however, is by speculative "bubble" effects on the price level. This possibility is discussed by McCallum (1990) who describes such bubbles as "equilibria in which a component of the price process exists only because it is arbitrarily expected to exist, yet does so in a manner that does not violate expectational rationality" (p. 985). McCallum himself, however, doubts the empirical significance of such bubbles. Another, more likely, channel through which price increases can become divorced from the underlying monetary growth process is where the velocity of money is changing due, for example, to financial innovation. This latter possibility actually occurred in many countries in the 1980s/90s.

16. As King (1994) notes, Friedman's statement that "inflation is always and everywhere a monetary phenomenon" is not very enlightening in this regard. By way of illustration, King goes on to say that in an analogous manner "a rise in the price of whisky is a whisky phenomenon - but that is not a very helpful statement" (p. 261)!

17. See the quotation at the beginning of Surrey (1989) for a concise definition of this *post hoc, ergo propter hoc* fallacy.

18. This approach, known as the monetary approach to the balance of payments, builds on earlier classical analysis, and is outlined in some detail in Frenkel and Johnson (1976).

19. These two transmission mechanisms would appear to be equivalent, respectively, to the current and capital account channels discussed in Browne (1984). Note that if the law of one price held instantaneously, the relative price of foreign and domestic goods would not change and the current account channel would become inoperative. This assumption of the law of one price for traded goods lies behind much of modern monetary approach thinking.

20. By Scandinavian models of inflation we are therefore simply referring to any theory which starts by disaggregating an economy into sheltered and exposed sectors and then proceeds to draw out the implications that this structure has for price determination and inflation under a variety of different assumptions. Some of the earlier work along these lines was undertaken by Edgren, Faxen and Odhner (1973) for the Swedish economy and by Aukrust (1977) for the Norwegian economy.

21. An exportable refers to goods which are actually exported as well as goods which are potentially exportable. Importables are any goods sold on the domestic market which have to compete with actual or potential foreign imports.

22. This assumes that the aggregate price index is comprised of constant weights of both sectors.

23. The dot above the variables represents their rates of change.

24. This type of effect is most closely associated with Balassa (1964) and Samuelson (1964).

25. Lindbeck (1979) draws several other inferences from the analytic structure of the Scandinavian model and points out that any inferences that can be drawn depend crucially on the endogeneity/exogeneity assumptions employed.
26. Such higher inflation is not problematic from a competitive viewpoint, however.
27. Obviously, not all of the factors discussed can be included. World inflationary expectations are, for example, excluded. One could envisage adding more variables and more boxes but only at a cost in terms of clarity.
28. Such spirals may well take on a life of their own once they get underway, especially if exchange rate/monetary policy is very accomodating.
29. Another recent survey is Leddin (1995).
30. In this section, we cover papers which are not necessarily dated prior to 1979 but also those papers published subsequently but which are constrained to use data which largely relates to the pre-EMS regime. In contrast, the next section is mainly concerned with papers which employ a sufficiently long run of data and can, therefore, analyse inflation in the EMS regime.
31. Effectively, prior to entry into EMS, Ireland had been in a monetary union with the UK for over 150 years. Between 1826 and 1928 the UK and Ireland shared the same currency. From 1928 to 1979, the exchange rate of the Irish pound and sterling was maintained on a fixed one-for-one basis.
32. In this paper, the term SOE model refers to a PPP theory of inflation. PPP is, in turn, largely consistent with the international monetarist approach outlined in section 2. Under the SOE model, in the absence of marked nominal exchange rate movements, Irish prices are taken to be determined abroad. The other strong implications sometimes inferred from this term, as discussed in Honohan (1982), are in no way intended.
33. The presence of possible multicollinearity in the equation would raise the standard errors of some of the estimated parameters. This may explain the inability to reject the hypothesis that some long-run effects are zero.
34. We have already seen how Irish inflation could deviate from that of its partner countries in the presence of productivity differentials. The new regime, with its quasi-fixed exchange rates, allowed even greater divergences to occur.
35. This is exactly what happened in the late 1980s, when the UK experienced a sharp rise in inflation.
36. If a country's real exchange rate is overvalued relative to equilibrium, a devaluation may merely result in equilibrium being achieved. Devaluation under such circumstances may, therefore, merely validate past inflation pressures rather than result in new ones. Nevertheless, under such circumstances, it is easy to envisage an inflation spiral taking hold.
37. The model has been subsequently updated in Nugent (1994) where the basic conclusions were shown to hold.
38. Accordingly, their study must be considered as an analysis of traded prices only.
39. Electrical Engineering and Paper Products Industries.

40. The table is intended as a summary of the principle findings in these previous studies, i.e. explanatory variables are marked as being significant if they are deemed by the authors to be relevant in explaining Irish inflation. Obviously, the table cannot make the vital distinction between short- and long-run determinants and consequently it is subject to the more detailed qualifications made earlier in the text.

41. This section is based in part on Kenny and McGettigan (1996b)

42. An informal chart-based analysis of the putative determinants of inflation forms the basis of Section 4 of Kenny and McGettigan (1996a). Such an analysis is not included here to preserve space.

43. An obvious example of such a trade-off is the choice of whether or not to include money stock variables (foreign and domestic) in our dataset. While we would concur with the idea that foreign monetary aggregates may be highly relevant from the point of view of a SOE, the investigation of alternative international monetary transmission mechanisms is left aside. In this paper, the impact of foreign money is, therefore, assumed to be transmitted *via* the foreign price variable P*.

44. The alternative measure, unit wage costs, is not appropriate for empirical analysis because, as is widely recognised, it overstates actual productivity growth in Ireland.

45. The multivariate approach, with its allowance for interactions between the determination of the variables of interest, eliminates the single-equation bias which would be problematic for many previous studies. Good guides to the Johansen procedure are Hansen and Juselius (1995) and Harris (1995).

46. The number of stable cointegrating relationships was determined using the standard Maximum Eigenvalue and Trace test statistics using a vector error correction specification of the data with five lags. Further details are provided in Kenny and McGettigan (1996a, 1996b).

47. Johansen and Juselius (1992, 1994) provide a thorough description of the identification issue.

48. Froot and Rogoff (1995) have commented on the fact that PPP coefficients obtained from the various international studies they surveyed varied enormously and were often implausible.

49. In Kenny and McGettigan (1996b) a similar analysis is performed using the traded component of the CPI. As would be expected, in the case of traded prices, the strict PPP restriction is much more acceptable to the data.

50. See Doornik and Hendry (1994), Chapter 10, for a description of these test statistics and for further references.

51. The estimation and system reduction is carried out using full information maximum likelihood estimation in the PcFiml package. See Doornik and Hendry (1994).

52. Both wages and the exchange rate also adjust to restore the system to its PPP equilibrium. The systematic interaction among each of the endogenous variables has the potential to either speed up or slow down the adjustment process following, for example, a shock to the exchange rate. Exactly how fast the

system adjusts back to equilibrium following a shock to either wages, prices or the exchange rate is discussed below using the results from impulse response analysis.

53. If the equilibrium real wage was normalised on prices the adjustment coefficient would, of course, be negative indicating that prices adjust downward if they are above their equilibrium level.

54. Some readers may view the finding that both ECMs enter the inflation equation to be contradictory. However, the positive effect of wages on prices is consistent with the observed PPP equilibrium given that persistent changes in the nominal exchange rate have taken place over the sample period.

55. The exchange rate overshooting literature, originating with Dornbusch (1976), relies on the assumption that exchange rate and asset markets adjust more quickly than goods markets.

56. As one moves out the time horizon, i.e. as N gets larger, the confidence bands on the estimated deviations tend to widen. As a result, any deviation less than or equal to 10 per cent should not be treated as being significantly different from zero.

57. Monetary policy makers could, of course, attempt to maintain a stable/fixed exchange rate in the face of such inflationary pressure. This would help to subdue domestic inflation. This policy would, however, be likely to involve costs in terms of lost output and higher unemployment and, hence, it would most likely prove unsustainable in the long run.

58. Arguably, the concept of an effective exchange rate may continue to play a central role in the determination of Irish inflation given the likelihood that a significant proportion of Irish trade will be conducted with non-participating countries after the establishment of the monetary union. The analysis in this paper, however, does not directly address this important issue.

59. Participation in EMU will remove the most damaging type of shock, i.e. exchange rate shocks, vis-à-vis other currency area participants.

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DISCUSSION

Kieran A Kennedy: It is both an honour and a pleasure to propose the vote of thanks to Geoff Kenny and Donal McGettigan for their excellent paper. The authors have presented an admirably clear and comprehensive survey of the theoretical and of the Irish empirical literature on the determinants of inflation. In the process, they have made available in a non-technical format the fruits of their own recent research, already published in two Central Bank Technical Papers. The paper before us tonight deserves to be widely read, since it enables any interested reader to enhance greatly his/her knowledge of a most important subject. For students especially, the paper will be a god-send - not only for its clarity but also because of the fair and balanced way in which the authors consider and evaluate opposing views.

I find myself in full agreement with the main conclusions of the paper. In particular, I endorse enthusiastically their final conclusion:

> *In order for the exchange rate to be used successfully in the pursuit of price stability, other domestic policies must ultimately be in harmony with it.*

This conclusion is so obvious that it would scarcely need to be stated, except that some economists still view the exchange rate as a great impersonal lever of power which can be manipulated at will by the monetary authorities to secure any desired rate of inflation. Indeed, even more fantastically, some of them seem to believe that it can be used at will to secure any desired improvement in competitiveness. Hopefully, this cogent and persuasive exposition of the complexities of the subject, will help to dispel such naiveté.

As I went through the paper, I found myself inserting approving ticks in the margin. Even when I inserted question marks, I found later on that the authors had anticipated and dealt with my objections. For instance, where they speak of the "wage significance fallacy", I noted (i) that this holds true only under a fixed exchange rate regime, and (ii) that even when wages do not affect prices, they may still affect the level of employment. Both of these points, however, are made later by the authors themselves - though I would prefer if they had stressed the second one rather more than they do.

Consequently I am at a bit of a loss to find critical things to say about the paper. If I must find something to criticise, however, it is that more might have been said on the *measurement* of inflation. I would especially like to know the authors' views on the extent to which the measure of inflation should take account of fluctuations in house prices. Of course it can be argued that housing is an asset and should not therefore be mixed up with consumption flows. On the other hand, housing sits uneasily between consumption and investment; increases in house prices may affect pay claims in a similar way to increases in the prices of consumption goods; and, as

recent Central Bank concerns show, soaring house prices have important implications for monetary policy.

As constituted at present, the Irish CPI has two elements relating to housing: mortgage interest payments and private and local authority rents. The authors net out the first of these on the grounds that movements in this component are dominated by fluctuations in mortgage interest rates, which may follow quite a different pattern from underlying trends in consumer prices. I do not disagree with them on this. The result, however, is that the only way in which housing is covered is through private and local authority rents. Given the prevalence of owner-occupation in Ireland, and its exclusion from the CPI, the rents included cover only a fraction of the total. Besides, rents may respond slowly to movements in house prices. I do not wish to be dogmatic about the extent and the manner in which account might be taken of house price changes, but I think it is a matter worthy of discussion - especially at the present time when, while consumer prices and mortgage interest rates are relatively stable, house prices have been rising at a rate that may have significant inflationary consequences.

Another important measurement issue relates to quality change. Economists generally assume that consumer price indices overstate the true rise in consumer prices by between 1 and 2 percentage points a year - partly because of failure to measure presumed improvements in the quality of goods. I myself do not fully share this benign consensus: I see too many examples also of quality deterioration to be sure where the balance lies. For example, while the extensive use of plastic wrapping has undoubtedly involved greater efficiency, it has also damaged taste. Be this as it may, the issue is an important one worthy of further research - especially as it bears on my next point, the appropriate policy objective in regard to inflation.

The authors' paper is explicitly confined to the determinants of inflation, and it is understandable that they leave aside other important issues regarding inflation. Coming from a Central Band background, they naturally take it as axiomatic that the policy objective should be the lowest possible rate of inflation. Yet even then, there is an issue worth discussing: should the aim be low inflation of 2-3 per cent, as at present, or outright price stability. There are good arguments for either, and I understand the authors have done some recent work evaluating these arguments, which they might get an opportunity to tell us about in their response.

Finally I might mention one other issue, research on which could throw more light on both the determinants of inflation and the appropriate policy objective, namely what happens to relative prices in the course of general price inflation. In other

words, do relative price movements vary depending on whether the inflation rate is high or low, and if so what are the consequences?

Again I would like to congratulate the two authors on a very fine paper.

Rodney Thom: Kenny and McGettigan have produced an excellent survey on the causes of Irish inflation. Their principal conclusion is that the small open economy model (SOE), or purchasing power parity (PPP), is the correct framework for analysing Irish inflation and that domestic factors can exert a causal influence only if they are accommodated by exchange rate policy. As I am in broad agreement with these conclusions I will confine my response to comments on two issues: the contrast between the sterling-link and ERM periods and the implications of Kenny and McGettigan's results for Irish participation in EMU.

The Sterling-Link and the ERM

Kenny and McGettigan's analysis of the sterling-link period should be of interest to younger economists who may be surprised that the profession found it necessary to debate the issue of external versus domestic causes of inflation in a regime characterised by a rigidly fixed exchange rate against the currency of our dominant trading partner. Given the relative size of the two economies, the high Irish trade dependency on the UK and the absence of uncertainty about the exchange rate, Ireland was a classic illustration of the SOE prediction that the domestic price equals the product of the foreign (UK) price and the nominal exchange rate.

Unfortunately this view was disputed by elements of the policy-making establishment who laboured under the belief that the causes of inflation could be proportioned into external and domestic factors and that by controlling the latter Ireland could achieve a rate inflation which differed from that prevailing in the UK. However, the work of economists such as Paddy Geary, Frank Browne and others confirmed the dominance of the SOE model and relegated the "cost-accounting" school to the dustbin of economic history. In fact the only question of real interest was, and to some extent remains, how long it takes for PPP to assert itself.

Ending the sterling-link in 1979 should not have affected the validity of the SOE model as the correct framework for analysing Irish inflation. If PPP were to hold continuously then the Irish inflation rate should follow the ERM rate rather than the UK rate. For example, consider a sudden rise in British inflation. How might this affect Irish inflation once the sterling link is broken? If PPP holds then sterling should depreciate against the ERM currencies and the resulting appreciation of the Irish pound would insulate the Irish economy from higher British inflation. Hence, irrespective of what happens to British inflation, Irish inflation should converge to the ERM average.

This simple argument was, of course, the economic rationale used to justify Irish participation in the ERM. In late 1978 sterling was correctly perceived as a high inflation, depreciating currency. By joining the new exchange rate system anchored on the DM the prediction was that Irish inflation would rapidly converge to the German level. In fact it took almost ten years for this to happen. Does this imply that the SOE model is no longer sufficient to explain the Irish inflation rate? I think not, and offer three arguments to explain why convergence took so long to achieve.

First, Kenny and McGettigan's econometric analysis shows PPP is valid in the long-run but there are persistent short-run deviations from equilibrium. Second, the switch in UK monetary policy following Mrs. Thatcher's election in May 1979. Put simply, the new government attacked inflation via a high interest rate strategy which attracted capital inflows and resulted in a significant appreciation of sterling over 1979 to 1981. Had UK inflation responded immediately this would have been of little consequence for Ireland as the inflationary effects of a depreciating Irish pound would have been offset by a corresponding fall in UK inflation with no implications for Irish inflation. However, PPP does not hold continuously and the nominal sterling appreciation lead to a real appreciation with the UK inflation rate continuing to exert an influence of the corresponding Irish rate. Third, even if PPP did hold continuously it does not necessarily follow that ERM participation would, by itself, guarantee inflation convergence with Germany. The SOE model predicts that if a small economy fixes its exchange rate against the currency of a large economy then it will experience the latter's inflation rate. The key condition is, of course, that the exchange rate remains fixed which implies that the small country must follow monetary and fiscal policies consistent with those in the large economy. In the context of the ERM, this requires that Irish policy should be a Bundesbank clone. This, of course, did not happen during the early years of the ERM. Over 1979-86 Ireland followed expansionary monetary and fiscal policies and the Irish pound depreciated by approximately 30 per cent against the DM. In the late 1980s when domestic policy became consistent with a hard currency peg convergence was eventually achieved.

Implications for EMU

Once Ireland joins the euro it is the domestic labour market, rather than the exchange rate, which must adjust to accommodate movements in sterling. Hence a high degree of labour market flexibility will be required if participation is to be successful. Unfortunately, Kenny and McGettigan's econometrics suggest that exchange rate shocks lead to persistent deviations from both PPP and real wage equilibrium. Long-run PPP is re-established after eight years and real wage equilibrium after three years. Kenny and McGettigan seem to think that twelve quarters is a relatively short adjustment period. To my mind it indicates labour market inflexibility and is not consistent with successful EMU participation. This, together with the obvious lack of synchronisation with the European core, points to one conclusion - the economic rationale for euro participation without sterling is at best tenuous.