

## **Dangers for Ireland of an EMU without the UK: Some Calibration Results**

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*Abstract:* This paper presents a small-open-economy model calibrated to Irish data. The model can be used for many purposes. It is applied here to the EMU debate. It comes close to replicating the employment effects of sterling weakness (with Ireland in EMU) reported in the recent ESRI study (Policy Research Series Paper No. 28, 1996). When the assumptions on wage flexibility are changed in an arguably more plausible direction, though, we find that the employment effects are magnified considerably. Given the narrowness of the outcome in the ESRI's judgement, our results provide support to remaining outside EMU until the UK joins.

### I INTRODUCTION

Three effects of EMU have been much discussed in the Irish case. These are the savings in foreign-currency transactions costs, the arguably beneficial interest-rate effects of participation in EMU, and the dangers for the Irish economy of a weak sterling if Ireland joins EMU and the UK does not.

Given the extent of Irish trade with the UK, the savings in transactions costs would be substantially less than in the case where the UK also joined. Even the higher savings in an EMU that comprised all EU countries, however, Eichengreen (1993) and others regard as relatively small compensation for taking on the risks associated with giving up the exchange rate.

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The 1996 ESRI report on the implications of EMU for Ireland (Baker, Fitz Gerald and Honohan, 1996) concentrates on evaluating the benefits of the posited interest rate reductions relative to the costs of potential sterling weakness. The overall conclusion of the report is that there are likely to be net benefits for Ireland of participation, even if the UK remains outside. In this event, however, the net benefits are likely to be small.

I will have nothing to say here on the ESRI's evaluation of the interest-rate benefits. Instead, I concentrate solely on the downside — the employment implications of sterling weakness. I argue that the ESRI report may have seriously underestimated these adverse effects. If this is correct then their overall conclusion of a net marginal benefit for Ireland of participation in an EMU that does not include the UK is likely to be overturned.

My argument is based primarily on the failure of the ESRI model to allow for asymmetries in the response of wages to inflationary and deflationary shocks. Nominal wages tend to be relatively sticky in a downwards direction and much more flexible in an upwards direction, as argued recently by Akerlof, Dickens and Perry (1996), so an exchange rate appreciation (against sterling) would be likely to raise real wages and generate unemployment while an exchange rate depreciation would be more likely to be dissipated in inflation.<sup>1</sup> Why is this not recognised in the ESRI model? The problem is that the wage formation process in that model is based on estimates of the response of wages to price movements between 1983 and 1995. There were no dramatic unanticipated price reductions over this period, however, since each sharp fall in sterling was followed by a devaluation of the Irish pound against the DM. It cannot be concluded from this data then that the response of wages to upward and downward price movements is symmetric. The refusal to renegotiate nominal wage agreements downwards when sterling fell sharply on departure from the ERM suggests, to the contrary, an asymmetric response.

A second relevant weakness of the ESRI model is that it does not take account of the potential for hysteresis in unemployment if the sterling-sensitive sectors are perturbed. Barry and Hannan (1996) show that workers in traditional industry are substantially less skilled than workers in the modern sector; Table 1 below.<sup>2</sup> They also point out that less skilled workers face much greater dangers of becoming long-term unemployed. The importance of this for the present argument is that it is clear from Baker

1. This is of course the basis of the convexity of the Phillips Curve.

2. In line with most international studies, the category "Administrative and Technical Staff" in the *Census of Industrial Production* is associated with skilled workers, and "Industrial Workers" with unskilled workers. While the categorisation is tenuous, it is the closest approximation available in the data.

(1993) and Bartolini (1993), taken in conjunction, that traditional industry is also more sterling-sensitive. A period of decline in the sterling-sensitive sectors is therefore more likely to generate hysteresis in unemployment than is a more broadly-based recession.

Table 1: *Skilled Employment as a Percentage of Total Employment*

	Skilled Relative to Total Employment (%)	
	1979	1990
Manufacturing		
of which:	10.3	12.8
Traditional	9.9	11
Modern <sup>3</sup>	13	17.9
Market Services	11.8	15.9
Building/Construction	5.2	6.7

Note: The Services and Building and Construction data refer to the years 1981 and 1991.

The remainder of the paper is structured as follows. The next section presents a brief overview of relevant theory. The ESRI results are then presented. Section IV develops a basic small-open-economy (SOE) model that we calibrate to Irish data. It demonstrates how successfully the model can replicate the ESRI results of interest, and the implications of various alternative scenarios can then be explored.

## II THE MACROECONOMICS OF EXCHANGE RATE SHOCKS

Exchange rate changes are typically thought of as *nominal* shocks. *In the absence of nominal rigidities* (such as money-wage stickiness) *such shocks should have no real effects* (e.g., on employment or real output), because all nominal variables will change equiproportionately. Relative prices (which in the absence of nominal rigidities determine the values of real variables) therefore remain unchanged. For example, under real wage rigidity, an exchange rate shock, through its effect on the CPI, changes nominal wage demands, leaving the nominal wage *relative to output prices* unaffected.

*If there are nominal rigidities* (such as money-wage stickiness), on the other hand, *the exchange rate shock has real effects* because relative prices are changed.

A traditional way of thinking about exchange rate shocks is that they

3. Baker (1988) definition.

affect employment in the short run (when nominal wages are sticky) but that these effects disappear over time as real wage levels are re-established; see e.g., Kouri (1979) and Risager (1987).<sup>4</sup> Besides this distinction between short-run and long-run effects, though, it is also frequently argued that the short-run responses to inflationary and deflationary shocks are not symmetric; i.e., that nominal wages and/or prices are more flexible upwards than downwards.<sup>5</sup> While there is some nominal wage stickiness in the short run in the ESRI model, wages respond symmetrically to inflationary and deflationary shocks. This is one of the key assumptions we change in the present paper.

There is one further difference between the ESRI model and the traditional view of the macroeconomics of exchange rate changes. This is that sterling weakness in the ESRI model is modelled (correctly, I believe) not as a nominal but as a real shock: because Purchasing Power Parity need not hold in the short-to-medium term, a sudden sterling depreciation changes the relative prices of sterling-denominated and DM-denominated goods.<sup>6</sup>

When a real shock is met with either nominal or real wage stickiness, real employment and output effects result. I will show that these effects are substantially larger under downward nominal wage stickiness than under the degree of nominal wage adjustment allowed for in the ESRI model.

### III RESULTS OF THE ESRI ANALYSIS

The ESRI study calculates the effects of a 20 per cent depreciation of sterling under the assumption that Ireland is in EMU. They find that it takes about 4 years for the real effects to disappear; i.e., for initial competitiveness levels to be re-established. About half of the real depreciation of sterling relative to the Irish currency (the euro) disappears over the first 2 years; half of this in turn comes about through an increase of 5 per cent in UK wages, and the other half through a fall of around 5 per cent in Irish wages (Baker *et al.*, 1996, pp. 101-102).

Assuming that man-years lost peaks in year 2 and returns symmetrically over time to zero, what is defined here as the medium-term employment loss from this real appreciation of the Irish currency against sterling is the mean of year-2 and year-3 job losses:

4. In the presence of hysteresis, of course, the short-run real effects persist into the long run; Barry (1997a).

5. One explanation for this builds on the assumption that workers are concerned with relative wages, and that wage contracts are staggered; this makes each group of workers reluctant to be the first to reduce wage demands. The New Keynesian literature (e.g., Ball and Mankiw, 1994) provides other explanations for why nominal variables may be more flexible upwards than downwards.

6. This requires that the two types of goods should not be perfect substitutes for each other; otherwise the "law of one price" would hold at all times.

Table 2: *ESRI Estimates of Job Losses from 20 Per Cent Fall in Sterling, with 5 Per Cent Rise in UK Wages and 5 Per Cent Fall in Irish Wages*

Manufacturing	11,000
Building	11,000
Market Services	3,000

Source: ESRI (1996), p.119

We interpret this shock as a 15 per cent fall in sterling (i.e., the 20 per cent fall offset by an increase of around 5 per cent in UK wages and prices) alongside a 5 per cent fall in Irish wages. If we can replicate these numbers with our calibrated small-open-economy model, we can then explore the implications of changing the ESRI study's assumptions on wage flexibility.

#### IV THE SMALL-OPEN-ECONOMY MODEL CALIBRATED TO IRISH DATA

##### 4.1 *The Basic Three-Sector SOE Model*

We assume that three types of goods are produced in Ireland: two tradables and one non-tradable. The economy is a price-taker in the market for each tradable good, and the prices of these goods on world markets are independent of each other. Tradable goods are subscripted B and G. Good B competes with British produced goods, or with other similar goods whose prices are determined on the British market. The Irish price of these goods is determined by the sterling price,  $p_{B^*}$ , multiplied by the Irish pound price of sterling,  $e_B$ :

$$p_B = e_B p_{B^*} \quad (1)$$

Good G is priced in euros and its price is dictated by the price of German goods, which is held constant throughout the analysis.

$$p_G = \text{constant} \quad (2)$$

There is no law-of-one-price relationship between these sterling-denominated and DM-denominated goods, so  $p_B$  and  $p_G$  are not equalised.<sup>7</sup>

Employment in each tradable sector is determined by the condition that the value marginal product of labour in each sector equal the (common) wage rate.

7. A PPP relationship between the UK and Germany does appear to reassert itself in the long-run, but deviations can be sufficiently long-lasting for the type of unemployment effects focused upon here to show up (Obstfeld, 1995).

$$w = p_B \text{MPL}_B \quad (3)$$

and

$$w = p_G \text{MPL}_G \quad (4)$$

A fall in the value of sterling, which is the shock with which we are concerned in this paper, implies a fall in  $p_B$  by Equation (1). Equation (2) shows that  $p_G$  is unaffected by this shock. If nominal wages do not come down, then, tradable-sector employment will fall through the contraction of the B sector.

The employment concept with which we are concerned in this paper is total private non-agricultural employment. This is determined by:

$$L = L_B(w_B) + L_G(w_G) + L_N(w_N) \quad (5)$$

where N refers to the non-traded sector (discussed below) and where  $w_i$  is *the real product wage in sector i*; (e.g.,  $w_B \equiv w/p_B$  etc). All three derivatives are, of course, negative.

Now consider the non-traded sector. The price of the non-traded good,  $p_N$ , is endogenous, with equilibrium determined at the intersection of the non-tradable supply and demand schedules. We simplify the demand structure by assuming log-linear utility, so that nominal demand for non-tradables is a fixed proportion of nominal income:

$$p_N D_N = \theta p_G Y \quad (6)$$

where real output,  $Y$ , is evaluated in terms of the price of G-goods:

$$Y = (p_N/p_G) Y_N[w_N] + (p_B/p_G) Y_B[w_B] + Y_G[w_G] \quad (7)$$

The derivatives of the terms in square brackets are all negative.

A useful property of the log-linear utility function for calibration purposes is that the fraction of income spent on non-tradables,  $\theta$ , is in turn the elasticity of the consumer price index (CPI) with respect to non-traded goods' prices.

In fact, the elasticity of the CPI with respect to each good's price is given by the coefficient on consumption of each good in the utility function; letting  $\alpha$  be the coefficient on G goods,  $\beta$  the coefficient on B goods,  $\theta$  the coefficient on N goods, and where  $P$  is the CPI, we have  $\varepsilon(P; p_N) = \theta$ , and so on.

Equilibrium in the non-traded sector is therefore determined by:

$$p_N Y_N(w_N) = [\theta/(1-\theta)][p_G Y_G(w_G) + p_B Y_B(w_B)] \quad (8)$$

We now need to study how  $p_N$  is affected by the fall in sterling. This requires evaluating the various output effects of the fall. Assuming output in each sector depends on capital and labour employed, this in turn requires us to make assumptions about how capital stocks are affected. While "ballpark" estimates of labour-demand elasticities are readily available, however, there is less evidence on the response of capital stocks to wages. Fortunately, this does not appear to matter too much since, for the parameter values used to calibrate the model, either of the following radically different sets of assumptions yield similar answers to the question of interest, which concerns the impact of changes in  $w$  and  $p_B$  on  $p_N$ .

Assume production functions are Cobb-Douglas; if capital stocks adjust fully, this implies that the elasticity of output with respect to wages comes to one plus the value of the elasticity of labour demand. Differentiation of (8) in this case, with the unit-elasticities of labour demand we assume for the B and N sectors (see Table 3 below), yields:

$$\begin{aligned} (dp_N/p_N) &= (dw/w)[(\theta/1-\theta)][\varepsilon(Y_G; w_G)Y_G/Y_N] \\ &\quad + (dp_B/p_B)[(\theta/1-\theta)]Y_B/Y_N \end{aligned} \quad (9a)$$

where  $\varepsilon(L_i; w_i)$  is the elasticity of labour demand in sector  $i$  with respect to the relevant real product wage, and where  $\varepsilon(Y_G; w_G) = 1 + \varepsilon(L_G; w_G)$ .

Adopting these unit-elasticities of labour demand in the present case, though, has the undesirable implication that wage changes have no output effects in the B and N sectors (the impact of the substitution effect on capital offsetting the impact on output of the reduction in employment). The alternative set of assumptions, with which we prefer to work, is that capital stocks are fixed (so that output growth equals labour's share in output times employment growth), while labour's share in each sector is close to that suggested by the data. Differentiation of (8) in this case yields:

$$\begin{aligned} &(dp_N/p_N)Y_N\{1 - s_N\varepsilon(L_N; w_N)\} \\ &= (dw/w) \{[(\theta/1-\theta)][s_G\varepsilon(L_G; w_G)Y_G + s_B\varepsilon(L_B; w_B)Y_B] - s_N\varepsilon(L_N; w_N)Y_N\} \\ &\quad + (dp_B/p_B)[(\theta/1-\theta)]Y_B\{1 - s_B\varepsilon(L_B; w_B)\} \end{aligned} \quad (9b)$$

where  $s_i$  represents labour's share in sector  $i$ . We will see below that for numerical purposes it does not matter much which of these sets of assumptions we work with.

It is clear that the effects of increases in either wages or B-good prices on

non-tradable prices are ambiguous a priori in the case represented by Equation (9b). Wage increases reduce both the supply of non-tradables and demand (the latter effect coming through output effects on the other sectors); typically we might expect the supply effect to dominate, so that prices would rise. Increases in B-goods prices can raise or lower nominal demand for non-tradables; we might typically expect nominal demand to increase, and so this effect would also be positive.

We use our calibration parameters to verify this, and then to evaluate the employment effects of a number of shocks. The parameter values with which we calibrate the model are presented in Table 3 and their derivation is explained in the appendix.

Table 3: *Parameter Values for the Calibrated SOE Model*

$\varepsilon(P;e_G) = \alpha$	Share of G-goods in CPI	0.33
$\varepsilon(P;e_B) = \beta^8$	Share of B-goods in CPI	0.22
$\varepsilon(P;p_N) = \theta$	Share of Non-Tradables in CPI	0.45
$L_B/L_M$	B-sector's share in Tradable employment	.61
$L_G/L_M$	G-sector's share in Tradable employment	.39
$L_M/L$	Tradables' share in total employment	.29
$L_N/L$	Non-Tradables' share in total employment	.71
$\varepsilon(L_B;w_B)$	Labour-demand elasticity in B-sector	-1
$\varepsilon(L_G;w_G)$	Labour-demand elasticity in G-sector	-0.6
$\varepsilon(L_N;w_N)$	Labour-demand elasticity in NT-sector	-1
$Y_B/Y_N$	Value-added in B relative to NT	0.6
$Y_G/Y_N$	Value-added in G relative to NT	0.6

Let us numerically evaluate Equation (9b) first of all. Assuming labour's share in non-tradables and in the B-sector at two-thirds, and in the G-sector at one-third, yields the following:<sup>9</sup>

$$(dp_N/p_N) = (dw/w) \{0.1439\} + (dp_B/p_B) \{0.49\} \quad (10)$$

8. A change in  $e_B$  will of course affect  $p_N$ , so the total elasticity of the CPI with respect to sterling is greater than this.

9. If full adjustment of the capital stock were taken into account, on the other hand, we would have, as a value for Equation (9a):  $(dp_N/p_N) = (dw/w)\{0.1963\} + (dp_B/p_B)\{0.49\}$ . It is easily verified that this yields almost exactly the same employment effects as the version chosen in the text.



#### 4.2 *Effects of the "ESRI Shock" (15 Per Cent Revaluation Against Sterling Plus 5 Per Cent Fall in Nominal Wages)*

In Section III above we reported the results of the ESRI analysis for a 20 per cent fall in sterling against the euro (with Ireland in EMU). Their analysis suggested that some 5 percentage points of this shock would disappear within a couple of years as UK wages and prices adjusted upwards. The shock therefore translates into a 15 per cent sterling devaluation. They argue that this would reduce Irish nominal wages by 5 per cent. Our hope is that the present model can generate employment effects close to those found by the ESRI study if subjected to the same shock.

We analyse the response of each of the three sectors in turn. Looking first at the B-sector, prices here fall 15 per cent while wages fall 5 per cent, so the real product wage  $w/p_B$  rises by 10 per cent. The impact this has on total employment is given by  $\varepsilon(L_B; w_B)(L_B/L)(dw_B/w_B)$  which is  $-1.77$  per cent; this generates job losses of 15,000 in sterling-dependent manufacturing.

This will be compensated to some extent by job gains in the G-sector as  $w/p_G$  falls by 5 per cent. (Recall that  $p_G$  is unaffected by the shock). Job gains here amount to  $\varepsilon(L_G; w_G)(L_G/L)(-0.05)$ , or  $+0.34$  per cent of total employment, implying a gain of 3,000 jobs in this segment of manufacturing.

The non-tradable sector case is more complicated. Evaluating the proportionate change in the real product wage in this sector requires that we take into account the influence of both the change in nominal wages and in the price of B-goods on non-tradable prices, as seen in Equation (10) above:

$$dw/w - dp_N/p_N = (dw/w)(1 - 0.1439) - (dp_B/p_B)(0.49) \quad (11)$$

With nominal wages coming down 5 per cent and  $p_B$  falling 15 per cent, the real product wage in non-tradables is found to rise by 3.07 per cent. The effect on employment in this sector is therefore given by  $\varepsilon(L_N; w_N)(L_N/L)(.0307)$  which comes to  $-2.18$  per cent or 18,000 job losses.

These results are summarised in Table 4 below. Comparison with the ESRI results reported in Table 2 indicates that we have come fairly close to replicating their results.

Table 4: *Job Losses from 15 Per Cent Fall in Sterling, with 5 Per Cent Fall in Irish Wages*

Manufacturing	12,000
Building plus Market Services	18,000

#### 4.3 *Effects of the Shock with No Reduction in Nominal Wages*

Our argument is that it may be more plausible to assume that Irish nominal wages would not come down in the event of an unanticipated fall in sterling. This appears to be the lesson of the 1992 currency crisis. We now wish to calculate the employment effects of a 15 per cent fall in sterling under this assumption of downwardly rigid nominal wages.

In this case the real product wage in the B-sector rises by the full 15 per cent fall in  $p_B$ , rather than by 10 per cent as in the previous case. The decline in total employment resulting from the contraction in this sector is therefore larger, at  $\varepsilon(L_B; w_B)(L_B/L)(.15) = -2.65$  per cent, representing a loss of 22,000 jobs. This is not now compensated for by any job gains in the G-sector since real product wages there stay constant, rather than falling 5 per cent as in the previous section.

What of the non-traded sector? Non-traded prices fall less than in the previous case because there is now no downward pressure coming from a reduction in wages; since the elasticity of non-tradable prices with respect to wages is less than unity, though, the real product wage in non-tradables increases further now than in the previous section. In this case we have:

$$dw/w - dp_N/p_N = -(dp_B/p_B)(0.49) = +7.35\% \quad (12)$$

Job losses in non-tradables amount to  $\varepsilon(L_N; w_N)(L_N/L)(.0735)$  of the total workforce; this comes to -5.22 per cent or 44,000 job losses.

If there is no downward adjustment of nominal wages in the event of a fall in sterling, then, total job losses may come to 66,000, more than double the number that emerges in the scenario advanced by the ESRI.

Table 5: *Job Losses from 15 Per Cent Fall in Sterling, with No Reduction in Irish Wages*

Manufacturing	22,000
Building plus Market Services	44,000

#### 4.4 *Effects of the Shock in a "Keynesian" Demand Constrained Environment*

There is one further scenario that we wish to explore; this is the Keynesian demand-constrained case, in which in addition to nominal wage rigidity the price of non-tradables does not adjust downwards to clear the non-traded goods market; quantity adjusts instead (Neary, 1990).<sup>10</sup> The equation

10. Recall that such short-run price stickiness lies at the heart of the exchange-rate overshooting model of Dornbusch (1976).

determining the output of non-tradables remains as represented in Equation (8) above, though  $Y_N$  is no longer dependent on the value of  $(w/p_N)$ .  $Y_N$  now adjusts to equal the right-hand-side of:

$$p_N Y_N = [\theta / (1 - \theta)] [p_G Y_G + p_B Y_B] \quad (13)$$

The elasticity of non-tradable sector output employment is found from this to be:

$$\varepsilon(L_N; e_B) = (\theta / 1 - \theta) [(1 - s_B \varepsilon(L_B; w_B)) / s_N] [Y_B / Y_N] \quad (14)$$

Given our assumptions this yields an elasticity of 1.2347. The reduction in total employment due to the contraction of the non-traded sector in the present case is given by  $\varepsilon(L_N; e_B)(L_N / L)(dp_B / p_B)$ , which amounts to 13.15 per cent of total employment, or a massive 110,000 jobs! All of these jobs are lost in the non-traded sector as a result of output prices failing to fall in response to the collapse in demand. To this must be added the job losses of 22,000 in manufacturing discussed in the previous section of the paper.<sup>11</sup>

Fortunately, however, of the various scenarios discussed this one is the least plausible, because in reality employment adjusts more sluggishly than prices. Before these huge job losses could occur, there would be sufficient time for other factors to adjust, be it the UK real exchange rate or Irish nominal wages and prices.

## V CONCLUSIONS

The results of the various models and scenarios discussed in the paper are gathered together in Table 6.

The similarities in the results obtained from the present model and that of the ESRI, when the same assumptions on wage flexibility are made, suggest that the present macro model may be usefully applied to a broad range of issues; its value relative to the large computer-based ESRI macro model is of course its transparency and ease of use.

11. If we allowed full adjustment of capital stocks in all sectors of the economy, i.e., using Equation (9a) rather than (9b), the employment loss in non-tradables would be less, for two reasons. First, the output fall in the B-sector would be less (as the substitution effect on capital would come into play) and second, downward adjustment of the NT-sector's capital stock would take some of the burden of adjustment off employment levels in that sector; Barry (1987). It is implausible to consider a Keynesian regime lasting long enough for these stock-adjustment effects to come into play, however.

Table 6: *Job Losses from 15 Per Cent Depreciation of Sterling in Various Models*

	<i>Total</i>	<i>T-Sector</i>	<i>NT-Sector</i>
ESRI model: downward adjustment of 5 per cent in nominal wages	25,000	11,000	14,000
Three-sector SOE with 5 per cent adjustment of wages (attempt to replicate the ESRI results using the present model)	30,000	12,000	18,000
Three-sector SOE with no adjustment of wages (the scenario we consider most plausible)	66,000	22,000	44,000
Keynesian model with no adjustment of wages or non-tradable prices	132,000	22,000	110,000

The main issue with which the present paper is concerned is the consequences of downward nominal wage rigidity in the event of a sterling shock.<sup>12</sup> We questioned the assumptions adopted in the ESRI study in the light of the general refusal to renegotiate the national wage agreement at the time of sterling's dramatic exit from the EMS in 1992. If our assumptions are correct, it appears that employment losses could be more than twice as large as the ESRI study predicts. We do not consider the "nightmare scenario" of the Keynesian model to be likely however, for reasons advanced in the text.

The overall conclusion of the ESRI study was that the interest rate benefits that it deemed likely under EMU would narrowly dominate the possible employment losses from sterling weakness. If our assumptions on wage stickiness are more realistic and our estimates of employment losses correct, it suggests that that conclusion may well be overturned and that Ireland should not enter EMU without the UK.

Our argument is further strengthened by the so-called "Stability and Growth Pact". An episode of sterling weakness would bring the automatic stabilisers into effect. If the budgetary limits imposed by the Stability Pact are approached, fiscal contraction would then need to be superimposed on the deflationary effects of exchange-rate developments, worsening the employment situation still further.

12. It might be argued that with productivity growth and some underlying inflation the nominal wage could remain constant while the real (productivity-adjusted) wage fell towards equilibrium levels. However, this more optimistic view is irrelevant if expected inflation and productivity growth continue to be built into long-lasting national wage agreements, as has been the case in Ireland for the last decade or so.

Even if the analysis presented here were to be universally accepted, though, would it necessarily change the minds of policymakers? It may not, in that their thinking seems to be that staying out of EMU would endanger FDI flows, and that the demise of traditional industry is a price we must be willing to pay to continue to attract FDI. As Eichengreen (1993) and Barry (1997b) make clear, however, the empirical evidence on the importance of exchange rate stability for trade and investment flows is in fact quite weak.

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## APPENDIX

### Derivation of Parameter Values Used for Calibration

#### (i) *Share of each good in the CPI:*

Some idea of the importance of Building and Construction and Services in the Irish CPI is given by the direct share of services and housing in the CPI (15 per cent plus 7 per cent) plus the share of wholesale and retail margins (around 13 per cent each) in the remainder.<sup>1</sup> The non-traded sectors will have a share then of around 45 per cent in the CPI<sup>2</sup>, i.e.,

$$\varepsilon(P; p_N) = \theta = 0.45$$

The remaining 55 per cent share is allocated between the sterling-sensitive and DM-sensitive sectors in line with Callan and Fitz Gerald (1989). In a study of the impact of foreign prices on Irish manufacturing prices they find the weight of German prices in Irish wholesale prices to be .6 while the weight of UK prices is .4. Allocating the 55 per cent share of tradables in these proportions yields:

$$\varepsilon(P; e_G) = \alpha = 0.33; \varepsilon(P; e_B) = \beta = 0.22.$$

The ESRI report (p.87) appears to assume, however, that Irish consumer prices are determined by UK consumer prices.<sup>3</sup> Kenny and McGettigan (1997), in contrast, find the tradable component of Irish consumer prices to be

1. Sources: *Statistical Bulletin* and *Annual Services Inquiry*, Dublin: Central Statistics Office.

2. Kenny and McGettigan (1997; data appendix) use a different, but no less arbitrary, disaggregation which implies the share of non-tradables in the CPI is around 30 per cent.

3. If this were the case, the nominal wage in the long run should fall to the same extent as sterling fell; there would therefore be no effect on the B sector, and beneficial effects for the other sectors. Thus sterling weakness would have paradoxical long-run employment effects.

driven one-for-one by a weighted average of UK and German wholesale prices, with the weights given by the share of the UK in Irish trade and by one minus this share. This supports our use of the numbers taken from the Callan and Fitz Gerald (1989) study.

(ii) *Employment Shares*

There is widespread agreement that the modern high-technology sector of Irish manufacturing (much of which is foreign-owned) is insulated from sterling, these goods being priced either in dollars or in DMs (Bartolini, 1993).

Traditional manufacturing, however, is heavily dependent on the UK market or competes on the domestic or on third-country markets against sterling-denominated goods, so it may be reasonable to assume that these goods are priced in sterling.

Baker (1988) uses a tight definition of the modern sectors, so that traditional manufacturing comprises 69 per cent of manufacturing employment (using 1996 figures).

Bradley, Fitz Gerald and Kearney (1993), whose labour-demand elasticities we adopt, use a broader definition of the modern sector (comprising Chemicals plus Metals and Engineering) so their traditional sector is smaller, at 57 per cent. Our preferred measure lies between these alternatives. It is based on a calculation, from the *1993 Census of Industrial Production*, of the number of indigenous and foreign manufacturing jobs dependent on domestic-market plus UK sales. There are two potential errors with this measure, but they work in opposite directions; some home-market sales will be in non-traded sectors, making the estimate of sterling-sensitive sectors too large, but some third-country sales will be competing with sterling-denominated products, making the estimates too small.

Table A1: *Possible Measures of Sterling-dependent Manufacturing*

Baker (1988) definition of Trad Manufacturing	69%
Bradley-Fitz Gerald-Kearney (1993) definition	57%
Indigenous manufacturing (CIP 1993)	56%
Preferred measure (CIP 1993)	60%

The employment data we work with are for 1995, and are taken from *Economic Review and Outlook* (Department of Finance, 1996, Table 12). The relevant sections of this table, along with some other data, are presented below.

The B sector comprises 60 per cent of manufacturing as defined in the

table above, and 61 per cent of manufacturing as we use the term in the text (which includes Mining/Quarrying/Turf). Thus  $L_B/L_M = 61\%$ ,  $L_G/L_M = 39\%$ ,  $L_M/L = 29\%$ , and  $L_N/L = 71\%$ .

Table A2: *Sectoral Employment Levels, 1995, '000s*

(1) Industry of which:	343
(2) Manufacturing	243
(3) Building/Construction	82
(4) Mining/Quarry/Turf	5
(5) Elec/Gas/Water	13
(6) Services of which:	751
(7) Public Sector* of which:	294
(8) Commercial semi-states**	56
(9) Non-Tradables [=(3)+(6)-(7)+(8)]	595
(10) Manufacturing, as defined here [=(2)+(4)]	248
Total (Private Non-Agricultural) Employment [=(9)+(10)] <sup>4</sup>	843

\* Source: CSO *Labour Force Survey 1996*, Appendix G.

\*\* Source: CSO *Public Sector Employment*, June 1996.

### (iii) *Sectoral Labour-demand Elasticities*

The manufacturing-sector labour-demand elasticities are taken from Bradley, Fitz Gerald and Kearney (1993). Their Table 6 indicates that the long-run elasticity in the traditional sector (with output endogenously determined) is around 1 while that in the high-tech sector is around .6.<sup>5</sup>

Bradley, Fitz Gerald and Kearney (1991) in a study of several services sectors find that the labour-demand elasticities there are "generally higher than those observed for the manufacturing sector". We therefore treat the unit elasticity found for traditional manufacturing as a lower bound for services.

4. We ignore agriculture throughout as it is largely constrained by Common Agricultural Policy restrictions.

5. This is in line with expectations since a sector's labour-demand can be written as the elasticity of substitution divided by one minus the cost share for labour, and the cost share for labour is far higher in the traditional sector.



(iv) *Sectoral Contributions to Value Added*

On occasion we need to make some assumptions about the relative contributions of the three sectors, the sterling- and DM-sensitive tradable sectors and the non-traded sector, to Value Added. In the text we work with the approximation that  $Y_G/Y_N = Y_B/Y_N = 0.6$ .

The rationale for this is as follows: *Economic Review and Outlook* (1996) indicates that Value Added in Industry (which is dominated by manufacturing) is about 1.2 times that in Market Services. With respect to manufacturing, what we are interested in is the relative contribution of each sector to aggregate demand rather than to GDP. This is probably more closely approximated by the wage bills of the sterling- and DM-sensitive sectors, which are rather similar, rather than by net output measures (which include profits). These values imply that the fraction of income emanating from non-tradables equals the elasticity of the CPI with respect to non-traded goods' prices.