Paper 112

THE IMPACT OF ENERGY PRICES ON THE IRISH ECONOMY DURING 1973-1981

E. W. HENRY

March, 1983

The

Economic and Social Research Institute

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THE ECONOMIC AND SOCIAL RESEARCH INSTITUTE
COUNCIL, 1982-1983

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THE IMPACT OF ENERGY PRICES ON THE IRISH ECONOMY DURING 1973-1981

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E. W. Henry is a Research Professor of The Economic and Social Research Institute. The Paper has been accepted for publication by the Institute, which is not responsible for either the content or the views expressed therein.

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E. W. HENRY

ISBN 0 7070 0054 8

Acknowledgements

The author acknowledges useful advice from K.A. Kennedy, the late R.C. Geary and R. O'Connor on earlier drafts. Thanks are due to Frank Convery and Peter Bacon for several ideas which have been incorporated in the present draft. The paper has been modified at several points to take account of the advice of the first referee. Tom Reeves of the Department of Industry and Energy provided retail price data. In preparing the final draft, careful attention has been paid to the points made by the second referee.

Pat Hopkins' admirable work on the six graphs will be seen below. The burden of the typing has been cheerfully borne by Mary Cleary and Regina Cosgrove with praiseworthy results. M. McElhone and P. Browne have taken the paper through the final stages of proof reading and publication.

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General Summary

Nine years have passed since the oil crisis of late 1973 issued in the era of escalating energy prices. We have to hand the facts and figures of the years 1973-1981, within which we may treat the year 1973 as a base of comparison. Since then energy prices have generally increased, with two major increases, one in 1974 and the other in 1979, and a minor decrease in 1978.

The demand for energy imports and final energy products in conditions of severe price increase is worthy of study. The paper deals comprehensively with a set of data which are of great inherent economic interest. An important part of the paper is to bring together the various time-series. Presenting the available information in an organised way should provide a public service and make a positive contribution to our knowledge of energy consumption in this country since 1973. In this context it is worth noting that the paper is to be regarded mainly as a descriptive and statistical analysis, intended to provide background knowledge rather than to address issues of causation or appropriate policy responses.

In considering the impact of energy prices on the Irish economy during 1973-1981 and a brief related analysis of a 1987 projection, the following topics and questions are treated:

1. *Methodology*. The basic data of imported energy quantities, values and prices are discussed as a historic time-series; a similar discussion applies to the nine-year final energy deliveries. This so far is non-controversial statistical material. But the effects of imported energy price increases on domestic inflation, terms of trade and the Balance of Payments are also considered as estimates of first-round orders of magnitude, in the sense of National Accounts at constant prices. The logic and validity of such estimates are discussed in this Methodology section, as well as the reasons for making them.

2. *Energy Imports and Total Primary Energy*. In the face of a ten-fold price increase between 1973 and 1980, the import tonnage increased from 6.5 million for 1973 to 7.2 million for 1980. The 1981 tonnage, however, decreased to 6.2 million with a further 19 per cent cost increase over 1980. In this lack of greatly-reduced demand in response to such enormous price increases, we can see the meaning of the word "essential" as applying to energy imports. By contrast, the average price of non-energy merchandise

imports rose by less than three times between 1973 and 1981.

For the two major import groups coal and oil, there is evidence of substitution of coal for oil since 1978 in response to a 1978-1981 coal price increase of 91 per cent, as against 169 per cent for crude oil.

Energy imports have decreased relative to real GDP since 1975 onwards, and for 1973-1981 their volume grew at 1.5 per cent per year, as against 3.5 per cent for real GDP. Likewise, total primary energy (i.e., energy to all users including Bord na Mona, ESB, gasworks, Whitegate refinery) has increased less in volume than real GDP for 1973-1977 showing a 1.4 per cent annual increase versus GDP 3.7 per cent, and for 1977-1981 showing 2.2 per cent annual rate versus GDP rate of 3.0. All of this is long-term movement.

In the short-run one might reasonably expect reduced demand associated with increasing price, and this hypothesis was tested at the quarterly level for the extreme case of sixteen largest quarter-to-quarter import price changes throughout 1973-1981. Results did not support this hypothesis. Not only was there no significant negative correlation between quantity and price, but there were, in fact, three positive correlations and three positive average quantity increases, out of the four experiments tried on these sixteen major price increases. Thus, in the short-run the demand for imported energy would seem to be extraordinarily unresponsive to price increase.

Terms of trade effects of imported energy price inflation mean that as a nation our real income and welfare are reduced because we have to pay a higher price in terms of exports for the same volume of imports. These effects were estimated for the 1973-1981 period, relative to the 1973 one-to-one import-export exchange rate being chosen as price base. Welfare gains occurred in three years and welfare losses in five years. But both gains and losses were only small percentages (between 0.1 and 2.3) of GDP at current prices.

The effects of energy import costs upon the Balance of Payments (BP) have been estimated in terms of above-average cost of energy goods themselves plus corresponding effects arising from energy content of non-energy merchandise imports. The combined effect is zero for 1973 and increases so as to reach the large value of £1,049 million for 1981, before allowance for the amount of this above-average cost passed on through exports. The net effect, after allowance for exports, is equivalent to between 34 and 59 per cent of the import excess each year since 1975 and thus could be an important factor in Balance of Payments considerations, if these first-round estimates be accepted as giving the order of magnitude of the true effect. It is also likely that such above-average effects as calculated are definitely on the low side, because they ignore the relatively high energy intensity of non-energy imports.

3. *Final Energy.* The total energy to final users (i.e., all users excluding Bord na Mona, ESB, gasworks, Whitegate refinery) varied between 5.2 and 6.6 million TOE (tonnes of oil equivalent) during 1973-1981, the maximum occurring in 1979, with a reduction to 6.3 for 1980 and 6.2 for 1981. Amounts purchased by households varied between 1.5 and 2.0 million TOE, comprising a steady 29-30 per cent of the total in all years; the maximum again occurred in 1979. These household purchases exclude some 1 million TOE of petrol for cars.

Gas oil and fuel oil in 1981 were some ten times as expensive as in 1973; electricity and gas some six to ten times; peat, coal, petrol and DERV[1] some three to five times. Retail prices generally showed smaller increases during 1973-81 than the energy import prices.

Because peat and coal showed less rapid retail price rises than other fuels, one may look for solid fuel substitution in place of other fuels. In household consumption, oil products showed a downward trend from 1975 onward, being 21 per cent in 1975 and 13 per cent in 1981. A compensating upward movement is shown by the solid fuel share – so we have solid fuel substituting for oil since 1975. In non-household consumption, oil products showed a downward trend, from 88 per cent for 1973 to 80 per cent for 1981. The other three fuel groups showed upward trends. So here also the oil products have been progressively substituted for by other fuels throughout 1973-1981.

In view of the severe increases of retail prices one would expect, in general, some reduction in the energy intensity of GDP as one goes from 1973 to 1981, and this indeed occurs. For total final energy and real GDP (by sector of origin) the 1973-1974 final energy/GDP average intensity was 1.72, compared with 1.58 for 1979-1980, the latter being 8 per cent smaller than the former. For industry and agriculture the 1979-1980 average intensity of 0.94 was 10 per cent below the 1973-1974 average value of 1.05. For commerce, transport and services (including petrol for private cars) the 1979-1980 average intensity of 1.29 was 9 per cent smaller than the 1973-1974 average of 1.42. But there is no evidence of reduced intensity of final energy to households. The 1973-1974 intensity was 0.65 and that for 1979-1980 was 0.67, the 1981 intensity being 0.66. Thus, the intensity of household demand for final energy has shown no tendency to fall, in the face of a 423 per cent rise in household coal price, a 971 per cent rise in fuel oil price and 617 per cent rise in townsgas price, between 1973 and 1981.

The reaction of final energy demand to annual price increases has been examined under the hypothesis that such short-term reaction should show

1. DERV are the initial letters of "diesel engine road vehicle" and the word is used by the Revenue Commissioners for taxable diesel oil used as road fuel.

quantity decrease significantly associated with price increase. Out of the total of 48 observations for household demand plus petrol for cars, five correlations have been calculated. For all items combined there is an average 2 per cent *increase* of quantity above that of the previous year, in spite of an average 26 per cent price increase over that of the previous year. But the correlation coefficient is negative, of value -0.22, which almost reaches the 10 per cent level of NHP significance. The general impression emerging from the correlation analysis is of large price increases (18-37 per cent) associated with small quantity *increases* (2-4 per cent) and only one small quantity decrease (-2 per cent). But in movements about the mean levels, some items show significant negative correlation of quantity and price. In other words, annual price increases above the average tend to occur in association with annual quantity increases below the average.

4. *Price Inflation Attributable to Above-Average Costs of Energy Imports.* Above-average costs of energy imports and of the energy content of other merchandise imports are taken as being the difference between the actual cost of such imports and what their cost would be if their prices rose in line with those of non-energy imports. Such above-average costs can be examined as possible sources of price or cost inflation of imports, of Final Demand, and of GDP, Final Demand being the aggregate of household and government consumption, capital formation, exports. A summary of the assumptions underlying such price inflation estimates is given in the conclusions section.

For total imports, the above-average cost of energy imports, and of energy content of non-energy merchandise imports, might possibly have a price inflation effect of between 8 and 16 per cent per year, the largest values occurring during 1979-1981, for the stated assumptions. During these recent years almost all price inflation of imports is equivalent to, or could be attributed to, such above-average cost of energy imports.

Such cost could account for one-quarter or less of year-to-year price inflation of total Final Demand during 1974-1977. But for 1978-1981 it could account for about one-third of such price inflation of Final Demand. Thus, this energy effect is of considerable importance, as an actual or potential factor of Final Demand price inflation.

For 1977-1981 such above-average energy import costs are of magnitude 3 to 7 per cent of GDP at current prices and one-third to one-half of GDP year-to-year price inflation. Thus these costs could possibly account for one-third to one-half of GDP year-to-year price inflation in recent years, if the stated assumptions hold true.

An input-output (I-O) analysis of 1980 illustrates how imported energy price inflation can be allocated to sub-sectors of Final Demand such as

household expenditure. At 1980 prices, energy imports comprise 7 per cent of aggregate Final Demand, being 10 per cent of household expenditure and 3 per cent of government current expenditure; thus within Final Demand as a whole, there is considerable variation of energy intensities between different sub-sectors. These I-O results can be used to give orders of magnitude of price inflation of Final Demand arising through energy imports, on the assumption that rises in costs of energy imports are fully passed on to the Final Demand consumer, and that second-round, etc., effects are much smaller than first-round effects. For example, the energy import cost of 1980 household expenditure is 10 per cent, thus under the stated assumptions, a 50 per cent rise in energy import unit cost would add 5 per cent to the cost of household expenditure, i.e., give an average price increase of 5 per cent. Likewise, a 50 per cent rise in energy import unit cost would give rise to price inflation of 1½ per cent for government current expenditure, 3 per cent for both capital formation and exports and 3½ per cent for aggregate Final Demand.

5. *Economic Implications of Assumed Future Energy Import Prices and Inter-fuel Substitution.* Some of the economic implications of assumed future energy import prices and possible inter-fuel substitution may be considered in connection with imports and the Balance of Payments. Energy policy and projections for the years 1985 and 1987 are treated in *The Way Forward* (1982) document of the previous government. It is likely that similar energy policy will be pursued by the new government.

In order to see how stated policy objectives affect the 1987 demand, one may compare the 1987 Plan structure with the 1981 actual structure. The 1987 total primary energy/GDP ratio is 10 per cent below that of 1981. If this 10 per cent decrease were fully reflected in decreases of oil imports, it would mean a 1987 import saving of £180 million at 1981 prices. One may also estimate how much import cost the Plan would save, by reference to the 1987 structure that would exist if that of 1981 were uniformly scaled up to give the 1987 Plan aggregate primary energy quantity. This comparison shows for the Plan an *extra* 925 thousand TOE of imported coal combined with a reduction of 1,459 thousand TOE of imported oil. Because of coal being cheaper than oil, this net result would mean a reduction of £156 million of import cost by the 1987 Plan.

The Plan policy results can be put into a scheme of import cost reduction and improved Balance of Payments (BP), for the assumption of one-third of energy import cost effects being passed on through exports, thus leaving two-thirds for domestic Final Demand. Getting the 1987 primary energy/GDP ratio down to 90 per cent of that of 1981 would mean a supposed £120m.

BP improvement. Peat production increase above that of 1981 would mean £52m. BP improvement. Corresponding increased Kinsale Gas production would mean £48m. BP improvement. Increasing coal imports to replace oil imports would mean a further £49m. BP improvement. These four changes are all included in the Plan and represent £269m. of BP improvement at 1981 prices, all in terms of reduced oil imports or replacement of oil by coal. Such planned improvement would be significant.

Two further price reductions are possible: a fall in imported oil price to £100 per TOE and a fall in imported coal price to £70 per TOE. These would mean further BP improvements of £203m. and £36m., respectively for 1987.

The combined result of these six changes in 1987 would mean £508m. BP improvement (and £762m. reduction of import cost). For 1981, Final Demand structure scaled up uniformly so as to give the 1987 Plan aggregate, the BP deficit would be £1,848m. Thus, in terms of 1981 structures the improvement of the 1987 BP due to £508m. would reduce it by 27 per cent, which is considerable.

1. *INTRODUCTION*

Nine years have passed since the oil crisis of late 1973 issued in the era of escalating energy prices. We have to hand the facts and figures of the years 1973-1981, within which we may treat the year 1973 as a base of comparison. Since then energy prices have generally increased, with two major increases, one in 1974 and the other in 1979, and a minor decrease in 1978.

The demand for energy imports and final energy products in conditions of severe price increase is worthy of study. The paper deals comprehensively with a set of data which are of general inherent economic interest. An important part of the paper is to bring together the various time-series. Presenting the available information in an organised way should provide a public service and make a positive contribution to our knowledge of energy consumption in this country since 1973. In this context it is worth noting that the following essay is to be regarded mainly as a descriptive and statistical analysis, intended to provide background knowledge rather than to address issues of causation or appropriate policy responses.

In considering the impact of energy prices on the Irish economy during 1973-1981 and a brief related analysis of a 1987 projection, the following topics and questions will be treated:

(a) *Methodology*. The basic data of imported energy quantities, values and prices will be discussed as a historic time-series; a similar discussion will apply to the nine-year final energy deliveries. This so far is non-controversial statistical material. But the effects of energy price increases on domestic inflation, terms of trade and the Balance of Payments will also be considered, as estimates of first-round orders of magnitude, in the sense of National Accounts at constant prices. The logic and validity of such estimates will be discussed in this section, as well as the reasons for making them.

(b) *Energy Imports*. The first block of historical data comprises the imported fuels during 1973-1981, at the level of seven items as well as the total. Quantities, values and prices will be considered. In view of the greater price increases of oil than coal, the extent of inter-fuel substitution will be reviewed. Also in this context the energy/GDP ratios will reveal how aggregate demand for imported energy responded to increasing prices.

Short-term reaction of demand to price increases will be analysed by means of quarterly changes, at the level of four fuel groups, and the correlation coefficients tested for significance.

In our external trading two related measures are crucially important: (a) the terms of trade, (b) the Balance of Payments. Both these measures will be considered, under the methodological approach put forward as appropriate, so as to estimate how much they are affected by rapidly-increasing imported energy prices.

(c) *Final Energy*. The second block of historical data comprises the final energy deliveries during 1973-1981, final energy being items such as coal for domestic fires, petrol for cars, electricity and townsgas. Because energy imports are not the whole story, a more complete account of the energy-economy relationships must include native fuels such as peat and Kinsale Gas. Such an account is provided by the final energy statistics, which comprise historical quantities and retail prices, at the level of eleven items, as well as the total. The analysis closely resembles that described above for energy imports, but without quarterly statistics, which are not available.

(d) *Price Inflation of the Irish Economy via Energy Imports*. Under the methodological approach described in its own section of this paper, one may estimate various first-round inflation effects of imported energy price rises. The first item thus considered will be how much aggregate import prices have been increased by energy import price increases. Further items for analysis will be GDP and aggregate Final Demand. Here the energy import price effect can be thought of as arising in two ways: (i) via the fuel imports themselves; (ii) via the energy content of non-energy imports. It is appropriate to mention here that these energy price effects come from energy costs only, in an accounting or arithmetic sense, and *do not* include effects of attempted wage compensation, parallel increases in pricing of native fuels and so on. As a final part of the imported energy price inflation analysis, there is an input-output analysis of the year 1980, so as to illustrate how imported energy inflation spreads through the various Final Demands.

(e) *Economic Implications of Assumed Future Energy Import Prices and Inter-Fuel Substitution*. This part of the paper examines such economic implications, by means of simulation exercises, directly arising from the analysis so far described. Within the framework of the Government Plan *The Way Forward*, one may look at the energy projections for, say, 1987

in several ways. It is likely that similar energy policy will be pursued by the new government. The 1987 energy/GDP ratios are smaller than those of 1980 and 1981. It is, therefore, possible to estimate the savings of energy imports (at, say, 1981 prices) resulting from such decreasing ratios. The implied substitution of coal and Kinsale Gas for imported oil can also be priced in terms of import savings. Hypotheses about changes in imported oil prices themselves can also be made and resulting import cost effects estimated. All of these changes in import costs can, of course, be put in a Balance-of-Payments setting.

(f) *Conclusions.* This section contains a summary of the key conclusions reached in relation to each question and topic considered throughout the paper.

2. *METHODOLOGY*

The basic methodology is descriptive and statistical, involving energy quantities, prices and values. There are some Pearson correlations calculated for quarterly price changes and related quantity changes; the usual NHP test of significance is used. There are also the usual and typical calculations of the economic statistician, e.g., volume indices, implicit price indices, and so on, mainly in the appendices.

There are various calculations of values of energy imports at constant prices, i.e., at prices other than actual. These kinds of calculations are done by Central Statistics Office either explicitly or implicitly as part of the annual set of National Accounts at constant prices, which require deflated values of exports and imports and so on. Any copy of *National Income and Expenditure* contains tables of national accounting items at constant prices. The August, 1982 issue of the ESRI *Quarterly Economic Commentary* has a Table I for National Accounts 1981-1982. This table shows values for 1981 and 1982, with the 1982 change from 1981 broken down into a volume change and a price change.

Such volume changes and sets of National Accounts at constant prices are used by governments everywhere to measure economic growth and changes at constant prices. There is a theoretical objection to such measures, and this objection will now be considered, together with a rejoinder which qualifies the interpretation of such constant price results.

Theoretical Objection and a Rejoinder

The main theoretical objection to such constant price calculations is that elasticities of demand exist with respect to price, and that, therefore, if (say) 1980 prices applied in 1981, the 1981 quantities of goods and services demanded would, of course, *not be the same* as those observed for 1981 at 1981 prices. Thus, there is a logical flaw in calculation of 1981 observed quantities at 1980 prices and such calculations give invalid results. In other words, conventional National Accounts at constant prices and related volume changes are inaccurate and, therefore, invalid.

This kind of objection and a rejoinder has been adequately discussed by Nolan (1981) in his paper "Redistribution of Household Income in Ireland by Taxes and Benefits", in the parallel situation of household income and spending with or without a particular tax or benefit. The hypothetical

"without" situation does not exist in fact, but must be at least considered. He summaries:

> To see the *impact* of a particular tax or benefit, or of the tax and benefit system as a whole, we must compare the situation with the tax, benefit or system in existence with that which would hold without the tax, benefit or system. The approach used in the CSO study, and in other such exercises, obviously does not provide this comparison, and the results presented in the study, and in this paper, must be seen in this light. The distribution of direct income, for example, is the distribution of observed pre-tax and pre-benefit income in the presence of taxes and benefits, not income as it would be in the absence of taxes and benefits.
>
> So what do such studies tell us? In the first place, they give us essential information on the *flows* of taxes and benefits to and from particular groups of households in a given year – a "snapshot", as Nicholson and Britton (1975) put it, of the tax and transfer system in operation. The analogy used by the UK CSO in describing their exercise is instructive: "In the sense that they use a set of accounting conventions recording the outcome of the circumstance prevailing in a given year, the estimates are closely analogous to Blue Book estimates of national income and expenditure". Secondly, they give us an idea of the size of first-round effects of changes in taxes or benefits: this information must be used in conjunction with research on behavioural relationships if we are to go further, but if these limitations are taken into account, they can be of great use (page 83).

Methodology Used in this Paper for Pricing and Price Effects

It is a fact that National Accounts at constant prices as conventionally calculated are widely used as if they were completely accurate. Likewise for volumes or aggregates which contain quantities at constant prices, either explicitly or implicitly (via deflation by a price index). But in the light of the discussion of the previous section, such results are merely approximations, to express orders of magnitude and give an idea of the size of first-round effects of various changes.

No further claim than this is made for the accuracy of the various price effects of energy imports or of the volume and ratio calculations made throughout the rest of this paper. To show orders of magnitude of things, in the sense of National Accounts at constant prices, is the objective. The energy price effects on import costs, Balance of Payments, etc., are so large

that first-round orders of magnitude are useful information. But a further justification for such an approach to energy imports is their *extraordinary inflexibility of response to price changes* in the short-run, as will appear below in the Part 3 analysis of quarterly movements in prices and quantities. In other words, the volumes of energy imports are scarcely affected at all by price changes, and therefore one has strong grounds for applying price changes to such invariant quantities in estimating price inflation effects arising from energy imports.

This brings us to a further major method used in the paper — price changes are applied to imported quantities of energy commodities or to the energy content of non-energy imports. The resulting import cost changes are then compared directly with GDP or Final Demand, as estimates of energy-import price inflation. In the light of the previous discussion, such estimates give first-round results satisfactorily. There is the omission of domestic reaction such as wage increases, parallel pricing of native energy products, and so on. The justification for such omissions is that in National Accounting, imports as such always appear as a separate entity, and that therefore any price modifications of imports have a direct first-round impact on the magnitude of GDP, without reference to further effects estimable by behavioural theory and econometric modelling.

The final major method of estimation is a 1980 input-output (I-O) analysis of the economy so as to explore how energy import price inflation is passed on to different Final Demand sectors, e.g., Household Expenditure, Exports. Conventional I-O costing methodology is used, whereby via primary inputs costs are passed on to Final Demand. These I-O results are again first-order approximations to what would emerge from a behavioural-econometric study, and are to be so understood.

In view of the fairly lengthy discussion of methodology in this part of the paper, little reference will be made elsewhere to the meaning or precision of results. If in all cases they are regarded as first-order approximations to what would emerge from more elaborate treatment (in the behavioural-econometric sense), then mistaken impressions as to their precision will not arise.

3. *ENERGY IMPORTS AND TOTAL PRIMARY ENERGY*

Historical Quantities and Values

The imported energy quantities and values during 1973-1981 are shown in Table 1. Seven kinds of fuels are distinguished, as well as their aggregate quantity and value for each year. An aggregate of the five oil products also appears. All quantities are given in thousands of metric tonnes, exactly as shown in the *Trade Statistics of Ireland.* No conversion into tonnes of oil equivalent (TOE) has been performed, as this was not considered relevant for the present section. All values and prices in Table 1 and elsewhere are in Irish pounds, even where this is not explicitly stated.

In TOE amounts, fuel imports are 77-82 per cent of Irish total primary energy for the nine years being considered. *Energy in Ireland* 1979-1981 issues show the shares of total primary energy due to imports and native resources for those years. Native resources comprise peat, hydro, a very small amount of coal, and Kinsale natural gas for 1979-1981. We see, therefore, that the Table 1 figures for energy imports cover most of the energy supplies since 1973.

The story told by Table 1 is rather startling. The aggregate picture shows the import tonnage increasing from 6.5 million for 1973 to 7.2 million for 1980, in the face of a ten-fold current price increase – from £71 million to £771 million. The year 1981 shows a reduction to 6.2 million tonnes, for a further £150 million cost increase over 1980.

The pattern of increasing quantities matched by extraordinary current price increases occurs throughout the three major fuel groups. The coal group increases its tonnage of 0.9 million in 1973 at £9 million to 1.3 million in 1981 for £86 million. Similarly the oil group moves during 1973-1980 from 5.6 million tonnes to 5.9 million, with a ten-fold price increase, and costs rising from £60 million to £690 million. There is a sharp quantity decrease of 1.2 million tonnes between 1980 and 1981, for a cost increase of £115 million. The gas group tonnage goes from roughly 60 to 150 thousand tonnes, with the cost increasing from £1.2 million to £27 million. The only years throughout 1973-1981 to show a noticeable drop in quantity are 1975, 1976, and 1981.

Fuel Import Price per Tonne

The price and quantity data of Table 1 have been used to calculate price

Table 1: *Ireland, imports of energy products 1973-1981 quantities and values*

Item	*1973*	*1974*	*1975*	*1976*	*1977*	*1978*	*1979*	*1980*	*1981*
	Quantity, thousand tonnes								
Coal, coke and briquettes	861.17	900.71	696.81	618.58	878.07	849.46	1226.67	1213.71	1308.17
Crude petroleum	2465.07	2625.06	2405.86	1698.74	2183.61	2067.76	2027.22	2113.99	652.68
Motor spirit	493.80	546.75	563.77	569.74	383.54	414.76	477.25	556.36	851.49
Kerosene and white spirit	313.48	238.35	311.97	414.02	526.11	577.43	680.13	546.74	452.52
Distillate fuels	696.30	432.75	515.09	606.65	631.16	718.16	870.80	798.83	1082.88
Residual fuel oils	1625.40	1726.94	1544.19	1797.26	1811.95	1735.47	1891.40	1854.31	1700.01
(Total oils)	(5594.05)	(5569.85)	(5340.88)	(5086.41)	(5536.37)	(5513.58)	(5946.80)	(5870.23)	(4739.58)
Gas, natural and manufactured	59.07	60.07	66.71	96.78	109.93	105.82	133.86	148.84	153.34
Total	6514.29	6530.63	6104.40	5801.77	6524.37	6468.86	7307.33	7232.78	6201.09
	Value IR£000								
	1973	*1974*	*1975*	*1976*	*1977*	*1978*	*1979*	*1980*	*1981*
Coal, coke and briquettes	9,331	16,611	15,211	15,249	27,043	29,354	47,435	59,175	86,429
Crude petroleum	22,364	84,567	92,385	85,585	129,726	112,918	129,411	222,421	95,914
Motor spirit	8,762	28,087	31,501	46,726	33,566	33,994	63,258	97,729	199,491
Kerosene and white spirit	5,464	12,192	16,964	28,918	41,924	44,869	89,164	90,988	96,075
Distillate fuels	8,907	19,593	24,829	38,824	44,548	49,336	101,661	118,737	206,828
Residual fuel oils	14,815	53,089	48,370	70,475	86,080	75,191	119,746	160,353	206,575
(Total oils)	(60,312)	(197,528)	(214,049)	(270,528)	(335,844)	(316,308)	(503,240)	(690,228)	(804,883)
Gas, natural and manufactured	1,222	2,250	3,794	7,206	9,575	9,044	12,585	22,001	27,339
Total	70,865	216,389	233,054	292,983	372,462	354,706	563,260	771,404	918,651

Sources: *Trade Statistics of Ireland*, December 1974, 1976, 1978, 1980, 1981. For later years "kerosene and white spirit" is taken as "kerosene" plus "other light oils", "distillate fuels" is taken as "gas oils", "residual fuel oils" is taken as "fuel oils n.e.s."

per tonne for each of the fuels, as set out in Table 2. This table also shows the ratio of 1981 average price to 1973 average price for the different fuels aggregate energy imports and for non-energy merchandise imports. The latter serve as a basis of comparison against which energy price rises can be considered. Figure 1 illustrates some of the data of Table 2.

The coal group shows a continuous year-by-year price increase per tonne between 1973 and 1981, so that the 1981 price is 6.1 times that of 1973. But this price increase is quite mild compared with that of the oil and gas groups.

Each product of the oil group shows a drop in price in 1978 compared with 1977; otherwise prices are rising year by year. This 1978 price drop was due to a rise in the dollar exchange rate, as will be explained below. In 1974 these products typically trebled their 1973 prices. Large increases again occur between 1975 and 1976 and again throughout 1979-1981. For oil products the 1981 price per tonne was between 12 and 16 times its 1973 price.

The gas price behaves in much the same way as do the oil prices, showing a drop in 1978 compared with 1977. The 1981 price is 8.6 times that of 1973.

For total energy imports the average 1981 price per tonne is 12.2 times that of 1973. This average price was obtained as the aggregate of 1981 quantities valued at 1981 prices divided by the aggregate of the same 1981 quantities valued at 1973 prices. The quantities are those of Table 1 and the prices those of Table 2. This energy price ratio of 12.2 means on average a compound price increase of 37 per cent per year each year since 1973, a huge increase compared with domestic price inflation of about 16 per cent per annum on average, derived from the Personal Expenditure data of Appendix 4. The year-to-year increases of these prices are highly variable; such variability will be discussed below at the level of quarter-to-quarter changes in the section dealing with reaction of demand to price increases.

Non-energy merchandise imports have a 1981 price ratio of 3.69, obtained in the way set out in Appendix 2. This price ratio is less than one-third that for the energy products and is equivalent to a price rise of 17.7 per cent per year since 1973, this rate of price increase being larger than the 14 per cent inflation rate of Irish Gross Domestic Product since 1973, the latter calculated in Appendix 4.

In summary, since 1973 the price per unit of energy imports has been increasing on average at 37 per cent per year, compared with 18 per cent for non-energy merchandise imports and 14 per cent for GDP. Thus, imported energy price inflation is about three times that of GDP for the last eight years.

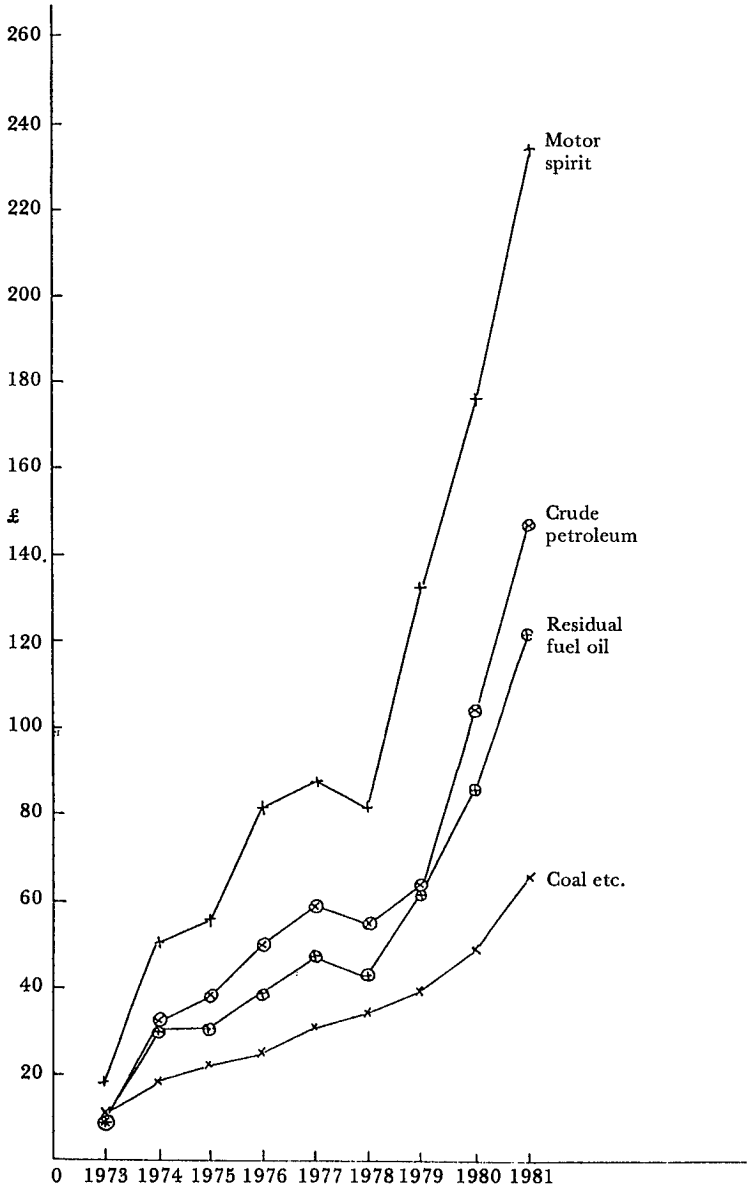
It is worthwhile to consider the phases in price increases in terms of US dollars, since dollar payments have been required by OPEC throughout the period. Such crude oil prices are calculated in Appendix 7, which applies

Table 2: *Ireland, imports of energy products 1973-1981, price per tonne and derived ratios (prices)*

Item	*Price per tonne in IR£*									*1981 price ÷ 1973 price*
	1973	*1974*	*1975*	*1976*	*1977*	*1978*	*1979*	*1980*	*1981*	
Coal, coke and briquettes	10.84	18.44	21.83	24.65	30.80	34.56	38.67	48.76	66.07	6.10
Crude petroleum	9.07	32.22	38.40	50.38	59.41	54.61	63.84	105.21	146.95	16.20
Motor spirit	17.74	51.37	55.88	82.01	87.52	81.96	132.55	175.66	234.28	13.21
Kerosene and white spirit	17.43	51.15	54.38	69.85	79.69	77.70	131.10	166.42	212.31	12.18
Distillate fuels	12.79	45.28	48.20	64.00	70.58	68.70	116.74	148.64	191.00	14.93
Residual fuel oils	9.11	30.74	31.32	39.21	47.51	43.33	63.31	86.48	121.51	13.34
Gas	20.69	37.46	56.87	74.46	87.10	85.47	94.02	147.82	178.29	8.62
Total energy imports										12.15
Non-energy merchandise imports										3.69

Source: Table 1 quantities and values. For non-energy merchandise imports, see Appendix 2. The price ratio for total energy imports is 918.65/75.60, both these figures are explained in Appendix 2 and representing the ratio of 1981 imports at 1981 prices to 1981 imports at 1973 prices.

Figure 1 (Table 2): *Ireland, imports of energy products, 1973-1981, price per tonne*



Coal etc. x, Crude petroleum ⊗, Motor Spirit +, Residual fuel oil ⊕

Dublin Market US$ exchange rates to Table 2 IR£ prices per tonne. The final column of Appendix 7 shows the year-to-year percentage increases in the dollar price per tonne of crude oil, thus calculated. There are four fairly large increases. The largest, namely 244 per cent, occurred in 1974. There was 17 per cent in 1977, 25 per cent in 1979 and 66 per cent in 1980. The price in dollars shows a 1 per cent increase in 1978 compared with 1977, thus a decrease in 1978 is true only for the IR£ price, not for the dollar price. (In 1977 the dollar per IR£ was 1.7455, compared with 1.9197 in 1978).

Inter-fuel Substitution within Imports

In view of the price rise of coal being so much less than those of the oil products during 1973-1981, as shown by the ratios of the last column of Table 2, one would expect substitution of coal for oil, to the extent that fuel-consuming apparatus permitted. Table 3 shows the shares of total imports held by the three groups, coal, oil, gas, during 1973-1981. It is seen that between 1973 and 1978 coal and oil showed no trend for small increases in the negligible share taken by gas. But between 1978 and 1981 the share movements have been in accordance with expectations of price effects: the coal share has increased from 13.1 per cent to 21.1 per cent; the oil share has decreased from 85.2 per cent to 76.4 per cent. The gas share shows a tendency to increase throughout the period, going from 0.9 per cent fo 1973 to 2.5 per cent for 1981.

In summary, for the two major import groups, coal and oil, there is evidence of substitution of coal for oil since 1978, in response to less rapid price increases of coal than oil. Table 2 data show a 1978-1981 price increase of 91 per cent for the coal group, as against 169 per cent for crude oil and 180 per cent for residual fuel oil.

Table 3: *Ireland, imports of energy products 1973-1981, percentage shares of total taken by three fuel groups*

Fuel group	*1973*	*1974*	*1975*	*1976*	*1977*	*1978*	*1979*	*1980*	*1981*
Coal	13.2	13.8	11.4	10.7	13.5	13.1	16.8	16.8	21.1
Oil	85.9	85.3	87.5	87.7	84.9	85.2	81.4	81.2	76.4
Gas	0.9	0.9	1.1	1.7	1.7	1.6	1.8	2.1	2.5
Total	100-	100-	100-	100-	100-	100-	100-	100-	100-

Source: Table 1 quantities.

Energy Related to Gross Domestic Product

Energy quantity, cost and growth rate can be related to GDP in several ways. Tables 4 and 5 and Appendix 3 comprise the subject matter for some such comparisons. Figure 2 illustrates some of the data of Table 4.

Table 4 shows the detail of valuing the energy imports volume at 1975 prices. The volume aggregate increases in value from £246 million for 1973 to £274 million for 1980, and then decreases to £240 million for 1981. This gives a compound growth rate of 1.5 per cent per year between 1973 and 1980. The final column of Table 4 shows that between 1973 and 1981 the different items had highly variable growth rates, with the aggregate being 2 per cent below that of 1973. This aggregate is one measure of the volume of energy imports during 1973-1981 and can be compared with a volume measure of GDP, as will appear below.

Table 5 juxtaposes energy imports with GDP, at current and at 1975 prices. GDP at 1975 prices is a measure of GDP volume. It ranges from £3,509 million for 1973 to £4,568 million for 1981, giving a compound annual growth rate of 3.4 per cent. The third row of Table 5 shows energy imports at 1975 prices as a percentage of GDP at 1975 prices. The percentage is 7.0 for 1973 and 6.6 for 1974 and is well below these levels for later years, the 1981 value of 5.2 being the smallest. We may conclude that energy imports have decreased relative to real GDP from 1975 onwards.[2] Another way of verifying this is to notice that throughout 1973-1981 the volume of energy imports grew at 1.5 per cent per year as against 3.5 per cent for GDP. This gives an imported energy "growth ratio" of 0.43, the quotient of 1.5 by 3.5. This growth ratio is well below unity, and is one indication of possible conservation effects of energy price inflation. For example, the growth ratio for 1968-1973 has been quoted as having the value of 1.77 in a Henry 1977 article in *Technology Ireland.*

The last three rows of Table 5 show energy imports compared with GDP, both being at current prices. Energy cost as a percentage of GDP illustrates how rapid was energy import price inflation compared with GDP inflation. We have just seen that imported energy volume grew less than GDP volume, yet energy cost increased from 2.6 per cent of 1973 GDP to 8.8 per cent of 1981 GDP. In this context it might be mentioned that increases in the price of home-produced energy only mean a redistribution of income within the country.

2. For the years 1963-1971 the energy imports/GDP ratio can be estimated as follows:

	1963	*1965*	*1967*	*1969*	*1971*
Energy imports, £million at 1975 prices	117.98	136.93	170.96	176.95	243.69
GDP, " " " "	2259.4	2400.8	2549.2	2923.1	3147.8
Energy imports, as percentage of GDP	5.22	5.70	6.71	6.05	7.74

Table 4: *Ireland, imports of energy products 1973-1981, value at 1975 prices*

Item	*IR£'000 at 1975 prices*									*Ratio of 1981 value to 1973 value*
	1973	*1974*	*1975*	*1976*	*1977*	*1978*	*1979*	*1980*	*1981*	
Coal, coke and briquettes	18,799	19,662	15,211	13,504	19,168	18,544	26,778	26,495	28,557	1.52
Crude petroleum	94,659	100,802	92,385	65,232	83,851	79,402	77,845	81,177	25,063	0.26
Motor spirit	27,594	30,552	31,503	31,837	21,432	23,177	26,669	31,089	47,581	1.72
Kerosene and white spirit	17,047	12,961	16,965	22,514	28,610	31,401	36,985	29,732	24,608	1.44
Distillate fuels	33,562	20,859	24,827	29,241	30,422	34,615	41,973	38,504	52,195	1.56
Residual fuel oils	50,908	54,088	48,364	56,290	56,750	54,355	59,239	58,077	53,244	1.05
Gas, natural and manufactured	3,359	3,416	3,794	5,504	6,252	6,018	7,613	8,465	8,720	2.60
Total	245,928	242,340	233,049	224,122	246,485	247,512	277,102	273,539	239,968	0.98

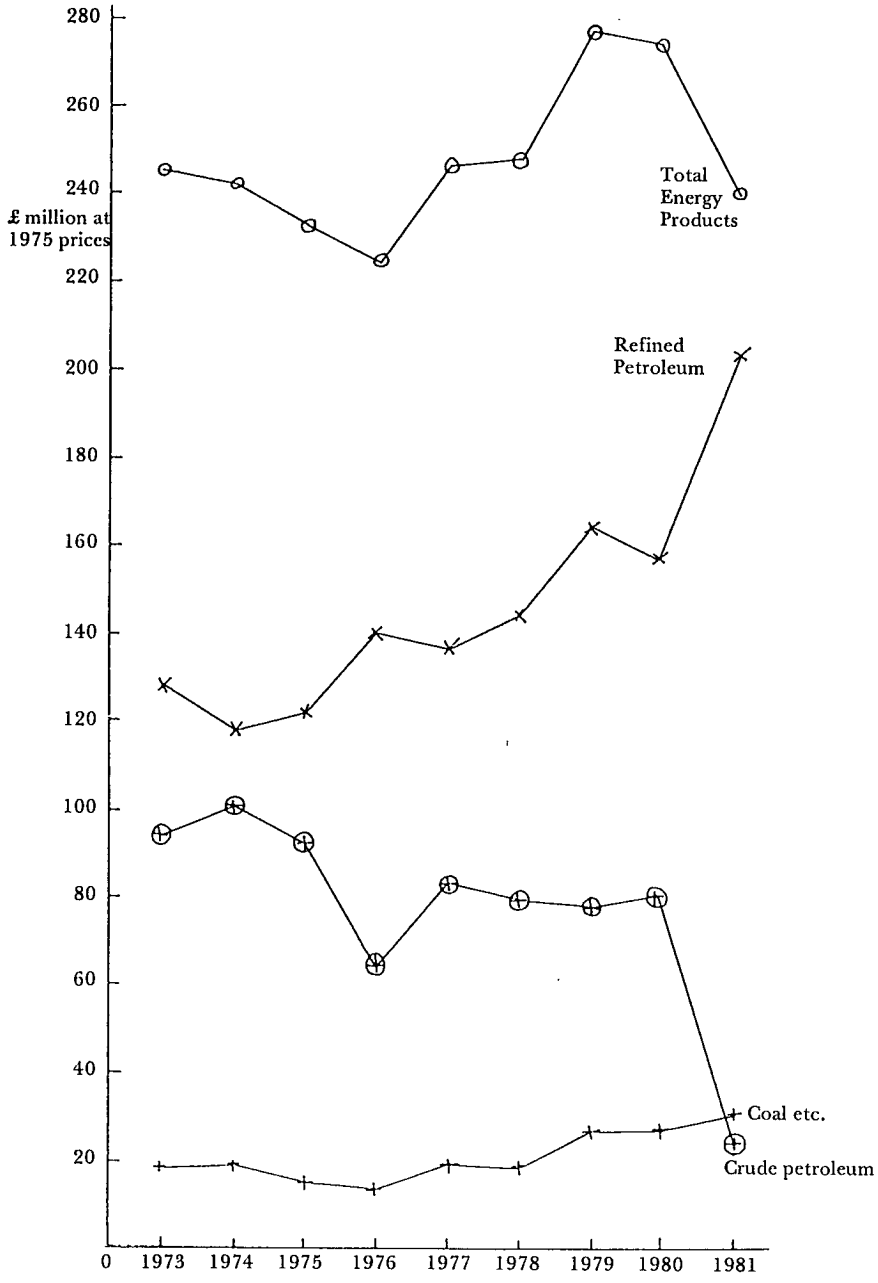
Source: Table 1 quantities, Table 2 1975 prices.

Table 5: *Ireland, imports of energy products 1973-1981, as percentages of GDP at 1975 prices and at current prices*

Item		*1973*	*1974*	*1975*	*1976*	*1977*	*1978*	*1979*	*1980*	*1981*
Energy imports at 1975 prices, £ million	(1)	245.928	242.340	233.049	224.122	246.485	247.512	277.102	273.539	239.568
Gross Domestic Product at 1975 prices, £ million	(2)	3509	3658	3731	3804	4064	4303	4404	4520	4568
(1) as a percentage of (2)	(3)	7.01	6.62	6.25	5.89	6.07	5.75	6.29	6.05	5.24
Energy imports at current prices, £ million	(4)	70.865	216.389	233.054	292.983	372.462	354.706	563.260	771.404	918.651
Gross Domestic Product at current prices, £ million	(5)	2703	2991	3731	4570	5491	6436	7462	8731	10,389
(4) as a percentage of (5)	(6)	2.62	7.23	6.25	6.41	6.78	5.51	7.55	8.84	8.84

Sources: Energy Imports, Tables 1 and 4. Gross Domestic Product, *Economic Review and Outlook Summer 1982*, Tables 3(a) and 3(b).

Figure 2 (Table 4): *Ireland, imports of energy products, 1973-1981, value at 1975 prices*



Coal etc. +, Crude petroleum ⊕, Refined Petroleum X, Total energy products ⊙

An unsatisfactory aspect of the discussion based on Tables 4 and 5 is that it considers energy imports only, rather than total energy. Appendix 3 has been prepared in order to compare the volume of total primary energy with the volume of GDP at 1975 prices. It shows, for example, 7083 thousand tonnes of oil equivalent for 1973 and 8159 for 1981. The energy/GDP volume index ratio shown in Appendix 3 is relatively high for 1973, 1974 and 1979, and relatively low for other years, the 1981 value being the lowest of all.

Let us examine two growth ratios derived from Appendix 3 data, for total primary energy versus GDP at 1975 prices, one ratio for 1973-1977 and the other for 1977-1981. For 1973-1977 total energy grew at 1.4 per cent per year and GDP at 3.7 per cent, yielding a growth ratio of 0.38 given by 1.41/3.74. For 1977-1981 total energy grew at 2.2 per cent and GDP at 3.0 per cent, giving a growth ratio of 0.73. This shows that in the short-term the growth ratio can fluctuate considerably.

Reaction of Demand for Energy Imports to Short-term Price Changes

For the 1973-1981 period quarterly imports are given in Appendix 6, with quantities, values and derived prices per tonne shown for each of four fuel groups: solid fuel, crude oil, refined oil, liquid gas. The quarterly issues of *Trade Statistics of Ireland* enabled these quantities and values to be derived, e.g., January-June figures less January-March figures give the second-quarter figures (April-June).

Appendix 6 price data have been used to calculate the quarterly price changes shown in Table 6, for the four fuel groups named above. Most of the percentage price changes from the previous quarter are positive, and some of them very large. We shall be considering the largest in Tables 7 and 8. The bottom of Table 6 shows that the mean price change per quarter for each of the four fuels is positive, in the range 6.6-11.7. The changes for each fuel show high variability, having coefficients of variation in the range 2.1-2.9.

It is reasonable to expect reduced demand being associated with increasing price in the short run, and this hypothesis is most likely to apply to the largest price changes and so is tested for the 16 largest price changes of Table 6: four changes for each fuel. These 16 largest price changes, with related quantity changes, are set out in Tables 7 and 8. The related quantity changes require some explanation. Those of Table 7 are given by the quantity in the quarter of price change plus the quantity of the following quarter, compared with aggregate quantity of corresponding two quarters one year earlier. The quantity changes of Table 8 are all derived from quarterly data compared with that of one year earlier, the selected quarters being that of the large price change, the following quarter, and the next or second follow-

Table 6: *Ireland, percentage price change from previous quarter, for each of four energy import groups*

Quarter	*Solid fuel*	*Crude oil*	*Refined oil*	*Liquid gas*
1973 II	-3.4	-0.4	6.1	-25.5
III	-15.2	-2.4	17.3	-2.2
IV	16.7	2.8	12.0	-16.6
1974 I	52.5	89.1	120.0	93.0
II	0.9	153.9	29.9	12.7
III	-12.1	-18.8	-8.2	10.8
IV	90.6	1.4	4.6	0.1
1975 I	-26.8	1.4	0.0	33.3
II	12.0	0.2	-0.9	1.2
III	-9.1	5.0	2.1	8.4
IV	7.3	9.7	12.6	-1.5
1976 I	2.0	10.4	1.1	18.1
II	4.6	2.8	10.1	4.9
III	5.8	9.2	18.9	2.7
IV	-2.2	8.1	2.2	5.8
1977 I	13.3	1.6	-1.9	11.8
II	6.4	3.6	1.5	-2.1
III	3.3	-1.0	-2.3	-0.8
IV	5.1	6.4	7.5	0.4
1978 I	2.5	-12.7	-8.4	-1.0
II	5.3	1.8	0.0	0.0
III	-3.7	-0.3	0.3	0.4
IV	3.1	-4.4	0.1	-0.8
1979 I	-6.2	0.0	16.3	-0.8
II	3.6	6.8	36.8	8.2
III	15.8	23.4	14.0	5.1
IV	13.0	10.8	6.3	11.5
1980 I	-0.7	19.2	5.1	22.4
II	1.1	20.6	1.3	11.8
III	18.1	-4.1	-0.2	5.8
IV	3.9	11.9	13.2	6.1
1981 I	7.6	17.7	12.5	6.1
II	12.6	10.6	10.6	-0.8
III	4.5		3.5	-1.5
IV	-0.7		5.3	12.3
Mean	6.61	11.65	9.98	6.84
Standard deviation	18.92	30.27	21.05	17.79
Coefficient of variation	2.86	2.60	2.11	2.60

Table 7: *Ireland, four largest percentage price changes from previous quarter, for each of four energy import groups, with related ('000 tonnes) quantity changes and derived percentages*

Item	*Solid fuel*	*Crude oil*	*Refined oil*	*Liquid gas*
Percentage price change:				
Mean++	6.61	11.65	9.98	6.84
Standard Deviation	18.92	30.27	21.05	17.79
Coefficient of Variation (mean/std. dev.)	2.86	2.60	2.11	2.60
First major price change:				
Percentage	52.5	89.1	120.0	−25.5
Quarter of occur.	1974 I	1974 I	1974 I	1973 II
*Quantity for present 6-months (A)	445.41	1,318.84	1,480.41	22.77
*Quantity for previous 6-months (B)	397.23	1,600.33	1,703.48	24.06+
Percentage change 100 [(B) − (A)] /[B]	12.1	−17.6	−13.1	−5.4
Second major price change:				
Percentage	90.6	153.9	29.9	93.0
Quarter of occur.	1974 IV	1974 II	1974 II	1974 I
*Quantity for present 6-months (A)	390.48	1,278.87	1,567.27	33.14
*Quantity for previous 6-months (B)	518.38	943.55	1,554.59	22.77
Percentage change 100 [(B)−(A)] /[B]	−24.7	35.5	0.8	45.5
Third major price change:				
Percentage	−26.8	23.4	18.9	33.3
Quarter of occur.	1975 I	1979 III	1976 III	1975 I
*Quantity for present 6-months (A)	310.33	1,040.19	1,643.00	34.30
*Quantity for previous 6-months (B)	445.41	983.70	1,510.32	33.14
Percentage change 100 [(B)−(A)] /[B]	−30.3	5.7	8.8	3.5
Fourth major price change:				
Percentage	18.1	20.6	36.8	22.4
Quarter of occur.	1980 IV	1980 II	1979 II	1980 I
*Quantity for present 6-months (A)	652.42	1,055.14	1,676.74	79.46
*Quantity for previous 6-months (B)	829.77	1,126.45	1,844.60	77.03
Percentage change 100 [(B)−(A)] /[B]	−21.4	−6.3	−9.1	3.2

* Present 6-months means quarter in which change occurred plus following quarter; previous 6-months means corresponding period 12 months earlier.
\+ First six months of 1972, 24.06 '000 tonnes estimated.
++Simple average of individual percentages.

ing quarter. The comparison with one year earlier is to eliminate seasonality effects, e.g., Quarter II imports of solid fuel are smaller than winter imports, viz., Appendix 6.

Pearson correlation coefficients were calculated for the association between these price and quantity changes, there being four sets of quarterly data of

Table 8: *Ireland, sixteen largest percentage price changes of imports from previous quarter, with related quarterly quantity changes*

Item and quarter	*Percentage price change from previous quarter*	*Quarterly quantity percentage changes*		
		Same quarter from that one year earlier	*Following quarter from that one year earlier*	*Second following quarter from that one year earlier*
Solid fuel				
1974 I	52.5	24.8	11.6	48.9
1974 IV	90.6	−37.9	−10.1	−55.5
1975 I	−26.8	−10.1	−55.5	−38.8
1980 IV	18.1	−33.2	−11.0	12.9
Crude oil				
1974 I	89.1	−16.9	−18.5	196.1
1974 II	153.9	−18.5	196.1	−3.6
1979 III	23.4	63.6	−35.6	30.8
1980 II	20.6	5.8	−14.6	−1.6
Refined oil				
1974 I	120.0	−28.6	1.7	−0.4
1974 II	29.9	1.7	−0.4	5.6
1976 III	18.9	11.1	6.8	16.4
1979 II	36.8	−4.7	−13.3	55.5
Liquid gas				
1973 II	−25.5	6.5	62.2	55.9
1974 I	93.0	38.7	53.2	−29.8
1975 I	33.3	−0.4	7.5	4.6
1980 I	22.4	15.6	−14.7	31.9

16 observations each. Summary statistics appear in Table 9. For 14 degrees of freedom the NHP value of $r_{0.10}$ is 0.426 and of $r_{0.05}$ is 0.574.

We might first observe how large the average price change is for the 16 selected quarters; it is 47 per cent higher than that of the previous quarter — a huge amount. The quantity reactions are certainly unexpected! For the 6-month period there is a reduction of less than 1 per cent. But at the quarterly level there are three *positive* reactions, namely, 1, 10 and 21 per cent. This says that in the face of a 47 per cent rise in price of a quarter, the quantity demand of that quarter rose 1 per cent above that of the same quarter last year, that of the next quarter rose 10 per cent and that of the following quarter rose 21 per cent.

Of the four correlation coefficients only one is significant at the 10 per cent level, that of the following quarter, and it is positive, implying that demand rose in spite of such price increases of the previous quarter. There is admittedly a negative correlation coefficient for the quarter of the price change, but it is not significant at the 10 per cent level. Such a negative

Table 9: *Ireland, association between price and quantity percentage changes for 16 largest quarterly price changes of imported fuels during 1973-1981*

Item	*Quarter of price change plus following quarter (6-month)*	*Quarter of price change*	*Following quarter*	*Second following quarter*
Average price change (over 16 largest changes) %		46.9		
Average quantity change %	−0.8	1.1	10.3	20.5
Correlation coefficient	0.40	−0.28	0.55	0.0025

result could mean scarcity of supply, as well as reaction to price.

After all that, one may reasonably conclude that, at least in the short run, energy imports have not significantly responded to major price changes. The 16 largest price changes were chosen with a view to getting concentrated effects of reaction. There is no significant negative reaction established for demand versus price increases. Perhaps the expected negative reaction is offset by the possibility of passing on such price increases to final purchasers?

Terms of Trade Effects of Imported Energy Prices

The terms of trade effects of imported energy price inflation were described in a talk by C. H. Murray, Governor of the Central Bank of Ireland, delivered to Athlone Chamber of Commerce on 6 March 1980 and published in the Central Bank Annual Report for the year ended 31 December 1979. The relevant extract is as follows (pp. 102-103):

> The decline in the growth of GNP and the increase in consumer prices do not, however, fully reflect the effects of the higher costs of energy on the standard of living. When the prices of goods we import, such as oil, are rising faster than the prices of our exports, i.e., when the terms of trade are unfavourable, there is a net loss of welfare. Conventional measures of GNP do not reflect this loss. If, for example, one adjusts the conventional 3 per cent growth in GNP last year for the deterioration in the terms of trade, the growth rate would fall to less than 1½ per cent. As a nation, our real income and welfare was reduced because we had to pay a higher price in terms of exports for the same volume of imports or, what is the same thing, because the same volume of exports bought a smaller volume of imports. Some groups in the community may benefit, though others will lose, as a result of a change

in the relative price structure of the economy; as a nation, *total* welfare is unambiguously reduced.

An estimation of the terms of trade effects of energy prices during 1973-1981 is set out in Table 10, the background to which appears in Appendix 1. The first three columns of Table 10 show the implicit price index of total imports, energy imports and non-energy imports, on a year-to-year basis, i.e., the index for each year is based on 1.0 for the previous year. The energy import price index exceeded that of non-energy imports and of total imports for five years out of nine. In fact, on a chain basis from 1973, the energy price index increased twelve-fold, as against a three-fold increase for non-energy imports.

Columns (4) and (5) show the price index of exports, which also increased two-fold during 1973-1981. The export price index divided by the import price index gives the terms of trade index, and two such indices are shown, one for total exports versus total imports and the other for non-energy exports versus non-energy imports, on a year-to-year basis. A terms of trade index greater than unity means "favourable" trading, i.e., export prices increasing more rapidly than import prices. It is seen that both indices are less than unity in six years out of nine, thus trade has generally been unfavourable.

It is clear that tne unfavourable effects of higher energy import prices will be shown by the "total" index of Column (6) being lower than the "non-energy" index of Column (7). For six years the "total" index is less than or equal to the "non-energy" index; the years 1975, 1977 and 1978 show the

Table 10: *Ireland, implicit price indices of imports and exports and index of terms of trade, showing year-to-year movements starting with one-to-one exchange base for 1973*

	Import price index			*Export price index total*	*Export price index non-energy*	*Index of terms of trade*	
Year	*Total*	*Energy*	*Non-energy*			*Total* (4) ÷ (1)	*Non-energy* (5) ÷ (3)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1973	1.000	1.000	1.000	1.000	1.000	1.0	1.0
1974	1.443	3.101	1.342	1.231	1.219	0.853	0.908
1975	1.205	1.120	1.218	1.188	1.188	0.986	0.975
1976	1.189	1.307	1.175	1.230	1.229	1.034	1.046
1977	1.168	1.156	1.170	1.147	1.148	0.982	0.981
1978	1.048	0.948	1.060	1.067	1.067	1.018	1.007
1979	1.135	1.419	1.108	1.096	1.095	0.966	0.988
1980	1.182	1.392	1.156	1.110	1.110	0.939	0.960
1981	1.188	1.355	1.174	1.171	1.171	0.986	0.997

Sources: Appendix 1 and Tables 3(a) and 3(b) of *Economic Review and Outlook Summer 1982.*

converse effect, i.e., the inclusion of energy on the import side improved the terms of trade position. This loss of purchasing power, i.e., loss of welfare can be measured as Column (7) index less that of Column (6), applied to exports at current prices. The amounts thus estimated can be expressed as percentages of GDP at current prices, as set out below:

Year	*Loss amount £ million*	*Percentage of GDP*
1973	0.0	0.0
1974	69.9	2.3
1975	-17.8	-0.5
1976	25.8	0.6
1977	-2.8	-0.1
1978	-37.1	-0.6
1979	87.2	1.2
1980	98.5	1.1
1981	61.3	0.6

The negative entries for 1975, 1977 and 1978 mean welfare gains in those years. The three largest values occur in 1974, 1979 and 1980. That of 1974 is a loss of £70 million, which is 2.3 per cent of 1974 GDP. That of 1979 is a loss of £87 million, which is 1.2 per cent of GDP. The largest figure is that of 1980, a loss of £99 million, which is 1.1 per cent of GDP. Underlying all the above calculations is the choice of the year 1973 as the base of the price indices, with assumed one-to-one purchasing power between 1973 exports and imports. The year 1973 can be justified as base of prices, to the extent that it is the base year we have chosen for many energy price calculations; it is the first year of the period being studied and the year in which the energy crisis began, prior to escalating prices.

In summary, relative to the 1973 one-to-one import-exchange rate being chosen as base, welfare gains occur in three years and welfare losses in five years. Both gains and losses are only small percentages of GDP at current prices. As stated in the quotation of C.H. Murray given above, these gains and losses are not reflected by conventional measures of GNP.

Effects of Energy Import Costs upon the Balance of Payments

A very important consideration is how the above-average cost inflation of energy imports affects the Irish Balance of Payments. It is first necessary to define "above average" and this has been done in Appendix 5. The average rate of price inflation is taken to be that of non-energy merchandise imports. Appendix 5 shows that above-average price effects of imported energy pro-

ducts as such could have created between 2.9 and 6.5 per cent annual price inflation rates of the Irish GDP during 1974-1981 (Table A5.1). Part 5 of the paper deals with this aspect in some detail. If we apply these same percentages to non-energy imports we obtain an above-average cost effect starting at zero for 1973 and reaching £377 million for 1981 (Table A5.2). The above-average cost of energy items themselves is based on the degree to which imported energy prices exceed the general price increase of non-energy imports: as shown in Appendix 5 this above-average cost goes from zero for 1973 to £672 million for 1981 (Table A5.1).

Table 11 brings together these two effects of above-average energy import costs upon the total cost of merchandise imports at current prices. This total effect is zero for 1973 and increases so as to reach £1,049 million for 1981, a large figure. The fourth column of Table 11 shows the Balance of Payments surplus of imports over exports at current prices. It is interesting to notice that for 1975 and later years the above-average import cost is at least half the magnitude of the Balance of Payments surplus, being some two-thirds of it during several years. In other words, if energy import prices had kept in line with the general non-energy import price movement, then in an arithmetic sense the Balance of Payments import surplus might have been reduced by at least one-half, during the past seven years. This result is, of

Table 11: *Ireland, comparison of import excess with above-average cost of imports and of net imports due to energy price effects, during 1973-1981*

Year	*Estimated above-average cost of imports due to energy price effects, less corresponding cost of exports £ million, current*			*Balance of Payments: excess of imports over exports £ million, current*	*Net imports as percentage of Balance of Payments excess*
	Imports (1)	*Less exports* (2)	*Net imports* (3)	(4)	(5)
1973	0.0	-0.0	0.0	185	0
1974	180.6	-52.7	127.9	437	29
1975	171.9	-56.0	115.9	195	59
1976	244.7	-72.6	172.1	315	55
1977	318.9	-94.2	224.7	440	51
1978	282.2	-80.9	201.3	570	35
1979	553.3	-158.7	394.6	1173	34
1980	815.8	-227.1	588.7	1125	52
1981	1048.5	-292.0	756.5	1448	52

Source: Table 3(a) of *Economic Review and Outlook, Summer 1982*. Imports, Col. (3) of Table A5.3; exports, Col. (6) of Table A5.4.

course, a first round effect, in the sense described in the Methodology section.

It can be argued that allowance should be made for the energy price effects on exports, and this has been done in Appendix Table A5.4, with results shown as the second column of Table 11. Subtraction of export effect from import effect gives Column (3) net imports results, arguably a more valid comparison with Balance of Payments import excess than figures of Column (1) for imports alone. It is seen that the figures of Column (3) are equivalent to between 34 and 59 per cent of the import excess since 1975 onwards, as shown in Column (5).

These Column (3) net import cost effects can be regarded as minimal because non-energy imports to Ireland are definitely *more* energy-intensive than Irish goods generally. Ireland has only one small steel mill, one paper mill, one glass-bottle factory. We import almost all metal goods, through all stages from crude post-smelted to vehicles and parts and all kinds of machinery and parts. We also import most of our pulp and paper requirements and much structural clay products. The writer believes, therefore, that in these circumstances the Column (3) estimated above-average cost of net imports due to energy price effects is definitely on the low side, due to underestimation of energy price effects included in the costs of non-energy imports.

4. *FINAL ENERGY*

Final Energy Quantities and Values

Final energy comprises the second-stage products such as petrol, electricity and townsgas going direct to business and households, as well as coal and peat going to similar destinations. Table 12 sets out the amounts of energy products directly consumed by final users for the years 1973-1981. The unit of quantity is thousand tonnes of oil equivalent (TOE). Eleven products are distinguished. Various issues of *Energy in Ireland* are the source of the data. The typical product in Table 12 shows a double row of figures. The first row gives the total final consumption of that product. The second row, in parentheses, shows the amounts consumed by Domestic (i.e., household) purchases. These amounts are taken directly from *Energy in Ireland* for 1976-1981. For 1973-1975 they are estimated by the writer by extending the trends shown during 1976-1981. Readers will note that household amounts for 1973-1975 are therefore less reliable than those for 1976-1981.

The total energy to final users varied between 5.2 and 6.6 million TOE, the maximum occurring in 1979, with reduction to 6.3 for 1980 and 6.2 for 1981. Amounts purchased by household users varied between 1.5 and 2.0 million TOE and comprised a steady 29-30 per cent of the total in all years, with again the maximum occurring in 1979. We note that gasolene (petrol) is not listed by *Energy in Ireland* as a household purchase but is allocated to transport; it comprised 15-18 per cent of the total throughout the period. Thus, petrol plus what is classified as household purchases account for nearly half the total purchases by energy users. We see that peat, coal, kerosene, townsgas and LPG are mainly purchased by household users.

Retail Fuel Prices

Retail current prices of nine energy products are shown in Table 13. The basic data for these prices came from the Department of Energy. Retail price data were not available for some energy products such as kerosene and LPG for the full nine-year period.

The rise in price between 1973 and 1981 is shown in the last column of Table 13. Gas oil and fuel oil had the greatest price increase, being in 1981 some 10 to 11 times as expensive as in 1973. Electricity and gas were 6 to 10 times as expensive. Peat, coal, petrol and DERV were 3 to 5 times as expensive. Retail prices generally showed smaller increases during 1973-1981 than the

Table 12: *Ireland, consumption of final energy products during 1973-1981 (with household shares in parentheses)*

Thousand TOE

Item	*1973*	*1974*	*1975*	*1976*	*1977*	*1978*	*1979*	*1980*	*1981*
Peat and peat	576	571	573	603	617	594	602	581	589
briquettes	(514)	(508)	(509)	(538)	(551)	(525)	(531)	(520)	(528)
Coal	499	466	366	428	464	502	741	751	832
	(439)	(406)	(306)	(358)	(406)	(421)	(622)	(595)	(634)
Gasoline (petrol)*	847	858	856	875	930	1022	1065	1085	1086
Kerosene	137	135	137	123	121	135	130	118	98
	(118)	(116)	(118)	(104)	(102)	(99)	(95)	(84)	(70)
Jet Fuel	293	283	294	301	311	292	290	209	193
Gas diesel	1200	1121	1100	1130	1257	1378	1466	1343	1316
	(180)	(190)	(200)	(210)	(243)	(217)	(234)	(195)	(172)
Residual	1331	1378	1108	1091	1151	1016	1250	1118	1016
fuel oil									
Electricity	525	536	522	570	619	666	738	737	726
	(229)	(233)	(225)	(244)	(262)	(282)	(314)	(309)	(305)
Natural gas							44	57	68
Townsgas	110	109	95	92	91	91	90	79	72
	(87)	(86)	(72)	(69)	(67)	(67)	(67)	(60)	(55)
LPG	103	109	114	130	140	145	168	178	177
(Liquid Petroleum gas)	(63)	(66)	(68)	(81)	(84)	(83)	(96)	(98)	(94)
Total	5621	5566	5165	5343	5701	5841	6584	6256	6173
	(1630)	(1605)	(1498)	(1604)	(1715)	(1694)	(1959)	(1861)	(1858)

Sources: *Energy in Ireland* years 1975-1981.

Note: The Domestic (i.e., household) amounts for 1973-1975 have been estimated via the trends of their shares of the total during 1976-1981, for all products except electricity, for which domestic amounts have been published for 1973-1975.

**Energy in Ireland* allocates all petrol to the transport sector.

energy import prices given in Table 2. Figures 3 and 4 illustrate Table 13 data. The year-to-year percentage increases are highly variable, as will appear below in the section dealing with quantity reaction to price changes.

Because of peat and coal showing less rapid price rises than gas oil, fuel oil, electricity and gas, one may look for solid fuel substitution for these items, as will be considered in the next section.

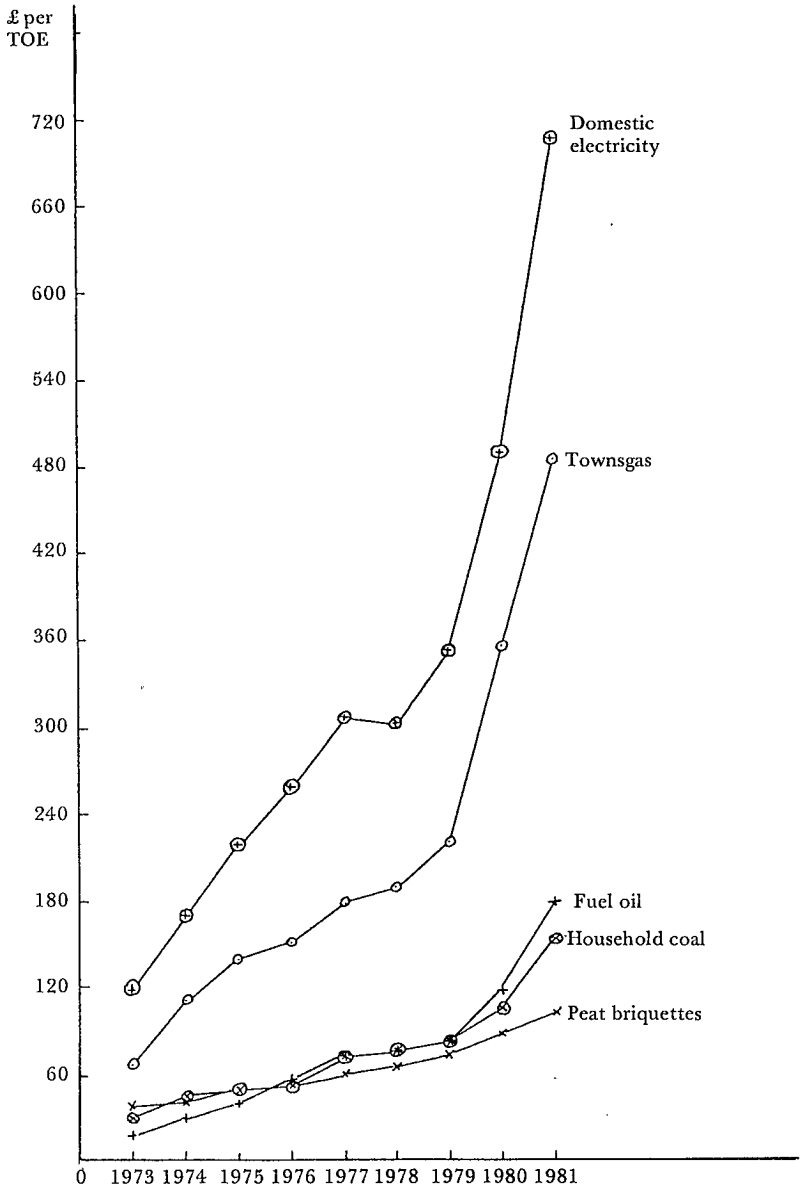
Table 13: *Irish retail prices of fuels, 1973-1981*

IR £ per TOE and derived ratios

Fuel	*1973*	*1974*	*1975*	*1976*	*1977*	*1978*	*1979*	*1980*	*1981*	*1981 price ÷ 1973 price*
Peat briquettes (bales)	38.15	41.50	48.78	51.65	58.82	63.77	72.22	87.12	101.15	2.65
Household coal	29.25	45.15	47.68	50.53	70.96	74.65	82.37	105.43	153.12	5.23
Petrol	101.89	128.69	190.80	228.91	267.71	261.57	282.51	387.75	556.24	5.46
DERV	79.80	100.50	120.73	129.89	144.68	149.20	165.97	248.62	393.32	4.92
Gas oil	21.80	42.50	51.66	70.55	88.93	91.27	108.87	167.89	230.45	10.57
Fuel oil	16.48	29.15	40.44	54.79	72.04	74.71	83.19	118.48	176.52	10.71
Domestic electricity	118.60	170.35	217.91	257.56	305.81	302.09	352.09	488.49	706.24	5.95
Industrial electricity	68.26	112.21	133.49	150.35	199.19	190.58	213.14	321.40	657.19	9.63
Townsgas	67.49	111.60	139.90	150.96	178.77	187.70	218.63	356.47	483.97	7.17

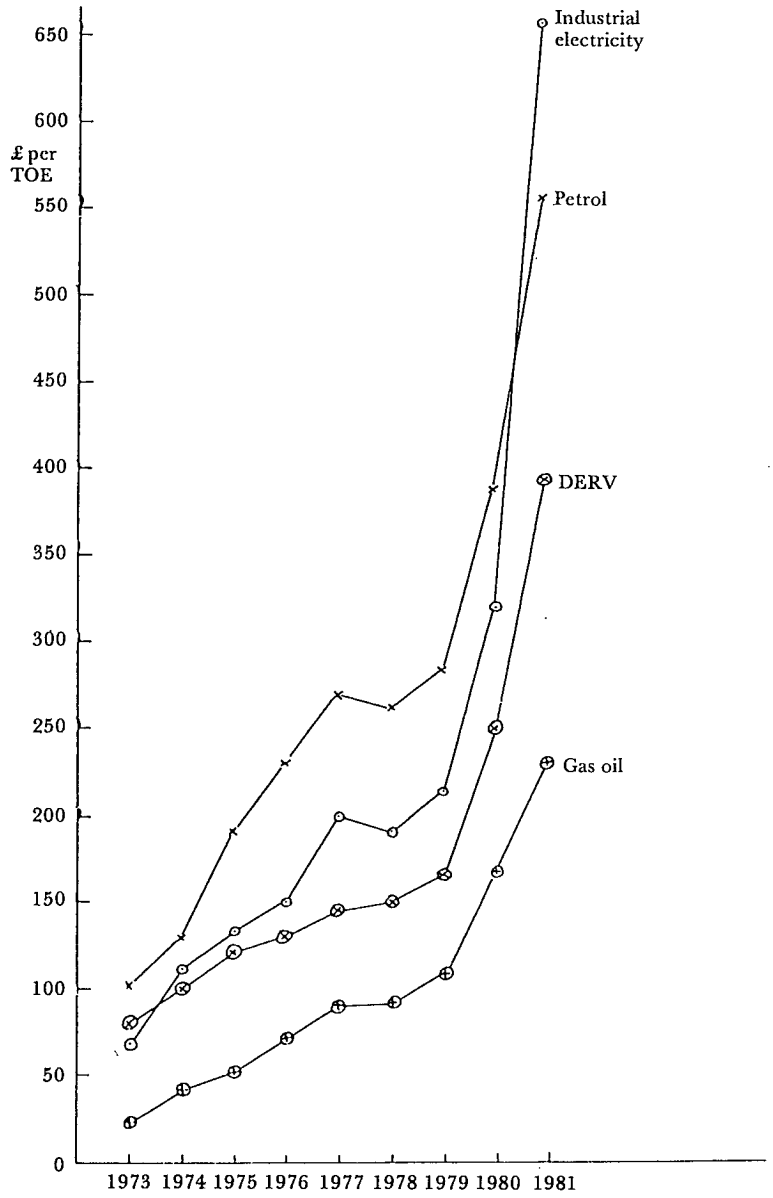
Note: The author calculated the prices shown above from data supplied by Department of Industry and Energy, Dublin. Conversion factors used were: gallons per tonne: petrol 297.3, DERV 252.8, gas oil 252.8, fuel oil 231.55, source Appendix 3 of Henry (1976). This same source gave 397 therms per TOE of townsgas and 0.086 TOE of electricity per 100 Kwh. *Energy in Ireland 1979* gave the following TOE per tonne conversion factors: peat briquettes 0.443, coal 0.665, petrol 1.0650, DERV and gas oil 1.0344, fuel oil 0.9849.

Figure 3 (Table 13): *Irish retail prices of five fuels, 1973-1981*



Peat briquettes x, Household coal ⊗ , Fuel oil +, Domestic Electricity ⊕ , Towngas ⊙

Figure 4 (Table 13): *Irish retail prices of four other fuels, 1973-1981*



Petrol x, DERV ⊗ , Gas oil ⊕ , Industrial electricity ⊙

Household and Non-Household Consumption of Final Energy Products and Inter-Fuel Substitution

The energy products can be grouped into four heads: solid fuel, oil products, electricity, townsgas plus LPG. This is done for household consumption in Table 14. We remember that household consumption excludes petrol for cars. Total energy is also shown. Figures 5 and 6 illustrate Table 14 data. The lower part of Table 14 shows the four fuel groups expressed as percentages of total household consumption. Solid fuel comprises very roughly 60 per cent, oil products and electricity very roughly 15 per cent each, with townsgas and LPG having roughly 10 per cent of the total.

Townsgas and LPG shows no trend throughout the period. Electricity shows a slight but steady upward trend, from 14.0 per cent for 1973 to 16.5 per cent for 1981. Oil products show a downward trend from 1975 onwards, being 21 per cent in 1975 and 13 per cent in 1981. A compensating upward movement is shown by the solid fuel share – so we have solid fuel substituting for oil since 1975. This makes sense in terms of retail prices of Table 13: the solid fuel prices in 1981 were two to five times those of 1973, whereas the oil prices were ten or eleven times those of 1973.

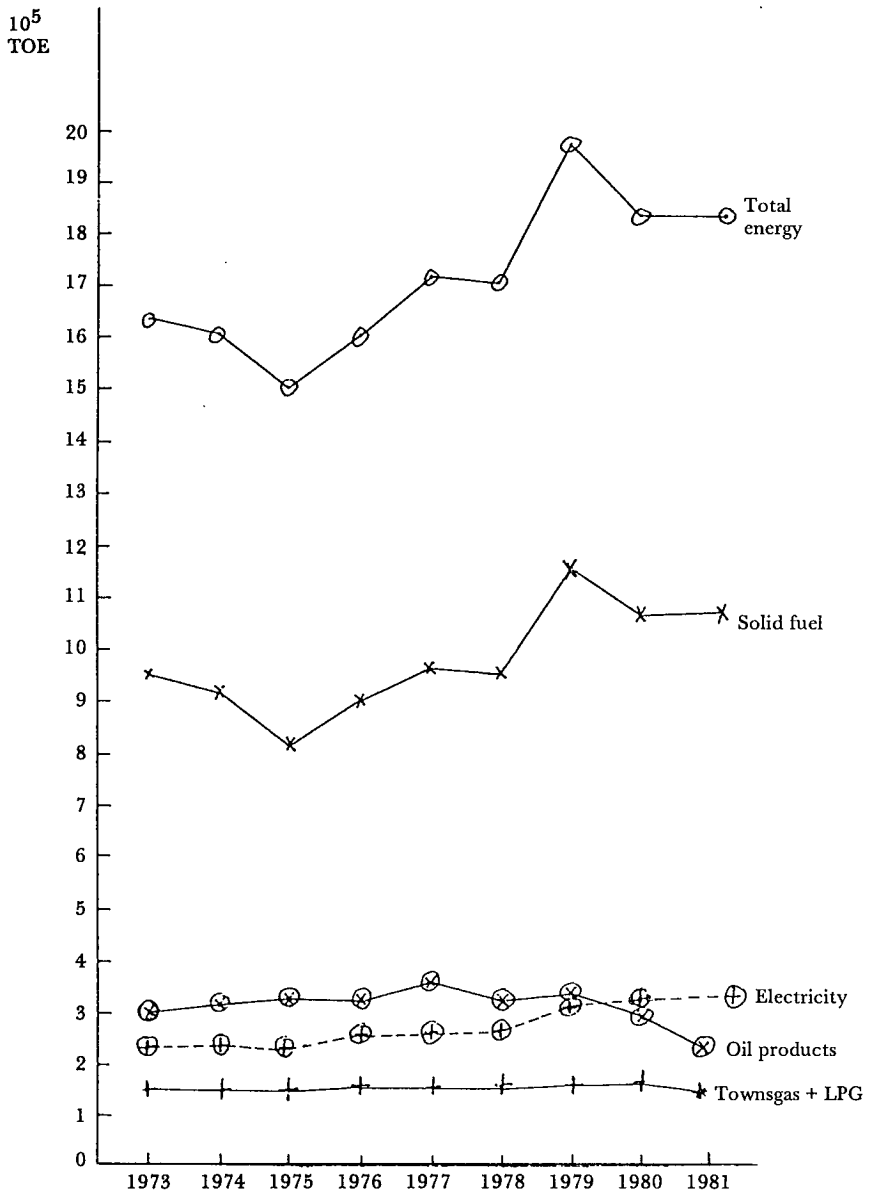
In a similar way the non-household consumption of energy is set out in Table 15. The lower part of Table 15 shows the fuel percentage shares of total non-household consumption. Oil products (including petrol) takes

Table 14: *Ireland, household consumption of final energy products and their shares of total 1973-1981*

Item	*1973*	*1974*	*1975*	*1976*	*1977*	*1978*	*1979*	*1980*	*1981*
Solid fuel, 1000 TOE	953	914	815	896	957	946	1,153	1,115	1,152
Oil products 1000 TOE	298	306	318	314	345	316	329	279	242
Electricity 1000 TOE	229	233	225	244	262	282	314	309	305
Townsgas and LPG 1000 TOE	150	152	140	150	151	150	163	158	149
Total Energy 1000 TOE	1,630	1,605	1,498	1,604	1,715	1,694	1,959	1,861	1,848
	Percentage of total held by products								
Solid fuel	58.5	56.9	54.4	55.9	55.8	55.8	58.9	59.9	62.3
Oil products	18.3	19.1	21.2	19.6	20.1	18.7	16.8	15.0	13.1
Electricity	14.0	14.5	15.0	15.2	15.3	16.6	16.0	16.6	16.5
Townsgas and LPG	9.2	9.5	9.3	9.4	8.8	8.9	8.3	8.5	8.1
Total Energy	100–	100–	100–	100–	100–	100–	100–	100–	100–

Sources: Energy products Table 12.

Figure 5 (Table 14): *Ireland, household consumption of final energy products, 1973-1981*
Quantities

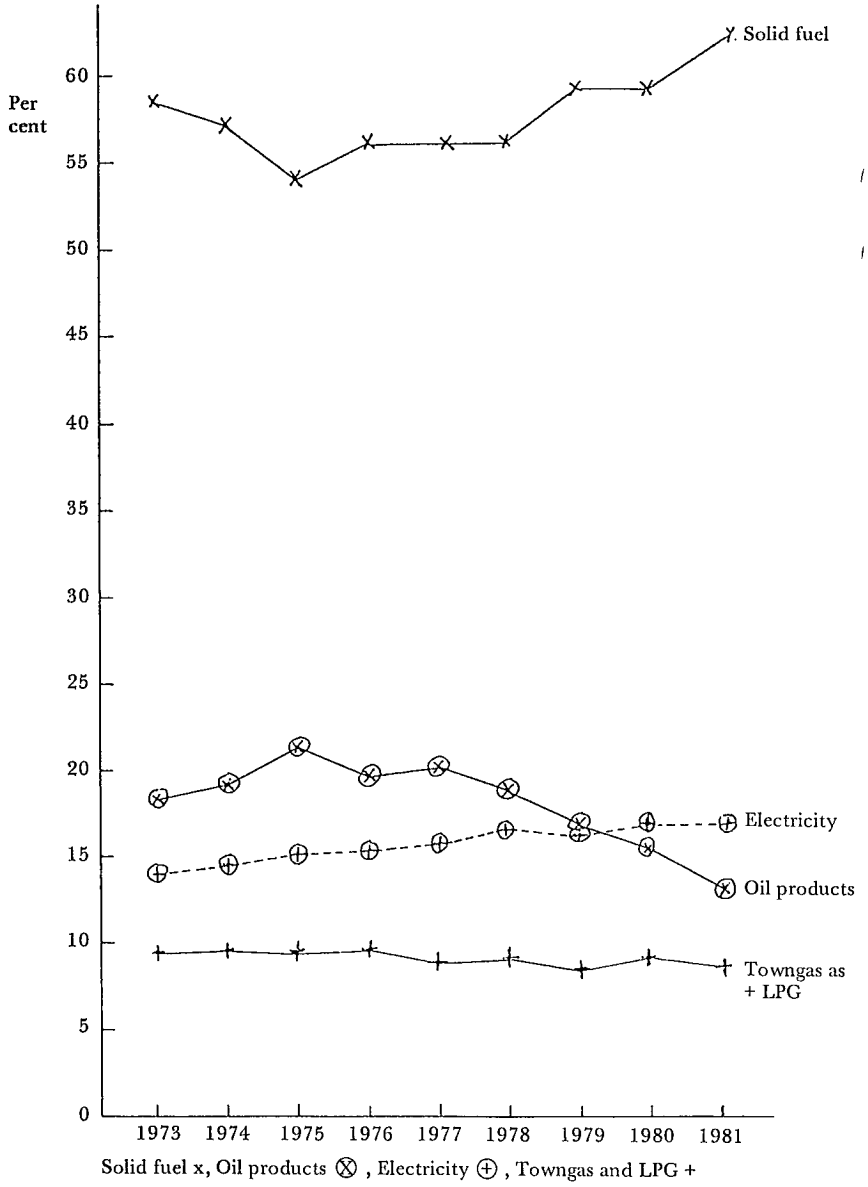


Solid fuel x, Oil products ⊗ , Towngas and LPG +, Electricity ⊕ , Total energy ⊙

Solid

Figure 6 (Table 14): *Ireland, household consumption of final energy products, 1973-1981*

Quantities as percentages of total quantity



Solid fuel x, Oil products ⊗ , Electricity ⊕ , Towngas and LPG +

Table 15: *Ireland, non-household consumption of final energy products and their shares of total 1973-1981*

Item	*1973*	*1974*	*1975*	*1976*	*1977*	*1978*	*1979*	*1980*	*1981*
Solid fuel 1000 TOE	122	123	124	135	124	150	190	217	259
Oil products 1000 TOE	3,510	3,469	3,177	3,206	3,425	3,527	3,872	3,594	3,467
Electricity 1000 TOE	296	303	297	326	357	384	424	428	421
Townsgas + LPG* 1000 TOE	63	66	69	72	80	86	139	156	168
Total Energy 1000 TOE	3,991	3,961	3,667	3,739	3,986	4,147	4,625	4,395	4,315
	Percentage of total held by products								
Solid fuel	3.1	3.1	3.4	3.6	3.1	3.6	4.1	4.9	6.0
Oil products	87.9	87.6	86.6	85.7	85.9	85.0	83.7	81.8	80.3
Electricity	7.4	7.6	8.1	8.7	9.0	9.3	9.2	9.7	9.8
Townsgas and LPG*	1.6	1.7	1.9	1.9	2.0	2.1	3.0	3.5	3.9
Total Energy	100—	100—	100—	100—	100—	100—	100—	100—	100—

*Includes Kinsale natural gas for 1979, 1980 and 1981.
Sources: Energy products, Table 12.

80-88 per cent of the total. Electricity is by far the largest of the remainder, taking 7-10 per cent. Oil products show a downward trend, from 88 per cent for 1973 to 80 per cent for 1981. The other three fuel groups show upward trends, the Kinsale natural gas being included with townsgas and LPG for 1979-1981. So here also the oil products are being progressively substituted for by other fuels, throughout the period, probably in response to price differences.

Final Energy Related to Gross Domestic Product

In parallel with the Table 5 comparison of energy imports with GDP, a comparison of final energy with real GDP by sector of origin at factor cost appears in Table 16. Three sub-divisions of energy are made: (a) industry and agriculture; (b) commerce, transport and services; (c) household. Corresponding GDP entities at 1975 prices are juxtaposed with these energy quantities for 1973-1980, no GDP suitable subaggregates being available for 1981. Total final energy is also compared with total GDP. Because of differences between subdivisions of final energy and of GDP, comparison is possible only at the level of three sub-sectors. Energy quantities divided by GDP amounts give the final energy/GDP intensities shown in Columns (3), (6), (9), and (12).

The energy intensity of the total may be considered first. In view of the

Table 16: *Ireland, final energy in proportion to real GDP by sector of origin at factor cost for 1973-1980 or -1981*

Year	*Industry and agriculture*			*Commerce, transport and services*		
	Final energy "industry" '000 TOE	*GDP by sector of origin £ million at 1975 prices*	*Energy intensity (1) ÷ (2)*	*Final energy "commercial" + "transport" '000 TOE*	*GDP by sector of origin, rest £m. at 1975 prices*	*Energy intensity (4) ÷ (5)*
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
1973	1,750	1,663.8	1.052	2,241	1,530.7	1.464
1974	1,814	1,734.4	1.046	2,147	1,568.5	1.369
1975	1,602	1,751.1	0.915	2,065	1,590.8	1.298
1976	1,659	1,770.9	0.937	2,080	1,635.2	1.272
1977	1,897	1,926.3	0.985	1,789	1,704.2	1.050
1978	1,749	2,063.7	0.848	2,398	1,811.2	1.324
1979	2,073	2,135.4	0.971	2,552	1,898.6	1.344
1980	1,946	2,138.0	0.910	2,449	1,975.0	1.240
	Household			*Total*		
	Final energy "domestic" '000 TOE	*Personal expenditure £m. at 1975 prices*	*Energy intensity (8) ÷ (7)*	*Final energy '000 TOE*	*GDP by sector of origin, £m. at 1975 prices*	*Energy intensity (10) ÷ (11)*
	(7)	*(8)*	*(9)*	*(10)*	*(11)*	*(12)*
1973	1,630	2,461.1	0.662	5,621	3,194.5	1.760
1974	1,605	2,502.0	0.641	5,566	3,302.9	1.685
1975	1,498	2,388.9	0.627	5,165	3,341.9	1.546
1976	1,604	2,446.0	0.656	5,343	3,406.1	1.569
1977	1,715	2,577.6	0.665	5,701	3,630.5	1.570
1978	1,694	2,791.3	0.607	5,841	3,874.9	1.507
1979	1,959	2,865.3	0.686	6,584	4,034.0	1.632
1980	1,861	2,870.0	0.653	6,256	4,113.0	1.521
1981	1,858	2,833.0	0.656			

Note: "Transport" includes petrol for private cars.

Sources: GDP by sector of origin at factor cost and personal expenditure, both at 1975 prices: *National Income and Expenditure 1980* and *Economic Review and Outlook Summer 1982.* Final energy: Total, Table 12; Household, Table 14; rest: various issues of *Energy in Ireland* and unofficial estimates for 1973-1975.

severe price rises shown already by the figures of Table 13, one would expect, in general, some reduction in energy intensity and this indeed appears to be the case. The 1973 intensity is 1.76, compared with 1.52 for 1980. The 1973-1974 average intensity is 1.72, compared with 1.58 for 1979-1980, the latter being 8 per cent smaller than the former. Thus, we find an 8 per cent reduction in energy intensity between the beginning and end of the period, very likely in response to large increases in price. This is the long-term movement.

For industry and agriculture there is again in evidence some reduction of intensity. The 1973 intensity was 1.05 and that of 1980 was 0.91. For 1973-1974 the average intensity was 1.05 and for 1979-1980 it was 0.94, the latter 10 per cent smaller than the former. For commerce, etc., yet again the intensity falls, being 1.46 for 1973 and 1.24 for 1980, with a 1973-1974 intensity of 1.42 and a 1979-1980 intensity of 1.29, the latter 9 per cent smaller than the former.

But for final energy to households (and excluding petrol for cars) there is no evidence of reduced intensity. The 1973 intensity was 0.66, that for 1980 was 0.65 and that for 1981 was 0.66; for 1973-1974 the average intensity was 0.65 and for 1979-1980 it was 0.67, the latter being 2 per cent *greater* than the former. One may, of course, question whether the energy intensity, as defined for households, is meaningful or reasonable. The answer is yes; to compare the volume of final energy with the total purchasing power of households (given by personal expenditure at 1975 prices) and look for reactions to energy price rises (in current and real terms) is quite reasonable. So that what we find for 1973-1981 is the volume of final energy to households rising in line with total purchasing power of households, in spite of a 423 per cent rise in household coal prices (Table 13), a 971 per cent rise in fuel oil prices and a 617 per cent rise in townsgas prices, compared with a 228 per cent rise in the aggregate implicit consumer price index (derived from Appendix 4, personal expenditure details). Thus, the intensity of household demand for final energy has shown no tendency to fall in the face of massive price increases.

In summary, the national demand for final energy has shown a decrease of 8 per cent in intensity between 1973-1974 and 1979-1980; industrial demand has shown a 10 per cent decrease, and commerce, etc., a 9 per cent decrease. But household demand has shown no decrease in intensity, why this should be so is not known, it is certainly unexpected. One possibility is that there has been a high income elasticity of demand to offset such energy price increases; this topic will not be investigated here.

Reaction of Final Energy Demand to Annual Price Increases

In parallel with the analysis of quarterly price and quantity changes of

energy imports centred on Tables 7 and 8, a limited analysis of annual changes for final energy is appropriate. Data are not available for quarterly changes. The analysis is confined to final energy to households plus petrol for cars, and year-to-year percentage changes in retail prices are compared with corresponding quantity changes, as set out in Table 17.

We are looking for the short-term reaction of energy demand to price increases. Table 17 shows 48 observations in all. The first impression shows mainly positive entries, with some very large price changes. It is also evident that both price and quantity percentage changes are highly variable.

Five correlations in all have been derived from Table 17 data to measure the association between price and quantity changes. Our hypothesis is that price increases should induce demand decreases in the short run, and vice versa. Results appear in Table 18. There are five groups: all items, solid fuel, gas oil, domestic electricity, petrol. The bottom rows of Table 18 show three NHP significance levels of the correlation coefficient: 10 per cent, 5 per cent and 1 per cent.

For all items combined there are 48 observations. The average price change

Table 17: *Ireland, percentage retail price and quantity changes from previous year, for final energy consumed by households and petrol for cars*

Year and Item	*Peat*	*Coal*	*Gas oil and kerosene*	*Domestic electricity*	*Townsgas + LPG*	*Petrol (gasolene)*
1974 Price	8.8	54.4	95.0	43.6	65.4	26.3
(Quantity)	(-1.2)	(-7.5)	(2.7)	(1.7)	(1.3)	(1.3)
1975 Price	17.5	5.6	21.6	27.9	25.4	48.3
(Quantity)	(0.2)	(-24.6)	(3.9)	(-3.4)	(-7.9)	(-0.2)
1976 Price	5.9	6.0	36.6	18.2	7.9	20.0
(Quantity)	(5.7)	(17.0)	(-1.3)	(8.4)	(7.1)	(2.2)
1977 Price	13.9	40.4	26.1	18.7	18.4	16.9
(Quantity)	(2.4)	(13.4)	(9.9)	(7.4)	(0.6)	(6.3)
1978 Price	8.4	5.2	2.6	-1.2	5.0	-2.3
(Quantity)	(-4.7)	(3.7)	(-8.4)	(7.6)	(0.0)	(9.9)
1979 Price	13.3	10.3	19.3	16.6	16.5	8.0
(Quantity	(1.1)	(47.7)	(4.1)	(11.3)	(8.7)	(4.2)
1980 Price	20.6	28.0	54.2	38.7	63.0	37.3
(Quantity)	(-2.1)	(-4.3)	(-15.2)	(-1.6)	(-3.1)	(1.9)
1981 Price	16.1	45.2	37.3	44.6	35.8	43.5
(Quantity)	(1.5)	(6.6)	(-13.3)	(-1.3)	(-5.7)	(0.0)

Note: Prices used were, respectively, those for peat briquettes, household coal, gas oil, domestic electricity, townsgas, petrol.

Table 18: *Ireland, association between year-to-year percentage changes of retail price and quantity demand, for final energy to households and petrol for cars, derived from data for 1973-1981*

	All items	*Solid fuel*	*Gas oil*	*Domestic electricity*	*Petrol for cars*
Price Change Percentage					
Mean*	25.7	18.7	36.6	25.9	24.8
SD	19.9	15.4	28.1	15.9	17.6
Coeff. of Variation	0.77	0.82	0.77	0.61	0.71
Quantity Change Percentage					
Mean*	2.0	3.4	−2.2	3.8	3.2
SD	10.0	15.0	9.1	5.6	3.5
Coeff. of Variation	5.0	4.4	−4.1	1.5	1.1
Pearson Correlation Coefficient	−0.22	−0.065	−0.038	−0.73	−0.89
Number of observations	48	16	8	8	8
Degrees of freedom	46	14	6	6	6
$r_{0.10}$	0.24	0.43	0.62	0.62	0.62
$r_{0.05}$	0.29	0.50	0.71	0.71	0.71
$r_{0.01}$	0.37	0.62	0.83	0.83	0.83

*The simple average of individual percentages.

per year is 26 per cent, with a standard deviation of 20 per cent and a coefficient of variation of 0.77, so it is highly variable. The corresponding average annual quantity change is 2 per cent, with sd 10 and cv 5. Thus, in spite of an average price change of 26 per cent increase there is a 2 per cent average *increase* of quantity. The correlation coefficient however is negative, at −0.22, which almost reaches the 10 per cent level of NHP significance. Thus, we find a negative association between the variations of price and quantity changes about their means, not quite at the 10 per cent level of significance. This suggests that price increases greater than 26 per cent are associated with quantity increases less than 2 per cent.

For solid fuel (peat and coal) there are 16 observations. The average price change is an increase of 19 per cent per year, matched by a quantity average increase of 3 per cent per year. Both items are highly variable, having the same sd value of about 15 per cent. The correlation coefficient has a negative sign, but is negligibly small. Thus there is no evidence here of negative reaction of demand changes to price increases, either on average or about the average.

For gas oil and 8 observations the average price increase is 37 per cent,

and there is an average annual quantity *decrease* of 2 per cent. Both items show considerable variability, the price change having an sd of 28 per cent and the quantity change 9 per cent. The negligibly small negative correlation coefficient means lack of significant association between variations of price and quantity changes about their means.

Domestic electricity, with 8 observations, shows an average price increase of 26 per cent, matched by an average quantity increase of 4 per cent. Thus, average growth in demand persists to this extent, in spite of 26 per cent average price rise. But there is a negative correlation of −0.73, which is significant at the 5 per cent level. This says that in variations about the mean levels there is a strong *negative* association between increasing price and increasing quantity, i.e., quantities decrease in association with price increases. Thus, price increases above 26 per cent are strongly associated with quantity decreases below 4 per cent average increase.

Petrol for cars has 8 observations and shows an average annual price increase of 25 per cent, matched by a quantity increase of 3 per cent. So some average annual growth is indicated, in the face of the average annual 25 per cent increase in price. As in the case of electricity, there is a strong negative correlation, of value −0.89, which is significant at the NHP level of 1 per cent. So this says that in variations about the means, rising price percentage rates are strongly associated with falling quantity percentage rates. That is, price increases of more than 25 per cent are strongly related to quantity decreases below the average growth rate of 3 per cent.

Thus, the general impression emerging from the correlation analysis of price and quantity changes of the five final energy items is of large price increases (18-37 per cent) associated with small quantity increases (2-4 per cent) and only one small quantity decrease (−2 per cent). But in movements about the mean levels, some items show significant quantity rate of decrease associated with price rate of increases, although this tendency does not reach the 10 per cent level of significance for all observations combined. In other words, price increases above the average annual percentage rate have some tendency to occur in conjunction with quantity increases *below* the average quantity annual percentage growth rate.

5. PRICE INFLATION OF IMPORTS, OF FINAL DEMAND AND OF GDP ATTRIBUTABLE TO ABOVE-AVERAGE COSTS OF ENERGY IMPORTS, FOR STATED ASSUMPTIONS

Objectives, Assumptions and Methodology

Balance of Payments aspects of the above-average costs of energy imports and of energy content of other merchandise imports were considered in the section "Effects of energy import costs upon the Balance of Payments" (pp. 29-31). The above-average costs, as defined and estimated, appeared in Table 11 and background Appendix 5. But such costs arising from energy imports can also be examined as possible sources of price/cost inflation of imports and of Irish Final Demand and GDP. (Final Demand consists of the aggregate of National Accounts items personal expenditure, government current expenditure, gross fixed capital formation, stock increases, exports). The objective of this present section of the paper is to estimate the extent of such possible cost or price inflation, as first-round effects and as orders of magnitude, for the behaviour assumptions to be considered next.

For imports, the first assumption is that demanded energy quantities are inflexible to price changes; this is certainly borne out by the non-significant relationship between price rises and quantity changes arising out of the 16 cases set out in Table 8. Likewise the energy content of non-energy imports is assumed to be non-responsive to price changes. The second major assumption is that if the given quantum of energy imports cost less, there would be no extra (compensatory) demand for non-energy imports. This assumption is not unreasonable for the tenable hypothesis that energy and non-energy imports are non-substitutable. Under all these stated assumptions, the above-average energy import cost may be treated as a straightforward cost-inflationary percentage of merchandise imports valued at current prices, and this is the methodology adopted below.

For Final Demand as a whole, the first assumption or principle is that we are considering the above-average costs of energy imports in an accounting sense alone, without allowance for wage compensation effects possibly resulting from (or sparked off by) increasing costs of energy imports. We are concerned only with measurable above-average costs of energy imports. The second assumption is that such costs are fully passed on to Final Demand; this principle is inherent in National Accounting practice, which subtracts full import cost from aggregate Final Demand in order to get GDP expen-

diture equal to GDP by sector of origin. The third assumption is that the volume flows of all other goods and services would be unaffected by reduced costs of energy imports, which, of course, probably would affect prices of many other items and bring price elasticities of demand into play, as mentioned above in the Methodology section. At all events for these stated assumptions the above-average costs of energy imports may be treated as a cost-inflationary percentage of Final Demand, and this is the methodology adopted.

For GDP the assumptions are the same as for Final Demand, except for the assumption that exports absorb and pass on a share of above-average energy import cost, in proportion to their absorption of energy and non-energy imports. What is implied here is that home demand absorbs the total effect, less what is passed on in exports. This assumption is reasonable, and the methodology used below treats the smaller (less exports) effect as a straightforward cost-inflationary percentage of GDP at current prices.

Price Inflation of Imports

Under the assumptions stated in the previous section, one may compare above-average cost of energy imports with their aggregate value at current prices and take the derived percentages as first-round estimates of price inflation. This is done in Table 19. The inflation due to energy imports as such ranges from 5 to 10 per cent per year, a sizeable amount. The inflation due to energy content of non-energy imports is generally about half that due to energy itself. The combined percentages range between 8 and 16 per cent, the largest values occuring during 1979-1981, as shown in Column (6).

But from the National Accounts results it is possible to derive a year-to-year implicit price index of imports, via value change divided by volume change. These results are shown in Column (7) of Table 19 and may be compared with Column (6) combined results. For 1974-1977 they are two to four times as large as Column (6) figures. For 1978 the implicit price increase is less than the combined result shown in Column (6) implying that non-energy imports fell in price; this by itself is not important and could well be due to the 10 per cent fall of the US$ against the IR£ as shown by Appendix 7 data. For 1979-1981 they are not much larger than Column (6) figures, *meaning that for recent years almost all price inflation of imports is equivalent to, or could be attributed to, the above-average cost of energy imports.* This result is important.

Price Inflation of Final Demand and of GDP

In the same way, the above-average costs of energy imports may be expressed as percentages of Total Final Demand and of GDP and compared

Table 19: *Ireland, above-average energy import costs as percentages of merchandise imports at current prices, 1973-1981*

Year	Merchandise imports at current prices	Above-average cost in energy imports as such	Above-average cost in non-energy merchandise imports	Above-average costs as percentages of merchandise imports			Year-to-year implicit price index of imports
				Energy imports as such	Non-energy merchandise imports	Combined result	
	£ million	£ million	£ million	Per cent	Per cent	Per cent	
	(1)	(2)	(3)	(2) ÷ (1) (4)	(3) ÷ (1) (5)	(4) + (5) (6)	(7)
1973	1137.2	0.0	0.0	0.0	0.0	0.0	
1974	1626.3	122.8	57.8	7.6	3.6	11.1	44.4
1975	1704.1	123.4	48.5	7.2	2.8	10.1	20.5
1976	2337.9	169.0	75.7	7.2	3.2	10.5	18.9
1977	3090.9	212.9	106.0	6.9	3.5	10.3	16.8
1978	3706.5	185.0	97.2	5.0	2.6	7.6	4.7
1979	4827.9	352.9	200.4	7.3	4.2	11.5	13.5
1980	5420.7	532.2	283.6	9.8	5.2	15.0	18.2
1981	6575.5	671.8	376.7	10.2	5.7	15.9	18.8

Sources: Merchandise imports, Table A5.2; energy costs Table A5.3. Year-to-year implicit price inflation of imports derived from Tables 3(a) and 3(b) of *Economic Review and Outlook, Summer 1982*, via value change divided by volume change.

with implicit year-to-year price indices derived from National Accounts data. These results appear in Table 20.

Total above-average energy import costs range from 3 to 6 per cent of Total Final Demand. If this be interpreted as a price inflation effect, according with the assumptions of the previous section, then it accounts for one-quarter or less of year-to-year total price inflation for the 1974-1977 period. But for 1978-1981, about one-third of total year-to-year price inflation of Final Demand could be attributed to the above-average costs of energy imports.

The results are quite similar for above-average energy import costs allocated to the home market (after deduction of export content). For 1977-1981 they are some 3 to 7 per cent of GDP at current prices and of magnitude one-third to one-half of GDP year-to-year price inflation. This comparison gives smaller ratios for 1975-1976. Thus, above-average energy import costs could possibly account for one-third to one-half of GDP year-to-year price inflation in recent years, if all the assumptions of the previous section held true.

A less acceptable alternative method of calculation is given in Appendix 4, and links 1981 directly to 1973. Energy imports as such are considered,

Table 20: *Ireland, above-average energy import costs compared with total final demand and GDP, both at current prices, together with implicit year-to-year price inflation*

Year	*Total final demand at current prices*	*Total above-average cost in energy imports and non-energy merchandise* before *allowing for export absorption*	*Above-average cost before as percentage of total final demand (2) ÷ (1)*	*Year-to-year implicit price inflation of total final demand*
	£ million (1)	*£ million (2)*	*Per cent (3)*	*Per cent (4)*
1973	3914.2	0.0	0.0	
1974	4699.1	180.6	3.8	17.9
1975	5545.1	171.9	3.1	21.7
1976	7037.4	244.7	3.5	19.7
1977	8747.6	318.9	3.6	14.0
1978	10,379.0	282.2	2.7	8.4
1979	12,596.2	553.3	4.4	13.3
1980	14,547.0	815.8	5.6	15.7
1981	17,413.0	1048.5	6.0	18.2
	GDP at market prices, current	*Above-average cost in energy imports and non-energy merchandise,* after *allowing for export absorption*	*Above-average cost after, as percentage of GDP (6) ÷ (5)*	*Year-to-year implicit price inflation of GDP*
	£ million (5)	*£ million (6)*	*Per cent (7)*	*Per cent (8)*
1973	2703.2	0.0	0.0	
1974	2990.7	127.9	4.3	6.1
1975	3731.1	115.9	3.1	22.3
1976	4570.2	172.1	3.8	20.2
1977	5490.8	224.7	4.1	12.4
1978	6435.6	201.3	3.1	10.7
1979	7462.1	394.6	5.3	13.3
1980	8731.0	588.7	6.7	14.0
1981	10,389.0	765.5	7.4	17.7

Sources and Methods: GDP and Final Demand, Table 3(a) of *Economic Review and Outlook, Summer 1982*; Above-average costs due to energy imports, Table 11. Implicit price inflation derived from Tables 3(a) and 3(b) of *Economic Review and Outlook Summer 1982*, as year-to-year value change ÷ volume change.

without inclusion of energy content of non-energy merchandise imports. Results of these calculations show an average annual overall price inflation of 16 per cent for Final Demand, and 14 per cent for GDP. Above-average cost of energy imports, as such, could possibly account for an average annual price inflation of 1.9 per cent for Final Demand and of 2.7 per cent for GDP. One obvious advantage of results in Tables 19 and 20 is that they use annual

information, whereas Appendix 4 uses only data of 1981 and 1973. Thus the year-to-year results of Tables 19 and 20 are more reliable and on that account to be preferred to those of Appendix 4.

Input-Output Analysis of 1980 to Show how Imported Energy Price Inflation could be Allocated to Sub-sectors of Final Demand

The purpose of this section is, first of all, to show how energy imports and other imports can be totally allocated to sub-sectors of Final Demand, by means of an eight-sector input-output (I-O) model of the Irish economy for the year 1980. It is then possible to estimate an energy content of non-energy imports for an assumed same energy/GDP intensity as applied in Ireland for 1980. Thus, the further purpose is achieved of estimating a total (combined energy, as such, plus energy content of non-energy imports) energy content of each of the specified (and usual) sub-sectors of Final Demand.

The data used for 1980 were preliminary; thus, small discrepancies occur in some places between Table 21 and background Appendix 8 items and corresponding items in other parts of the paper. These differences are not important; the preliminary figures in Table 21 and Appendix 8 will suffice to give orders of magnitude, which is all that is being sought here. The I-O model is a linear model, which means, in effect, that it gives only first-order results of the kind described above in the Methodology section and again at the beginning of Part 5. The I-O approach assumes that all import costs are fully passed on to Final Demands, either directly or indirectly; thus, in I-O accounting, each Final Demand sub-sector has a calculated import content, such that this content of aggregate Final Demand fully accounts for total import cost.

The main results appear in Table 21, one set for Final Demands and energy imports at 1975 prices, the other set for these entities at 1980 prices. At 1975 prices, energy imports comprise 5 per cent of aggregate Final Demand, being 7 per cent of household expenditure and 2 per cent of government current expenditure. Thus, within Final Demand as a whole, there is considerable variation of energy intensities between different sub-sectors. At 1980 prices, energy imports comprise 7 per cent of aggregate Final Demand, being 10 per cent of household expenditure and 3 per cent of government current expenditure. It, therefore, appears that in cost terms the energy/GDP intensities have increased between 1975 and 1980; this, of course, results from energy import prices rising faster than those of aggregate Final Demand, as is evident from Appendix 1 data; the implicit price index of energy imports to base 1.0 for 1975 was 2.82 for 1980, while that of aggregate Final Demand was 1.94.

Table 21 entries can be used to give orders of magnitude of price inflation

of Final Demand arising through energy imports, on the assumption that rises in costs of energy imports are fully passed on to the Final Demand consumer, and that second-round, etc., effects are much smaller than first-round effects. Let us consider Row (F) percentages at 1980 prices. The energy import content of household expenditure is 10 per cent, thus, under the stated assumptions a 50 per cent rise in energy import unit cost would add 5 per cent to the cost of household expenditure, i.e., give an average price increase of 5 per cent. Likewise, a 50 per cent rise in unit cost of energy imports would give a 3½ per cent price increase to Final Demand as a whole. Corresponding price increases would be 1½ per cent for government current expenditure, and some 3 per cent for capital formation and for exports.

Table 21: *Ireland, 1980 energy imports allocated to final demands, at 1975 prices and at 1980 prices*

Item	*Household expenditure*	*Government current expenditure*	*Capital formation*	*Exports*	*Total final demand*
At 1975 prices					
Energy imports	150.4	13.7	37.5	71.9	273.5
Energy content of non-energy imports	43.7	6.1	22.2	28.3	100.3
Total energy in imports (A)	194.1	19.8	59.7	100.2	373.8
Total Final Demand (B)	2795	836	1179	2557	7367
(A) as percentage of (B) = (C)	6.9	2.4	5.1	3.9	5.1
At 1980 prices					
Energy imports	423.8	38.8	103.1	205.8	771.5
Energy content of non-energy imports	116.6	16.2	59.1	75.5	267.4
Total energy in imports (D)	540.4	55.0	162.2	281.3	1038.9
Total Final Demand (E)	5566	1871	2468	4642	14547
(D) as percentage of (E) = (F)	9.7	2.9	6.6	6.1	7.1

6. *ECONOMIC IMPLICATIONS OF ASSUMED FUTURE ENERGY IMPORT PRICES AND INTER-FUEL SUBSTITUTION*

Introduction

This part of the paper examines some of the economic implications of assumed future energy import prices and inter-fuel substitution, by means of simulation exercises. Discussion will be confined to matters arising directly from what has gone before, in connection with imports and the Balance of Payments. The year 1987 will be examined as the last year of the Government Plan set out in *The Way Forward*, published in October 1982.

Energy policy and projections for the years 1985 and 1987 are treated in pages 73-79 of *The Way Forward*. The main objectives are summarised in paragraph 12 of page 76:

> 12. The main objective of Government policy over the Plan period will be to ensure a supply of energy at reasonable prices so that, as far as possible, neither supply nor price constrains economic development. In order to attain this objective, policies are at present being, and for the period of the Plan will continue to be, directed towards reducing the country's dependence on imported energy and improving the security of supply, promoting the development of all indigenous energy sources, encouraging hydrocarbon exploration, improving flexibility in the use of available energy supplies, ensuring that energy production and distribution under State control is efficient and competitive in the market place and that the cost of security measures are identified and kept to a minimum and promoting the efficient use of energy in all sectors of the economy.

It is likely that similar energy policy will be pursued by the new government. It is conceded that future oil prices are uncertain. "There is, however, uncertainty about the future trend of oil prices. A pick up in both demand and prices could occur during the Plan period and a supply disruption cannot be ruled out" (pp. 73-74).

1987 Plan Compared with 1981 Actual

In order to see how stated policy objectives affect the 1987 demand, one

may compare the 1987 Plan structure with the 1981 actual structure. This is done in Table 22, which also includes the other data and calculations.

The 1987 Plan is seen to include 1,320 thousand TOE of Kinsale natural gas. By comparison with the situation of no natural gas at all and replacement of the 1,320 thousand TOE by oil imports, the saving of imports would be £224 million at 1981 prices (£169.82 per TOE of oil). It is to be noted that this is an absolute comparison, without reference to 1981.

The last row of Table 22 shows primary energy/GDP ratios for 1987 Plan and 1981 actual. The 1987 ratio is 10 per cent below that of 1981 and this

Table 22: *Ireland, primary energy amounts for 1981 and Plan 1987, together with potential 1987 savings of imports, and primary energy/GDP ratios*

Primary energy type	*1981 Actual*	*1987 Plan* (a)	*1987 Plan if pattern like 1981* (b)	*Potential 1987 import savings (b) less (a)* (c)	*1981 import price per TOE £* (d)	*Potential 1987 import saving at 1981 prices £'000 (c) × (d)* (e)
Native:						
Peat	1,120	1,580	1,283			
Hydro	222	190	254			
Natural gas	896	1,320	1,027			
Coal	45	60	52			
Total native ('000 TOE)	2,283	3,150	2,616			
Imported:						
Coal	807	1,850	925	−925	99.35	−91,899
Oil	5,069	4,350	5,809	1,459	169.82	247,767
Total imported ('000 TOE)	5,876	6,200	6,734	534		155,868
Total primary energy ('000 TOE)	8,159	9,350	9,350			
GDP at 1981 prices (£ million)	10,389	13,259				
Primary energy/GDP Ratio	0.785	0.705				

Sources and Assumptions: Energy, 1981 and 1987 Plan, page 76 of *The Way Forward* (1982), except for native coal, for which 1981 actual is from *Energy in Ireland 1981* and 1987 is an estimate by the writer. Import price per TOE for 1981, Table 2 data: coal, etc., £66.07 per tonne ÷ 0.665 gives £99.35 per TOE; Table 1 data: average price per tonne of imported oil, £169.82, taken to be per TOE. GDP at 1981 prices: 1981 actual from Table 5, value £10,389 million, 1987 based on nil growth for 1982 over 1981 and 5 per cent compound thereafter, as per page 32 of *The Way Forward.*

decrease is both reasonable and acceptable, by reference to the changes of similar ratios shown in Appendix 3: the volume ratio decreased from 1.0 to 0.91 between 1973 and 1975; it again decreased from 0.97 to 0.88 between 1979 and 1981. Thus, changes of the order of 10 per cent can occur rapidly. We may assume that the planned decrease during 1982-1987 would partly arise from energy conservation policies of various kinds. If this 10 per cent decrease in energy/GDP intensity were fully reflected in decreases of oil imports, it would mean a 1987 import saving of £180 million at 1981 prices, the product of 1,060.7 thousand TOE and £169.82 per TOE.

A further comparison with 1981 is shown in Columns (a) and (b) of Table 22. This comparison shows how much imports cost the Plan would save, by reference to the 1987 structure that would exist if that of 1981 were uniformly scaled up to give the 1987 Plan aggregate quantity. Column (c) shows that the Plan would mean an *extra* 925 thousand TOE of imported coal, for a reduction of 1,459 thousand TOE of imported oil. Because of coal being cheaper than oil, this net result would mean a reduction of £156 million of import costs for the 1987 Plan, as shown in Column (e) of Table 22.

Possible 1987 effects on Imports and the Balance of Payments

The Plan policy results considered above can be put into a scheme of import cost reduction and improved Balance of Payments. This is done in Table 23, which shows the effects of a couple of further possibilities. Table 21 data reveal that at 1980 prices some 27 per cent of the full cost of energy imports and of energy contained in non-energy imports was absorbed by exports. For 1987 let us assume an absorption of 33⅓ per cent, because of Plan exports growing at 12 per cent between 1983 and 1987, a faster growth rate than other Final Demand sub-sectors (see page 35 of *The Way Forward*). This means a net Balance of Payments (BP) improvement of two-thirds of the full import amount, this net effect appearing in Column (3) of Table 23.

The first effect treated in Table 23 is that of getting the primary energy/GDP intensity down from that of 1981 to that specified in the 1987 Plan. The resulting import reduction would mean £180m. at 1981 prices, with supposed £120m. of improvement of the Balance of Payments. Next, we consider increased peat production, to mean £78m. saving of oil imports and £52m. BP improvement. Increased Kinsale natural gas production would mean replacement of oil imports worth £72m. and BP improvement of £48m. Finally, increasing coal imports to replace oil imports would mean a further £74m. cut in import cost and £49m. BP improvement. These four changes so far considered are all included in the Plan, and represent £404m. reduced import cost and £269m. improved BP, by comparison with a 1987 situation having 1981 quantities as specified and oil imports making up the extra required.

Table 23: *Ireland, possible 1987 import cost and Balance of Payments effects of policies and price changes of primary energy*

Policy or price change from 1981 actual situation	*Quantity of primary energy involved '000 TOE*	*Import reduction, at 1981 prices £ million*	*Supposed Balance of Payments improvement, at 1981 prices £ million*
	(1)	*(2)*	*(3)*
1. Getting energy/GDP intensity down from 1981 level to that of 1987 Plan, in terms of oil imports	1,061	180	120
2. Increasing peat production above 1981 level, as shown in Plan, in terms of oil imports	460	78	52
3. Increasing Kinsale gas production above 1981 level, as shown in Plan, in terms of oil imports	424	72	48
4. Increasing coal imports above 1981 level, as shown in Plan, in terms of saving of cost of importing same quantity of oil	1,043	74	49
5. Supposed fall in imported oil prices, to £100 per TOE	4,350	304	203
6. Supposed fall in imported coal prices, to £70 per TOE	1,850	54	36
Aggregate effect		762	508

But two further price reductions could occur, if the present oil glut continued into the future and OPEC producers decided to pursue individual pricing policies. The figures used in Table 23 are illustrative only. With oil falling to £100 per TOE at 1981 prices, there would be a £304m. reduction of import cost and a BP improvement of £203m. Finally, and least likely, a cut in coal prices to £70 per TOE would mean £54m. reduction of import cost and £36m. BP improvement.

The combined result of these six changes in 1987 would mean £762m. less of import cost and £508m. BP improvement. For 1981 Final Demand structure scaled up uniformly so as to give the Plan 1987 aggregate, total imports would be £8,948m. and the BP deficit £1,848m. (exports less imports). Thus, in terms of 1981 structures the improvement of the 1987 BP arising from £508m. would reduce it by 27 per cent, which is considerable.

7. *CONCLUSIONS*

This section provides a summary of the key conclusions reached, in relation to each question and topic considered throughout the paper. It follows the same order of presentation as did the previous text and groups conclusions under corresponding headings.

Energy Imports and Total Primary Energy

In the face of a ten-fold price increase between 1973 and 1980, the import tonnage increased from 6.5 million for 1973 to 7.2 million for 1980. The 1981 tonnage, however, decreased to 6.2 million for a further 19 per cent cost increase over 1980. In this lack of greatly reduced demand in response to such enormous price increases, we can see the meaning of the word "essential" as applying to energy imports. By contrast, the average price of non-energy merchandise imports rose by less than three times between 1973 and 1981.

For the two major import groups, coal and oil, there is evidence of substitution of coal for oil since 1978 in response to a 1978-1981 coal price increase of 91 per cent as against 169 per cent for crude oil.

Energy imports have decreased relative to real GDP since 1975 onwards, and for 1973-1981 their volume grew at 1.5 per cent per year, as against 3.5 per cent for real GDP. Likewise total primary energy has increased less in volume than real GDP, for 1973-1977 showing a 1.4 per cent annual increase versus GDP 3.7 per cent, and for 1977-1981 showing 2.2 per cent annual rate versus GDP rate of 3.0. All of this is long-term movement.

In the short run one might reasonably expect reduced demand associated with increasing price, and this hypothesis was tested at the quarterly level for the 16 largest quarter-to-quarter import price changes throughout 1973-1981. Results did not support this hypothesis. Not only was there no significant negative correlation between quantity and price, but there were, in fact, three positive correlations and three positive average quantity increases out of the four experiments tried on these 16 major price increases. Thus, in the short run the demand for imported energy would seem to be extraordinarily unresponsive to price increase. There may be, however, the question of the most appropriate time lag between price increase and quantity response, which other researchers could investigate.

Terms of trade effects of imported energy price inflation mean that as a

nation our real income and welfare are reduced because we have to pay a higher price in terms of exports for the same volume of imports. These effects were estimated for the 1973-1981 period, relative to the 1973 one-to-one import-export exchange rate being chosen as price base. Welfare gains occurred in three years and welfare losses in five years. But both gains and losses were only small percentages (between 0.1 and 2.3) of GDP at current prices.

The effects of energy import costs upon the Balance of Payments (BP) have been estimated in terms of above-average cost of energy goods themselves plus corresponding effects arising from energy content of non-energy merchandise imports. The combined effect is zero for 1973 and increases so as to reach the large value of £1,049 million for 1981, before allowance for the amount of this above-average cost passed on through exports. The net effect, after allowance for exports, is equivalent to between 34 and 59 per cent of the import excess each year since 1975 and thus could be an important factor in Balance of Payments considerations, if these first-round estimates be accepted as giving the order of magnitude of the true effect. It is also likely that such above-average effects as calculated are definitely on the low side, because they ignore the relatively high energy intensity of non-energy imports.

Final Energy

The total energy to final users varied between 5.2 and 6.6 million TOE during 1973-1981, the maximum occurring in 1979, with a reduction to 6.3 for 1980 and 6.2 for 1981. Amounts purchased by domestic users (households) varied between 1.5 and 2.0 million TOE, comprising a steady 29-30 per cent of the total in all years; the maximum again occurred in 1979. These household purchases exclude some 1 million TOE of petrol for cars.

Gas oil and fuel oil in 1981 were some 10 times as expensive as in 1973; electricity and gas some 6 to 10 times; peat, coal, petrol and DERV some 3 to 5 times. Retail prices generally showed smaller increases during 1973-1981 than did the energy import prices.

Because peat and coal showed less rapid retail price rises than other fuels, one may look for solid fuel substitution in place of other fuels. In household consumption, oil products showed a downward trend from 1975 onward, being 21 per cent in 1975 and 13 per cent in 1981. A compensating upward movement is shown by the solid fuel share — so we have solid fuel substituting for oil since 1975. In non-household consumption, oil products showed a downward trend, from 88 per cent for 1973 to 80 per cent for 1981. The other three fuel groups showed upward trends. So here also the oil products have been progressively substituted for by other fuels throughout 1973-1981.

In view of the severe increases of retail prices, one would expect in general some reduction in the energy intensity of GDP as one goes from 1973 to 1981, and this indeed occurs. For total final energy and real GDP (by sector of origin) the 1973-1974 average intensity was 1.72, compared with 1.58 for 1979-1980, the latter being 8 per cent smaller than the former. For industry and agriculture the 1979-1980 average intensity of 0.94 was 10 per cent below the 1973-1974 average value of 1.05. For commerce, transport and services (including petrol for private cars) the 1979-1980 average intensity of 1.29 was 9 per cent smaller than the 1973-1974 average of 1.42. But there is no evidence of reduced intensity of final energy to households. The 1973-1974 intensity was 0.65 and that for 1979-1980 was 0.67, the 1981 intensity being 0.66. Thus, the intensity of household demand for final energy has shown no tendency to fall, in the face of a 423 per cent rise in household coal price, a 971 per cent rise in fuel oil price and a 617 per cent rise in towns-gas price, between 1973 and 1981.

The reaction of final energy demand to annual price increases has been examined under the hypothesis that such short-term reaction should show quantity decrease significantly associated with price increase. Out of the total of 48 observations for household demand plus petrol for cars, 5 correlations have been calculated. For all items combined there is an average 2 per cent *increase* of quantity above that of the previous year, in spite of an average 26 per cent price increase over that of the previous year. But the correlation coefficient is negative, of value -0.22, which almost reaches the 10 per cent level of NHP significance. The general impression emerging from the correlation analysis is of large price increases (18-37 per cent) associated with small quantity *increases* (2-4 per cent) and only one small quantity decrease (— 2 per cent). But in movements about the mean levels, some items show significant negative correlation of quantity and price. In other words, annual price increases above the average tend to occur in association with annual quantity increases below the average.

Price Inflation Attributable to Above-Average Costs of Energy Imports

Above-average costs of energy imports and of the energy content of other merchandise imports are taken as being the difference between the actual cost of such imports and what their cost would be if their prices rose in line with those of non-energy imports. Such above-average costs can be examined as possible sources of price or cost inflation of imports, of Final Demand, and of GDP.

A summary of the assumptions underlying such price inflation estimates is appropriate:

(a) demanded energy import quantities are non-responsive to price changes, likewise for the energy content of non-energy merchandise imports;
(b) if the given quantum of energy imports cost less, there would be no extra (compensatory) demand for non-energy imports;
(c) for Final Demand, above-average costs of energy imports are being considered alone *per se*, without allowance for wage compensation effects or any domestic price inflation sparked off by such costs;
(d) such above-average costs of energy imports are fully passed on to Final Demand;
(e) the volume flows of all other goods and services are unaffected by reduced costs of energy imports;
(f) exports absorb and pass on a share of above-average energy import cost in proportion to their absorption of energy and non-energy imports.

For total imports, the above-average cost of energy imports, and of energy content of non-energy merchandise imports, might possibly have a price inflation effect of between 8 and 16 per cent per year, the largest values occurring during 1979-1981, for the stated assumptions. During these recent years almost all price inflation of imports is equivalent to, or could be attributed to, such above-average cost of energy imports.

Such cost could account for one-quarter or less of year-to-year price inflation of total Final Demand during 1974-1977. But for 1978-1981 it could account for about one-third of such price inflation of Final Demand. Thus, this energy effect is of considerable importance as an actual or potential factor of Final Demand price inflation.

For 1977-1981 such above-average energy import costs are of magnitude 3 to 7 per cent of GDP at current prices and one-third to one-half of GDP year-to-year price inflation. Thus, these costs could possibly account for one-third to one-half of GDP year-to-year price inflation in recent years if the above-listed assumptions hold true.

An input-output analysis of 1980 illustrates how imported energy price inflation can be allocated to sub-sectors of Final Demand such as household expenditure. At 1980 prices, energy imports comprise 7 per cent of aggregate Final Demand, being 10 per cent of household expenditure and 3 per cent of government current expenditure; thus, within Final Demand as a whole, there is considerable variation of energy intensities between different sub-sectors. These I-O results can be used to give orders of magnitude of price inflation of Final Demand arising through energy imports, on the assumption that rises in costs of energy imports are fully passed on to the Final Demand

consumer, and that second-round, etc., effects are much smaller than first-round effects. For example, the energy import cost of 1980 household expenditure is 10 per cent, thus under the stated assumptions a 50 per cent rise in energy import unit cost would add 5 per cent to the cost of household expenditure, i.e., give an average price increase of 5 per cent. Likewise, a 50 per cent rise in energy import unit cost would give rise to price inflation of 1½ per cent for government current expenditure, 3 per cent for both capital formation and exports and 3½ per cent for aggregate Final Demand.

Economic Implications of Assumed Future Energy Import Prices and Inter-fuel Substitution

Some of the economic implications of assumed future energy import prices and possible inter-fuel substitution may be considered in connection with imports and the Balance of Payments. Energy policy and projections for the years 1985 and 1987 are treated in *The Way Forward* (1982) document of the previous government. It is likely that similar energy policy will be pursued by the new government. It is conceded that future oil prices are uncertain.

In order to see how stated policy objectives affect the 1987 demand, one may compare the 1987 Plan structure with the 1981 actual structure. The 1987 total primary energy/GDP ratio is 10 per cent below that of 1981. If this 10 per cent decrease were fully reflected in decreases of oil imports, it would mean a 1987 import saving of £180 million at 1981 prices. One may also estimate how much import cost the Plan would save, by reference to the 1987 structure that would exist if that of 1981 were uniformly scaled up to give the 1987 Plan aggregate primary energy quantity. This comparison shows for the Plan an *extra* 925 thousand TOE of imported coal combined with a reduction of 1,459 thousand TOE of imported oil. Because of coal being cheaper than oil, this net result would mean a reduction of £156 million of import cost by the 1987 Plan.

The Plan policy results can be put into a scheme of import cost reduction and improved Balance of Payments (BP), for the assumption of one-third of energy import cost effects being passed on through exports, thus leaving two-thirds for domestic Final Demand. Getting the 1987 primary energy/GDP ratio down to 90 per cent of that of 1981 would mean a supposed £120m. BP improvement. Peat production increase above that of 1981 would mean £52m. BP improvement. Corresponding increased Kinsale natural gas production would mean £48m. BP improvement. Increasing coal imports to replace oil imports would mean a further £49m. BP improvement. These four changes are all included in the Plan and represent £269m. of BP improvement at 1981 prices, all in terms of reduced oil imports or replacement of oil by coal. Such planned improvement would be significant.

Two further price reductions are possible: a fall in imported oil price to £100 per TOE and a fall in imported coal price to £70 per TOE. These would mean for 1987 further BP improvements of £203m. and £36m., respectively.

The combined result of these six changes in 1987 would mean £508m. BP improvement (and £762m. reduction of import cost). For 1981 Final Demand structure scaled up uniformly so as to give the 1987 Plan aggregate, the BP deficit would be £1,848m. Thus, in terms of 1981 structures, the improvement of the 1987 BP due to £508m. would reduce it by 27 per cent, which is considerable.

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Appendix 1

GDP COMPONENTS

Table A1.1: *GDP components at current prices, values and value indices, 1973-1981*

Year	*Total final demand (1)*	*Energy imports (2)*	*Non-energy imports (3)*	*GDP expenditure (4)*
		£ million at current prices		
1973	3914.0	70.9	1140.1	2703
1974	4699.4	216.4	1492.0	2991
1975	5545.0	233.1	1580.9	3731
1976	7037.2	293.0	2174.2	4570
1977	8747.8	372.5	2884.3	5491
1978	10,379.4	354.7	3588.7	6436
1979	12,596.1	563.3	4570.8	7462
1980	14,547.0	771.4	5044.6	8731
1981	17,413.0	918.7	6105.3	10,389
		Value index based on 100 for 1973		
1973	100—	100—	100—	100—
1974	120.1	305.2	130.9	110.7
1975	141.7	328.8	138.7	138.0
1976	179.8	413.3	190.7	169.1
1977	223.5	525.4	253.0	203.1
1978	265.2	500.3	314.8	238.1
1979	321.8	794.5	400.9	276.1
1980	371.7	1088.0	442.5	323.0
1981	444.9	1295.8	535.5	384.4

Sources: Total Final Demand is the sum of Columns (2) to (4). Energy imports come from Table 5, so does GDP expenditure. Non-energy imports are total imports per Table 3(a) of *Economic Review and Outlook Summer 1982* less Column (3) values.

Table A1.2: *GDP components at 1975 prices, values and volume indices, 1973-1981*

Year	*Total final demand (1)*	*Energy imports (2)*	*Non-energy imports (3)*	*GDP expenditure (4)*
		£ million at 1975 prices		
1973	5616.3	245.9	1861.4	3509
1974	5717.1	242.3	1816.8	3658
1975	5545.0	233.0	1581.0	3731
1976	5878.5	224.1	1850.4	3804
1977	6408.0	246.5	2097.5	4064
1978	7013.1	247.5	2462.6	4303
1979	7512.2	277.1	2831.1	4404
1980	7498.0	273.5	2704.5	4520
1981	7595.0	239.6	2787.4	4568
		Volume index based on 100 for 1973		
1973	100–	100–	100–	100–
1974	101.8	98.5	97.6	104.2
1975	98.7	94.8	84.9	106.3
1976	104.7	91.1	99.4	108.4
1977	114.1	100.2	112.7	115.8
1978	124.9	100.7	132.3	122.6
1979	133.8	112.7	152.1	125.5
1980	133.5	111.2	145.3	128.8
1981	135.2	97.4	149.7	130.2

Sources: Same as Table A1.1 with 3(b) instead of 3(a).

Appendix 2

CALCULATION OF PRICE INDEX OF 1981 NON-ENERGY IMPORTS TO BASE 1.0 FOR 1973

			£ million
Per TSI December 1981, total merchandise imports for 1981 at current prices		=	6,575.48
Less energy imports (Table 1)			-918.65
1981 Non-energy imports at current prices	A		5,656.83
Per TSI December 1981, the 1981 average monthly price index of imports to base 1.0 for 1975 is 2.314. Link to 1973 via factor 1.7649 derived from price indices 245.5 and 139.1 shown on page 8 of TSI December 1976			
			£ million
2.314 X 1.7649 = 4.08398 Thus 1980 merchandise imports at 1973 prices (given by 6575.48/4.08398)		=	1,610.07
Less 1981 energy imports at 1973 prices (Table 1 quantities at Table 2 prices)			-75.60
1981 non-energy imports at 1973 prices	B		1,534.47
Implicit price index of 1981 non-energy imports to base 1.0 for 1973		$\frac{A}{B}$ =	3.6865
$(3.6865)^{1/8} = 1.1771$, giving an annual price inflation of 17.7 per cent on average, since 1973			

Appendix 3

NATIVE AND IMPORTED PRIMARY ENERGY 1973-1981 IN THOUSAND TOE AND VOLUME INDEX, COMPARED WITH GDP, TOGETHER WITH TOTAL PRIMARY ENERGY/GDP VOLUME INDEX RATIO

Item	*1973*	*1974*	*1975*	*1976*	*1977*	*1978*	*1979*	*1980*	*1981*
Native energy	1312	1385	1352	1391	1478	1388	1675	1890	2283
Imported energy	5771	5824	5435	5648	6013	6307	6937	6443	5876
Total primary energy ('000 TOE)	7083	7209	6787	7039	7491	7695	8612	8333	8159
(A) Volume index	1.00	1.02	0.96	0.99	1.06	1.09	1.22	1.18	1.15
Gross Domestic Product at 1975 Prices, £ million	3509	3658	3731	3804	4064	4303	4404	4520	4568
(B) Volume index	1.00	1.04	1.06	1.08	1.16	1.23	1.26	1.29	1.30
Total primary energy/GDP volume index ratio, (A)/(B)	1.00	0.98	0.91	0.92	0.91	0.89	0.97	0.91	0.88

Sources: Energy from *Energy in Ireland 1979*, Table 1.3 and *Energy in Ireland 1981*, Table 1.3. GDP from same source as Table 5.

Appendix 4

CALCULATION OF 1981 PRICE INFLATION ATTRIBUTABLE TO ENERGY IMPORTS, FOR ASSUMPTIONS EXPLAINED IN MAIN TEXT

1973 is taken as base year.

First GDP total inflation 1981 to base 1.0 for 1973

$$\frac{\text{GDP 1981 current prices}}{\text{GDP 1981 at } p_{1975}} = \frac{10{,}389}{4{,}568} = 2.2743 \text{ (A)}$$

$$\frac{\text{GDP 1973 at 1975 prices}}{\text{GDP 1973 at 1973 prices}} = \frac{3509.0}{2703.2} = 1.2981 \text{ (B)}$$

(A) × (B) = 2.95225

$(2.95225)^{1/8} = 1.1449$

giving GDP annual inflation rate 14.5 per cent over the 8 years 1973-1981.

Second

	£ million
1981 GDP at 1973 prices =	3,519.0

given by $\frac{10{,}389}{2.95225}$

Third

	£ million
1981 energy imports at 1981 prices (X)	918.65
1981 energy imports at 1973 prices (Y)	75.60
(X) - (Y)	843.05

the latter direct inflation due to imported energy costs.

Fourth

$$\frac{843.05}{3519.0} = 0.23957$$

gives 1981 inflation due to energy imports

$(1.23957)^{1/8} = 1.0272$

So annual inflation rate of GDP due to cost of energy imports was an average 2.72 per cent per year since 1973.

	(1) *1973 at p. 73*	*(2)* *1973 at p. 75*	*(2) ÷ (1)*
Personal	1738.5	2461.1	
Government	421.9	614.1	
Fixed Capital	656.3	974.2	
Stocks	+71.1	+67.0	
Exports	1026.4	1499.9	
Total Final Demand	3914.2	5616.3	1.43485

	(1) *1981 at p. 75*	*(2)* *1981 at p. 81*	*(2) ÷ (1)*
Personal	2833	6565	
Government	907	2271	
Fixed Capital	1295	3089	
Stocks	-40	-88	
Exports	2600	5576	
Total Final Demand	7595	17413	2.29269

Source: Tables 3(a) and 3(b) of *Economic Review and Outlook Summer 1982.*

$1.43485 \times 2.29269 = 3.28967$

$(3.28967)^{1/8} = 1.1605$

i.e., 16.0 per cent inflation of Final Demand (including oil) per annum.

1981 Final Demand at 1973 prices is

$$\frac{17413}{3.28967} = 5293.2$$

$$\frac{843.05}{5293.2} = 0.15927$$

$(1.15927)^{1/8} = 1.0186$

i.e., 1.86 per cent per annum possibly due to energy import price inflation.

Appendix 5

ESTIMATION OF HOW THE ABOVE-AVERAGE ENERGY IMPORT COST AFFECTED IRISH IMPORTS AND EXPORTS DURING 1973-1981

This appendix first estimates how the above-average price inflation of energy imports directly affected Irish import costs during 1973-1981. Then an estimate is made of similar energy price effects inherent in non-energy imports. The two sets of results are then combined to show the joint effect. Finally, the price effect of imported energy content of exports is estimated. "Above-average" here means greater than the average price movement of non-energy imports of merchandise.

Effects Through Energy Imports as Such

The calculations shown in Table A5.1 came from data already included in Appendix 1 and using the idea of non-energy prices already put forward, i.e., if energy imports increased in price like all non-energy merchandise imports. The prices used are those of non-energy shown by the index of Column (3) of Table 10, re-based on 1.0 for 1973. The energy imports at 1973 prices are those at current prices in Table 1 based back to 1973, i.e., in getting

Table A5.1: *Calculation of above-average energy import cost during 1973-1981*

Year	*Non-energy price index*	*Cost of energy imports at current prices increasing in accord with column (1)*	*Above-average cost, given by actual energy import cost less column (2) cost at current prices*	
	(1)	*£ million (2)*	*£ million (3)*	*As % of GDP (4)*
1973	1.0000	70.9	0.0	0.0
1974	1.3415	93.6	122.8	4.1
1975	1.6340	109.7	123.4	3.3
1976	1.9199	124.0	169.0	3.7
1977	2.2467	159.6	212.9	3.9
1978	2.3807	169.7	185.0	2.9
1979	2.6373	210.4	352.9	4.7
1980	3.0474	239.2	532.2	6.1
1981	3.5784	246.9	671.8	6.5

Column (2) of Table A5.1 the values of Table 1 at current prices were deflated by the ratio of Column (3) to Column (2) of Table 10, re-based on 1.0 for 1973. The actual costs then used to get Column (3) of Table A5.1 are the total's values of Table 1. Column (4) shows this above-average cost as a percentage of GDP at current prices.

It is important to notice that the 1981 above-average cost of energy imports was £672m., thus possibly worsening the appallingly large Balance of Payments in 1981 by no less than IR£672m. as a first-round order of magnitude, in the sense explained in the Methodology section.

Effects Through Non-energy Imports

To get an estimate of the "above-average" effect of energy costs included in non-energy imports, one applies the Column (4) percentages of Table A5.1 to non-energy merchandise imports, as shown in Table A5.2. The assumption here is that non-energy imports have the same energy intensity as Irish GDP generally. This assumption very probably underestimates the energy content of imports, which include large amounts of energy-intensive products such as metals and metal products.

Table A5.2: *Calculation of above-average cost of non-energy imports due to inherent above-average energy cost, during 1973-1981*

Year	*Total merchandise imports £ million current (1)*	*Total energy imports £ million current (2)*	*Non-energy merchandise imports £ million current (1) less (2) (3)*	*"Above-average" energy import cost effect percentages (4)*	*"Above-average" energy import cost estimated as content of non-energy merchandise imports (4) applied to (3) £ million (5)*
1973	1137.24	70.87	1066.37	0.0	0.0
1974	1626.31	216.39	1409.92	4.1	57.8
1975	1704.11	233.05	1471.06	3.3	48.5
1976	2337.93	292.98	2044.95	3.7	75.7
1977	3090.89	372.46	2718.43	3.9	106.0
1978	3706.51	354.71	3351.80	2.9	97.2
1979	4827.92	563.26	4264.66	4.7	200.4
1980	5420.70	771.40	4649.30	6.1	283.6
1981	6575.48	918.65	5656.83	6.5	376.7

Sources: Total merchandise imports, *Trade Statistics of Ireland*, December issues. Total energy imports, Table 1. "Above-average" import cost percentages taken from Table A5.1, Column 4.

Column (5) thus shows the above-average energy cost inherent in non-energy merchandise imports for the assumptions made. This cost is at current prices. It runs from zero for 1973 to £377m. for 1981, a large amount.

Total Above-Average Cost Effect of Energy Imports and Energy Content of Imports

Table A5.3 brings together the total above-average energy cost for 1973-1981. The combined above-average cost became large in recent years, exceeding £1,000 million for 1981. As a percentage of total merchandise imports it ranged from 0.0 for 1973 to 15.9 for 1981.

A corresponding calculation for Exports is shown in Table A5.4 and footnotes; this table estimates by how much exports at current prices have been inflated by the "above-average" cost of their imported energy content.

Thus, for the assumptions made, the net effect on the Balance of Payments is given by Table A5.3 Column (3) results *less* those of Table A5.4 Column (6).

Table A5.3: *Estimated aggregate above-average cost of energy imports plus energy content of non-energy merchandise imports to Ireland during 1973-1981*

Year	*Above-average cost in energy imports £ million (1)*	*Above-average cost in non-energy merchandise imports £ million (2)*	*Combined above-average (1) + (2) £ million (3)*	*(3) as percentage of total merchandise imports (4)*
1973	0.0	0.0	0.0	0.0
1974	122.8	57.8	180.6	11.1
1975	123.4	48.5	171.9	10.1
1976	169.0	75.7	244.7	10.5
1977	212.9	106.0	318.9	10.3
1978	185.0	97.2	282.2	7.6
1979	352.9	200.4	553.3	11.5
1980	532.2	283.6	815.8	15.0
1981	671.8	376.7	1,048.5	15.9

Table A5.4: *Estimation of above-average cost of imported energy content of Irish exports during 1973-1981*

Year	*Energy exports £ million current*	*Deflator of (1)*	*Energy exports deflated £ million*	*Above-average imported energy cost as such*	*Above-average energy import cost content of of non-energy imports*	*Total effect of energy imports: (1) less (3) plus (4) + (5) £ million*
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
1973	6.34	1.0	6.3	0.0	0.0	0.0
1974	14.74	1.392	10.6	32.3	16.3	52.7
1975	18.63	2.150	8.7	32.4	13.7	56.0
1976	11.74	2.420	4.9	44.4	21.4	72.6
1977	14.46	2.338	6.2	56.0	29.9	94.2
1978	9.43	2.119	4.5	48.6	27.4	80.9
1979	14.78	2.688	5.5	92.8	56.6	158.7
1980	10.26	3.220	3.2	139.9	80.1	227.1
1981	12.25	3.808	3.2	176.6	106.3	292.0

Source: Energy exports, *Trade Statistics of Ireland*. Deflator of latter, price index of average price per tonne of imported energy as shown in Table 1, divided by the price index of non-energy imports formed as quotient of Table A1.2 Column (3) by Table A1.1 Column (3) and re-based on 1.0 for 1973.

Method: The input-output study of 1980 described elsewhere in this paper shows that 1980 exports absorbed 26.29 per cent of energy imports and 28.23 per cent of non-energy imports. For want of better information these percentages are assumed to apply to all years, and are used with Columns (1) and (2) of Table A5.3 to give the Table A5.4 entries in Columns (4) and (5), i.e., the above-average costs of both kinds of imports are allocated to exports in proportion to 1980 estimated shares of such imports absorbed by exports.

Appendix 6

IRELAND, QUARTERLY IMPORTS OF ENERGY PRODUCTS DURING 1973-1981: QUANTITY, VALUE AND PRICE

Year and Quarter		*Solid fuel*			*Crude oil*			*Refined oil*			*Liquid gas*		
		Quantity '000 tonnes	*Value £'000*	*Price per tonne £*	*Quantity '000 tonnes*	*Value £'000*	*Price per tonne £*	*Quantity '000 tonnes*	*Value £'000*	*Price per tonne £*	*Quantity '000 tonnes*	*Value £'000*	*Price per tonne £*
1973	I	219.69	2536	11.54	894.40	8145	9.11	831.82	8667	10.42	12.03	335	27.85
	II	177.54	1979	11.15	705.93	6406	9.07	871.62	9637	11.06	10.74	223	20.76
	III	192.76	1823	9.46	237.62	2104	8.85	682.97	8857	12.97	14.68	298	20.30
	IV	271.18	2993	11.04	627.12	5709	9.10	742.57	10,787	14.53	21.62	366	16.93
1974	I	247.20	4162	16.84	743.64	12,795	17.21	593.66	18,973	31.96	16.68	545	32.67
	II	198.21	3368	16.99	575.20	25,131	43.69	886.75	36,812	41.51	16.46	606	36.82
	III	286.94	4287	14.94	703.67	24,968	35.48	680.52	25,935	31.11	10.30	420	40.78
	IV	168.36	4794	28.47	602.55	21,673	35.97	783.86	31,241	39.86	16.63	679	40.83
1975	I	222.12	4626	20.83	550.60	20,085	36.48	707.01	28,189	39.87	16.61	904	54.43
	II	88.21	2059	23.34	618.52	22,621	36.57	717.69	28,365	39.52	17.69	974	55.06
	III	175.56	3725	21.22	649.59	24,942	38.40	695.69	28,078	40.36	10.77	643	59.70
	IV	210.92	4801	22.76	587.15	24,737	42.13	814.63	37,032	45.46	21.64	1273	58.83
1976	I	151.12	3509	23.22	601.87	28,001	46.52	741.25	34,086	45.98	26.98	1875	69.50
	II	114.52	2781	24.28	343.41	16,425	47.83	1003.42	50,792	50.62	19.71	1437	72.91
	III	158.46	4071	25.69	322.22	16,823	52.21	773.16	46,534	60.19	17.44	1306	74.89
	IV	194.48	4888	25.13	431.24	24,336	56.43	869.84	53,531	61.54	32.65	2588	79.26
1977	I	259.61	7389	28.46	636.32	36,473	57.32	862.60	52,045	60.34	34.39	3047	88.60
	II	152.75	4625	30.28	523.38	31,079	59.38	887.65	54,379	61.26	26.97	2339	86.73
	III	181.44	5678	31.29	499.12	29,338	58.78	763.28	45,689	59.86	17.78	1530	86.05
	IV	284.27	9351	32.89	524.79	32,836	62.57	839.23	54,005	64.35	30.79	2659	86.36
1978	I	235.21	7932	33.72	488.14	26,653	54.60	878.92	51,790	58.92	35.36	3022	85.46
	II	105.35	3740	35.50	595.92	33,128	55.59	900.61	53,052	58.91	29.38	2512	85.50
	III	245.51	8395	34.20	409.91	22,722	55.43	943.99	55,803	59.11	18.04	1548	85.81
	IV	263.39	9287	35.26	573.79	30,415	53.01	722.30	42,745	59.18	23.04	1962	85.16
1979	I	245.79	8133	33.09	531.35	28,163	53.00	1119.91	77,099	68.84	45.36	3833	84.50
	II	305.30	10,469	34.29	455.68	25,794	56.61	858.14	80,807	94.17	31.67	2897	91.47
	III	287.97	11,437	39.72	670.77	46,854	69.85	818.60	87,856	107.32	21.47	2064	96.13
	IV	387.61	17,396	44.88	369.42	28,600	77.42	1122.93	128,067	114.05	35.36	3791	107.21
1980	I	442.16	19,705	44.57	695.22	64,156	92.28	1036.71	124,300	119.90	52.44	6881	131.22
	II	261.93	11,803	45.06	482.28	53,655	111.25	960.99	116,732	121.47	27.02	3964	146.71
	III	250.61	13,338	53.22	572.86	61,095	106.65	912.23	110,632	121.28	28.31	4394	155.21
	IV	259.01	14,329	55.32	363.63	43,415	119.39	846.31	116,143	137.23	41.07	6762	164.65
1981	I	393.41	23,420	59.53	387.46	54,471	140.58	848.49	130,992	154.38	42.90	7492	174.64
	II	295.68	19,824	67.05	265.22	41,223	155.43	879.60	150,184	170.74	35.64	6176	173.29
	III	269.10	18,851	70.05	nil	nil	nil	1177.48	208,024	176.67	31.84	5436	170.73
	IV	349.98	24,334	60.53	nil	nil	nil	1181.33	219,769	186.04	42.96	8235	191.69

Appendix 7

CRUDE OIL IMPORT PRICE ESTIMATES IN US $, 1973-1981

Year	*Crude Petrol Table 2 c.i.f. price per tonne IR£* (1)	*US $ per IR£, Dublin Market, Central Bank* (2)	*US $ per tonne crude* (1) X (2) (3)	*Percentage increase from previous year* (4)
1973	9.07	2.4492	22.21	
1974	32.22	2.3705	76.38	244
1975	38.40	2.1693	83.30	9
1976	50.38	1.7668	89.01	7
1977	59.41	1.7455	103.70	17
1978	54.61	1.9197	104.83	1
1979	63.84	2.0474	130.71	25
1980	105.21	2.0609	216.83	66
1981	146.95	1.6158	237.44	10

Note: Column (2) figures are either annual figures shown in Central Bank *Quarterly Reports* 1974-1982 or averages of quarterly figures where annual figures are not given.

Appendix 8

IRISH 1980 INPUT-OUTPUT BACKGROUND DATA

Table A8.1: *Ireland 1980 eight-sector input-output transaction table at 1975 producer prices, £ million*

	Solid fuel	*Oil refining*	*Electricity*	*Gas*	*Agriculture*	*Industry*	*Commerce*	*Transport*	*Household expenditure*	*Government current expenditure*	*Capital formation*	*Exports*	*Total Output*	
Solid fuel	0.147		14.307			0.118	1.679		15.319		−3.064	0.308	28.814	Solid
Oil refining		1.422	13.422		4.462	13.612	4.332	6.949	27.910				72.109	Oil
Electricity	0.560			0.200	10.546	35.549	20.824		52.516				120.195	Elec.
Gas			15.394	0.555		0.399	1.959		8.393				26.700	Gas
Agriculture					8.000	935.000	4.000		124.000	3.000	29.000	74.000	1,177.000	Ag.
Industry	0.500				310.992	483.815	800.206	3.051	621.862	50.000	717.064	2,307.692	5,295.182	Ind.
Commerce	5.050			0.700	281.000	1,056.250	1,917.000	17.000	798.000	783.000	38.000	33.000	4,929.000	Com.
Transport					3.000	1.000	30.000	1.000	50.000		17.000	142.000	244.000	Trans.
Total imports	3.443	69.002	37.669	6.911	111.000	1,119.975	325.000	67.000	856.000		378.000	0.490	2,974.490	Imp.
Indirect taxes less subsidies					−15.000	53.000	144.000	2.000	241.000		3.000		428.000	Tax
Wages and salaries	13.591	0.849	21.626	5.909	37.000	972.025	1,315.000	122.000					2,488.000	Wage
Profits and depreciation	5.523	0.836	17.777	12.425	426.000	624.439	365.000	25.000					1,477.000	Prof.
	Solid	Oil	Elec.	Gas	Ag.	Ind.	Com.	Tran.	Hous.	Gov.	Cap.	Exp.	Total	
Total input	28.814	72.109	120.195	26.700	1,177.000	5,295.182	4,929.000	244.000	2,795.000	836.000	1,179.000	2,557.490		
	Solid	Oil	Elec.	Gas	Ag.	Ind.	Com.	Tran.	Hous.	Gov.	Cap.	Exp.	Total	
Energy imports														
Coal						1.829	2.058		19.014		3.104	0.490	26.495	Coal
Petrol					1.887				29.202				31.089	Petr.
Kerosene				5.205		0.876	0.876		4.328				11.285	Kero.
Jet fuel								10.769					10.769	Jet
Gas/Diesel oil	1.160	3.032			6.158	8.218	7.389	13.973	6.252				46.182	G/D
Residual fuel oil			32.823			22.455	2.067	0.732					58.077	RFO
LPG				0.201		2.318	1.058	0.655	4.233				8.465	LPG
Crude petroleum		65.670									15.507		81.177	Crude
Total energy imports	1.160	68.702	32.823	5.406	8.045	35.696	13.448	26.129	63.029		18.611	0.490	273.539	Ener.
Total non-energy imports	2.283	0.300	4.846	1.505	102.955	1,084.279	311.552	40.871	792.971		359.389		2,700.951	Non-E
	Solid	Oil	Elec.	Gas	Ag.	Ind.	Com.	Tran.	Hous.	Gov.	Cap.	Exp.	Total	

Table A8.2: *Distribution of 1980 quantities of Irish native energy products and imports in thousand TOE*

	Solid fuel	*Oil refining*	*Electricity*	*Gas*	*Agriculture*	*Industry*	*Commerce*	*Transport*	*Household*	*Govt. cur.*	*Capital formation (stocks)*	*Exports*	*Total*
Native Energy													
Peat	5		555			4	57		520		-104	1	1,038
Coal			31									9	40
Petrol					30				462				492
Gas/Diesel Oil		30			61	94	74	140	63				462
Residual fuel oil			422			288	26	10					746
Electricity					79	272	156		241				748
Natural gas			484	8									492
Townsgas						5	14		60				79
LPG									14				14
Hydro			214										214
Total native	5	30	1,706	8	170	663	327	150	1,360	0	-104	10	4,325
	Solid	*Oil*	*Elec.*	*Gas*	*Ag.*	*Ind.*	*Com.*	*Trans.*	*Hous.*	*Gov.*	*Cap.*	*Exp.*	*Total*
Imported Energy													
Coal						56	63		582		95	15	811
Petrol					36				557				593
Kerosene				101		17	17		84				219
Jet fuel								209					209
Gas/Diesel Oil		64			130	198	156	295	132				975
Residual fuel oil			1,032			706	65	23					1,826
LPG				4		46	21	13	84				168
Crude petroleum		1,749									413		2,162
Total imported		1,813	1,032	105	166	1,023	322	540	1,439	0	508	15	6,963

Table A8.3: *Ireland, imports required by 1980 Final Demand, at 1975 prices, with derived percentages*

Item	*Household expend.*	*Govt. current expend.*	*Capital formation*	*Exports*	*Total Final Demand*
Energy imports:					
Direct £ million	63.0		18.6	0.5	82.1
Indirect £ million	87.4	13.7	18.9	71.4	191.4
Total £ million (A)	150.4	13.7	37.5	71.9	273.5
Non-energy imports:					
Direct £ million	793.0		359.4		1,152.4
Indirect £ million	384.6	163.6	238.0	762.4	1,548.6
Total £ million (B)	1,177.6	163.6	597.4	762.4	2,701.0
Total Final Demand (C) £ million	2,795.0	836.0	1,179.0	2,557.0	7,367.0
(A) as percentage of (C)	5.38	1.64	3.18	2.81	3.71
(B) as percentage of (C)	42.13	19.57	50.67	29.82	36.66
Supposed 3.71 % energy content of (B) = (D)	43.7	6.1	22.2	28.3	100.3
(D) as percentage of (C)	1.56	0.73	1.88	1.11	1.36
(A) + (D) as percentage of (C)	6.94	2.37	5.06	3.92	5.07

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