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Foreign Direct Investment in Ireland: Empirical Evidence and Theoretical Implications

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Précis: This paper summarises the existing literature on foreign direct investment and the multinational enterprise with emphasis on those aspects which are particularly relevant to Ireland. Empirical analysis of data on new grant-aided manufacturing industry for the year 1976/77 shows that (i) the branch plants of overseas firms in Ireland tend to belong to relatively small parent companies and (ii) analysis of the capital intensity, technological sophistication and industrial linkages of domestic and overseas New Industry shows that the New Industry manufacturing sector is not characterised by a dual economy. It is concluded that the existing theory of foreign direct investment is deficient in that it tends to view the process from the perspective of the country undertaking the investment.

I INTRODUCTION

The role of foreign direct investment (FDI) in generating industrial growth in the Irish economy has received increasing attention in recent years (see Buckley, 1974; O'Farrell, 1975; Ó hUiginn, 1972; McAleese, 1972 and 1977; McAleese and McDonald, 1978; Teeling, 1975; and Stewart, 1976a and 1976b). There is little doubt that FDI has made a significant and important contribution to Irish industrial development in terms of employment, exports and growth (see McAleese, 1977, for a comprehensive treatment). However, very little work has been done on the determinants and characteristics of FDI in the Irish economy.

This paper examines some of the characteristics of overseas industry in

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Ireland and tests a number of hypotheses which are generated from the existing literature on international investment. The data are based on a stratified random sample of 320 plants which have received a grant under the New Industry programme of the Industrial Development Authority (IDA).[1] Where possible, data for the calendar year 1976 were collected, but in some cases only data for the financial year 1976/77 were available. In such cases those data were treated as if they referred to calendar year 1976.

The paper is organised as follows. Section II summarises the major aspects of theories concerned with explaining international investment, with emphasis upon those which may be of greater relevance to Ireland. Section III presents empirical evidence on the characteristics of FDI in the Irish Republic such as employment size of plant and parent company, export propensity, and the extent of domestic linkages, and then the theoretical implications of this evidence is discussed. Conclusions are summarised in Section IV.

II FOREIGN DIRECT INVESTMENT AND THE MULTINATIONAL ENTERPRISE

In contrast to the neatness of international trade theory, international investment theory consists of a collection of hypotheses and theories dealing with various aspects of international capital flows. Here we are primarily concerned with the literature which relates to the role of the multinational enterprise (MNE) in international capital movements. Grubel (1977, pp. 531-543) discusses some of the factors which induce FDI such as

> *Technical externalities* Firms may engage in vertical integration across national boundaries in order to internalise external economies.
>
> *Risk diversification* The portfolio model of investment can be applied to an explanation of foreign investment by considering the fact that, typically, the rates of return on all assets within one country are subject to the same influences, such as the business cycles and government policies, and, therefore, investors can achieve higher levels of efficiency by diversifying internationally. Empirical evidence cited by Grubel (1977, pp. 540-543) supports this hypothesis.

Other factors affecting FDI are imperfections in product and factor markets and the effects of government policies. One of the more important explanations of FDI is the product-cycle model which was developed by Vernon (1966) to provide a dynamic framework for the analysis of international

1. For a detailed description of sampling technique, response rates, etc., see O'Loughlin (1978), Chapter 2.

trade and investment (see also Posner, 1961; Hufbauer, 1965; and Hirsch, 1967). This model ". . . puts less emphasis upon comparative cost doctrine and more upon the timing of innovation, the effects of scale economies, and the roles of ignorance and uncertainty in influencing trade patterns" (Vernon, 1966, p. 190). Hence, Vernon relaxes the basic assumptions of the orthodox Heckscher-Ohlin theory of international trade.[2] However, the major characteristic of the product-cycle model is the central role given to innovation and product and process development.

The product-cycle model was developed solely in relation to the foreign trade and investment of the US economy. Vernon hypothesised that the US would be the first to develop new products due to the combination of the following characteristics of the US economy:

(i) the high level of *per capita* income,
(ii) the existence of a large domestic demand, latent or otherwise, for new products due to the sheer size of the US domestic market, and
(iii) the high relative cost of labour which leads to a continuous search for labour-saving products and processes.

Also, the initial production facilities for new products will probably locate in the US due to

(a) the availability of skills,
(b) the availability of a wide range of inputs,
(c) consumer feedback, and
(d) low price elasticity of demand.

The first two are important since the production function will be changing over the early stages of product development and, therefore, the production facility will locate where it can easily alter its mix of inputs. Consumer feedback will be a factor in determining location of production due to the high level of uncertainty with regard to prices, market size, etc., at the early stages of product development. Also, in the early stages, the price elasticity of demand is likely to be low, implying that cost differences are less important when deciding upon a location for production.

As the product matures, Vernon argues that US producers will start exporting the product primarily to countries characterised by high *per capita* incomes. This is in line with Linder (1961) who hypothesises that trade is likely to take place between countries with similar *per capita* incomes and economic structures. At this (second) stage of the product-cycle, the

2. For a concise comparison of the assumptions underlying the Heckscher-Ohlin theory and the product-cycle theory, see Wells, Jr. (1972), p. 20.

problem of where to locate production becomes one of cost-minimisation.[3]

At the third stage of the product-cycle, production facilities will be located in foreign markets. Foreign investment will only occur if comparative costs indicate that it would be more profitable than exporting and if the US producer perceives a threat to the firm's established position in foreign markets from other US producers or from new foreign producers. Caves (1971) has argued that a firm will invest abroad only if it has some unique asset – a potential invention or a differentiated product – on which it can earn maximum profit in foreign markets only by locating the production facility abroad. A firm will undertake foreign investment, as opposed to exports or licensing, only when there is complementarity between exploitation of the firm's unique assets and local (foreign) production.

Vernon's model is deficient in that while it does provide plausible reasons why an enterprise might want to invest abroad, it does not explain how this desire to invest abroad is translated into action. At the next stage of the product-cycle the US begins to import the good and subsidiaries in (say) Europe start exporting to less developed countries (LDCs). Eventually production may shift from the initial subsidiary location to locations in the LDCs if comparative costs indicate that such a move would be profitable.

There is some empirical evidence to support the product-cycle hypothesis.[4] However, Vernon (1971) has noted that the product-cycle could become defunct if international corporations adopted a global outlook. While the product-cycle may provide an adequate explanation of how an enterprise becomes international, it is not capable of explaining the behaviour of the longer established multinational enterprises (MNEs). Rather than innovation occurring in the US and then being transmitted to other countries, ". . . stimulation to the system could come from the exposure of any element in the system to its local environment, and response could come from any part of the system that was appropriate for the purpose" (Vernon, 1971, p. 110). Helleiner (1973) argues that, due to vertical integration, international corporations will locate those stages of the production process with high and unskilled labour inputs in the LDCs, irrespective of whether the product is mature or not. He states (p. 43) that

> the introduction of the possibility of overseas component manufacture and middle-stage processing within international industries rather knocks the bottom out of any stage theory . . . which focuses, as do the Linder/Vernon/Hirsch product-cycle explanation, upon final products.

3. See Moses (1958) for an integrated examination of theories of location and production.

4. For example, see Gruber, Mehta and Vernon (1967); Wells (1969); Gruber and Vernon (1970); Hirsch (1972); and Stobaugh (1972). Finger (1975) found that his results supported the factor proportions theory rather than the product-cycle model.

This is a fundamental criticism of the product-cycle model since it suggests that foreign investment occurs due to differences in factor endowments between countries, combined with the ability of firms to split their production processes into several discrete stages, each with significantly different production functions.

Baldwin (1979) found that US net exports and FDI tend to be relatively high in industries utilising comparatively large numbers of highly educated employees. While this provides some support for the product-cycle model, he argues that when investing abroad US firms adapt their production functions to use a relatively small number of highly skilled employees and a relatively large number of workers with few years of formal education since such labour is relatively abundant. While unskilled labour is relatively abundant in LDCs, it is not abundant in the industrialised countries where the bulk of FDI takes place. However, Baldwin's arguments are similar to those of Helleiner in focusing on the nature of factor inputs, rather than on the stage of the product-cycle.

While Vernon and Helleiner postulate plausible explanations of why FDI should take place, they do not adequately tackle the question of why certain firms actually engage in FDI. Dunning (1977) argues that firms have ownership-specific endowments and they engage in FDI in order to overcome the imperfections in external mechanisms of resource allocation. The need to fully exploit the returns from innovation is emphasised (p. 404) – "It is our contention that the need both to generate innovations and ideas and to retain exclusive right to their use, has been one of the main inducements for enterprises to internalise their activities in the last two decades".

Magee (1977) hypothesises that MNEs are specialists in the production of information that is less efficient to transmit through markets than within firms and that MNEs produce sophisticated technologies because appropriability is higher for these than for simple technologies. He also argues that private market generation of new information and new techniques may require concentrated industry structures and large optimum firm size.

While most theories of FDI emphasise the oligopolistic nature and large scale of international firms, it should be noted that much of this work has been stimulated by the rapid growth of US foreign investment in the post-war era. In a study of Japanese FDI, Ozawa (1979) has argued that the oligopolistic theory of FDI does not fit the Japanese experience. Japanese overseas manufacturing investments are clustered in the LDCs; at the end of 1975 the ratio of Japan's overseas manufacturing investment concentrated in developing countries was as high as 74.6 per cent, compared to 17.3 per cent for the US and 20 per cent for West Germany. The most active Japanese overseas investors are small and medium-sized manufacturers (< 300 employees) who produce relatively unsophisticated products overseas.

In trying to determine the relevance of the above explanations of FDI to the Irish situation, other factors, particularly institutional factors, play a role. Undoubtedly the role of the IDA is crucial and may explain why a large number of foreign firms decided to locate in Ireland. Also membership of the EEC is another factor which could be expected to affect the foreign investment decision. Other factors such as political stability, language, pleasant environment, etc. may have influenced the decisions of some firms. However, in most cases the decision to come to Ireland would have resulted from a consideration of a wide variety of factors.

The empirical analysis presented here does not try to answer the question of why MNEs decided to invest in Ireland. Rather it examines the characteristics of MNEs in relation to Irish firms and tests whether these characteristics are consistent with what would be expected from the theoretical literature on FDI, while also taking account of factors which may be peculiar to the Irish situation. For instance, Teeling has argued that risk and uncertainty are important factors affecting the investment decision. He argues that the IDA reduces the riskiness and uncertainty of investing in Ireland through its promotion of Ireland as an attractive location and through its back-up services for firms investing in Ireland. Teeling further argues that the package of services offered by the IDA is particularly attractive to smaller or less experienced MNEs since they would not have the resources or experience to conduct an exhaustive analysis of alternative overseas investment locations. Major multinationals would be more concerned with the financial incentives offered, since their managements would already have experience in overseas investment. Therefore, it may be postulated that Ireland should attract a relatively high proportion of fairly small MNEs who are undertaking foreign investment for the first time. Data presented in the next section on employment size of parent company provide some evidence to support this.

III IRISH NEW INDUSTRY AND FOREIGN DIRECT INVESTMENT

In this section Irish New Industry is compared with New Industry foreign plants[5] and a number of hypotheses are tested in an attempt to provide an explanation of the extent of FDI in Ireland. The basis of comparison could have been extended to the entire Irish manufacturing sector or to equivalent plants located in the countries of the parent companies, but such a comparison is not attempted here. The empirical analysis relies solely on the sample data described in the introduction.

5. The New Industry sector includes any plant which has received a grant under the IDA New Industries programme and this includes plants which have engaged in a major expansion. A plant is defined as belonging to the Irish New Industry sector if all the major decisions concerning the plant are made within Ireland.

Methodology

The hypotheses were tested using Ordinary Least Squares (OLS). In some cases, the independent variables consisted solely of dummy variables. In order to test for differences between the coefficients of the dummy variables within each block, a matrix of all possible differences between the coefficients was formed and this was translated into a matrix of t-values by dividing each difference by its standard error (see Walsh and Whelan, 1973).

In interpreting the results of the regression equations it needs to be borne in mind that an analysis such as that presented here cannot be expected to produce high $\bar{R}^2$s. This is because it is not possible to take into account in a single equation all the factors which influence the dependent variable. For example, such factors as efficiency and cyclical variation are known to be present, but are not included in the analysis. Also no attempt is made to take account of the influence of institutional factors. Therefore, the obtaining of coefficients (for the explanatory variables which *are* included) which possess both the expected sign and statistical significance is the most that can be hoped for.

Empirical Results

The notation used in the following analyses is set out in Appendix I.

(i) *Size:* It is generally accepted that larger firms are more likely to engage in foreign investment than smaller firms and this is borne out by the evidence (e.g., Horst, 1972). However, this may not be the case for overseas investors in Ireland. Tables 1 and 2 present data on the employment size and number of branches owned by the parent companies of MNEs operating in Ireland. The median employment size of MNE parent companies with Irish branches is 1,500 (mean 15,880) with a median number of branches owned of 7 (mean 18) which implies a highly positively skewed distribution. While the parent companies of MNEs operating in Ireland are large by Irish standards, the question of whether they are large by international standards is more difficult to determine. One comparison may be made with 1966 data for US MNEs; Vernon (1971), Table 1.1, found that the mean employment size of his sample was 35,800 which is substantially larger than the figures quoted above for MNEs operating in Ireland. However, Vernon only included MNEs which belonged to the top 500 industrial companies in the US. The summary statistics, mean and median, for MNEs operating in Ireland indicate that there is a high degree of dispersion in terms of size so that generalisations about whether MNEs operating in Ireland may be classified into large- or medium-sized corporations cannot be made. As expected, the size of National Multi-regional Enterprises (NMREs)[6] is much smaller than that of

6. A NMRE is defined as a plant which belongs to an Irish company which owns two or more manufacturing plants. The figures include branch plants belonging to Irish companies which may be located abroad.

Table 1: *Characteristics of new industries – mean employment of parent company, number of branches and mean branch size classified by industrial sector*[1], *1976*

Industrial sector	*Number of new establishments in Ireland*		*Mean employment of parent*		*Mean total number of branches worldwide*		*Mean employment of plant*[2]	
	MNE	*NMRE*	*MNE*	*NMRE*	*MNE*	*NMRE*	*MNE*	*NMRE*
Food	8	19	24,497	1,138	31	6	644	237
Textiles	14	7	5,750	1,650	13	8	3,583	186
Clothing and footwear	7	8	1,294	1,577	7	6	220	267
Chemicals and plastics	20	6	7,871	2,800	13	12	447	497
Metals and engineering	49	16	26,009	796	19	4	708	322
Other manufacturing	39	10	11,749	622	25	4	938	458
Total	137	66	15,880	1,551	18	6	1,001	313
Median			1,500	670	7	4	250	140
Standard deviation			49,662	2,865	24.8	6.8	4,245	550

1. Joint ventures were not included. Two plants in the NMRE sub-group were excluded due to inadequate data.
2. Mean plant size was estimated by first calculating mean plant size of each individual company and then calculating the mean for the sample.

MNEs due to the small size of Ireland. The median plant size of MNEs is 250 (mean 1,001); the sectoral breakdown shows that there is considerable variation between sectors with that in the textiles sector (mean 3,583) being the largest. These results are consistent with a finding by Teeling (1975, pp. 81-90) that Ireland attracts a large proportion of investors with no prior international manufacturing experience and of relatively small size.

(ii) *Capital Intensity:* It is expected that overseas subsidiaries will be more capital-intensive than domestic firms. *Net output per employee* per establishment was used as a measure of capital intensity and will provide a reasonable proxy if it can be assumed that differences in net output per employee between plants are largely due to differences in capital per employee. Net output or value added per employee has been used as a measure of capital

Table 2: *New industries – mean employment of parent company, number of branches and mean branch size classified by nationality*[1]

Nationality	*Number of new establishments in Ireland*	*Mean employment of parent company*	*Mean number of branches worldwide*	*Mean plant size*[2]
Irish	66	1,551	6	313
British	37	21,251	22	791
American	60	17,891	21	1,461
German	23	2,361	4	446
Other	17	15,383	14	574
Total	203	11,222	14	777
Standard deviation		41,333	21	3,512
Median		1,050	5	200

1. Joint ventures were not included. Two plants in the NMRE sub-group were excluded due to inadequate data. Average plant size calculated as in Table 1.

intensity by a number of authors (for example, see Lary, 1968, and Hirsch, 1971). Lary argued that the wage and salary part of net output is a good proxy for human capital and the remainder of value added is a good proxy for physical capital. Lary (p. 22) also states that "Taken literally, the assumption that inter-industry variations in value added by manufacture per employee reflect differences in the aggregate value of services rendered by human and physical capital would imply fully competitive factor and product markets in which the marginal contribution of these services is precisely matched in each case by the rewards paid". Undoubtedly, there are a number of other factors affecting net output per employee in a given year including (i) differences in efficiency, (ii) cyclical factors (e.g., the demand for a plant's product in a given year may be exceptionally low), and (iii), in the case of branch plants, transfer-pricing may significantly influence net output per employee. In addition to these, profits in industries and wage differentials may also vary due to *monopolistic* tendencies in industries and unionisation. Despite these qualifications, net output per employee is probably not inferior to the more usual measure – fixed assets per employee. Both Hirsch (ch. 3) and Lary (p. 42) found that fixed assets per employee and net output per employee were highly correlated. In the analysis here no attempt is made to distinguish between human and physical capital.

In testing the hypothesis relating to capital intensity, plant size and industrial sector were controlled for and the results of the analysis show that the firm classification effect (see Appendix I) is not significant (Table 3).

Therefore, it may be concluded that, with industrial sector controlled, MNEs do not have higher capital intensities than other plants. The coefficients of the sectoral dummy variables indicate that S_1 (Food) and S_3 (Clothing and Footwear) have significantly lower capital intensities than the other sectors, while there are no significant differences between the remaining seven sectors (Equations 2 and 3). A relatively high proportion of plants in the less capital-intensive sectors are Irish, implying that MNEs tend to be concentrated in those sectors with relatively higher capital intensity. Of the 320 sampled plants, 154 or 48 per cent are Irish while 75 per cent of plants in the Food sector are Irish and 50 per cent of plants in the Clothing and Footwear sector are Irish. This is what would be expected, but the data clearly show that overseas subsidiaries in Ireland do not have production functions which require significantly greater capital inputs than comparable domestic firms in given industrial sectors.

(iii) *Technology:* It is hypothesised that subsidiaries of MNEs will produce goods which are more technology-intensive than goods produced by other firms and that US subsidiaries will tend to be more technology-intensive than other subsidiaries. The derivation of an appropriate proxy variable to capture the technological intensity of an enterprise's outputs is a complex problem. The more common measures of technology and rate of technological change,[7] such as expenditure on research and development or the number of scientists and engineers in the workforce, were deemed inappropriate for this analysis, since at the level of the individual plant much of the technological input may be supplied by the parent company or government agencies. The value-weight (VWR)[8] ratio of a plant's major output was used as a proxy variable for technological intensity, a high VWR ratio implying high technological intensity. A high VWR ratio has the advantage of using a characteristic of the plant's output to measure the technological sophistication of the product. However, the measure is partially deficient in that other factors besides technological sophistication may affect it; for example, on average, intermediate goods may be expected to have lower VWR ratios than final demand goods. The VWR ratio may be related to capital-intensity, but there is no *a priori* reason why, for instance, relatively capital-intensive firms should produce goods with relatively high VWR ratios. The use of the VWR ratio as a measure of technological intensity is based on the assumption that goods with high VWR ratios will have been produced using relatively large

7. For a discussion of the problems associated with measurement of these variables, see Mansfield (1968).

8. The VWR ratios derived by Chinitz (1960) were used. Chinitz estimated the VWR ratios for a large number of industries in cents/pound and these ratios were applied according to the major output of the plant.

Table 3: *Regression model with log of net output per employee as dependent variable*[a]

Equation number				$\bar{R}^2$	*F*	*Sig. P <*
1.	Y	=	3.67 − 0.77 Log PSIZE (0.70)	−	0.49	NS
2.	Y	=	3.72 − 0.42 S_1 − 0.39 S_2 − 0.59 S_3 − 0.31 S_4 + 0.15 S_5 − 0.24 S_6 − 0.86 S_7 (2.23)* (1.82) (2.63)** (1.09) (0.70) (0.83) (0.50)	0.034	2.61	0.025
3.	Y	=	3.71−0.34 S_1−0.47 S_3−0.32 F_1−0.88 F_2+0.12 F_3−0.31 F_4−0.26 F_5−0.10 F_6 (2.34)* (2.46)* (0.13) (0.27) (0.45) (1.10) (0.92) (0.39)	0.030	2.23	0.025

Notes: t-values in parentheses(* =significant at $P < 0.05$, ** = significant at $P < 0.01$, NS = not significant at $P < 0.05$).
a Mean = 3.53, SD = 0.94.

Table 4: *Regression model with log of value-weight ratio as dependent variable (Y)*[a]

Equation number		$\bar{R}^2$	*F*	*Sig. P <*
1.	$Y = 1.49 + 0.14$ Log PSIZE (2.45)*	0.015	5.99	0.025
2.	$Y = 1.34 + 0.15$ Log PSIZE $- 0.12 S_1 + 0.27 S_2 + 0.42 S_3 - 0.24 S_4 + 0.28 S_5 + 0.22 S_6 + 0.18 S_7$ (2.86)** (1.26) (2.58)** (3.74)** (1.68) (2.65)** (1.54) (2.17)*	0.129	6.91	0.001
3.	$Y = 1.34 + 0.14$ Log PSIZE $+ 0.35 S_2 + 0.52 S_3 + 0.32 S_5 + 0.22 S_7 - 0.09 F_1 - 0.11 F_2 + 0.13 F_3$ (2.58)** (3.98)** (5.46)** (3.59)** (3.60)** (0.74) (0.71) (1.02) $- 0.17 F_4 + 0.09 F_5 + 0.11 F_6$ (1.22) (0.66) (0.90)	0.144	5.88	0.001

Notes: t-values in parentheses (* = significant at $P < 0.05$, ** = significant at $P < 0.01$).
a Mean = 1.76, SD = 0.49.

Table 5A: *New industries: cross-classification of firm classification and production system used*

	Independent Irish	*Independent foreign*	*American MNEs*	*British MNEs*	*Other MNEs*	*NMREs*	*Other*	*Total*
Unit and small batch production	42 (27)	6 (6)	21 (21)	12 (13)	11 (14)	13 (23)	4 (6)	109
Large batch production	25 (34)	10 (8)	24 (26)	16 (16)	18 (17)	35 (29)	8 (7)	136
Mass production	6 (11)	1 (3)	8 (9)	8 (5)	11 (6)	9 (10)	2 (2)	45
Process production	5 (6)	1 (2)	7 (5)	1 (3)	0 (3)	10 (6)	2 (1)	26
Total	76	18	60	37	40	67	16	316

$\chi^2 = 38.20$; df = 18; $P < 0.004$
(25 per cent expected frequencies < 5)
Goodman and Kruskal's tau statistics: $r_b = 0.094$; $r_a = 0.084$
Expected values in parentheses.

Table 5B: *The major contribution to chi-square*

Variable combination: Firm classification/production system	*Contribution to* χ^2	*More (M) or fewer (F) plants than expected*
NMRE/unit and small batch	7.69	F
Independent Irish/unit and small batch	5.36	M
Independent Irish/mass production	4.17	F
Independent foreign/mass production	4.00	F
British MNEs/mass production	4.00	M
Independent Irish/large batch production	3.24	F
Other MNEs/mass production	2.27	M

amounts of skilled labour. In other words, the skill intensity or human capital input in such goods will be higher than for goods with relatively low VWR ratios.

The results of calculating a regression model with the log VWR ratio as the dependent variable show that once plant size and industrial sector have been taken into account, the firm classification dummy variable is not significant (Table 4). The matrix of t-values and standard errors for the firm classification dummy variable indicate that the differences between the individual coefficients are not significant. Therefore, MNEs are not more technologically sophisticated than other plants. This is a surprising result since it is generally accepted that MNEs are concentrated in technology-intensive industries. For example, with reference to the US, Long (1973, p. 556) showed that MNEs accounted for 52 per cent of all R & D expenditure in manufacturing. It should be noted that the sign of the coefficient for US plants (F_3) is positive, as predicted, though not significant.

(iv) *Production System:* It is hypothesised that overseas subsidiaries will use production techniques which are more standardised than other firms. A classification system derived from Woodward (1970) was used (see Appendix II). A chi-square test was applied to test whether there was a relationship between firm classification and production system used (Table 5A). In order to ascertain whether it was necessary to control for industrial sector, a further chi-square test was carried out between industrial sector and production system used. The relationship in the latter test was significant at $P<0.001$, but the values of Goodman and Kruskal's tau indicated a weak relationship; knowledge of industrial sector reduces the probability of error in predicting production system used by only 7.5 per cent. Therefore, it is not necessary to control for industrial sector. The chi-square statistic for firm classification and production system used indicates a relationship significant at $P<0.004$ while the values for Goodman and Kruskal's tau indicate a weak degree of association; knowledge of firm classification reduces the probability of error in predicting production system used by only 9.4 per cent. The major contributions to chi-square provide only weak evidence in support of the hypothesis (Table 5B). Independent Irish, NMREs and Independent foreign plants tend to use "unit and small batch" production techniques to a greater extent than expected, while the number of British MNEs and "Other" MNEs using mass production techniques is more than expected. Therefore, the above hypothesis is not rejected, but the results indicate that it is only British and "Other" MNEs that tend to be concentrated in the more standardised production processes; US MNEs are not concentrated in the latter category.

(v) *Export Propensity:* It is expected that overseas firms will be characterised by relatively high export propensities for a number of reasons. First, industrial policy since the early 1960s has pursued an export-led growth strategy and the IDA has actively encouraged projects which would have a high propensity to export. Also the Export Profits Tax Relief incentive, which exempts profits arising from exports from corporation profits tax up to 1990, has operated to encourage export-oriented, rather than import-substituting, FDI. Secondly, if plants are tied into an internationally vertically integrated system of production as suggested by Helleiner, then each individual plant should have a related high export propensity.

Table 6 shows that the foreign manufacturing sector has a higher export propensity than the New Industry Irish sector. This is confirmed by a regression equation with the export propensity as the dependent variable which shows that Irish firms have, on average, an export/sales ratio which is 22.2 per centage points less than overseas firms (Table 7).[9]

Table 6: *New Industries: sales and exports classified by nationality, 1976*

Nationality	*Home sales (£m)*	*Exports (£m)*	*Total sales (£m)*	*Exports/ sales, 1976 (%)*	*Exports/ sales, 1974 (%)**
Irish	205.4	327.8	561.2	58.4	54
British	30.2	70.5	101.4	60.5	82
American	10.2	238.2	248.5	95.9	95
German	5.6	30.4	36.0	84.4	82
Other EEC	9.7	39.4	40.4	97.5	–
Other	10.4	102.8	113.2	90.8	–
Total	262.8	809.1	1100.7	73.5	73.6

**Source:* McAleese (1977, Chart 4.1 and Table 4.3).

Note: Home sales and exports do not add exactly to total sales due to differences in the way the data were gathered. The overall discrepancy is 2.6 per cent which is acceptable.

(vi) *Linkages:* An industrial linkage may be defined as a recurring flow of goods and services between individual plants, with backward linkages referring to purchases of raw materials and services and forward linkages referring to sales of output for further processing. Wage and salary payments may also be considered as a backward linkage. The role of industrial linkages as an inducement mechanism in the development process has received a fair

9. The equations presented in Tables 7 and 8 are derived from an analysis of the industrial linkages of New Industry in Ireland (O'Loughlin, 1978).

Table 7: *Regression equation with exports as a percentage of sales as the dependent variables (Y)*[a]

			$\bar{R}^2$	F	*Sig.* $P <$
All New Industry					
Y	=	36.8 + 10.5 Log PSIZE − 0.6 AGE + 3.0 PRODSYS − 22.2 N_1 − 21.3 S_3 (2.96)** (4.85)** (3.85)** (6.42)** (3.55)**			
		+ 12.5 Log DDUB (3.69)**	0.324	26.5	0.001

Notes: t-values in parentheses (** = significant at $P < 0.01$).

a Mean = 72.2, SD = 36.2.

amount of attention (for example, see Hirschman, 1958; Little and Mirlees, 1968 and 1974; and Thoburn, 1977).

The discussion in Section II suggests that overseas plants in Ireland will be characterised by production processes which would not rely heavily upon external economies and could, therefore, locate in a relatively underdeveloped and/or small industrial system. With respect to the Irish economy, Buckley (1974) has argued that the extent of absorption into the domestic economy by the foreign sector may be judged by the strength of the domestic linkage effects created by the foreign sector. Stewart (1976b) has also examined the possibility that dualism[10] exists between Irish and overseas manufacturing firms. The domestic backward and forward linkages of New Industry have been analysed by O'Loughlin (1978, Chapters 8-12). Unity minus the export/sales ratio was used to measure domestic forward linkages. This ratio includes domestic sales for final demand, as well as domestic sales for further processing; only the latter represent "true" domestic forward linkages. Nevertheless, unity minus the export propensity is a reasonable first indicator of the extent of domestic forward linkage. For example, McAleese and McDonald (1978) used unity minus the export propensity to measure the domestic forward linkages of New Industry for 1975. Two variables were defined to measure backward linkages: (1) retained value (RV)[11] as a percentage of gross output (GO) which measures a plant's first-round payments to the Irish economy, and (2) raw material expenditure in Ireland as a percentage of total raw material expenditure.

(a) *Domestic Forward Linkages*

As shown above, Irish plants have an export propensity which is, on average, 22.2 percentage points lower than foreign plants. Therefore, the domestic forward linkages of foreign enterprise are substantially lower than Irish enterprise. Two of the other explanatory variables in the regression equation call for comment, namely, the VWR ratio and number of years in production (Table 7). The positive coefficient of the VWR ratio is as expected for two reasons: first, goods which are technologically sophisticated are likely to require a world market and, secondly, goods with higher VWR ratios are likely to have longer forward linkages.[12] Number of years in production was included as an explanatory variable to try to take into account the development of linkages over time. It may be hypothesised that the export

10. Hirschman (1958), pp. 110-111, discusses the concept of an enclave sector while Singer (1970) provides a definition and discussion of dualism.

11. RV = expenditure on domestic raw material, component and service inputs + wage and salary payments + other current domestic first-round payments.

12. Lever (1974), in a study of manufacturing firms in West Central Scotland, found a significant positive correlation between VWR ratio and distance travelled.

propensity of a plant should fall over time, *ceteris paribus,* as it becomes more familiar with the domestic market and as sales opportunities grow in line with the overall growth of the domestic market. McAleese and McDonald (1978, p. 330) carried out a comparison of the same cohort of New Firms' domestic backward linkages between 1966 and 1974 which showed that the export ratio declined by three percentage points over a decade. A regression analysis was also carried out on the population of New Industry in 1974. The cross-sectional analysis also showed that the export ratio should decline by three percentage points over a decade (p. 332). The analysis in this paper only uses cross-sectional data and, therefore, the coefficient of number of years in production of 0.6 (Table 8) may be interpreted as showing that plants which are 10 years older tend to export six percentage points less of their output.

There are two factors which could contribute to this result: (1) a tendency for plants to reduce their export propensity over time, and (2) a tendency for newer plants to have progressively lower export propensities at start-up than older plants. Such a tendency could occur due to changes in the type of plants being set up over time. For instance, newer plants may be concentrated in industrial sectors characterised by high export ratios. However, the regression equation includes sectoral and nationality dummy variables as well as other explanatory variables. Therefore, it would seem reasonable to interpret the coefficient of number of years in production as implying that a plant can be expected to reduce its export propensity by six percentage points over a decade. This result may be compared with that of McAleese and McDonald (1978) who found that the export/sales ratio declined by three percentage points over a decade which is half the result here. Two reasons may be put forward to explain this difference. First, projects which have set up since 1973/74 may have begun with a lower export propensity than plants which were set up before this date. Secondly, plants may be accelerating the rate at which they increase domestic sales. A regression equation for MNEs only was also calculated and the results confirm the findings for the sample as a whole (Table 8).

(b) *Domestic Backward Linkages*

Table 9 shows that with the effects of other variables controlled, Irish firms purchase 6.7 percentage points more of their raw material and components in Ireland than overseas firms.[13] (The mean percentage of raw material and component expenditure purchased in Ireland is 25.8 per cent for

13. The category "Overseas industry" differs from the MNE category in that it includes independent foreign plants and joint ventures as well as MNEs.

Table 8: *Regression equation with exports as a percentage of sales as the dependent variable (Y)*[a]

Multinational enterprise sub-group				
Y = 78.5 + 9.6 Log VWR − 0.7 AGE (2.26)* (3.59)**	$\bar{R}^2$ 0.113	F 9.7	Sig. P < 0.001

Notes: t-values in parentheses (* = significant at P <0.05, ** = significant at P <0.01).
a Mean = 88.9, SD = 24.7, n = 137.

Table 9: *Regression equation with domestic raw material and component expenditure as a percentage of total raw material and component expenditure (Y)*[a]

All new industry			
Y = 30.9 − 12.1 Log VWR + 0.17 AGE − 0.00006 OUTPUT − 58.2 S_1 + 15.8 S_3 (4.09)** (1.75) (2.44)** (15.47)** (3.22)** + 7.6 P_1 + 6.7 N_1 (2.29)* (2.29)*	$\bar{R}^2$ 0.539	F 54.2	Sig. P < 0.001

Notes: t-values in parentheses (* = significant at P <0.05, ** = significant at P <0.01).
a Mean = 31.8, SD = 35.3.

Irish firms and 19.1 per cent for overseas firms.)[14] Also subsidiaries of MNEs have a RV/GO percentage which is 8.4 per cent less than that for all other firms (Table 10). (The mean RV/GO percentage for Irish firms is 43.8 per cent and 35.4 per cent for MNEs.)[15] Overseas firms, therefore, have lower domestic backward and forward linkages than Irish New Industry, but with regard to domestic backward linkages, the magnitude of the difference is not very large and one cannot come to the strong conclusion that the New Industry manufacturing sector is characterised by a dual economy. However, the results are consistent with the hypothesis that foreign firms in less developed areas do not require the external economies associated with relatively advanced areas.

Raw material backward linkages are negatively related to VWR ratio and capital intensity and are positively associated with number of years in production (Table 9). Number of years in production is also positively associated with RV/GO (Table 10). The backward linkages for the MNE sub-group were analysed separately (Tables 11 and 12). The coefficient of number of years in production is positive for both dependent variables, but the t-values indicate statistical insignificance. For the sample as a whole the coefficient of number of years in production was positive and statistically significant. These results are consistent with those of McAleese and McDonald (1978) except that number of years in production was statistically significant in their sample. One would expect somewhat different results for the two studies due to the different dates to which the data refer and discrepancies due to sampling and measurement error. Such effects should, however, be quite small. The dependent variable used by McAleese and McDonald is Irish current expenditure (materials + services + labour costs) as a percentage of total current expenditure. This variable is, therefore, not directly comparable with either of the dependent variables used here. Another difference between the two studies is that McAleese and McDonald looked at all overseas firms (including joint ventures) whereas the results presented here refer to subsidiaries of MNEs exclusive of independent foreign plants and joint ventures. The negative relationship between RV/GO and the percentage of imported raw materials supplied by the parent and/or affiliates (a proxy variable for the degree to which a subsidiary is vertically integrated within the parent company) implies that plants belonging to international corporations characterised by a vertically integrated system of production are likely to have a relatively low RV/GO percentage (Table 12).

14. Figures are calculated for an "average" plant with S_1, S_3 and P_1 set equal to zero (Table 10). These figures, therefore, refer to the values of the individual "average" plant and the percentages based on aggregate figures would be somewhat different.

15. Figures are calculated for an average plant with S_1, R_1 and R_5 set equal to zero (Table 11).

Table 10: *Regression equations with retained value as a percentage of gross output as the dependent variable (Y)*[a]

All new industry

	$\bar{R}^2$	F	Sig. P <
$Y = 31.9 + 0.3\ AGE + 38.0\ S_1 - 8.4\ F_3 + 10.8\ R_1 + 15.2\ R_5$	0.344	28.88	0.001
(2.49)* (9.39)** (2.69)** (2.00)*			

Notes: t-values in parentheses (* = significant at P < 0.05, ** = significant at P < 0.01).
a Mean = 48.3, SD = 32.2.

Table 11: *Regression equations with domestic raw material and component expenditure as a percentage of total raw material and component expenditure as the dependent variable (Y)*[a]

Multinational enterprise sub-group

		$\bar{R}^2$	F	Sig. P <
1.	$Y = 35.83 - 9.75\ \text{Log VWR} + 0.16\ AGE + 0.14\ PRODSYS - 0.11\ CORMS + 0.00004\ T\ SIZE$	0.10	3.04	0.01
	(2.58)* (0.82) (0.14) (2.20)** (1.00)			
2.	$Y = 32.0 - 10.2\ \text{Log VWR} + 54.8\ S_1 + 34.9\ S_6$	0.424	34.4	0.001
	(3.09)** (8.31)** (4.25)**			

Notes: t-values in parentheses (* = significant at P < 0.05, ** = significant at P < 0.01).
a Mean = 17.8, SD = 23.6, n = 137.

Table 12: *Regression equations with retained value as a percentage of gross output as the dependent variable (Y)*[a]

Multinational enterprise sub-group									
								$\bar{R}^2$	F	Sig. P <
1.	Y = 50.21 − 0.0002 OUTPUT − 0.15 CORMS + 0.26 AGE − 5.06 Log VWR + 0.00002 TSIZE							0.19	7.3	0.001
		(4.09)**	(3.58)**	(1.56)	(1.46)	(0.66)				
2.	Y = 41.0 − 0.0002 OUTPUT − 0.1 CORMS + 29.8 S_1 + 17.3 R_1							0.323	17.2	0.001
		(4.95)**	(3.77)	(4.69)**	(2.76)					

Notes: t-values in parentheses (** = significant at P < 0.01).

a Mean = 37.1, SD = 20.8, n = 137.

The product-cycle model implies that firms engaging in FDI will tend to produce final demand products which are relatively technology-intensive and capital-intensive. The analysis here implies that the higher the VWR ratio of a plant's major output, the lower will be its domestic linkages both backward and forward. Also, greater capital intensity will be associated with lower RV/GO. Therefore, if the foreign manufacturing sectors of economies become more technology-intensive and capital-intensive, their linkages with the host economy will be lower, *ceteris paribus.*

In discussing the role of FDI in an economy it is important to recognise that firms engaging in overseas investment do so for a wide variety of reasons. Lall (1978) distinguishes between import-substituting and export-oriented industries. Since FDI in Ireland is almost exclusively export-oriented, Lall's discussion of export-oriented activities is pertinent to an analysis of overseas investment in Ireland.

He defines four types of export-oriented transnational corporations (TNCs) which have different implications for the creation of domestic linkages:

(1) TNCs which begin as import-substituting industries, but which develop export markets over time,
(2) foreign firms which produce and export "traditional" products like footwear, textiles, processed foods, etc.,
(3) TNC investments in modern industries in LDCs undertaken specifically for export, transferring fairly complex technologies to LDCs to service established world markets, and
(4) "sourcing" investments where only a particular (labour-intensive) process is transferred to LDCs, the more capital-intensive process being retained in the home countries where the requisite skills, equipment and R & D facilities exist.

FDI in Ireland would seem to predominate in the third and fourth categories, although there is also some in the first two categories. Lall (p. 273) states, "Of these four types of TNC investment, the first two are likely to create the most linkages, the third rather less, and the fourth least of all". Therefore, *a priori,* one would expect the domestic linkages of overseas firms in Ireland to be relatively low.

(vii) *Some Parent-Affiliate Relationships:* It is to be expected that the degree and nature of interdependence between the various branches of an international company will change over time. Prachowny and Richardson (1975), in a study of the balance of payments transactions for 1966 between US multinationals and their foreign affiliates, showed that

(1) the age of an affiliate and its dependence on the parent company for capital is negatively related ($P < 0.10$),
(2) there is a negative relationship between age and dependence on the parent for technical assistance ($P < 0.10$), and
(3) earnings rates and age are positively associated ($P < 0.10$).

With respect to overseas subsidiaries operating in Ireland, the following hypotheses are tested:

(a) number of years in production and gross profits will be positively related;

(b) number of years in production and percentage of raw materials supplied from the parent and/or affiliates will be negatively associated; and

(c) there will be a positive relationship between the percentage of total output going for further processing to the parent and/or other affiliates and the number of years in production.

Regression equations were calculated on MNEs operating in Ireland with the number of years in production as the dependent variable in each case. The direction of the relationship is as postulated in each equation, but only the relationship between the number of years in production and the percentage of sales going for further processing within the company is significant at $P < 0.05$ (Table 13). The findings here are consistent with those of Prachowny and Richardson in that the gross profits of the older subsidiaries tend to be greater than younger subsidiaries; also, older subsidiaries tend to rely less on the parent or other affiliates for raw materials than do younger affiliates. However, these relationships are only significant at $P < 0.10$. The result with respect to the percentage of imported raw materials supplied by affiliates indicates that for a subsidiary in operation for a decade the percentage of imported raw materials supplied by affiliates is 4.4 percentage points lower than for a new subsidiary. Examination of the scattergram showed that 65 plants purchased nothing from affiliates while 26 plants purchased more than 90 per cent of their imported raw materials from affiliates. Also only 26 out of 137 plants sold any output for further processing to other affiliates. These figures suggest that few foreign subsidiaries in Ireland belong to companies characterised by a vertically integrated production system. This would seem to suggest that in the Irish case, the increasingly vertically-integrated international system of production as put forward by Helleiner (1973) does not apply. Also, it implies that relatively few foreign firms in Ireland could be classified as "sourcing" investments as defined above.

Table 13: *Parent-affiliate relationship, regression equations*[1]

			R^2
1.	PROFITS =	35.21 + 2.94 AGE (1.85)	0.017
2.	CORMS =	34.66 − 0.44 AGE (1.66)	0.013
3.	COSALS[2] =	9.40 + 0.07 AGE (2.58)**	0.042

t-values in parentheses (** = significant at $P < 0.01$).

[1] Tests were carried out on MNE sub-group (n = 137).

[2] 111 plants sold no output for further processing to the parent company (equation 3).

IV CONCLUSIONS

The analysis has been limited in scope since it is based on a cross-sectional sample. However, a major benefit of this study is that it provides a comparative description of the overseas manufacturing sector in Ireland. This is of obvious local interest, but it also provides some valuable insights into the role of FDI in general. The results of the empirical analysis may be briefly summarised as follows:

(1) By Irish standards, overseas subsidiaries belong to relatively large corporations. However, a more interesting aspect of the size of the parent companies of subsidiaries operating in Ireland is the wide range of employment size as indicated by the difference between the mean and median employment size and the large standard deviations.

(2) While overseas firms may be concentrated in industrial sectors characterised by relatively high capital intensity and high technological intensity (as measured by the VWR ratio), they are not more capital- and technology-intensive than domestic New Industry when the effect of industrial sector is controlled.

(3) The production system used by overseas subsidiaries tends to be more standardised than that of Irish New Industry, as predicted by the product-cycle model.

(4) Overseas firms have lower backward and forward domestic linkages than domestic New Industry. In relation to backward linkages, industrial sector accounts for a large proportion of the variation which is explained. This is largely due to the importance of the Food sector which accounts for such a high proportion of aggregate domestic backward linkages.

(5) The gross profits and the percentage of output going for further processing to affiliates is greater for older MNEs, although the former was only significant at $P < 0.10$.
(6) The percentage of imported raw materials supplied by affiliates is lower for older MNEs, but this relationship is only significant at $P < 0.10$.

The results indicate that FDI in Ireland is a mixture of the type of firms described by the product-cycle model and firms which belong to corporations which adopt a "global strategy". It would, therefore, seem that FDI can best be explained by development of a number of models which explicitly take into account organisational and behavioural aspects of the corporation, rather than by the development of a single all-embracing model. A study such as this, which focuses on the experience of an economy which is a recipient of FDI, highlights a weakness in the existing theory in that such theory tends to view FDI from the viewpoint of the country from which the investment originates. The type of hypothesis put forward by Teeling discussed above, is an approach which could be built upon. The results were regarding the size of MNEs with branch plants in Ireland confirms Teeling's hypothesis that foreign companies in Ireland will tend to belong to relatively small MNEs who do not have a large number of branch plants worldwide and who are concerned about reducing the risk and uncertainty associated with FDI.[16] This suggests that, in attracting FDI, Ireland should seek out products which are at an early stage in their product-cycle when the manufacturer in question may be just beginning to assess the possibility of investing overseas.

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16. The relatively small size of MNEs with branches in Ireland could be partly due to a policy by the IDA to actively seek out such enterprises. However, discussions with IDA personnel indicated that while the size of the project to be set up in Ireland was an important factor, the size of the parent company was not considered a relevant factor.

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APPENDIX I

List of Variable Identities

TSIZE = Employment size of total company
PSIZE = Plant employment size
PRODSYS = Production system used
CORMS = Percentage of imported raw materials supplied by affiliates
AGE = Number of years in production
COSALS = Percentage of total sales sold for further processing to affiliates
DDUB = Distance to Dublin
VWR = Value-weight ratio of major output
OUTPUT = Net output per employee
PROFITS = Estimated gross profits of plant

Industrial Sector
S_1 = Food
S_2 = Textiles
S_3 = Clothing and footwear
S_4 = Wood and furniture/paper and printing
S_5 = Chemicals and plastics
S_6 = Glass and cement
S_7 = Metals and engineering
Reference category = Miscellaneous

Firm Classification
F_1 = Independent Irish plants
F_2 = Independent foreign plants
F_3 = American MNEs
F_4 = British MNEs
F_5 = Other MNEs
F_6 = NMREs
Reference cagetory = "Other"

Nationality
N_1 = Irish
N_2 = British
N_3 = American
N_4 = German
Reference Group: All other nationalities, including joint ventures.

Raw Material Purchasing Autonomy
P_1 = Total autonomy
P_2 = Less than 100 per cent and greater than 50 per cent autonomy

P_3 = Less than 50 per cent and greater than zero autonomy

Reference Group: Zero autonomy

Region

R_1 = Donegal/North-West
R_2 = West
R_3 = Mid-West
R_4 = South-West
R_5 = South-East
R_7 = North-East
R_8 = Midlands

Reference Group = East (R_6)

APPENDIX II: PRODUCTION CLASSIFICATION SYSTEM[a]

	Classification	*Classification Number*
Unit and small batch production	Production of units to customers' requirements	1
	Production of prototypes	2
	Fabrication of large equipment in stages	3
	Production of small batches to customers' orders	4
Large batch and mass production	Production of large batches	5
	Production of large batches on assembly lines	6
	Mass Production	7
Process Production	Intermittent production of chemicals in multi-purpose plant	8
	Continuous flow production of liquids, gases and crystalline substances	9

a This classification system was derived by Woodward (1970, pp. 14-36).