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Innovation, Ownership and Profitability

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Abstract:
This paper considers the relationship between innovation, ownership and profitability for a panel of manufacturing plants in Ireland and Northern Ireland. Previous literature suggests that innovators are persistently more profitable than non-innovators, but little is known about how this link is moderated by external versus domestic ownership. We consider the link between innovation and profits separately for innovators and non-innovators, and for indigenous innovators and non-innovators and externally-owned plants. We also consider the determinants of innovation over the distribution of plant-level profitability, and find that the determinants of profitability – including innovation and external ownership – vary over the distribution from low to high profitability plants. We find support for the view that innovators and non-innovators have different profitability determinants, and that the profitability of externally-owned plants depends on very different factors to that of indigenously-owned enterprises.

Key words: Innovation; Ownership; Profitability; Ireland; Northern Ireland
Jel codes: O32; F14; L60

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1. Introduction

Research on the link between (product) innovation and profitability at the firm or establishment level suggests that innovators are persistently more profitable than non-innovators (Geroski et al., 1993; Leiponen, 2000; Cefis and Ciccarelli, 2005). This may arise because innovators, due perhaps to their market position, are able to protect their new products from the competition which normally erodes such profits, or because innovating firms are able to introduce multiple innovations over time, and are therefore able to maintain high profits although the profit effect of any individual innovation may be transitory. The empirical evidence here is mixed. Both Geroski et al. (1993) and Leiponen (2000), for instance, conclude that the profitability effects of individual innovations are relatively transitory, and that innovators are persistently more profitable than non-innovators because they have superior internal capabilities. By contrast, in an analysis of the US pharmaceutical industry, Roberts (1999) finds evidence of a 'conveyor belt' of new products, each of which provides only a temporary monopoly position, but which collectively result in persistently high profits among innovating firms.

In the case of economies such as Ireland, where a significant element of productive capacity is externally-owned, making general inferences about the relationship between innovation and profitability is further complicated by two issues. First, foreign-owned enterprises tend to be more productive (and by implication more profitable) than their indigenous counterparts (Stone and Peck, 1996; Griffith et al., 2004), largely because they are more technologically advanced (Oulton 2001)[1]. So, there may be differences between the profitability of indigenous and foreign plants

[1] Birnie and Hitchens (1998), for example, comparing Census of Production data from Ireland and the UK, suggest that in 1989: manufacturing productivity in externally-owned firms in Ireland was 69 per cent above that of externally-owned firms in the UK, while indigenously-owned firms in Ireland lagged 8 per cent behind indigenously-owned firms in the UK; the productivity differential between externally-owned and indigenously owned firms in Ireland was 178 per cent compared to 52 per cent in the UK. Similarly, Cassidy (2004) in his recent review of Irish productivity growth concludes that: 'Ireland's superior productivity performance in manufacturing has been largely a consequence of two factors, namely higher productivity growth in the high-technology sectors than the European average and also a greater degree of specialisation in these sectors' (p.93).

regardless of their product innovation performance. Secondly there is evidence of a link between foreign ownership and innovation, with the balance of evidence suggesting that externally-owned firms are generally more likely to be innovative than indigenously-owned firms in terms of both products (Harris and Trainor, 1995; Love and Ashcroft, 1999), and their adoption of new process technologies (Hewitt-Dundas et al., 2002). Thus, not only may innovators be different from non-innovators in terms of their organisational or internal capabilities aside from innovation, but externally-owned plants may be different from indigenously-owned plants partly as a result of innovation performance, complicating the innovation-profitability relationship.

In this paper we consider the relationship between innovation and profitability for a large sample of manufacturing plants in Ireland and Northern Ireland. The economies of both Ireland and Northern Ireland are heavily weighted towards externally-owned enterprises with, for example, 50.5 per cent of employment and 81.9 per cent of value added being accounted for by externally-owned firms in manufacturing and tradable services in Ireland in 2005 (Forfás, 2006)[2]. So, in order to allow for these differences, we consider not only the link between innovation and profits but do so separately for innovators and non-innovators, and for indigenously-owned and externally-owned plants[3]. Because of the tendency for considerable enterprise-level heterogeneity in performance even within industries (Bartelsman and Doms, 2000; Goddard et al., 2006), we also consider the determinants of innovation over the distribution of plant-level profitability, and find that the determinants of profitability – including the impact of innovation and external ownership – vary over the distribution from low to high profitability plants. Our analysis also provides support for the view that innovators have different capabilities from non-innovators, and that it is these capabilities, rather than innovation *per se*, that explains their superior profitability. In

[2] The extent of externally-owned productive capacity in Northern Ireland is less clear with published figures identifying 724 foreign-owned firms operating in Northern Ireland in 2005 (DETI, 2005). Around a third of these plants are owned by firms with headquarters in Ireland and a further quarter by US firms. No figures are published, however, for the number of plants in Northern Ireland owned by UK firms with headquarters in other regions (see Hewitt-Dundas et al., 2005 for a more detailed discussion).

[3] For Ireland, a nation state, the terms 'externally-owned' and 'foreign-owned' are of course synonymous. For Northern Ireland, 'externally-owned' plants include all those which are 'foreign-owned' but also those which are headquartered in other UK regions. Throughout the paper our discussion relates to this wider group of externally-owned plants.

addition, however, we find that externally-owned plants have a quite different set of profitability determinants from indigenously-owned plants, and that this is not related directly to innovation being conducted in the Irish plant.

2. Linking ownership, innovation and profitability: empirical evidence

This section briefly reviews the empirical evidence on the three sets of relationships that are relevant to the present research: the link between innovation and profitability; the link between external ownership and performance; and finally the link between external ownership and innovation.

Innovation and profitability

A considerable empirical literature has considered the link between R&D inputs, innovation and firm profitability. The consensus is overwhelmingly of a positive relationship, but with some debate about the precise nature of the relationship.

Using UK firm-level data from 1972-83, Geroski and Machin (1992) and Geroski et al. (1993) find that there are positive effects of firm-level innovation on profits, but these are relatively small and transitory. Indirect effects are larger and more long lasting: that is, it is the *process* of innovation that really matters for profitability (i.e. the transformation of internal capabilities), rather than individual innovations. The fact that innovators persistently earn higher profits than non-innovators are a result of three components: a small, transitory difference associated with the production of specific innovations; a substantial permanent difference (improved capabilities though the process of innovating); and a large cyclical component (non-innovators' profit margins are more sensitive to trade cycle than those of innovators).

Subsequent studies have built on this work, particularly on the idea that the process of innovation helps build the internal capabilities of firms. Another UK study, this time for the period 1988-92, also finds that innovators are persistently more profitable than non-innovators, and that the gap is greater between persistent innovators and non-innovators. (Cefis and Ciccarelli, 2005). Cefis and Ciccarelli (2005) also find that

innovation has a positive effect on profitability which decreases over time (i.e. there is a decay effect). Using data for Finnish manufacturing firms, Leiponen (2000) is able to assess the profitability of both process and product innovation, and finds that process innovation has a positive effect on profitability, while product innovation has a negative effect. Leiponen also finds that the profitability of innovators and non-innovators are determined by different factors, with competencies built on knowledge-based factors being much more important for innovators.

Canadian data appear to confirm the positive relationship between R&D/innovation and profitability. Using data on 278 quoted Canadian companies, Hanel and St-Pierre (2002) find that firm-level R&D capital has a positive (but lagged) effect on profitability, and that this is especially strong in sectors in which the firm is able to appropriate the results of its own R&D activity i.e. where there is effective patent protection. This latter finding raises the issue of whether the persistently higher profits of innovators relative to non-innovators arises because firms introduce new products which are somehow protected from the competition which normally erodes such profits (an anti-competitive effect) or because firms successfully introduce multiple innovations over time, and so are able to maintain high profits although the profit effect of any individual innovation is transitory (an innovation effect).

Roberts (1999) specifically examines these competing explanations for US pharmaceutical firms from 1977 to 1993, and finds strong support for the latter effect: US pharmaceutical firms are adept at bringing forward a conveyor belt of new products each of which provides only a temporary monopoly position, but which collectively provide persistently high profits at the firm level. There is little support for the anti-competitive hypothesis in this sector: however, there may be some doubt about the generalisability of Roberts' findings. The pharmaceuticals industry is one largely predicated on the continuous search for new products, which is not a feature of other industries. For example, using a large database of innovations over the period 1945-82, Geroski et al. (1997) look for evidence of 'dynamic economies of scale' i.e. the possibility that increases in the volume of innovations produced by a firm in one time period increases the likelihood that it will continue to innovate subsequently. They find very little evidence that innovative activity is self-sustaining: it is very rare

for firms to innovate persistently, and even the ones that do so do not innovate over long periods.

External ownership and performance

There is strong theoretical and empirical evidence of a positive link between external ownership and economic performance. The traditional starting point for considering the determinants of foreign direct investment (FDI) from the perspective of the firm involves the assumed possession of some competitive or 'ownership' advantage, often knowledge-based. The public good nature of these firm-specific assets may make international exploitation of the advantage by contractual means hazardous, thus giving an incentive to engage in FDI (Buckley and Casson, 1976; Dunning, 1988; Horstmann and Markusen, 1996).

The consensus of the empirical literature supports the view that externally-owned plants are more productive than their indigenous counterparts, even within advanced industrialised economies (Caves, 1996; Oulton, 2001; Griffith et al., 2004). There are a few caveats, however. Globerman et al. (1994), for example, find that multinationals in Canada are not significantly more productive than Canadian domestically owned firms after controlling for capital intensity and size, hence they suggest that the superior performance of externally-owned plants is due to their high capital intensity and large size. Driffield and Girma (2003) find that although externally-owned firms in the UK are more productive, they pay higher wages to an extent that outweighs the productivity advantages.

A substantial body of academic research has recognized and documented the contribution of multinational firms to the Irish economy (e.g. Barry and Bradley, 1997; Love and Roper, 2001; Görg and Strobl, 2002, 2003; Girma et al., 2004; Cassidy et al., 2005). For example, Cassidy et al. (2005) analyse productivity determinants using Irish plant-level survey data over 1999-2002 for plants with at least 10 employees. They find that both domestic and foreign-owned exporting plants tend to be more productive (in TFP terms) than their non-exporting counterparts, with the results being stronger for foreign firms than domestic ones. And Girma et al.

(2004) compare the productivity of purely domestic plants, domestic exporters and domestic multinationals in Ireland, and finds evidence that the distribution of performance of domestic multinationals dominates that of the other groups[4].

External Ownership and Innovation

Conceptually, the literature on the link between external ownership and innovation suggests the effect could be positive or negative, depending on whether the beneficial effects of access to group resources outweigh the potentially detrimental 'branch plant' effect. Externally-owned plants may have access to technological resources such as access to large-scale R&D facilities operated by the parent, or to proprietary knowledge developed by the parent (Brugger and Stuckey, 1987)[5]. Alternatively, access may be available to a wide range of non-scientific resources such as finance, an international marketing organisation through which new products can be diffused, or through patenting or other support functions. On the other hand, the 'branch plant' literature suggests that externally-owned plants are less likely to have in-situ R&D facilities on which innovation crucially depends. For example, early work by Malecki (1980) and Howells (1984) suggest that the location of R&D is likely to be heavily influenced by corporate decisions, with basic scientific research, for example, typically assumed to be the most scale-intensive activity and therefore more likely to be centralised by the parent company than applied research and development work.

The limited empirical evidence on this issue appears to suggest that, on balance, a positive effect of external ownership on innovation is likely. Harris and Trainor (1995) concludes that externally-owned plants in Northern Ireland are more likely to innovate, at least in part because they devote more resources to R&D. This conclusion is supported by Love et al. (1996) and Love and Ashcroft (1999), who find evidence that foreign-owned manufacturing plants in Scotland (but not other UK-

[4] Note, however, that this may be more an issue of multi-nationality than of foreign ownership.

[5] The evidence suggests that Ireland benefits disproportionately from this type of inward knowledge or technology transfer. OECD provides figures on the Technology Balance of Payments (TBOP) which reflects the balance of inward and outward knowledge transfer through patents, licensing etc. Countries such as Finland and Denmark with historically higher levels of business and university R&D both have small positive TBOPs (c. 0.1 per cent of GDP) while Ireland has a TBOP deficit (i.e. net inward transfer) equivalent to 10.5 per cent of GDP.

owned plants) are more likely to innovate than their indigenous counterparts. In an analysis of innovation among UK, German and Irish manufacturing plants, Love and Roper (2001) find that external ownership generally has a negative effect on innovation intensity (number of innovations per employee); in Germany and Ireland, however, external ownership is positively associated with innovation success (the proportion of sales attributable to new products). The implication is that although plants which are externally owned tend to make relatively fewer innovations than indigenously owned enterprises, these innovations are typically more successful commercially.

The consensus from these three separate strands of literature appears to be as follows. First, innovation is positively linked to profitability, although the precise nature of the relationship is unclear. Secondly, externally-owned enterprises generally perform better than domestically-owned enterprises (although this is not always the case), and Ireland has benefited considerably from the employment and spillover effects of this superior performance. And finally, externally-owned plants are more likely to innovate, but may not innovate *more*, than indigenous plants. What is not clear from the literature is how these influences interact: specifically, we understand little of how the superior performance of externally-owned plants is directly linked to their innovation activity, or how the superior performance of innovators is moderated by the influence of external ownership. In the empirical work below we attempt to tackle these issues.

3. Empirical Model, Data and Estimation

The empirical model follows the standard literature in using a simple market structure–firm performance model augmented by indicators of innovation and ownership and other characteristics which are known to be linked to profitability such as plant vintage and capital intensity (Geroski et al.,1993; Leiponen, 2000).

This suggests a basic model of the form:

$$\log\pi_{it} = \beta_0 + \beta_1 M_{jt} + \beta_2 I_{it} + \beta_3 O_{it} + \beta_4 C_{it} + \mu_{it} \qquad (1)$$

where π_i is profitability (i.e. return on sales) of plant i at time t, M_{jt} is a set of indicators of market structure, I_{it} is a set of innovation indicators, O_{it} is a set of plant ownership variables, and C_{it} is a set of plants' other characteristics.

Our empirical analysis is based on data from the Irish Innovation Panel (IIP) which provides information on the innovation, technology adoption, ownership and performance of manufacturing plants throughout Ireland and Northern Ireland over the period 1991-2002. The IIP comprises four linked surveys conducted using similar postal survey methodologies, sampling frames provided by the economic development agencies in Ireland and Northern Ireland, and questionnaires with common questions. Each survey covers the innovation activities and performance of manufacturing plants with 10 or more employees over a three year period with an average survey response rate of 34.5 per cent[6]. In our analysis here we use the last three waves of the survey covering the period 1994-2002, with descriptive statistics given in Table 1a.

The set of market structure variables (M_{jt}) comprises three elements. The first is a Herfindahl index measured by the sum of squares of plants' market share in terms of sales in each two-digit industrial sector (j) in each wave of the IIP survey (HHI). The second market structure indicator is a measure of the average innovation intensity of the two-digit sector of which the plant is part (measured as the mean proportion of total sales derived from products newly introduced in the last three years). And finally, we employ a series of two-digit dummy variables to capture other sectoral variations such as appropriability conditions. Economically and statistically, the concentration measure proxied by HHI captures different information from the set of industrial dummies (see Appendix Table A2).

Innovation (I_{it}) in the IIP is represented by three main variables. The first two are binary indicators of product innovation and process innovation[7]. Over the whole

[6] Details of each wave of the survey can be found in Roper et al. (1996), Roper and Hewitt-Dundas (1998), Roper and Anderson (2000), Roper et al., (2004).
[7] For this variable a product (process) innovator was defined as an establishment which had introduced any new or improved product (process) during the previous three years.

sample, 62.5 per cent of plants were product innovators while 59.2 per cent were process innovators (Table 1a). Notably, however, the overlap between the group of product and process innovators was not complete: around 70.2 per cent of product innovators were also process innovators, with 75.3 per cent of process innovators also being product innovators. The final innovation output measure is the proportion of plants' total sales (at the end of each three year period) derived from products newly introduced during the previous three years. This variable – 'innovation success' - reflects not only plants' ability to introduce new products to the market but also their short-term commercial success. On average, 15.1 per cent of plants' sales were derived from new products across the IIP (Table 1a).

Indicators of ownership (O_{it}) are dummy variables representing externally-owned plants with headquarters in the UK, US and elsewhere respectively. Other plant characteristics (C_{it}) include measures of employment size, age, capital intensity, export intensity, labour qualifications, and market share (proportion of sales per two-digit sector).

Our measure of profitability is also derived from the IIP and is defined as sales less the cost of materials, labour and capital inputs. Average profitability across the final three waves of the IIP was £1.76m, or 19 per cent of sales. Two notes of caution are worth highlighting, however, about our profitability indicator. First, it is clear from Table 1 and previous studies that the heterogeneity of profit rates even within sectors can be substantial reflecting evidence of substantial variations in firm performance within Irish industries (Anyadike-Danes and Heller, 2006). Second, there is substantial evidence of issues relating to transfer pricing in externally-owned businesses in Ireland. This can substantially distort both the cost of inputs purchased by plants – particularly inputs or technology 'purchased' by Irish plants from their parent companies - and/or the value of sales made by externally-owned Irish plants to other group plants or the marketing and sales units of their firms. For example, if an Irish branch is not fully charged for the cost of such external activities, this will artificially raise its recorded value-added or productivity. To achieve this they can supply inputs to the Irish branch from other parts of the firm at relatively low prices, or they can sell products from the Irish branch to other parts of the firm at relatively

high prices. In either case this would tend to artificially raise the recorded level of value-added or turnover per employee in the Irish branch, a pattern which may be encouraged by relatively low rates of corporation tax in Ireland.

Table 1b shows descriptive statistics separately for non-innovators versus innovators and indigenously-owned versus externally-owned plants respectively. There is a strong similarity in the patterns of characteristics: innovators/externally-owned plants are larger, more capital intensive, have more highly qualified staff, are more export intensive and have higher market shares than non-innovating/indigenous plants. Innovators are also nearly twice as likely to be externally-owned as non-innovators, and externally-owned plants are significantly more likely than indigenously-owned plants to be innovators, illustrating the links between innovation and external ownership. However, there is no evidence of profitability differences between the groups: indeed the mean profitability is almost identical between the different groups, although with a large degree of heterogeneity in profitability performance.

Two main econometric issues arise in operationalising equation (1): potential endogeneity of the innovation output measures, and heterogeneity in performance outcomes. The potential endogeneity of innovation output measures in models of business performance has been discussed extensively in the literature, and a range of potential approaches have been adopted including two-stage estimation methods (e.g. Crépon et al., 1998) and the simultaneous estimation of the innovation and augmented production functions (e.g. Lööf and Heshmati, 2002). However, here we have adopted a simple panel regression estimation approach, the reasons for which are twofold. First, in conceptual terms, we have argued elsewhere that the relationship between an innovation event and its successful exploitation is essentially recursive (Roper et al., 2006): innovation output measures are necessarily predetermined prior to exploitation – the innovation cannot be exploited until it has been introduced.[8] Secondly, the IIP incorporates a built-in lag between innovation and performance, with profitability at time t being related to innovation over the previous three years.

[8] We accept, of course, that there may be a more general relationship between profitability and subsequent innovation performance.

In terms of heterogeneity, it is clear that very large variations can exist in business performance, and especially in profitability, across sectors. Recent studies of firm-level performance have documented the large and persistent heterogeneity across firms even within fairly narrowly defined industries (Bartelsman and Doms, 2000; D'Este, 2005; Goddard et al., 2006), and this is apparent in the profitability statistics shown in Table 1. To counter the potential bias introduced by outliers we perform inter-quartile range tests, and as a result drop around 5% of the observations in the sample. However, this may not go far enough. Under conditions of persistent profit heterogeneity merely considering the conditional mean function of the dependent variable may obscure important aspects of the relationship between dependent and independent variables. For example, in the case of innovation and profitability one might reasonably expect product innovation to have variable effects on plants at different points of the profitability distribution. As noted in some applied work (for example Girma and Görg, 2005), methods such as quantile regression have been used to deal with this problem (Koenker and Bassett, 1978). Quantile regression allows one to trace the entire conditional distribution of plant level productivity, conditional on the set of regressors, and has the additional advantage of providing a more robust and efficient alternative to least squares estimators when the error term is non-normal. This is relevant in the present case as plant-level profitability is clearly not (log)normally distributed either for the sample overall or for its subsets (see Appendix). In the analysis below we therefore employ quantile regression in addition to the standard panel regression estimation.

4. Results of Estimation

The initial estimations (Table 2) provides a baseline for exploring the innovation-profitability relationship for our entire sample of plants (column 1), and provide some initial indication of how innovation interacts with ownership to affect profitability (column 2). Capital intensity, plants' market share and market concentration have significant coefficients, the latter two with intuitive signs (market share boosts profitability while being in a highly concentrated market reduces profitability for most enterprises). There is also some impact on profitability arising from the country of

ownership: non-US externally-owned plants are significantly less profitable than indigenously-owned or UK/US-owned plants. The effect of innovation is clear: being a product innovator makes a plant more profitable, but there is no corresponding effect from process innovation. In addition, there is no profitability boost from *additional* innovation: the inclusion of the extent of innovation (i.e. proportion of new products as a proportion of total sales) proved insignificant in all estimations (not shown).

In column 2 the product innovator dummy variable is interacted with the external ownership dummies, which throws the US/non-US ownership issue into sharper focus. There is a large significant and negative interaction between innovation and non-US ownership which is larger than the coefficient on product innovation itself, indicating not only that non-US innovating plants are less profitable than other innovators, but that the innovation 'premium' is entirely lost for non-US foreign plants

Quantile regression estimations (Table 3) shed further light on the roles of innovation and ownership. Results are shown for plants in the 10^{th}, 25^{th}, 50^{th} (median), 75^{th} and 90^{th} percentiles of the profitability distribution. Product innovation shows a monotonically decreasing effect with respect to profitability, in terms of both coefficient size and significance, suggesting that the least profitable plants obtain the greatest benefits from product innovation, and that the positive effect becomes insignificant for plants much above median profitability. The negative profitability effect of non-US external ownership is also somewhat modified, being restricted to plants at the lower end of the profitability distribution. The quantile estimations also demonstrate that some variables which appear insignificant overall do have significant effects on some parts of the profitability distribution. For example, export intensity is positively linked to profitability for plants at or above the 75^{th} percentile of the distribution. This conforms with previous research suggesting a positive association between exporting and performance, although there remains some ambiguity about the direction of this effect (e.g. Greenaway and Kneller, 2004). Workforce qualifications and employment also demonstrate significant effects on profitability for plants at different parts of the distribution of profitability.

The models outlined in Tables 2 and 3 provide clear evidence of a (product) innovation effect on profitability, but the question remains of how this occurs. Is it a direct innovation effect or does it occur because innovators are different from non-innovators in terms of other capabilities, and so have fundamentally different profitability determinants? And, if this is the case, given the link between ownership, innovation and profitability indicated by Table 2, are externally-owned innovators different in some way from indigenously-owned innovators?

To tackle the first of these issues Table 4 shows profitability estimations conducted separately for innovators and non-innovators[9]. In the case of non-innovators a Breusch-Pagan test indicates the appropriateness of a random effects model, but the pooled model results are also shown for comparison. The determinants of profitability are quite different. For non-innovators, the key determinant of profitability is the industry – little else matters. There is some suggestion of a size effect, and older plants tend to be more profitable than younger ones, but *position* in the market matters little; broadly, these plants are swept along by the industry achieving levels of profitability which appear not to differ systematically from industry average levels. For innovators the situation is quite different. For these plants market share and the concentration of the market in which they operate are key influences on profitability: by contrast industry effects are very slight. So innovators are able to insulate themselves to some extent from market influences: where you are in the market matters more than what market you are in, while the reverse is true for non-innovators. The boost from product innovation is again apparent: even relative to other innovators (i.e. process innovators), plants which are product innovators have higher profitability.

The suggestion is therefore that innovators have different determinants of profitability from non-innovators, and that this does not arise merely from the fact of being an innovator. This in turn lends *prima facie* support for the findings of Gersoski et al. (1993) and Leiponen (2000) that innovators and non-innovators differ in ways that are linked to the transformation of capabilities provided by the process of innovating

[9] An innovator is defined as any plant introducing at least one product or process innovation during the period of study.

rather than directly to the quasi-monopoly effects of individual innovation events. However, for the present sample this apparent difference between innovators and non-innovators may disguise more than it reveals. Approximately 60 per cent of innovators in the sample are externally-owned, and so what appears to be a difference between innovators and non-innovators may actually be an issue of external versus indigenous ownership.

To examine this in more detail we are able to split the sample further between indigenously-owned non-innovators, indigenously-owned innovators and externally-owned plants. Ideally it would be desirable also to perform separate estimations for externally-owned innovators and non-innovators, but as almost all externally-owned plants are innovators there are insufficient observations to perform these estimations separately. Results of the panel estimation are shown in Table 5 and are striking. For indigenous non-innovators *only* the sector matters. Profitability in these enterprises is dictated largely by the sector they are in, with plants having virtually no means of differentiating their profitability from the norms of the sector. Such plants also suffer if they are located in a high-innovation sector (the coefficient on mean sectoral innovation is negative and significant). This is as one would expect; indigenous non-innovators lose market share to innovators in innovation-intensive sectors, and are less profitable as a result.

By contrast, indigenously-owned innovators are able to differentiate their profit performance from sectoral norms to some extent. Absolute size matters (negatively) and they get a strong boost from product innovation, but having a high market share does not matter for the profitability of indigenously-owned innovators. Indigenously-owned innovators in Northern Ireland are less profitable than those in Ireland: this is not the case for non-innovators. Therefore indigenously-owned plants have greater profitability if they are relatively small and labour intensive product innovators operating in Ireland, suggesting the benefit of being a small, nimble niche operator which is prepared to introduce new products.

Externally-owned plants have a quite different set of profitability determinants from both indigenously-owned innovators and non-innovators (Table 5, third column).

What matters for these plants is not the boost they get from innovating (there is none) but instead their position in the domestic market. These plants reap profits by having a high market share, and by avoiding markets which are highly concentrated. Other sectoral influences are entirely absent in the case of externally-owned plants: moreover, the choice of industrial sector does not determine their level of profitability, as it does for indigenously-owned non-innovators (wholly) and even partly for indigenously-owned innovators. In this estimation it is also clear that US-owned plants are more profitable than UK or other non-US owned plants[10].

Quantile regression results for each of these sub-samples are shown in Tables 6, 7 and 8 respectively. In the case of indigenously-owned non-innovators (Table 6) there is virtually no quantile effect; regardless of their position in the profitability distribution, indigenous non-innovators are sector-dependent in terms of profitability. For indigenously-owned innovators the quantile regression results are more revealing (Table 7). The employment and capital intensity effects are restricted to plants in the upper parts of the distribution, while the monotonically declining effect of product innovation with respect to the profitability distribution first noted in Table 3 is shown here to be a phenomenon linked only to indigenously-owned innovators. For externally-owned plants (Table 8) the quantile regressions show that the positive link between exporting and profitability noted earlier among the most profitable plants is entirely related to non-indigenous plants (there is no corresponding effect evident in Table 7), while the positive US-ownership effect is restricted to plants below median profitability.

The main empirical conclusion of the estimations in Tables 5 to 8 is that the determinants of innovators' profitability are different from those of non-innovators even among indigenously-owned plants, and that externally-owned plants are totally different from both. Externally-owned innovators (effectively the same as the group of externally-owned plants) are not at all like indigenous innovators: they behave entirely differently and are subject to different profitability determinants. These results also highlight that some of the apparent differences between innovators and non-innovators shown in Table 4 are actually *ownership* rather than *innovation* issues,

[10] In this estimation the reference point for ownership dummies are non-US/UK owned foreign plants

notably the importance of market share and concentration, and the role of product innovation. Indigenously-owned innovators, especially those at the lower end of the profitability distribution, obtain a very large profitability boost from being innovators which is not shared by their foreign counterparts, an effect which is hidden when a simple innovator/non-innovator split is made.

5. Conclusions

Although there is a substantial body of literature on the link between innovation and profitability, there is very little evidence on the inter-relationship between innovation, ownership and profitability. The present analysis therefore sheds further light on, for example, the differences between innovators and non-innovators.

Our results suggest that, in profitability terms, innovators are not simply plants that innovate: their level of profitability is subject to different determinants from those of non-innovators. Innovators are able to insulate themselves from market forces to some degree, at least part of which is because of innovating. However, the fact that product innovation *per se* has a negligible effect on the profitability of indigenous innovators at the upper end of the profitability distribution supports the view that it is not the quasi-monopoly rents of innovation which distinguishes the most profitable innovators from the rest, but the fact that these plants have capabilities or competences which others lack. These capabilities may be linked the *process* of innovation, but they are unlikely to be solely related to innovating. There is thus support for the view of Geroski et al. (1993) and Leiponen (2000) that innovators are different from non-innovators, but the quantile regression results appear to provide little support for the view of Roberts (1999) and the 'conveyor belt' hypothesis of the link between innovation and profitability.

Equally importantly, externally-owned plants, almost all of which are innovators, have markedly different profitability determinants from indigenous enterprises, and these differences are not directly linked to the fact of innovation *per se*. While innovation is a competitive weapon for indigenous plants, it is simply a fact of life for externally-owned plants. These plants compete, and have their profitability

determined, in a quite different way from *all* indigenous plants, both innovators and non-innovators. Although market share matters for the profitability of externally-owned plants, in most respects they are not really competing against most indigenous plants at all. In terms of profitability determinants, indigenous innovators and non-innovators inhabit different parts of the same world, while externally-owned innovators (effectively foreign plants) operate in a different world from both sets of indigenous enterprises. In this sense our results reflect comments made a decade ago by Wrynn (1997) which emphasised the lack of interaction between externally-owned plants in Ireland and the nation's innovation system.

In policy terms our results suggest both optimistic and cautionary messages. On the positive side our results suggest that efforts to promote innovation activity among indigenously-owned plants are likely to have significant longer term benefits through their capability effects. This may not lead to persistent innovation (e.g. Roper and Hewitt-Dundas, 2005) but does seem likely to be leading to behavioural additionality or learning effects (e.g. Buisseret et al., 1995) which in turn are contributing to longer-term business profitability. For the development agencies in Ireland this is a reassuring result given their emphasis on developing the technological capability of indigenously-owned plants since the Culliton Report of the early-1990s. On the more negative side, the lack of any relationship in our models between the innovation activities of externally-owned plants and their (profitability) performance raises potential concerns. This finding may reflect the lack of linkages between externally-owned plants and their Irish resource base, in turn raising some worrying issues about the 'embeddedness' of much FDI into Ireland and therefore its 'stickiness' in the face of Ireland's increasing high relative cost base. Here, however, it is important to bear in mind that our analysis relates to the period 1994-2002, and much of the increase in investment in public R&D in Ireland under the 2000-06 National Development Plan actually post-dates our study. Whether in future years externally-owned plants in Ireland will draw more strongly on the Irish innovation system remains to be seen.

Table 1a: Summary statistics – Whole Sample

Variable	N	Mean	SD
Profit (£000)	1536	1834.651	5998.553
Profit Margin (%, profit/turnover)	1536	0.209	0.192
Employment (number)	1977	113.187	248.544
Vintage (years)	1925	32.288	30.437
Capital intensity (capital investment per employee)	1661	5.294	13.954
Percentage of staff with degree (%)	1877	9.099	12.025
Export intensity (exports as proportion of sales)	1919	0.266	0.346
Market share (in sales in each sector and wave)	1770	0.006	0.022
Externally-owned plants (%)	2002	0.330	0.470
Externally-owned plants with head quarter in the UK	2002	0.060	0.237
Externally-owned plants with head quarter in the US	2002	0.094	0.292
Externally-owned plants with head quarter in other countries	2002	0.088	0.284
Herfindahl Index (HHI, sum of squares of plants' market share in each sector and wave)	2002	0.022	0.066
Average product innovation success (in total sales)	2002	0.155	0.062

Source: Irish Innovation Panel, Waves 2, 3 and 4.

Table 1b: Summary statistics – Sample sub-groups

Variable Definitions	Non-innovating Plants			Innovating Plants			t-test
	Obs	Mean	SD	Obs	Mean	SD	
Profit (£000)	343	858.302	1906.557	1193	2115.361	6703.777	-3.432***
Profit Margin (%, profit/turnover)	343	0.212	0.173	1193	0.208	0.197	0.309
Employment (number)	439	50.743	81.300	1538	131.010	275.868	-6.021***
Vintage (years)	417	34.300	31.001	1508	31.732	30.265	1.525
Capital intensity (capital investment per employee)	357	2.417	3.842	1304	6.081	15.529	-4.421***
Percentage of staff with degree (%)	408	6.276	10.323	1469	9.883	12.345	-5.401***
Export intensity (as proportion of sales)	418	0.151	0.282	1501	0.298	0.355	-7.825***
Market share (in sales in each sector and wave)	399	0.003	0.014	1371	0.007	0.024	-2.653***
Externally-owned plants (%)	441	0.197	0.398	1561	0.367	0.482	-6.771***
Externally-owned plants with head quarter in the UK	441	0.043	0.203	1561	0.065	0.246	-1.689***
Externally-owned plants with head quarter in the US	441	0.043	0.203	1561	0.108	0.311	-4.159***
Externally-owned plants with head quarter in other countries	441	0.050	0.218	1561	0.099	0.299	-3.234***
Herfindahl Index (sum of squares of plants' market share in each sector/wave)	441	0.021	0.064	1561	0.022	0.067	-0.400
Average product innovation success (in total sales)	441	0.138	0.059	1561	0.160	0.062	-6.849***
	Indigenously-owned Plants			Externally-owned Plants			t-test
	Obs	Mean	SD	Obs	Mean	SD	
Profit (£000)	1068	903.754	1975.678	468	3959.005	10141.50	-9.448***
Profit Margin (%, profit/turnover)	1068	0.211	0.189	468	0.205	0.197	0.579
Employment (number)	1326	63	90	651	216	394	-13.522***
Vintage (years)	1285	32.931	31.654	640	30.998	27.812	1.313
Capital intensity (capital investment per employee)	1127	3.884	7.324	534	8.267	21.910	-6.042***
Percentage of staff with degree (%)	1261	7.775	10.739	616	11.809	13.922	-6.910***
Export intensity (as proportion of sales)	1280	0.159	0.266	639	0.481	0.385	-21.378***
Market share (in sales in each sector and wave)	1228	0.003	0.006	542	0.013	0.038	-9.242***
Externally-owned plants (%)	1342	0.736	0.441	660	0.868	0.339	-6.771***
Externally-owned plants with head quarter in the UK	1342	0.000	0.000	660	0.182	0.386	-17.261***
Externally-owned plants with head quarter in the US	1342	0.000	0.000	660	0.285	0.452	-23.108***
Externally-owned plants with head quarter in other countries	1342	0.000	0.000	660	0.268	0.443	-22.165***
Herfindahl Index (sum of squares of plants' market share in each sector/wave)	1342	0.022	0.064	660	0.022	0.070	0.153
Average product innovation success (in total sales)	1342	0.144	0.056	660	0.178	0.067	-11.9089***

Note: *** indicates significance at the 1% level.

Table 2: Determinants of profitability: panel estimation (all plants)

	(1)		(2)	
Plant Characteristics	**Coefficient**	**S.E.**	**Coefficient**	**S.E.**
Employment	-0.000723	0.00060	-0.000669	0.00060
Employment squared	0.0000241	0.000027	0.0000218	0.000027
Plant vintage	0.00221	0.0018	0.00210	0.0018
Capital intensity	-0.123***	0.046	-0.126***	0.046
Staff with degree	0.00227	0.0054	0.00157	0.0054
Export intensity	0.0664	0.19	0.0609	0.19
Product innovator	0.236**	0.11	0.326***	0.13
Process innovator	-0.107	0.11	-0.123	0.11
UK HQ	0.102	0.24	0.406	0.44
US HQ	0.229	0.21	0.329	0.35
Other HQ	-0.528***	0.20	0.0116	0.37
Market share	8.447*	4.36	8.743**	4.37
Market Characteristics				
Herfindahl Index	-2.540**	1.01	-2.439**	1.01
Innovation intensity in sector	-1.454	1.87	-1.479	1.87
Interaction Effects				
HQ_UK*product innovator			-0.431	0.52
HQ_US*product innovator			-0.159	0.39
HQ_oth*product innovator			-0.724*	0.41
Industry and Location Dummies				
Textiles, textile products, leather and footwear	-0.0653	0.21	-0.0715	0.21
Wood and products of wood and cork	0.266	0.24	0.267	0.24
Pulp, paper, paper products, printing and publishing	0.404*	0.23	0.423*	0.23
Chemical, rubber, plastics and fuel products	0.634**	0.25	0.641**	0.25
Basic metals and fabricated metal products	0.456***	0.17	0.474***	0.17
Machinery and equipment	0.502**	0.21	0.506**	0.21
Electrical and optical equipment	0.390	0.30	0.412	0.31
Transport equipment	0.103	0.35	0.103	0.35
Northern Ireland	-0.147	0.10	-0.143	0.10
Constant	-1.712***	0.29	-1.757***	0.29
Observations	1139		1139	
R-squared	0.05		0.06	
BP LM test for random effects, P-value	0.135		0.137	
Final estimator	Pooled		Pooled	

Note 1: *** p<0.01, ** p<0.05, * <0.1.

Note 2: The Breusch-Pagan Lagrange Multiplier (LM) test for random effects tests the significance of individual-specific effects of the panel. A rejection of the test favours random effects.

Table 3: Quantile regressions of profitability (all plants)

	(1)	(2)	(3)	(4)	(5)
Point in distrib.	0.1	0.25	0.5	0.75	0.9
Plant Characteristics					
Employment	0.000453	-0.000114	-0.000119	-0.000353	-0.000566**
	(0.00049)	(0.00042)	(0.00027)	(0.00027)	(0.00028)
Empl squared	-0.0000227	0.00000388	0.00000370	0.00000617	0.0000429***
	(0.000019)	(0.000017)	(0.0000095)	(0.0000090)	(0.000010)
Plant vintage	-0.00105	0.000693	0.00102	0.000670	0.000475
	(0.0016)	(0.0013)	(0.00085)	(0.00072)	(0.00074)
Capital intensity	-0.0794	-0.0821**	-0.0998***	-0.0528***	-0.0824***
	(0.054)	(0.037)	(0.022)	(0.020)	(0.027)
Staff with degree	0.00371	0.00400	0.00579**	0.00543**	0.00319
	(0.0081)	(0.0043)	(0.0025)	(0.0022)	(0.0023)
Export intensity	-0.0697	-0.0119	0.106	0.267***	0.253***
	(0.19)	(0.14)	(0.089)	(0.080)	(0.097)
Market share	-0.447	1.583	1.055	0.218	-1.164
	(2.71)	(2.81)	(1.77)	(1.82)	(1.55)
Product innovator	0.339***	0.184**	0.0994*	0.0597	0.0474
	(0.12)	(0.085)	(0.053)	(0.048)	(0.062)
Process innovator	0.127	0.0865	0.0760	-0.0315	-0.0133
	(0.11)	(0.084)	(0.052)	(0.047)	(0.061)
HQ in UK	-0.299	0.00933	0.0875	0.0495	0.180
	(0.25)	(0.17)	(0.11)	(0.10)	(0.12)
HQ in US	0.341	0.306*	0.166*	0.0282	0.0184
	(0.23)	(0.16)	(0.097)	(0.088)	(0.11)
HQ in other country	-0.406**	-0.158	-0.179*	-0.138	-0.134
	(0.20)	(0.15)	(0.095)	(0.089)	(0.11)
Market Characteristics					
Herfindahl Index	2.273**	1.073	0.312	0.444	0.307
	(1.09)	(0.77)	(0.47)	(0.41)	(0.53)
Innovation intensity in sector	-0.0153	1.279	0.771	0.170	-0.300
	(2.02)	(1.42)	(0.88)	(0.79)	(1.01)
Industry and Locational Dummies					
Textiles etc	0.252	0.126	0.0352	-0.0113	-0.163
	(0.23)	(0.16)	(0.10)	(0.091)	(0.12)
Wood etc	0.488**	0.441**	0.169	0.132	0.130
	(0.24)	(0.18)	(0.11)	(0.100)	(0.13)
Paper etc	1.139***	0.961***	0.554***	0.315***	0.0307
	(0.25)	(0.18)	(0.11)	(0.099)	(0.12)
Chemicals etc	1.112***	0.720***	0.478***	0.341***	0.101
	(0.26)	(0.19)	(0.12)	(0.11)	(0.13)
Metals etc	1.001***	0.792***	0.542***	0.315***	-0.0211
	(0.18)	(0.13)	(0.081)	(0.074)	(0.092)
Machinery etc	0.637***	0.480***	0.366***	0.214**	0.0356
	(0.23)	(0.16)	(0.10)	(0.090)	(0.11)
Electrical etc.	0.0459	0.00284	0.108	0.117	-0.0828
	(0.31)	(0.22)	(0.14)	(0.13)	(0.16)
Transport etc.	0.210	0.252	0.257	0.0329	-0.131
	(0.34)	(0.25)	(0.16)	(0.15)	(0.20)
Northern Ireland	-0.127	-0.0822	-0.150***	-0.0882**	-0.0171
	(0.11)	(0.079)	(0.049)	(0.045)	(0.056)
Constant	-3.265***	-2.723***	-2.004***	-1.388***	-0.821***
	(0.31)	(0.22)	(0.14)	(0.12)	(0.16)
Observations	1139	1139	1139	1139	1139

Note 1: Standard errors in parentheses; *** p<0.01, ** p<0.05, * <0.1.

Table 4: Determinants of profitability: innovators and non-innovators

	Non-innovators		Innovators
	Pooled estimator (for comparison)	Random effect panel	Pooled
Plant Characteristics			
Employment	-0.00223*	-0.00210	-0.000802
	(0.0013)	(0.0014)	(0.00069)
Employment squared	0.000501***	0.000440**	0.0000245
	(0.00018)	(0.00019)	(0.000030)
Plant vintage	0.00410**	0.00348*	0.00236
	(0.0016)	(0.0019)	(0.0024)
Capital intensity	0.0193	0.000651	-0.160***
	(0.047)	(0.048)	(0.057)
Staff with degree	-0.00960*	-0.00987*	0.00453
	(0.0057)	(0.0059)	(0.0068)
Export intensity	0.324	0.224	0.0241
	(0.23)	(0.23)	(0.22)
Market share	-27.48*	-24.81*	11.21**
	(14.2)	(14.8)	(4.93)
Product innovator			0.317*
			(0.17)
Process innovator			-0.0196
			(0.16)
HQ in UK	0.395	0.484	0.121
	(0.36)	(0.31)	(0.27)
HQ in the US	0.325	0.390	0.246
	(0.29)	(0.29)	(0.25)
HQ in other country	-0.308		-0.548**
	(0.31)		(0.23)
Market Characteristics			
Herfindahl Index	0.720	0.574	-3.682***
	(1.03)	(0.76)	(1.28)
Innovation intensity in sector	-3.169	-2.890	-1.396
	(2.00)	(1.80)	(2.30)
Industry and Locational Dummies			
Textiles etc	0.598***	0.606***	-0.156
	(0.23)	(0.23)	(0.27)
Wood etc	0.683***	0.617**	0.241
	(0.26)	(0.28)	(0.29)
Paper etc	0.303	0.328	0.454
	(0.21)	(0.22)	(0.30)
Chemicals etc	0.607*	0.537	0.638**
	(0.31)	(0.34)	(0.30)
Metals etc	0.591***	0.593***	0.467**
	(0.17)	(0.18)	(0.22)
Machinery etc	0.742***	0.734***	0.469*
	(0.25)	(0.25)	(0.26)
Electrical etc.	0.627*	0.618*	0.412
	(0.33)	(0.33)	(0.37)
Transport etc.	1.073**	1.095***	-0.114
	(0.42)	(0.39)	(0.43)
Northern Ireland	-0.0432	-0.0501	-0.200
	(0.10)	(0.11)	(0.13)
Constant	-1.711***	-1.725***	-1.793***
	(0.30)	(0.28)	(0.39)
Observations	238	238	901
R-squared	0.16	0.15(overall)	0.07
BP LM test P-value		0.002	0.718
Final estimator		Random effects	Pooled

Note 1: Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.
Note 2: The Breusch-Pagan Lagrange Multiplier (LM) test for random effects tests of the significance of individual-specific effects of the panel. A rejection of the test favours random effects.

Table 5: Determinants of profitability: indigenous and externally-owned plants

	Indigenous non-innovators		Indigenous innovators	Externally-owned
	Pooled estimator (for comparison)	Random effect panel	Pooled	Pooled
Plant Characteristics				
Employment	-0.00406	-0.00419	-0.00475**	-0.000514
	(0.0026)	(0.0028)	(0.0020)	(0.00093)
Employment squared	0.00107	0.00103	0.000560**	0.0000116
	(0.00077)	(0.00083)	(0.00027)	(0.000038)
Plant Vintage	0.00305*	0.00273	0.00245	0.00286
	(0.0018)	(0.0021)	(0.0025)	(0.0049)
Capital intensity	0.0191	0.00151	-0.106*	-0.268**
	(0.052)	(0.053)	(0.063)	(0.11)
Staff with degree	0.00000231	-0.000736	0.00117	-0.00176
	(0.0084)	(0.0088)	(0.0076)	(0.010)
Export intensity	0.179	0.209	0.195	-0.257
	(0.27)	(0.29)	(0.26)	(0.38)
Market share	-20.23	-14.87	24.58	18.10***
	(17.8)	(19.0)	(21.0)	(6.37)
Product innovator			0.545***	-0.0241
			(0.18)	(0.26)
Process innovator			0.0185	-0.107
			(0.17)	(0.27)
HQ in UK				0.120
				(0.33)
HQ in US				0.759***
				(0.27)
Market Characteristics				
HHI	0.825	0.667	2.450	-8.375***
	(1.09)	(0.80)	(1.67)	(1.82)
innovation intensity in sector	-3.859*	-3.342*	-1.577	0.924
	(2.17)	(1.93)	(2.54)	(4.20)
Industry and Locational Dummies				
Textiles etc	0.690***	0.665***	-0.539*	0.168
	(0.24)	(0.25)	(0.30)	(0.53)
Wood etc	0.707***	0.650**	-0.0447	-0.727
	(0.27)	(0.29)	(0.32)	(0.79)
Paper etc	0.239	0.281	0.475	0.471
	(0.23)	(0.23)	(0.32)	(0.59)
Chemicals etc	0.752*	0.673	0.705**	0.421
	(0.41)	(0.48)	(0.36)	(0.50)
Metals etc	0.594***	0.593***	0.446*	0.123
	(0.18)	(0.19)	(0.23)	(0.47)
Machinery etc	0.729***	0.721***	0.336	0.265
	(0.26)	(0.27)	(0.29)	(0.52)
Electrical etc.	0.540	0.563	0.493	-0.194
	(0.36)	(0.36)	(0.42)	(0.67)
Transport etc.	1.060**	1.063**	-0.178	-0.317
	(0.43)	(0.42)	(0.55)	(0.70)
Northern Ireland	-0.0524	-0.0756	-0.281**	-0.0211
	(0.11)	(0.12)	(0.14)	(0.26)
Constant	-1.594***	-1.639***	-1.844***	-1.664**
	(0.33)	(0.31)	(0.43)	(0.69)
Observations	202	202	593	344
R-squared	0.15	0.15 (overall)	0.07	0.15
BP LM test P-value		0.004	0.77	0.846
Final estimator		Random effects	Pooled	Pooled

Note 1: Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.
Note 2: The Breusch-Pagan Lagrange Multiplier (LM) test for random effects tests of the significance of individual-specific effects of the panel. A rejection of the test favours random effects.

Table 6: Quantile regressions of profitability (indigenous non-innovators)

	(1)	(2)	(3)	(4)	(5)
Point in distrib.	0.1	0.25	0.5	0.75	0.9
Plant Characteristics					
Employment	-0.00401	-0.00494	-0.00252	0.000326	-0.00253
	(0.0090)	(0.0057)	(0.0020)	(0.0037)	(0.0042)
Empl squared	0.00164	0.00135	0.000270	-0.000455	0.000873
	(0.0023)	(0.0014)	(0.00046)	(0.00083)	(0.00093)
Plant vintage	0.000876	0.00316	0.00570***	0.00367	0.00356
	(0.0062)	(0.0039)	(0.0015)	(0.0025)	(0.0024)
Capital intensity	0.0758	0.0576	0.0616	0.0774	0.0154
	(0.21)	(0.12)	(0.044)	(0.089)	(0.12)
Staff with degree	-0.0227	-0.00898	0.000943	0.00321	-0.00343
	(0.024)	(0.017)	(0.0065)	(0.011)	(0.013)
Export intensity	0.595	0.310	0.305	0.293	0.0492
	(0.68)	(0.65)	(0.21)	(0.40)	(0.44)
Market share	-21.34	-29.32	-19.62*	-12.32	-11.60
	(38.8)	(32.2)	(11.0)	(23.0)	(19.0)
Market Characteristics					
HHI	-0.997	0.619	0.425	2.016	1.088
	(1.73)	(2.11)	(0.84)	(1.35)	(0.85)
innovation intensity	-6.611	-7.506	-0.143	-3.167	-0.960
	(8.51)	(5.11)	(1.78)	(3.58)	(4.17)
Industry and Locational Dummies					
Textiles etc	1.092*	1.644***	0.633***	0.288	-0.0751
	(0.61)	(0.52)	(0.20)	(0.37)	(0.45)
Wood etc	1.466***	1.022*	0.740***	0.566	0.354
	(0.56)	(0.53)	(0.22)	(0.43)	(0.47)
Paper etc	0.862	0.665	0.575***	-0.207	-0.352
	(0.95)	(0.52)	(0.19)	(0.37)	(0.44)
Chemicals etc	2.038**	1.771*	0.538*	-0.0110	-0.283
	(0.80)	(0.97)	(0.31)	(0.65)	(0.38)
Metals etc	0.983	1.114***	0.824***	0.336	0.00966
	(0.73)	(0.41)	(0.15)	(0.28)	(0.31)
Machinery etc	1.510	1.537***	0.670***	0.336	-0.234
	(1.11)	(0.58)	(0.21)	(0.38)	(0.38)
Electrical and optical	1.288	1.852**	0.326	0.300	-0.154
	(1.04)	(0.72)	(0.29)	(0.62)	(0.75)
Transport equip.	2.651***	1.929***	0.926***	0.303	0.165
	(0.83)	(0.64)	(0.34)	(0.67)	(0.46)
Northern Ireland	0.0420	-0.00263	-0.158*	-0.0697	-0.161
	(0.47)	(0.26)	(0.094)	(0.19)	(0.20)
Constant	-2.608**	-2.030***	-2.160***	-1.132**	-0.676
	(1.20)	(0.76)	(0.27)	(0.55)	(0.61)
Observations	202	202	202	202	202

Note 1: Standard errors in parentheses; *** p<0.01, ** p<0.05, * <0.1.

Table 7: Quantile regressions of profitability (indigenous innovators)

	(1)	(2)	(3)	(4)	(5)
Point in distrib.	0.1	0.25	0.5	0.75	0.9
Plant Characteristics					
Employment	0.000242	-0.00112	-0.00142***	-0.00149*	-0.00185
	(0.0019)	(0.0012)	(0.00042)	(0.00078)	(0.0013)
Empl squared	0.000108	0.000140	0.000191***	0.000207**	0.000274*
	(0.00022)	(0.00014)	(0.000059)	(0.000094)	(0.00014)
Plant vintage	-0.00162	-0.000152	-0.000124	0.000162	0.000811
	(0.0023)	(0.0016)	(0.00053)	(0.00085)	(0.0012)
Capital intensity	-0.0860	-0.0464	-0.0776***	-0.0583**	-0.114***
	(0.091)	(0.045)	(0.014)	(0.024)	(0.037)
Staff with degree	0.00429	0.00298	0.00820***	0.00700**	0.00483
	(0.013)	(0.0055)	(0.0017)	(0.0028)	(0.0042)
Export intensity	-0.0192	-0.0349	0.0104	0.0486	0.194
	(0.33)	(0.18)	(0.056)	(0.10)	(0.14)
Market share	-11.62	4.249	6.070	-2.016	-7.861
	(18.6)	(12.5)	(3.90)	(6.56)	(9.15)
Product innovator	0.333	0.269**	0.149***	0.130*	0.169
	(0.23)	(0.13)	(0.039)	(0.070)	(0.10)
Process innovator	-0.0724	0.0208	0.0969***	0.0983	0.146
	(0.21)	(0.12)	(0.037)	(0.067)	(0.100)
Market Characteristics					
HHI	5.239***	1.449	0.426	0.878*	0.290
	(1.15)	(1.30)	(0.32)	(0.53)	(0.71)
innovation intensity	0.243	0.606	0.491	0.478	-1.861
	(3.10)	(1.86)	(0.55)	(0.95)	(1.20)
Industry and Locational Dummies					
Textiles etc	-0.0998	0.0137	0.122*	0.0270	0.170
	(0.36)	(0.22)	(0.065)	(0.11)	(0.17)
Wood etc	0.394	0.349	0.208***	0.113	0.0347
	(0.38)	(0.23)	(0.068)	(0.13)	(0.19)
Paper etc	1.153***	0.860***	0.612***	0.513***	0.198
	(0.39)	(0.23)	(0.070)	(0.12)	(0.17)
Chemicals etc	1.183***	0.779***	0.476***	0.373***	0.409**
	(0.38)	(0.26)	(0.078)	(0.14)	(0.18)
Metals etc	0.998***	0.782***	0.570***	0.345***	0.273*
	(0.29)	(0.16)	(0.051)	(0.093)	(0.14)
Machinery etc	0.624*	0.424**	0.342***	0.245**	0.350**
	(0.36)	(0.21)	(0.062)	(0.11)	(0.16)
Electrical and optical	0.0205	0.266	0.283***	0.226	0.433**
	(0.49)	(0.28)	(0.091)	(0.16)	(0.21)
Transport equip.	-1.053***	0.168	0.259**	-0.00610	0.0523
	(0.36)	(0.37)	(0.12)	(0.22)	(0.31)
Northern Ireland	-0.146	-0.128	-0.170***	-0.0448	-0.0250
	(0.17)	(0.095)	(0.030)	(0.053)	(0.079)
Constant	-3.071***	-2.543***	-1.977***	-1.577***	-0.973***
	(0.50)	(0.31)	(0.094)	(0.16)	(0.23)
Observations	593	593	593	593	593

Note 1: Standard errors in parentheses; *** p<0.01, ** p<0.05, * <0.1.

Table 8: Quantile regressions of profitability (externally-owned plants)

	(1)	(2)	(3)	(4)	(5)
Point in distrib.	0.1	0.25	0.5	0.75	0.9
Plant Characteristics					
Employment	-0.000320	-0.000193	0.000241	0.000305	0.000505
	(0.0012)	(0.00081)	(0.00055)	(0.00032)	(0.00045)
Empl squared	0.00000244	0.0000105	-0.00000935	-0.0000148	-0.0000242*
	(0.000045)	(0.000031)	(0.000019)	(0.000011)	(0.000013)
Plant vintage	0.00447	0.0000340	0.00128	0.00168	0.000696
	(0.0070)	(0.0043)	(0.0031)	(0.0015)	(0.0015)
Capital intensity	-0.213	-0.223**	-0.189***	-0.111***	-0.0762
	(0.15)	(0.10)	(0.069)	(0.037)	(0.062)
Staff with degree	-0.0101	-0.000908	0.00309	0.00352	0.00131
	(0.014)	(0.011)	(0.0061)	(0.0031)	(0.0036)
Export intensity	0.234	0.144	0.486*	0.391***	0.248
	(0.53)	(0.35)	(0.25)	(0.14)	(0.20)
Market share	12.19	4.416	0.573	-1.240	-1.666
	(11.0)	(4.93)	(3.33)	(1.94)	(1.81)
Product innovator	0.0142	0.209	0.0854	-0.00345	0.00681
	(0.41)	(0.23)	(0.17)	(0.092)	(0.15)
Process innovator	-0.177	0.000511	0.0714	-0.0984	-0.186
	(0.41)	(0.24)	(0.17)	(0.095)	(0.15)
HQ in the UK	0.0162	0.282	-0.00211	0.0267	0.156
	(0.58)	(0.32)	(0.23)	(0.13)	(0.17)
HQ in the US	0.488	0.571*	0.0639	0.00655	-0.0577
	(0.58)	(0.34)	(0.23)	(0.13)	(0.20)
HQ in other country	-0.456	0.232	-0.214	-0.195	-0.223
	(0.57)	(0.32)	(0.22)	(0.13)	(0.19)
Market Characteristics					
HHI	-2.826	-0.404	-0.0636	0.588	0.608
	(3.33)	(1.46)	(1.15)	(0.59)	(0.67)
Innovation intensity	-2.565	2.585	3.383	2.891**	1.608
	(6.26)	(3.66)	(2.66)	(1.44)	(2.19)
Industry and Locational Dummies					
Textiles etc	1.197	-0.0742	-0.404	-0.115	-0.108
	(0.75)	(0.45)	(0.33)	(0.19)	(0.26)
Wood etc	0.416	0.385	0.00671	0.148	0.221
	(0.77)	(0.73)	(0.47)	(0.23)	(0.26)
Paper etc	0.859	0.948*	0.667*	0.559***	0.533*
	(0.92)	(0.50)	(0.38)	(0.21)	(0.31)
Chemicals	1.010	0.422	0.144	0.0804	0.128
	(0.73)	(0.45)	(0.32)	(0.19)	(0.27)
Metals etc	1.115*	0.507	0.261	0.217	0.0927
	(0.61)	(0.43)	(0.30)	(0.17)	(0.25)
Machinery etc	0.811	0.295	0.0250	0.111	0.153
	(0.70)	(0.46)	(0.33)	(0.19)	(0.27)
Electrical etc	0.701	-0.488	-0.705	-0.455*	-0.292
	(1.14)	(0.61)	(0.43)	(0.24)	(0.35)
Transport equip.	0.0678	-0.129	-0.176	-0.236	-0.342
	(0.82)	(0.61)	(0.45)	(0.24)	(0.38)
N. Ireland	-0.268	-0.208	-0.202	-0.0748	-0.0403
	(0.41)	(0.23)	(0.17)	(0.095)	(0.13)
Constant	-2.791**	-2.718***	-2.073***	-1.576***	-1.036***
	(1.12)	(0.65)	(0.45)	(0.24)	(0.37)
Observations	344	344	344	344	344

Note 1: Standard errors in parentheses; *** p<0.01, ** p<0.05, * <0.1.

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Appendix: Normality tests

Figure A1: All plants

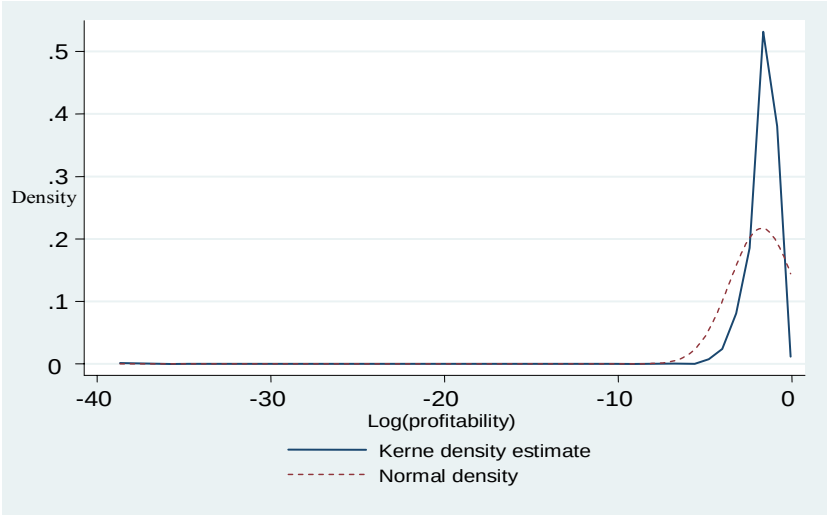

Figure A2: Indigenous non-innovators

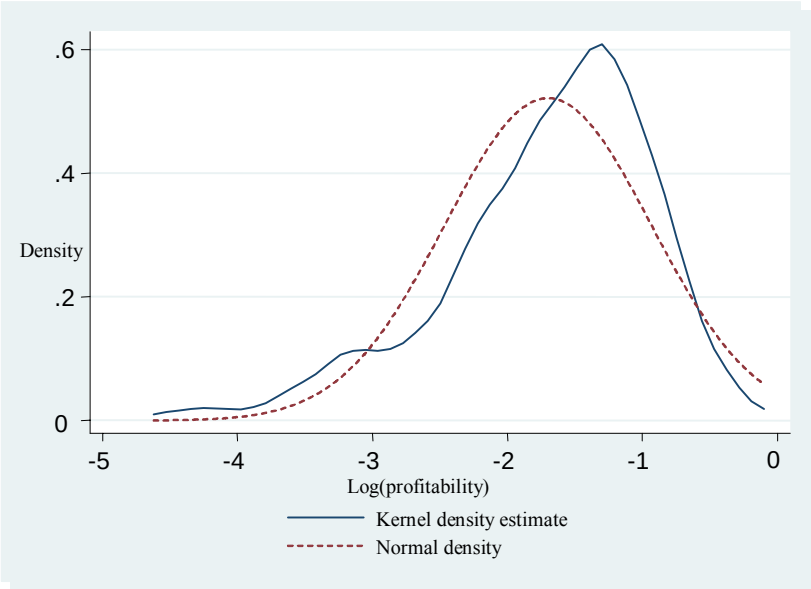

Figure A3: Indigenous innovators

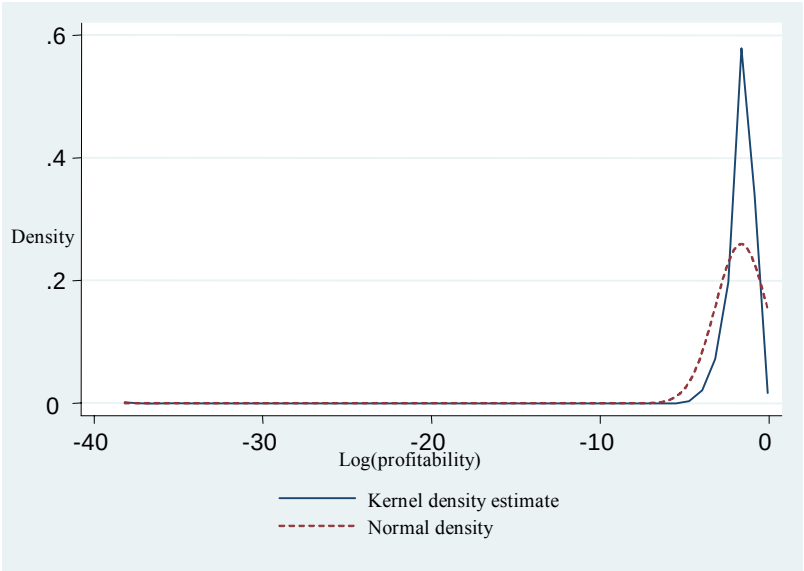

Figure A4: Externally-owned plants

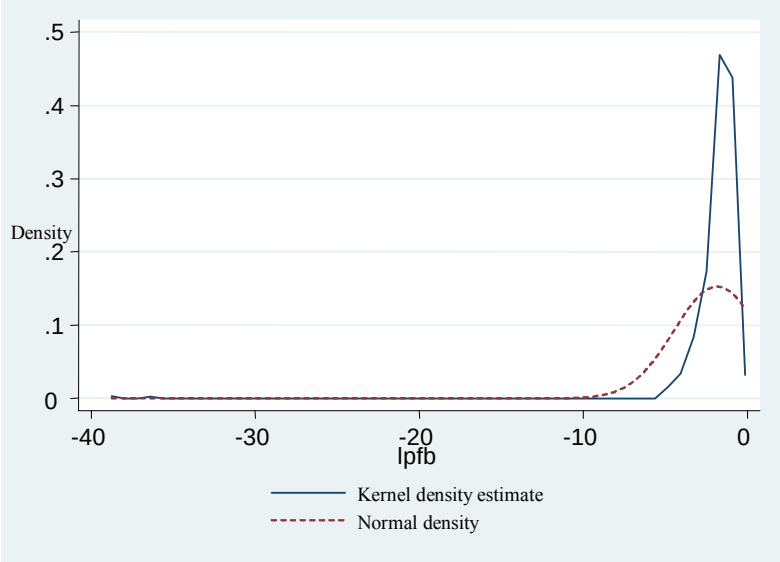

Table A1: test statistics

	All plants	Indigenous non-innovators	Indigenous innovators	Externally-owned
mean	-1.72812	-1.700074	-1.657758	-1.866473
median	-1.51676	-1.544899	-1.504077	-1.520675
std dev	1.836422	0.7652626	1.536543	2.614199
Skewness	-16.136	-0.9611405	-18.41698	-12.17776
Kurtosis	315.6822	3.903376	433.4762	166.7301
Observation	1410	263	725	422
Skewness/Kurtosis tests (D'Agostino et al, 1990) for Normality				
Pr(Skewness)	0.000	0.000	0.000	0.000
Pr(Kurtosis)	0.000	0.000	0.015	0.000
Shapiro-Francia (Shapiro and Francia, 1972) W' test for normal data				
P-value	0.00001	0.00001	0.00001	0.00001

Table A2: Correlation between HHI and industrial dummies.

Key: **spearman correlation coefficient ;sig.level, p-value**	**HHI**	**Industry 1**	**Industry 2**	**Industry 3**	**Industry 4**	**Industry 5**	**Industry 6**	**Industry 7**	**Industry 8**	**Industry 9**
HHI	1									
Industry 1	-0.057	1.000								
	0.010									
Industry 2	0.347	-0.199	1.000							
	0.000	0.000								
Industry 3	0.354	-0.131	-0.099	1.000						
	0.000	0.000	0.000							
Industry 4	-0.383	-0.167	-0.126	-0.083	1.000					
	0.000	0.000	0.000	0.000						
Industry 5	-0.226	-0.141	-0.106	-0.070	-0.089	1.000				
	0.000	0.000	0.000	0.002	0.000					
Industry 6	0.212	-0.172	-0.129	-0.086	-0.109	-0.092	1.000			
	0.000	0.000	0.000	0.000	0.000	0.000				
Industry 7	0.212	-0.172	-0.129	-0.086	-0.109	-0.092	1.000	1.000		
	0.000	0.000	0.000	0.000	0.000	0.000	0.000			
Industry 8	-0.193	-0.221	-0.166	-0.110	-0.140	-0.118	-0.144	-0.144	1.000	
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
Industry 9	0.292	-0.107	-0.080	-0.053	-0.068	-0.057	-0.070	-0.070	-0.089	1.000
	0.000	0.000	0.000	0.017	0.003	0.011	0.002	0.002	0.000	

Industry 1 - 9 refer to: Food and beverage; Textiles, textile products, leather and footwear; Wood and products of wood and cork; Pulp, paper, paper products, printing and publishing; ,Chemical, rubber, plastics and fuel products; Basic metals and fabricated metal products; Machinery and equipment; Electrical and optical equipment; Transport equipment.