Innovation and Productivity in Services:

Evidence from Germany, Ireland and the United Kingdom[1]

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Abstract

We examine the links between innovation investment, innovation output and productivity in service enterprises. For this purpose, we use micro data from the Community Innovation Surveys 2006-2008 in Germany, Ireland, and the United Kingdom and estimate an augmented structural model which links innovation inputs, innovation outputs and productivity. Our estimates suggest that innovation in service enterprises was linked to higher productivity. In all three countries analysed, amongst the innovation types that we consider, the strongest link between innovation and productivity was found for marketing innovations. Successful innovation in service enterprises appears to be associated with size, innovation expenditure intensity (in Germany and the United Kingdom), foreign ownership (Ireland), exporting and engagement in co-operation for innovation activities. The determinants of innovation in service enterprises appear remarkably similar to the determinants of innovation in manufacturing enterprises.

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1 Introduction

Innovation is of crucial importance for growth and competitiveness in the context of intensified global competition. Understanding determinants of enterprise innovation and productivity is important for designing effective innovation policies. Services account for a growing share of advanced economies and innovation in services is widely seen as a new source of economic growth. Furthermore, technological advances, particularly in information and communication technologies (ICT) have enabled a greater tradability of services and thus a greater exposure to competition. In this context, innovation in services has become increasingly important for survival and sustainable economic growth.

Notwithstanding this growing importance of services in modern economies, existing empirical evidence on innovation in services is still limited.

To fill this gap, this paper examines the links between investment in innovation, innovation outputs and productivity in service enterprises. More specifically, we ask the following research questions: (i) Which types of enterprises are more likely to invest in innovation? (ii) Which types of enterprises have higher innovation investment per employee? (iii) Which types of enterprises are more successful in translating innovation investment into innovation outputs? (iv) Is innovation linked to higher productivity? For this purpose, we use micro data from the Community Innovation Surveys 2006-2008 in Germany, Ireland, and the United Kingdom and estimate an augmented structural model which links innovation inputs, innovation outputs and productivity. To identify possible specific features of innovation in services, we compare these results with results for manufacturing enterprises.

Our estimates suggest that innovation in service enterprises was linked to higher productivity, also when we take into account other enterprise and industry characteristics. In all three countries analysed, the strongest link between innovation and productivity was found for marketing innovations. Successful innovation in service enterprises appears to be associated with size, innovation expenditure intensity (in Germany and the United Kingdom), foreign ownership (Ireland), exporting and engagement in co-operation for innovation activities.

The rest of this paper is organised as follows. Section 2 discusses the analytical framework that underpins our analysis. Section 3 discusses our empirical methodology. Section 4 describes the data sets and summary statistics. Section 5 presents the empirical results. Finally, Section 6 summarises the key findings and considers policy implications.

2 Analytical Framework

To answer our research questions, we draw on four literature strands: (i) endogeneous growth; (ii) industrial organization; (iii) innovation systems; and (iv) international trade with heterogeneous firms.

The *endogeneous growth* literature (Romer, 1990; Grossman and Helpman 1990; Griliches, 1996; Aghion and Howitt, 1992) has established that technological change is endogenous and that private R&D investment and knowledge spillovers affect productivity growth. The point of departure of the theories of endogeneous growth is the fact that knowledge possesses two related characteristics: (i) knowledge is non-rival (the marginal costs for an additional technology user is negligible); (ii) knowledge is partially non-excludable due to imperfect intellectual property protection which implies that the return to investments in knowledge/innovation is partly private and partly public (social).

Existing empirical evidence at enterprise and industry levels suggests that social rates of return to R&D/innovation investment are higher than the private rates of return (Griliches, 1992; Hall et al. 2010). Jones and Williams (1998) relate the theoretical models of new growth theory to empirical results of the productivity literature and show that these results can be taken as lower bounds for the social rate of return to R&D.

A key policy message of this literature is that given the presence of knowledge spillovers and other market failures in the innovation process, there is a role for government intervention to incentivise investment in innovation.

The importance of technological change and innovation for economic growth was largely ignored until the writings of Schumpeter (1942). In addition to linking technological change to economic growth, he argued that large enterprises operating in concentrated markets are more likely to innovate. Following on from Schumpeter's contribution, the literature on *industrial organisation* has focused on the relationships between enterprise size, market structure and innovation (measured by R&D expenditures or patents) and neglected other determinants of technological change and innovation (Cohen, 2010).

The arguments most often made for a positive relationship between enterprise size and innovation are as follows (Cohen and Levin, 1989, Symeonidis, 1996, Ahn, 2002):

- *Economies of scale in R&D*: the returns to investment in R&D are higher for enterprises with a large volume of sales over which to spread the fixed costs of innovations;

- *Economies of scope in R&D*: large enterprises are likely to be more diversified and to be able to benefit from positive spillovers between the various research programmes;
- *Diversification of risks*: large enterprises can undertake several projects at the same time and hence diversify the risks associated with R&D investment;
- *Availability and stability of external and internal funds:* large enterprises with market power are more likely to secure finance for risky R&D.

However, as enterprises grow large, efficiency losses with respect to performing R&D might occur, in particular from losing managerial control and diminished ability of innovators to appropriate the benefits from their innovative efforts (Cohen and Levin, 1989).

Many empirical studies have interpreted Schumpeter's argument about the advantage of size for innovation as a hypothesis that innovative activity increases more than proportionately with enterprise size and have tested the relationship between measures of innovative activity and enterprise size. However, Schumpeter (1942) did not claim that a continuous relationship exists between enterprise size and performing R&D. Rather, he noted the qualitative differences between innovation activities of small entrepreneurial enterprises and large corporations with formal R&D laboratories (Cohen, 2010).

With respect to the relationship between market power and innovation, Schumpeter's view can be summarised as follows (Cohen and Levin, 1989; Ahn, 2002):

- *Ex ante* market power favours innovation: with imperfect capital markets, the rents from market power provide enterprises with internal financial resources for innovative activities;
- Incentives to invest in R&D are linked to expected *ex post* market power.

Empirical evidence on the relationship between market concentration and innovation is mixed with most recent studies suggesting that this relationship is non-linear and that market structure is influenced by innovation (Cohen and Levin, 1989; Geroski and Pomroy, 1990; Sutton, 1996, 1998;) rather than being exogenous (an independent determinant) as often assumed in earlier studies.

More recent studies have considered additional enterprises and industry characteristics, beyond enterprise size and market concentration, in explaining innovation activity.[2]

The main contribution of the literature on *innovation systems* (Freeman, 1987; Lundvall, 1992; Nelson, 1993) is the finding that, at the national aggregate level, innovation is the result of interactions between enterprises and institutions at the micro level which are governed by both

[2] A recent review of this literature is Cohen (2010).

market forces and non-market institutions. Five main insights on innovation have emerged from this literature (Soete, et al. 2010): (i) the role of non-R&D inputs in determining innovation; (ii) the role of institutions and organisations; (iii) the role of interactive learning; (iv) the role of interactions between agents involved in innovation; (v) the role of social capital.

The efficiency of the innovation system depends on the performance of individual actors and the institutions that govern their interactions. The main policy message of this literature is the central role the government can play as a co-ordinating agent to correct systemic failures. One policy limitation of this national innovation system concept is its failure to take account of the growing internationalisation of R&D and innovation and in relation to this of the need to consider the international context in which innovation takes place.

The most recent *international trade theory* (New-New Trade Theory[3]) has established that enterprises with international linkages are more productive than enterprises serving only the domestic markets. Existing empirical evidence indicates that enterprises with international linkages (exporters, importers and multinational firms) differ systematically from enterprises that serve only the national market.[4] They are larger, generate higher value added, employ more capital per worker, have higher skilled workers and have higher productivity.

A large empirical literature has established that exporters are more productive than non-exporters and they often have higher productivity growth.[5] This productivity advantage of exporters could be explained by two hypotheses (Bernard and Jensen, 1999; Bernard and Wagner, 1997: (i) more productive enterprises self-select into export markets; (ii) learning-by-exporting. Self-selection of more productive enterprises into export markets can be explained by the presence of fixed and variable costs of exporting (Melitz, 2003). The presence of these costs implies that only enterprises with a productivity level above a critical threshold find it profitable to export. Exporting could make enterprises more productive through two channels: (i) export starters could improve their post-entry performance due to knowledge flows from international buyers; (ii) international competition may put pressure on exporters to improve their productivity faster than firms selling only in domestic markets. Helpman et al. (2004) show that in the presence of fixed costs of exporting and of undertaking foreign direct investment, multinationals are the most productive enterprises in their country of origin, followed by domestic exporters.

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3 New-new trade theoretical models have been introduced by Melitz (2003) and Helpman et al. (2004).

4 Recent micro-econometric evidence has been surveyed by Helpman (2006), Greenway and Kneller (2007) and Wagner (2007).

5 Wagner (2007) and Martins and Yang (2009) surveyed recent empirical studies.

A growing empirical literature has focused on the links between importing and productivity and found that importers are more productive than firms that do not trade internationally.[6] Enterprises that export and import are more productive than enterprises that import only and enterprises that export only, or do not trade internationally. Importers are the next most productive group followed by exporters. Enterprises serving only the domestic markets come last. The theoretical explanations for the productivity advantage of importers are similar as in the case of exporters: self-selection of more productive firms into imports and learning-by-import effects (Kasahara and Lapham, 2008; Andersson et al, 2008; Castellani et al., 2010).

While this literature has assumed that enterprise productivity is exogeneous, more recent theoretical contributions allow for the possibility of enterprises increasing their productivity through innovation activities (Yeaple, 2005; Bustos, 2011). A positive correlation between exporting and innovation activity has been found in several studies (Wagner, 1996; Roper and Love, 2002). In addition, a number of recent empirical studies have found that exporters are more likely to introduce product innovation (Liu and Buck, 2007; Salomon and Shaver, 2005; Bratti and Felice, 2010). Furthermore, additional recent empirical evidence suggests that foreign-owned enterprises and exporters are more likely to innovate (Criscuolo et al. 2010; Siedschlag et al. 2010).

In summary, bringing together these literatures, the analytical framework that results allows us to think of innovation as a complex and non-linear process which is the result of many interactions between enterprises and institutions including government. Innovation takes place in the context of increased internationalisation of economic activities including a growing internationalisation of R&D and innovation activities. Furthermore, this analytical framework highlights the rationale for government intervention to foster innovation and productivity in enterprises. However, the cost of government intervention needs also to be taken into account when policy choices about allocation of scarce public financial resources are made.

3 Empirical Methodology

To analyse the relationships between innovation investment, innovation outputs and productivity we estimate an augmented version of the widely used structural model proposed by Crepon, Duguet and Mairesse (1998), known as the CDM model. The CDM model estimates three sets of relationships. The first set consists of two equations relating to the innovation investment phase, namely the propensity of enterprises to invest in innovation and the innovation expenditure intensity (innovation expenditure per employee) conditional on innovation investment. The second set relates the various types of innovation outcomes to innovation expenditure intensity and other

[6] Vogel and Wagner (2010) review this new and growing empirical literature.

enterprise and industry characteristics. The third set links productivity to innovation outcomes and other enterprise characteristics. The CDM model allows us to address two econometric issues. First, selection bias might arise due to the fact that a number of questions are asked in surveys only to innovative enterprises and this set of enterprises might be non-random. Second, innovation inputs, innovation output and productivity might be simultaneously determined. These econometric issues are corrected for using appropriate estimation techniques.[7]

We estimate an augmented version of the original CDM model which includes additional explanatory variables suggested by the analytical framework that we discuss in Section 2. More specifically, we add variables measuring international trade and investment activities of enterprises and engagement in co-operation for innovation activities within national innovation systems.

We describe below in more detail this augmented version of the CDM model that we estimate in this paper.

The Innovation Investment Equations

This stage of the model comprises two equations which explain in turn the firms' decision to invest/not invest in innovation and, if investing, the amount of innovation expenditure per employee. We only observe the innovation expenditure reported by innovative firms. To the extent that this group of firms is not random, this implies a possible selection bias. To account for this potential bias, the propensity of firms to invest in innovation is modelled by the following selection equation:

$$y_i = \begin{cases} 1 \;\; if \;\; y_i^* = x_i\gamma + u_i > \tau \\ 0 \;\; if \;\; y_i^* = x_i\gamma + u_i \leq \tau \end{cases} \qquad (1)$$

y_i is an observed binary variable which equals one for firms engaged in innovation investment and zero for the rest of the firms. Firms engage in innovation and/or report innovation expenditure if y_i^* ,an unobserved latent endogenous variable, measuring the propensity to innovate, is above a certain threshold level τ . x_i is a vector of variables explaining the innovation decision, γ is the vector of parameters and u_i is the error term.

Conditional on investing in innovation, the amount of innovation expenditure per employee (w_i) is given by the following equation:

[7] Selection bias is corrected by using a Heckman two-step estimator. To correct for simultaneity, innovation output and productivity are estimated using the expected (predicted) values of innovation input and innovation output respectively.

$$w_i = \begin{cases} w_i^* = z_i\beta + \omega_i, \ \ if \ y_i = 1 \\ 0 \ \ if \ \ y_i = 0 \end{cases} \quad (2)$$

w_i^* is an unobserved latent variable, z_i is a vector of firm characteristics and ω_i is an error term.

The Equations (1) and (2) are estimated simultaneously using a Heckman two-step estimator. Enterprise size is excluded in equation (2); identification is not solely dependent on functional form.

The Innovation Output Equations

This second stage of the model explains the innovation outcomes given by the following innovation production function:

$$g_i = w_i^*\alpha + h_i\delta + e_i \quad (3)$$

where g_i is innovation output proxied by product, process, organisational, and marketing innovation indicators. w_i^* is the predicted innovation expenditure per employee estimated from the selection model. These values are predicted for all firms and not just the sample reporting innovation expenditure. By using the predicted rather than observed values of innovation effort w_i, we account for the possibility that innovation expenditure per employee and the innovation outputs could be simultaneously determined. The (1) selection and (2) innovation expenditure intensity equations correct for this endogeneity in this instrumental variables approach. The three digit industry dummies included in estimating (1) and (2) are excluded in estimating (3); instead we use two digit industry dummies in estimating (3) (statistical tests validate these exclusion restrictions). h_i is a vector of other determinants of innovation output, α and δ are the parameter vectors and e_i is the error term.

The Output Production Equation

The last stage of the model explains output production as a function of labour, capital, and innovation outcomes as follows:

$$p_i = k_i\lambda + g_i\mu + \nu_i \quad (4)$$

p_i is labour productivity (log of sales per employee), k_i is the log of physical capital per worker and g_i denotes innovation outcomes (product, process, organisational, and marketing innovation), ν_i is the error term and λ and μ are vectors of parameters. To correct for the fact that productivity and innovation output could be simultaneously determined, predicted innovation output probabilities

estimated in the previous stage (3) are used for g_i. (The cooperation variables included in estimating (3) function as exclusion restrictions.)

4 Data and Summary Statistics

We use data from the Community Innovation Surveys (CIS) 2008 from Germany, Ireland and the United Kingdom. The data sets cover enterprises with more than 10 employees over the period 2006-2008. The core variables include innovation expenditures (in-house R&D expenditure, purchase of external R&D, spending on acquisition of machinery, equipment and software, acquisition of other external knowledge); innovation outputs (indicators for product, process, organisational, marketing innovation); engagement in co-operation for innovation activities (with other enterprises within same enterprise group; with suppliers of equipment, materials, components or software; with clients or customers; with competitors or other enterprises in the same sector; with consultants, commercial labs or private R&D institutes; with universities or other higher education institutions; with government or public research institutes). In addition, we use data on employment, ownership, exporting and industry affiliation. We focus on market services including the following sectors: wholesale trade; transport, storage and communications; financial services; computer and related activities; and other business activities. In total, our sample consist of 1,333 German, 1,286 Irish and 4,344 British service enterprises.

Table 1 shows weighted summary statistics[8] for service enterprises for the main variables, for all enterprises and separately for three types of enterprises: foreign-owned, domestic-exporters, and domestic non-exporters. This distinction is motivated by the fact that, as discussed in Section 2, enterprises with international activities differ systematically from those serving only domestic markets.

[Table 1 about here]

With respect to the types of service enterprises, in the samples for Germany and the United Kingdom, over two thirds of all enterprises serve only the domestic market, while in Ireland enterprises with international activities (foreign owned and domestic exporters) represent half of the sample. This is not surprising given the smaller size and higher openness of the Irish economy. Foreign owned enterprises have a much larger share in Ireland (18.6 per cent) in comparison to Germany (3.1 per cent) and the UK (8.3 per cent), while domestic exporters account for about one third of all enterprises in the three countries. It appears that the average size of service enterprises is

[8] For comparability purposes, these summary statistics are weighted to correct for the stratification of the CIS sample by size class, industry and region.

higher in the UK (86 employees) than in Germany (50.5 employees) and Ireland (50.4 employees).[9] Foreign owned service enterprises are larger in the UK (171 employees) compared to Germany (119 employees) and Ireland (90.3 employees). Further, domestic exporters in the UK are much larger (116 employees) compared to domestic exporters in Germany (45 employees) and in Ireland (47 employees). The average size of service enterprises that serve domestic markets only is again larger in the UK (61 employees) in comparison to Germany (50 employees) and Ireland (38 employees). Against this size background, average labour productivity (sales per employee) in Ireland is 3.7 times higher than in Germany and 2.3 times higher than in the United Kingdom. Total average innovation expenditure per employee (across enterprises) in Ireland is also higher than in Germany (2.3 times higher) and the UK (9 per cent higher). However, while 51 per cent of service enterprises in the UK report innovation expenditures, the corresponding figures for Germany and Ireland are lower (37 per cent and 26 per cent, respectively). The average R&D expenditures are the highest in the UK (4 times higher than in Germany and 35 per cent higher than in Ireland). While 28 per cent of service enterprises in the UK reported R&D expenditures, the corresponding shares for Germany and Ireland are half of that share.

The predominant type of innovation in service enterprises appears to be organisational innovation in Ireland and the UK and marketing innovations in Germany (however, the share of service enterprises with organisational innovations is only slightly lower in Germany). Organisational innovation appears to be the dominant innovation type in foreign owned service enterprises in all countries (in Ireland the share of service enterprises with product innovations appears equally important). Product innovation appears the most prevalent innovation type amongst domestic exporters in Germany and the UK (organisational innovation appears equally important), while in Ireland, organisational innovation is the most common type of innovation amongst domestic exporters. In the case of service enterprises serving domestic markets only, organisational innovations appear the most important (in Germany, marketing innovation appears equally important).

The patterns of engagement in co-operation for innovation activities differs in the three countries, with the highest engagement rates reported for the UK. The highest engagement rates in all three countries are reported for co-operation with suppliers and co-operation with clients or customers. For example, while on average 25 per cent of enterprises in the UK reported engagement in co-operation for innovation with clients and customers, the corresponding rates for Germany and Ireland were 2 per cent and 5 per cent respectively.

[9] The sampling unit in the UK is the establishment rather than the enterprise (the vast majority of establishments are in single establishment enterprises).

For comparison purposes Table 2 shows weighted summary statistics for enterprises in manufacturing in Germany, Ireland and the UK.

[Table 2 about here]

In all three countries enterprises with international activities represent around 60% of enterprises included in the sample (61% in the cases of Germany and Ireland and 56 per cent in the UK). The average size of manufacturing enterprises is more similar than in the case of service enterprises: it is the largest in Germany (80 employees) and the lowest in the UK (64 employees) while Ireland lies in the middle position (72 employees). Ireland leads again with respect to average labour productivity in all enterprises and in each of the three types of enterprises. In the case of foreign owned enterprises, labour productivity is two times higher than in Germany and 2.5 times higher than in the UK.

The average innovation expenditure per employee is the highest in Germany for all enterprises. However, Ireland stands out with the highest average innovation expenditure per employee in foreign owned manufacturing enterprises about 3.5 times higher than in the UK and two times higher than in Germany. In contrast, Germany stands out with the highest innovation expenditure per employee in enterprises that serve only the domestic market. It turns out to be 4.6 times higher than in Ireland and about 3 times higher than in the UK. Average R&D expenditure per employee is the highest in Ireland for all manufacturing enterprises and for manufacturing enterprises with international activities (foreign owned and domestic exporters), while average R&D expenditures per employee in manufacturing enterprises that serve only domestic markets are the highest in Germany.

A striking result that emerges from the statistics is that the predominant innovation type in manufacturing enterprises is different in the three analysed countries: marketing innovations in Germany, process innovations in Ireland and product innovations in the UK. However, in all three countries, product innovation is the dominant innovation type in foreign owned manufacturing enterprises. Product innovation is also the dominant innovation type for domestic exporters as well as domestic non-exporters in manufacturing in the UK, while in Ireland the predominant innovation type is process innovation for Irish owned exporters and non-exporters and in Germany, marketing innovations are the most wide spread innovation type for German owned enterprises. In the case of German owned exporters product innovations are equally important. Organisational innovation, the most prevalent innovation activity in services, appears less important in manufacturing.

As in the case of service enterprises, among the three analysed countries, the UK has the highest rates for engagement in co-operation for innovation activities. In the UK the highest rates were for

engagement in co-operation for innovation activities with clients or customers (30.5 per cent of all manufacturing enterprises), while in Germany and Ireland, the highest rates were for co-operation with suppliers of equipment, materials, components or software (6.3 per cent and 8.4 per cent respectively).

5 Empirical Results

Tables 3 to6 show the estimates of the augmented CDM model for innovation and productivity in service enterprises in Germany, Ireland and the UK over the period 2006-2008.

Table 3 presents the estimates of the Heckman two–stage model of innovation investment. The propensity to invest in innovation (first stage) is estimated by a probit model as a function of enterprise size (measured as the log of number of employees), ownership (a dummy variable which takes the value one for foreign owned enterprises and zero otherwise), exporting (a dummy which takes the value one for domestic exporters and zero otherwise) and industry specific effects (industry dummies at 3-digit NACE Rev. 1 classification). The innovation expenditure intensity is measured as innovation expenditure per employee and it is estimated as a function of ownership, exporting, and industry specific effects. Following Griffith et al. (2006) we use firm size as exclusion restriction in the innovation investment equation. As the innovation intensity is already scaled by size, this implies that we assume a proportional relationship between the amount of innovation expenditure and firm size.

The figures shown in Table 3 are marginal effects.

[Table 3 about here]

Our results indicate that service enterprises that invested in innovation were more likely to be large enterprises, and enterprises with exporting markets. In Germany and the UK, innovation expenditure intensity was significantly higher for domestic service enterprises with export markets, than for domestic non-exporters and foreign owned firms while in Ireland foreign-owned enterprises had a significantly higher innovation expenditure intensity. In the UK, both foreign-owned enterprises and domestic exporters show significantly higher innovation intensity than domestic non-exporters.

Table 4 shows the estimates for product innovation in the three analysed countries. In addition to the indicator for product innovation, it distinguishes between product innovations that are new to the market (market novelties) and those new to the enterprise but not new to the market (firm novelties). The dependent variable is a categorical variable which takes the value one if product innovation was reported and zero otherwise. The explanatory variables include the innovation expenditure intensity predicted on the basis of the innovation investment equations, size,

ownership, exporting, engagement in co-operation for innovation activities (dummy variables equal to one if co-operation was reported and zero otherwise) and industry specific effects (industry dummies at 2 digit level NACE Rev. 1 classification[10]).

[Table 4 about here]

The results shown in Table 4 highlight that higher innovation expenditure intensity significantly increases the likelihood of successfully introducing product innovations in services. (this result does not hold in Ireland). The probability to implement product innovations is also higher for large enterprises, (not valid in the case of UK), and enterprises with exporting markets. In Ireland foreign owned enterprises were more likely to successfully implement product innovations, in particular market novelties. Service enterprises with successful product innovation were more likely among those engaged in co-operation for innovation with other enterprises within the same enterprise group, with suppliers (Ireland and the UK), with customers (Germany and the UK), with universities (Germany), and with public research labs (the UK). Co-operation with science (universities in Germany or public research labs in the UK) turns out to matter particularly for introducing market novelties in services.

Table 5 shows the results of the probit model for other innovation outputs, namely process, organisational and marketing innovations in service enterprises in the three countries analysed. The dependent variables in the probit models are categorical variables which take the value 1 if the respective innovation output was reported, and 0 otherwise.

[Table 5 about here]

As shown in Table 5, process innovation in service enterprises was more likely in larger enterprises, in enterprises with higher innovation expenditure intensity (Germany and the UK), in foreign-owned and exporting enterprises (in Ireland). Over and above these enterprise characteristics, successful process innovation was positively linked to engagement in co-operation for innovation activities with other enterprises (Germany and the UK), with suppliers (Ireland and the UK), with customers (Germany and Ireland) and with consultants and universities (Ireland). In contrast, in the sample analysed, in the UK, service enterprises with co-operation with competitors, and in Ireland those with co-operation with public research labs were less likely to introduce process innovations.

Further, our results indicate that organisational innovation in service enterprises was more likely in larger enterprises, in enterprises with higher innovation expenditure intensity (Germany and the

[10] The industry dummies are at 2 digit level NACE Rev. 1 classification to ensure the identification of the determinants of innovation outputs, as we used 3-digit industry dummies in the innovation expenditure intensity equation. Wald tests validate the exclusion of three digit industry dummies.

UK), in foreign owned enterprises (Ireland and the UK), and domestic exporters (Ireland). Over and above these characteristics, successful implementation of organisational innovation in service enterprises was positively linked to co-operation in innovation activities with other enterprises within the same enterprise group (Germany and the UK), and with suppliers and with customers (Ireland and the UK). In contrast, in Germany, service enterprises that cooperated with public research institutes were less likely to implement successfully organisational innovations.

Finally, Table 5 indicates that marketing innovation in service enterprises was more likely amongst enterprises with higher innovation expenditure per employee, larger enterprises (Germany and Ireland), and domestic exporters (Ireland). Over and above these enterprise characteristics, successful implementation of marketing innovations was positively linked to co-operation with other enterprises within the same enterprise group (Germany), with suppliers (Ireland and the UK), with customers (the UK), and with universities (Germany).

Table 6 shows the estimates of the productivity equation for service enterprises in the three countries analysed. The dependent variable is log(turnover/employee). The explanatory variables include the predicted probability to innovate successfully (to implement product, process, organisational or marketing innovations), enterprise size, ownership, and exporting. Unfortunately, the CIS data does not contain data on physical capital in all countries. We control for differences in capital endowment by including industry dummies at 3 digit level (NACE Rev. 1 classification). The productivity equation for Germany also includes a dummy variable which is equal to 1 for enterprises located in East Germany since even 20 years after reunification there is a productivity gap between firms in West and East Germany.

[Table 6 about here]

Innovative service enterprises had higher productivity. This positive link is evident for all types of innovation in Germany and the UK; in Ireland innovation is also positively correlated with productivity, but is statistically significant only in the cases of process and marketing innovations. In all three countries the strongest link between innovation and productivity is found for marketing innovation (productivity elasticity with respect to marketing innovation was 0.32 in Germany, 0.77 in Ireland and 0.07 in the UK).

Although our main interest is innovation in service enterprises, given the dearth of evidence, we also consider innovation in manufacturing enterprises for the sake of comparison. Tables 7 to 10 show the estimates for innovation and productivity in manufacturing enterprises in Germany, Ireland, and the UK.

Table 7 shows the results for the innovation investment equations.

[Table 7 about here]

Our results indicate that, in all three countries, manufacturing enterprises which were more likely to invest in innovation were those which were larger, foreign owned and those with export markets. In Ireland and the UK, foreign owned and domestic exporters had the highest innovation expenditure intensity, while in Germany innovation expenditure intensity was positively associated with human capital and training.[11]

Table 8 shows the results for the product innovation in manufacturing enterprises.

[Table 8 about here]

In all three countries the probability to implement product innovations is higher in domestic manufacturing enterprises with exporting markets. In Germany and Ireland larger enterprises and foreign owned enterprises were more likely to have product innovations. This result holds for products new to the market as well as products new to the enterprise but not new to the market. A higher innovation expenditure intensity was positively associated with the probability to have product innovations in Germany (for both market and enterprise product novelties) and the UK (for products new to the market).

Further, our results indicate that manufacturing enterprises engaged in co-operation in innovation activity were more likely to introduce new or significantly improved products. We identify such positive associations in the case of the following co-operation types: co-operation with other enterprises within the same industry (in Germany and the UK), co-operation with supplies (all three countries), co-operation with clients or customers (in all three countries), co-operation with universities (in all three countries), co-operation with public research institutes (in Germany). With the exception of the importance of co-operation with universities, the importance (and type) of co-operation for successful innovation is similar amongst both manufacturing and service enterprises.

Table 9 shows the results for determinants of the other types of innovations, namely, process, organisational and marketing innovations.

[Table 9 about here]

In all three countries analysed, process innovations in manufacturing enterprises were more common in larger enterprises and in domestic enterprises with export markets. In Germany and Ireland, foreign owned enterprises were more likely to introduce process innovations. Innovation

[11] These variables are excluded elsewhere (services and other countries) because these data are not available for Ireland; it was not possible to identify the model for German manufacturing without these additional variables.

expenditure intensity was positively associated with the probability of introducing process innovations in Germany only.

Our results identify a positive link between the propensity to introduce process innovations and engagement in various co-operation types as follows: co-operation with other enterprises in Germany and the UK; co-operation with suppliers in all three countries; co-operation with customers in Germany and the UK; co-operation with consultants and private research laboratories in Ireland. Co-operation with competitors was negatively associated with the introduction of process innovations in the UK.

The propensity to introduce organisational innovations was positively associated with enterprise size and with being a larger domestic exporter in all countries, with foreign ownership- in Ireland and the UK, and with higher innovation expenditure intensity - in Germany. Engagement in co-operation in innovation activities was positively linked to the propensity to introduce organisational innovations as follows: co-operation with other enterprises within the same group – in the UK; co-operation with suppliers- in Ireland and the UK; with clients or customers in Germany and the UK; with consultants - in Germany and the UK; with universities in Germany and Ireland; with public research institutes in Ireland. In Ireland, co-operation with competitors was negatively associated with the propensity to introduce organisational innovations.

The propensity to introduce marketing innovations was higher in domestic manufacturing exporters in all three countries, in foreign owned enterprises and in enterprises with higher innovation intensity expenditure in Germany only. Enterprise size was not significantly associated with the propensity to introduce marketing innovations. Engagement in co-operation for innovation activities was positively associated with the propensity to introduce marketing innovations as follows: co-operation with other enterprises within the same group, with suppliers, with universities – in the UK; co-operation with clients or customers in Germany and the UK; with consultants- in Ireland and the UK. In Ireland, co-operation with public research institutes was negatively associated with the introduction of marketing innovations.

Table 10 shows the estimates for the innovation- productivity link in manufacturing enterprises.

[Table 10 about here]

With respect to the innovation-productivity link, innovative manufacturing enterprises in Germany and the UK had a higher labour productivity. In Ireland, there is also a positive link between innovation and productivity in manufacturing, but it is not statistically significant. The strongest innovation – productivity link was in the case of marketing innovations in Germany and the UK (the productivity elasticity with respect to innovation was 0.32 and 0.08 respectively).

6 Summary and Policy Implications

The predominant innovation types in services are organisational and marketing innovations. In manufacturing, the highest innovation rates vary across the three countries analysed: in Germany, the highest innovation rates are for marketing innovations, in Ireland for process innovation and in the UK for product innovation.

The importance of internationalisation in the context of innovation is apparent in all three countries. For all types of innovations, innovation rates were the highest in enterprises with international activities (foreign-owned and domestic exporters) in Ireland and the UK. In Germany, this is true for foreign-owned firms, while firms serving only the domestic market had higher process and marketing innovation rates compared to domestic exporters.

We find that the determinants of innovation and productivity in service enterprises were similar, in many respects, to the determinants of innovation and productivity in manufacturing enterprises. These findings suggest that service enterprise innovation could benefit from many of the policies that are thought to benefit manufacturing enterprises: policies which enable exporting, and which enhance innovation capability and co-operation in innovation activities with other enterprises and institutions. We also find some differences in the determinants of innovation and productivity between manufacturing and service sector enterprises. Foreign-owned enterprises in manufacturing appear more likely to invest in innovation in comparison to foreign-owned enterprises in services. Engagement in co-operation with universities appears to play a more important role for innovation outputs in manufacturing than in services.

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Table 1. CIS 2008, Services Weighted Sample: Summary Statistics

	Innovators and non-innovators					
Country	Germany	Ireland	UK	Germany	Ireland	UK
Enterprise type	All			Foreign-owned		
	N=1,333	N=1,286	N=4,344	N=84	N=291	N=580
Enterprise characteristics						
Foreign owned (per cent)	3.1	18.6	8.3			
Domestic exporter (per cent)	32.5	31.7	29.2			
Domestic non-exporter (per cent)	64.5	49.7	62.5			
Size (number of employees)	50.5	50.4	86.0	118.9	90.3	171.1
Labour productivity (sales per employee)	242,600	897,863	389,850	1,392,071	3,361,860	2,714,350
Innovation input						
Decision to invest in innovation (per cent)	36.6	25.9	50.7	58.0	28.4	39.3
Total innovation expenditure per employee	2,131.3	4,968.9	4,547	9,433.2	11,032.5	5,036
Decision to invest in R&D (per cent)	14.3	14.6	28.1	29.2	19.6	22.8
R&D expenditure per employee	697	2,094	2,826	2,673	4,858	989
Innovation output						
Product innovation (per cent)	28.6	24.7	30.3	36.6	41.9	37.8
Market novelties (per cent)	9.0	15.1	14.6	18.9	25.5	21.9
Firm novelties (per cent)	25.2	18.1	22.7	33.1	28.7	26.3
Process innovation (per cent)	27.5	29.9	18.8	47.6	41.5	19.1
Organisation Innovation (per cent)	39.1	32.2	32.9	56.7	42.0	42.7
Marketing innovation (per cent)	39.3	26.5	24.4	53.7	29.8	24.8
Innovative turnover share (per cent)	6.2	6.9	11.6	9.5	10.4	13.1
Innovative turnover share (new to market, per cent)	1.1	3.2	2.6	2.5	5.4	2.4
Innovative turnover share (new to firm, per cent)	5.1	3.7	4.0	6.9	5.0	3.7

Notes: Innovators are enterprises that report having at least one of the following types of innovation; product, process, organisational or marketing innovation. Firms reporting no innovation are considered non-innovators. Types of firms include: foreign-owned firms (as indicated in the original survey), domestic exporters (non-foreign-owned firms that export) and domestic non-exporters (firms that serve domestic markets only). The samples are weighted by number of firms stratified by size class, industry and region. UK figures converted from £ to € using the exchange rate 1.2588.

Table 1 (ctd.). CIS 2008, Services Weighted Sample: Summary Statistics

	Innovators and non-innovators					
Country	Germany	Ireland	UK	Germany	Ireland	UK
Enterprise type		Domestic exporters			Domestic non-exporters	
	N=354	N=404	N=1,193	N=895	N=591	N=2,571
Enterprise characteristics						
Size (number of employees)	45.1	47.3	116.1	50.0	37.5	60.6
Labour productivity (sales per employee)	324,412	384,241	225,500	146,925	302,815	103,700
Innovation input						
Decision to invest in innovation (per cent)	41.6	36.6	60.9	33.0	18.1	47.4
Total innovation expenditure per employee	2,853	6,062	7,353	1,422	2,003	1,672
Decision to invest in R&D (per cent)	15.3	22.9	43.0	13.0	7.4	21.8
R&D expenditure per employee	900.0	3,075.8	6,401.0	500.4	433.5	494.0
Innovation output						
Product innovation (per cent)	42.1	32.6	41.7	21.4	13.3	24.1
Market novelties (per cent)	14.5	22.8	20.3	5.8	6.4	10.9
Firm novelties (per cent)	36.3	23.0	32.0	19.3	11.1	17.8
Process innovation (per cent)	22.6	36.5	26.9	29.0	21.4	15.0
Organisation Innovation (per cent)	38.5	42.9	40.5	38.5	21.7	28.0
Marketing innovation (per cent)	37.8	35.4	29.5	39.3	19.5	22.0
Innovative turnover share (per cent)	9.2	9.6	16.3	4.5	3.8	9.3
Innovative turnover share (new to market, per cent)	1.5	4.9	3.3	0.8	1.3	2.3
Innovative turnover share (new to firm, per cent)	7.8	4.7	6.1	3.7	2.5	3.1

Notes: Innovators are enterprises that report having at least one of the following types of innovation; product, process, organisational or marketing innovation. Firms reporting no innovation are considered non-innovators. Types of firms include: foreign-owned firms (as indicated in the original survey), domestic exporters (non-foreign-owned firms that export) and domestic non-exporters (firms that serve domestic markets only). The samples are weighted by number of firms stratified by size class , industry and region. UK figures converted from £ to € using the exchange rate 1.2588.

Table 1 (ctd.) CIS 2008, Services Weighted Sample: Summary Statistics

	Innovators and non-innovators					
Country	Germany	Ireland	UK	Germany	Ireland	UK
Enterprise type		All			Foreign-owned	
	N=1,333	N=1,256	N=4,344	N=84	N=288	N=580
Engagement in cooperation for innovative activity						
Cooperation with other enterprises within the same enterprise group (per cent)	2.5	4.9	17.0	9.4	14.6	33.1
Cooperation with suppliers (per cent)	2.5	5.7	20.9	6.3	8.6	26.6
Cooperation with clients or customers (per cent)	2.0	5.4	25.4	3.8	8.8	36.0
Cooperation with competitors (per cent)	1.2	2.8	11.4	0.1	4.5	14.7
Cooperation with consultants, commercial labs or private R&D institutions (per cent)	2.1	2.9	9.3	1.1	4.7	10.8
Cooperation with universities or other higher education institutes (per cent)	2.0	3.3	8.1	6.3	5.1	10.5
Cooperation with government or public research institutes (per cent)	0.4	1.8	8.1	0.0	2.4	8.6

Notes: Innovators are enterprises that report having at least one of the following types of innovation; product, process, organisational or marketing innovation. Firms reporting no innovation are considered non-innovators. Types of firms include: foreign-owned firms (as indicated in the original survey), domestic exporters (non-foreign-owned firms that export) and domestic non-exporters (firms that serve domestic markets only). The samples are weighted by number of firms stratified by size class, industry and region. UK figures converted from £ to € using the exchange rate 1.2588.

Table 1 (ctd.) CIS 2008, Services Weighted Sample: Summary Statistics

	Innovators and non-innovators					
Country	Germany	Ireland	UK	Germany	Ireland	UK
Enterprise type		Domestic exporters			Domestic Non- exporters	
	N=354	N=402	N=1,193	N=895	N=566	N=2,571
Engagement in cooperation for innovative activity						
Cooperation with other enterprises within the same enterprise group (per cent)	2.3	3.1	20.5	2.2	2.3	13.2
Cooperation with suppliers (per cent)	3.6	7.0	26.6	1.7	3.7	17.4
Cooperation with clients or customers (per cent)	3.1	8.3	29.9	1.4	2.3	21.9
Cooperation with competitors (per cent)	1.4	3.3	11.9	1.2	1.8	10.8
Cooperation with consultants, commercial labs or private R&D institutions (per cent)	2.6	4.2	10.2	1.9	1.4	8.7
Cooperation with universities or other higher education institutes (per cent)	2.9	5.6	9.2	1.4	1.0	7.2
Cooperation with government or public research institutes (per cent)	0.9	3.0	8.1	0.2	0.9	8.0

Notes: Innovators are enterprises that report having at least one of the following types of innovation; product, process, organisational or marketing innovation. Firms reporting no innovation are considered non-innovators. Types of firms include: foreign-owned firms (as indicated in the original survey), domestic exporters (non-foreign-owned firms that export) and domestic non-exporters (firms that serve domestic markets only). The samples are weighted by number of firms stratified by size class, industry and region. UK figures converted from £ to € using the exchange rate 1.2588.

Table 2. CIS 2008, Manufacturing Weighted Sample: Summary Statistics

	Innovators and non-innovators					
Country	Germany	Ireland	UK	Germany	Ireland	UK
Enterprise type		All			Foreign-owned	
	N=2,292	N=831	N=2,990	N=257	N=218	N=580
Enterprise characteristics						
Foreign owned (per cent)	6.1	19.2	11.0			
Domestic exporter (per cent)	55.2	41.8	45.4			
Domestic non-exporter (per cent)	38.7	39.0	43.6			
Size (number of employees)	79.5	72.4	64.3	189.2	187.9	177.8
Labour productivity (sales per employee)	150,826	265,215	138,342	323,100	645,548	254,278
Innovation input						
Decision to invest in innovation (per cent)	61.6	40.9	62.4	78.2	55.3	65.1
Total innovation expenditure per employee	6,449	5,932	3,074	7,385	14,289	4,013
Decision to invest in R&D (per cent)	41.1	28.1	42.7	62.4	41.3	53.3
R&D expenditure per employee	2,095	2,462	1,109	3,674	4,681	2,281
Innovation output						
Product innovation (per cent)	46.3	33.9	37.8	63.9	49.6	48.7
Market novelties (per cent)	21.5	19.5	20.8	33.7	31.6	28.8
Firm novelties (per cent)	40.7	25.8	28.2	58.7	33.0	36.4
Process innovation (per cent)	42.0	44.3	20.7	54.2	55.0	24.1
Organisation Innovation (per cent)	42.6	33.2	32.5	57.3	48.7	45.1
Marketing innovation (per cent)	48.3	28.7	19.4	54.6	31.9	24.7
Innovative turnover share (per cent)	12.4	7.9	12.5	14.4	10.4	14.4
Innovative turnover share (new to market, per cent)	3.0	3.4	3.1	3.9	5.3	3.7
Innovative turnover share (new to firm, per cent)	9.4	4.5	4.1	10.5	5.1	4.2

Notes: Innovators are enterprises that report having at least one of the following types of innovation; product, process, organisational or marketing innovation. Firms reporting no innovation are considered non-innovators. Types of firms include: foreign-owned firms (as indicated in the original survey), domestic exporters (non-foreign-owned firms that export) and domestic non-exporters (firms that serve domestic markets only). The samples are weighted by number of firms stratified by size class, industry and region. UK figures converted from £ to € using the exchange rate 1.2588.

Table 2 (ctd.) CIS 2008, Manufacturing Weighted Sample: Summary Statistics

	Innovators and non-innovators					
Country	Germany	Ireland	UK	Germany	Ireland	UK
Enterprise type		Domestic exporters			Domestic non-exporters	
	N=1,467	N=350	N=1,367	N=568	N=263	N=1,043
Enterprise characteristics						
Size (number of employees)	101.2	62.3	63.8	31.3	26.2	36.2
Labour productivity (sales per employee)	164,205.0	198,038.7	144,007.0	104,766.7	149,696.1	102,970.0
Innovation input						
Decision to invest in innovation (per cent)	73.3	52.7	72.3	42.3	21.2	51.4
Total innovation expenditure per employee	6,604	6,381	3,920	6,081	1,328	1,956
Decision to invest in R&D (per cent)	54.9	38.1	56.7	18.1	11.0	25.6
R&D expenditure per employee	2,860	3,420	1,645	756	338	256
Innovation output						
Product innovation (per cent)	56.8	46.5	47.9	28.6	12.7	24.7
Market novelties (per cent)	30.3	26.2	28.1	7.1	6.5	11.1
Firm novelties (per cent)	49.2	37.1	34.7	25.9	10.2	19.4
Process innovation (per cent)	47.6	55.1	23.9	32.0	27.4	16.5
Organisation Innovation (per cent)	47.9	40.5	38.4	32.8	17.7	23.1
Marketing innovation (per cent)	57.0	37.5	21.1	34.9	17.6	16.4
Innovative turnover share (per cent)	15.3	11.5	15.7	8.0	2.7	8.6
Innovative turnover share (new to market, per cent)	4.0	4.7	4.3	1.5	1.1	1.8
Innovative turnover share (new to firm, per cent)	11.3	6.8	4.9	6.5	1.7	3.2

Notes: Innovators are enterprises that report having at least one of the following types of innovation; product, process, organisational or marketing innovation. Firms reporting no innovation are considered non-innovators. Types of firms include: foreign-owned firms (as indicated in the original survey), domestic exporters (non-foreign-owned firms that export) and domestic non-exporters (firms that serve domestic markets only). The samples are weighted by number of firms stratified by size class, industry and region. UK figures converted from £ to € using the exchange rate 1.2588.

Table 2 (ctd.) CIS 2008, Manufacturing Weighted Sample: Summary Statistics

	Innovators and non-innovators					
Country	Germany	Ireland	UK	Germany	Ireland	UK
Enterprise type		All			Foreign-owned	
	N=2,292	N=808	N=2,990	N=257	N=217	N=580
Engagement in cooperation for innovative activity						
Cooperation with other enterprises within the same enterprise group (per cent)	3.8	6.2	17.5	19.0	18.8	41.4
Cooperation with suppliers (per cent)	6.3	8.4	25.8	17.2	13.6	38.1
Cooperation with clients or customers (per cent)	4.5	7.6	30.5	10.6	12.6	43.2
Cooperation with competitors (per cent)	2.2	2.4	10.7	2.5	3.1	11.5
Cooperation with consultants, commercial labs or private R&D institutions (per cent)	2.5	6.7	11.4	2.8	11.7	19.2
Cooperation with universities or other higher education institutes (per cent)	6.9	5.7	9.3	13.9	12.3	15.9
Cooperation with government or public research institutes (per cent)	2.6	4.0	6.7	3.9	3.7	9.7

Notes: Innovators are enterprises that report having at least one of the following types of innovation; product, process, organisational or marketing innovation. Firms reporting no innovation are considered non-innovators. Types of firms include: foreign-owned firms (as indicated in the original survey), domestic exporters (non-foreign-owned firms that export) and domestic non-exporters (firms that serve domestic markets only). The samples are weighted by number of firms stratified by size class, industry and region. UK figures converted from £ to € using the exchange rate 1.2588.

Table 2 (ctd.) CIS 2008, Manufacturing Weighted Sample: Summary Statistics

	Innovators and non-innovators					
Country	Germany	Ireland	UK	Germany	Ireland	UK
Enterprise type		Domestic exporters			Domestic Non- exporters	
	N=1,467	N=350	N=1,367	N=568	N=241	N=1,043
Engagement in cooperation for innovative activity						
Cooperation with other enterprises within the same enterprise group (per cent)	3.7	4.3	18.3	1.4	1.7	10.5
Cooperation with suppliers (per cent)	8.5	10.0	30.0	1.5	3.6	18.3
Cooperation with clients or customers (per cent)	5.6	9.7	36.5	1.8	2.4	21.1
Cooperation with competitors (per cent)	2.5	3.0	11.6	1.7	1.2	9.6
Cooperation with consultants, commercial labs or private R&D institutions (per cent)	3.4	7.6	14.2	1.1	2.9	6.6
Cooperation with universities or other higher education institutes (per cent)	9.4	6.2	11.9	2.2	1.6	4.8
Cooperation with government or public research institutes (per cent)	3.7	6.1	7.8	0.9	1.7	4.8

Notes: Innovators are enterprises that report having at least one of the following types of innovation; product, process, organisational or marketing innovation. Firms reporting no innovation are considered non-innovators. Types of firms include: foreign-owned firms (as indicated in the original survey), domestic exporters (non-foreign-owned firms that export) and domestic non-exporters (firms that serve domestic markets only). The samples are weighted by number of firms stratified by size class, industry and region. UK figures converted from £ to € using the exchange rate 1.2588.

Table 3: Innovation Investment in Service Enterprises, 2006-2008

Country	**Germany**		**Ireland**		**UK**	
	Innovation Investment Equations					
Dependent variable	Propensity to invest in innovation	Intensity of Innovation expenditure per employee	Propensity to invest in innovation	Intensity of Innovation expenditure per employee	Propensity to invest in innovation	Intensity of Innovation expenditure per employee
Estimator	Heckman stage 1	Heckman stage 2	Heckman stage 1	Heckman stage 2	Heckman stage 1	Heckman stage 2
Size (log # emp.)	0.085***	-	0.050***		0.046***	
	(0.012)		(0.011)		(0.006)	
Foreign owned	0.033	0.171	0.049	0.962***	-0.070***	0.375**
	(0.066)	(0.254)	(0.037)	(0.271)	(0.026)	(0.148)
Domestic exporter	0.153***	0.399***	0.165***	0.179	0.093***	0.686***
	(0.035)	(0.118)	(0.032)	(0.233)	(0.018)	(0.099)
Industry fixed effects (3 digit)	Yes	Yes	yes	yes	yes	yes
Constant	Yes	Yes	yes	yes	yes	yes
Observations	1333		1286		4346	
lambda	0.936***		1.5683**		1.828***	
	(0.179)		(0.6055)		(0.139)	
rho	0.627***		0.7421***		0.822***	
	(0.091)		(0.1700)		(0.033)	
Wald test for H0: rho=0	24.31***		6.37**		130.2***	
Wald test (Industry fixed effects)	578.06***		3630.50***		865.59***	
Log-likelihood	-1787.94		-1374.86		-7246.00	

Notes: Marginal effects; robust standard errors; CIS 2006-2008

Table 4: Determinants of Innovation Outputs in Service Enterprises, 2006-2008

Country	Germany			Ireland			UK		
Innovation Output Equation – Product Innovation									
Dependent variable	Product innovation	Market novelties	Firm Novelties	Product innovation	Market novelties	Firm Novelties	Product innovation	Market novelties	Firm Novelties
Estimator	Probit	Probit	Probit	Probit	Probit	Probit	Probit	Probit	Probit
Predicted innovation expenditure	0.083***	0.033***	0.074***	0.040	0.029	0.024	0.055***	0.022***	0.043***
	(0.016)	(0.009)	(0.015)	(0.026)	(0.018)	(0.022)	(0.008)	(0.005)	(0.007)
Size (log # emp.)	0.022**	0.007	0.029***	0.041***	0.011	0.023**	0.005	0.001	0.002
	(0.011)	(0.006)	(0.010)	(0.013)	(0.009)	(0.011)	(0.006)	(0.003)	(0.005)
Foreign owned	0.012	0.048	-0.006	0.142***	0.095**	0.065	-0.032	0.001	-0.025
	(0.061)	(0.040)	(0.056)	(0.053)	(0.044)	(0.045)	(0.025)	(0.015)	(0.020)
Domestic exporter	0.148***	0.055**	0.157***	0.124***	0.115***	0.055	0.051**	0.043***	0.031*
	(0.037)	(0.023)	(0.035)	(0.041)	(0.033)	(0.035)	(0.021)	(0.013)	(0.017)
Co-operation with other enterprises	0.243**	0.024	0.159*	0.305***	0.203***	0.128*	0.110***	0.042**	0.071***
	(0.095)	(0.041)	(0.082)	(0.097)	(0.073)	(0.070)	(0.030)	(0.017)	(0.024)
Co-operation with suppliers	0.072	0.019	0.066	0.316***	0.108	0.234***	0.132***	0.038**	0.089***
	(0.111)	(0.044)	(0.094)	(0.094)	(0.067)	(0.083)	(0.027)	(0.016)	(0.023)
Co-operation with customers	0.408***	0.131*	0.165	0.095	0.066	0.113	0.423***	0.192***	0.311***
	(0.112)	(0.068)	(0.102)	(0.089)	(0.059)	(0.074)	(0.023)	(0.019)	(0.022)
Co-operation with competitors	-0.022	0.056	-0.034	0.112	0.061	0.039	0.009	-0.000	0.024
	(0.095)	(0.055)	(0.079)	(0.117)	(0.076)	(0.078)	(0.033)	(0.016)	(0.026)
Co-operation with consultants	0.145	-0.017	0.053	0.059	0.057	0.089	0.023	0.025	0.011
	(0.104)	(0.033)	(0.086)	(0.104)	(0.072)	(0.087)	(0.034)	(0.019)	(0.026)
Co-operation with universities	0.168	0.135**	0.114	0.217	0.024	0.144	-0.064*	-0.024	-0.025
	(0.108)	(0.067)	(0.094)	(0.142)	(0.067)	(0.100)	(0.037)	(0.018)	(0.029)
Co-operation with public research lab	-0.039	0.056	-0.078	0.043	0.013	-0.075	0.006	0.060**	-0.033
	(0.133)	(0.070)	(0.097)	(0.156)	(0.074)	(0.062)	(0.042)	(0.029)	(0.029)
Industry fixed effects (2 digit)	Yes	Yes	yes	yes	yes	yes	yes	yes	yes
Constant	Yes	Yes	yes	yes	yes	yes	yes	yes	yes
Observations	1333	1327	1333	1256	1247	1256	4346	4333	4346
Log-likelihood	-665.694	-385.769	-660.119	-584.228	-451.396	-530.409	-1956	-1360	-1851
R^2/ Pseudo R^2	0.2037	0.1760	0.1743	0.2024	0.1852	0.1519	0.272	0.234	0.211
Wald test (Industry fixed effects)	40.80***	10.41	39.40***	9.32	13.91*	9.44	35.43***	49.93***	11.38

Notes: Marginal effects; robust standard errors; CIS 2006-2008

Table 4: Determinants of Innovation Outputs in Service Enterprises, 2006-2008 (ctd.)

Country	**Germany**			**Ireland**			**UK**		
	Innovation Output Equation – Process, Organisational and Marketing Innovations								
Dependent variable	Process innovation	Organisational innovation	Marketing innovation	Process innovation	Organisational innovation	Marketing innovation	Process innovation	Organisational innovation	Marketing innovation
Estimator	Probit	Probit	Probit	Probit	Probit	Probit	Probit	Probit	Probit
Predicted innovation expenditure	0.089***	0.050***	0.055***	0.013	0.039	0.050*	0.027***	0.029***	0.023***
	(0.016)	(0.015)	(0.015)	(0.030)	(0.029)	(0.026)	(0.006)	(0.008)	(0.007)
Size (log # emp.)	0.076***	0.061***	0.038***	0.028**	0.061***	0.025**	0.008*	0.035***	0.003
	(0.010)	(0.011)	(0.011)	(0.014)	(0.014)	(0.013)	(0.004)	(0.006)	(0.005)
Foreign owned	-0.049	-0.027	-0.010	0.115**	0.114**	-0.010	-0.019	0.061**	-0.016
	(0.057)	(0.065)	(0.059)	(0.054)	(0.054)	(0.047)	(0.018)	(0.028)	(0.021)
Domestic exporter	0.027	0.028	-0.022	0.103**	0.170***	0.089**	0.007	0.009	0.005
	(0.036)	(0.037)	(0.037)	(0.042)	(0.042)	(0.038)	(0.015)	(0.021)	(0.017)
Co-operation with other enterprises	0.458***	0.402***	0.207***	0.048	-0.023	0.063	0.061***	0.128***	0.034
	(0.074)	(0.057)	(0.078)	(0.084)	(0.074)	(0.071)	(0.022)	(0.030)	(0.023)
Co-operation with suppliers	0.164	0.021	-0.070	0.407***	0.170**	0.297***	0.149***	0.116***	0.119***
	(0.104)	(0.116)	(0.088)	(0.077)	(0.086)	(0.081)	(0.023)	(0.027)	(0.023)
Co-operation with customers	0.216**	-0.022	0.053	0.197*	0.251***	0.015	0.233***	0.336***	0.225***
	(0.101)	(0.109)	(0.097)	(0.104)	(0.086)	(0.076)	(0.022)	(0.023)	(0.022)
Co-operation with competitors	-0.016	0.004	0.116	-0.000	-0.003	0.067	-0.054***	-0.008	-0.018
	(0.091)	(0.101)	(0.096)	(0.112)	(0.100)	(0.093)	(0.018)	(0.035)	(0.024)
Co-operation with consultants	0.089	0.145	0.016	0.255*	0.120	0.112	0.070**	0.033	0.033
	(0.097)	(0.102)	(0.085)	(0.135)	(0.106)	(0.100)	(0.028)	(0.036)	(0.028)
Co-operation with universities	-0.062	0.061	0.173*	0.269**	0.159	0.043	-0.032	-0.030	-0.044
	(0.082)	(0.099)	(0.091)	(0.128)	(0.107)	(0.095)	(0.025)	(0.043)	(0.028)
Co-operation with public research lab	-0.093	-0.269**	-0.129	-0.209**	-0.094	-0.008	-0.021	0.018	0.031
	(0.113)	(0.111)	(0.112)	(0.093)	(0.109)	(0.111)	(0.026)	(0.045)	(0.035)
Industry fixed effects (2 digit)	Yes	yes	yes	yes	yes	yes	yes	yes	yes
Constant	yes	yes	yes	yes	yes	yes	yes	yes	yes
Observations	1333	1333	1333	1256	1247	1256	4346	4346	4346
Log-likelihood	-737.580	-843.752	-855.947	-699.129	-729.851	-689.118	-1686	-2333	-2016
R^2/ Pseudo R^2	0.1340	0.0864	0.0616	0.1146	0.1018	0.0786	0.206	0.181	0.135
Wald test (Industry fixed effects)	20.68**	28.73***	25.97***	4.51	14.62*	5.98	34.71***	42.86***	24.34***

Notes: Marginal effects; robust standard errors; CIS 2006-2008

Table 5: Innovation and Productivity in Service Enterprises, 2006-2008

Country	**Germany**			**Ireland**			**UK**		
	Productivity Equation (Dependent variable = Turnover/Employees)								
Dependent variable	Product innovation	Market novelties	Firm Novelties	Product innovation	Market novelties	Firm Novelties	Product innovation	Market novelties	Firm Novelties
Estimator	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS
Predicted innovation output	0.163***	0.131*	0.270**	0.188	0.580	0.451	0.043*	0.055*	0.051*
	(0.063)	(0.080)	(0.112)	(0.283)	(0.398)	(0.333)	(0.023)	(0.030)	(0.027)
Size (log # emp.)	0.009	0.016	-0.005	0.051	0.043	0.044	-0.092***	-0.092***	-0.092***
	(0.021)	(0.021)	(0.023)	(0.044)	(0.042)	(0.042)	(0.013)	(0.013)	(0.013)
Foreign owned	0.454***	0.403***	0.457***	0.747***	0.705***	0.734***	0.867***	0.869***	0.867***
	(0.141)	(0.141)	(0.141)	(0.144)	(0.143)	(0.136)	(0.061)	(0.061)	(0.061)
Domestic exporter	0.270***	0.296***	0.200**	0.307***	0.256**	0.299***	0.455***	0.449***	0.455***
	(0.069)	(0.071)	(0.091)	(0.098)	(0.104)	(0.093)	(0.038)	(0.039)	(0.038)
East Germany	-0.221***	-0.215***	-0.220***						
	(0.044)	(0.043)	(0.044)						
Industry fixed effects (3 digit)	yes	yes	yes	yes	yes	yes	yes	yes	yes
Constant	yes	yes	yes	yes	yes	yes	yes	yes	yes
Observations	1333	1327	1333	1256	1247	1256	4346	4333	4346
Log-likelihood	-1544.808	-1530.697	-1545.249	-2150.776	-2136.429	-2149.938	-6090	-6070	-6090
R^2	0.504	0.505	0.504	0.2018	0.2029	0.2029	0.401	0.399	0.401
Wald test (Industry fixed effects)	38.71***	36.28***	39.25***	1132.10***	597.65***	203.07***	81.53***	80.39***	81.51***

Notes: Marginal effects; robust standard errors; CIS 2006-2008

Table 5: Innovation and Productivity in Service Enterprises, 2006-2008 (ctd.)

Country	**Germany**			**Ireland**			**UK**		
	Productivity Equation (Dependent variable = Turnover/Employees)								
Dependent variable	Process innovation	Organisational innovation	Marketing innovation	Process innovation	Organisational innovation	Marketing innovation	Process innovation	Organisational innovation	Marketing innovation
Estimator	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS
Predicted innovation output	0.211***	0.226***	0.320**	0.508*	0.520	0.767*	0.065**	0.056**	0.070**
	(0.071)	(0.084)	(0.129)	(0.297)	(0.438)	(0.436)	(0.028)	(0.028)	(0.035)
Size (log # emp.)	-0.027	-0.017	-0.013	0.041	0.023	0.035	-0.095***	-0.097***	-0.093***
	(0.026)	(0.025)	(0.025)	(0.042)	(0.050)	(0.043)	(0.013)	(0.014)	(0.013)
Foreign owned	0.474***	0.467***	0.468***	0.713***	0.701***	0.741***	0.867***	0.854***	0.868***
	(0.141)	(0.141)	(0.141)	(0.137)	(0.149)	(0.131)	(0.061)	(0.061)	(0.061)
Domestic exporter	0.317***	0.337***	0.356***	0.272***	0.224*	0.233**	0.458***	0.462***	0.462***
	(0.060)	(0.059)	(0.058)	(0.097)	(0.126)	(0.109)	(0.037)	(0.037)	(0.037)
East Germany	-0.223***	-0.222***	-0.221***						
	(0.044)	(0.044)	(0.044)						
Industry fixed effects (3 digit)	yes	yes	yes	yes	yes	yes	yes	yes	yes
Constant	yes	yes	yes	yes	yes	yes	yes	yes	yes
Observations	1333	1333	1333	1256	1247	1256	4346	4346	4346
Log-likelihood	-1542.575	-1543.706	-1545.310	-2149.246	-2136.920	-2148.947	-6089	-6090	-6090
R^2	0.506	0.505	0.504	0.2038	0.2023	0.2042	0.401	0.401	0.401
Wald test (Industry fixed effects)	36.89***	39.71***	37.16***	1254.48***	95.43***	273.09***	76.43***	77.44***	76.34***

Notes: Marginal effects; robust standard errors; CIS 2006-2008

Table 7: Innovation Investment in Manufacturing Enterprises, 2006-2008

Country	**Germany**		**Ireland**		**UK**	
	Innovation Investment Equations					
Dependent variable	Propensity to invest in innovation	Intensity of Innovation expenditure per employee	Propensity to invest in innovation	Intensity of Innovation expenditure per employee	Propensity to invest in innovation	Intensity of Innovation expenditure per employee
Estimator	Heckman stage 1	Heckman stage 2	Heckman stage 1	Heckman stage 2	Heckman stage 1	Heckman stage 2
Size (log # emp.)	0.085***	-	0.139***		0.045***	
	(0.009)		(0.022)		(0.008)	
Foreign owned	0.119***	0.021	0.188***	0.972***	0.053*	0.574***
	(0.036)	(0.135)	(0.068)	(0.311)	(0.029)	(0.119)
Domestic exporter	0.200***	0.003	0.274***	0.441*	0.157***	0.394***
	(0.029)	(0.109)	(0.049)	(0.244)	(0.021)	(0.094)
HC	0.004***	0.016***				
	(0.001)	(0.003)				
Training	0.085***	0.301***				
	(0.012)	(0.036)				
Industry fixed effects (3 digit)	Yes	Yes	yes	yes	yes	yes
Constant	Yes	Yes	yes	yes	yes	yes
Observations	2,292		831		2990	
lambda	0.065		0.9658**		0.489***	
	(0.105)		(0.4187)		(0.104)	
rho	0.052		0.6125***		0.305***	
	(0.084)		(0.2089)		(0.061)	
Wald test for H0: rho=0	0.38		4.55**		22.26***	
Wald test (Industry fixed effects)	287.03***		4.3e+05***		8249.52***	
Log-likelihood	-3600.07		-1136.68		-5430.00	

Notes: Marginal effects; robust standard errors; CIS 2006-2008

Table 8: Determinants of Product Innovation in Manufacturing Enterprises, 2006-2008

Country	**Germany**			**Ireland**			**UK**		
	Innovation Output Equation – Product Innovation								
Dependent variable	Product innovation	Market novelties	Firm Novelties	Product innovation	Market novelties	Firm Novelties	Product innovation	Market novelties	Firm Novelties
Estimator	Probit	Probit	Probit	Probit	Probit	Probit	Probit	Probit	Probit
Predicted innovation expenditure	0.148***	0.118***	0.101***	0.026	-0.008	0.021	0.068**	0.048**	0.017
	(0.024)	(0.020)	(0.023)	(0.030)	(0.023)	(0.025)	(0.029)	(0.021)	(0.025)
Size (log # emp.)	0.071***	0.042***	0.066***	0.069***	0.032**	0.044**	0.002	-0.002	-0.001
	(0.010)	(0.008)	(0.010)	(0.021)	(0.015)	(0.018)	(0.009)	(0.007)	(0.008)
Foreign owned	0.086*	0.088**	0.095**	0.175**	0.164**	0.124*	0.032	0.038	0.037
	(0.045)	(0.045)	(0.046)	(0.078)	(0.072)	(0.073)	(0.040)	(0.032)	(0.036)
Domestic exporter	0.185***	0.152***	0.162***	0.292***	0.197***	0.234***	0.132***	0.095***	0.096***
	(0.029)	(0.024)	(0.029)	(0.056)	(0.049)	(0.050)	(0.028)	(0.022)	(0.024)
Co-operation with other enterprises	0.154**	0.095**	0.002	0.188	0.105	0.005	0.091***	0.057**	0.059**
	(0.063)	(0.046)	(0.054)	(0.117)	(0.082)	(0.081)	(0.034)	(0.025)	(0.029)
Co-operation with suppliers	0.231***	0.127***	0.186***	0.188*	0.121	-0.019	0.237***	0.099***	0.165***
	(0.048)	(0.042)	(0.047)	(0.110)	(0.082)	(0.075)	(0.030)	(0.024)	(0.028)
Co-operation with customers	0.215***	0.033	0.136***	0.307***	0.213**	0.301***	0.385***	0.212***	0.260***
	(0.057)	(0.041)	(0.052)	(0.093)	(0.087)	(0.089)	(0.025)	(0.024)	(0.025)
Co-operation with competitors	0.095	0.022	0.066	-0.074	0.081	0.001	-0.080**	-0.047*	0.020
	(0.076)	(0.047)	(0.067)	(0.221)	(0.142)	(0.135)	(0.041)	(0.025)	(0.035)
Co-operation with consultants	0.043	0.029	0.025	0.010	0.043	0.084	0.027	0.002	0.014
	(0.080)	(0.050)	(0.063)	(0.118)	(0.075)	(0.089)	(0.041)	(0.027)	(0.033)
Co-operation with universities	0.172***	0.137***	0.169***	0.321***	0.202**	0.009	0.129***	0.115***	0.038
	(0.042)	(0.038)	(0.043)	(0.104)	(0.091)	(0.082)	(0.047)	(0.035)	(0.038)
Co-operation with public research lab	0.146**	0.116**	0.005	0.126	-0.069	0.139	-0.063	0.012	-0.008
	(0.070)	(0.051)	(0.060)	(0.153)	(0.067)	(0.113)	(0.052)	(0.035)	(0.042)
Industry fixed effects (2 digit)	Yes	Yes	yes	yes	yes	yes	yes	yes	yes
Constant	Yes	Yes	yes	yes	yes	yes	yes	yes	yes
Observations	2,292	2,292	2,292	806	806	806	2986	2986	2986
Log-likelihood	-1256.785	-1091.567	-1320.278	-410.832	-335.317	-418.327	-1482	-1305	-1518
R^2/ Pseudo R^2	0.2089	0.1848	0.1621	0.2457	0.2442	0.1550	0.270	0.203	0.184
Wald test (Industry fixed effects)	60.50***	35.33**	75.65***	34.89**	37.25**	31.64**	68.26***	65.36***	59.23***

Notes: Marginal effects; robust standard errors; CIS 2006-2008

Table 9: Determinants of Process, Organisational and Marketing Innovations in Manufacturing Enterprises, 2006-2008

Country	**Germany**			**Ireland**			**UK**		
	Innovation Output Equations – Process, Organisational and Marketing Innovations								
Dependent variable	Process innovation	Organisational innovation	Marketing innovation	Process innovation	Organisational innovation	Marketing innovation	Process innovation	Organisational innovation	Marketing innovation
Estimator	Probit	Probit	Probit	Probit	Probit	Probit	Probit	Probit	Probit
Predicted innovation expenditure	0.064***	0.069***	0.081***	-0.006	0.010	0.002	-0.021	-0.000	-0.009
	(0.022)	(0.023)	(0.022)	(0.029)	(0.029)	(0.026)	(0.021)	(0.027)	(0.021)
Size (log # emp.)	0.070***	0.053***	0.013	0.082***	0.071***	0.005	0.023***	0.056***	0.003
	(0.009)	(0.010)	(0.009)	(0.020)	(0.020)	(0.018)	(0.007)	(0.009)	(0.006)
Foreign owned	0.091**	0.065	0.110***	0.124*	0.150**	0.066	-0.001	0.081**	0.006
	(0.045)	(0.044)	(0.043)	(0.071)	(0.075)	(0.069)	(0.029)	(0.038)	(0.029)
Domestic exporter	0.099***	0.074**	0.148***	0.200***	0.190***	0.184***	0.045**	0.103***	0.040*
	(0.029)	(0.029)	(0.028)	(0.052)	(0.055)	(0.049)	(0.022)	(0.027)	(0.021)
Co-operation with other enterprises	0.093*	-0.010	0.036	-0.029	0.042	0.148	0.074***	0.176***	0.063**
	(0.053)	(0.050)	(0.049)	(0.118)	(0.119)	(0.090)	(0.027)	(0.032)	(0.025)
Co-operation with suppliers	0.134***	0.042	0.012	0.373***	0.350***	-0.015	0.244***	0.151***	0.083***
	(0.046)	(0.045)	(0.044)	(0.074)	(0.093)	(0.077)	(0.026)	(0.029)	(0.023)
Co-operation with customers	0.088*	0.195***	0.144***	0.091	0.070	0.127	0.148***	0.222***	0.131***
	(0.049)	(0.046)	(0.046)	(0.110)	(0.103)	(0.082)	(0.024)	(0.027)	(0.023)
Co-operation with competitors	0.083	-0.011	-0.069	0.024	-0.297***	-0.139	-0.058**	-0.060	0.007
	(0.061)	(0.058)	(0.055)	(0.201)	(0.084)	(0.091)	(0.026)	(0.039)	(0.028)
Co-operation with consultants	0.014	0.119**	0.046	0.257**	0.187	0.209**	0.022	0.084**	0.048*
	(0.059)	(0.057)	(0.054)	(0.111)	(0.117)	(0.093)	(0.028)	(0.039)	(0.028)
Co-operation with universities	0.042	0.107***	0.033	0.138	0.281***	0.073	0.038	0.054	0.057*
	(0.041)	(0.041)	(0.041)	(0.114)	(0.099)	(0.086)	(0.033)	(0.043)	(0.032)
Co-operation with public research lab	0.092	-0.062	0.023	-0.117	0.272**	-0.130*	-0.016	-0.007	-0.009
	(0.056)	(0.053)	(0.052)	(0.154)	(0.121)	(0.075)	(0.034)	(0.050)	(0.032)
Industry fixed effects (2 digit)	Yes	yes	yes	yes	yes	yes	yes	yes	yes
Constant	yes	yes	yes	yes	yes	yes	yes	yes	yes
Observations	2,292	2,292	2,292	806	802	808	2986	2990	2990
Log-likelihood	-1406.668	-1472.351	-1497.262	-468.841	-426.135	-457.045	-1354	-1606	-1359
R^2/ Pseudo R^2	0.1027	0.0716	0.0573	0.1608	0.2082	0.0914	0.185	0.196	0.118
Wald test (Industry fixed effects)	27.97*	22.44	81.62***	18.76	31.79**	31.37**	24.88	18.32	33.84**

Notes: Marginal effects; robust standard errors; CIS 2006-2008

Table 10: Innovation and Productivity in Manufacturing Enterprises, 2006-2008

Country	**Germany**			**Ireland**			**UK**		
	Productivity Equation (Dependent variable = Turnover/Employees)								
Dependent variable	Product innovation	Market novelties	Firm Novelties	Product innovation	Market novelties	Firm Novelties	Product innovation	Market novelties	Firm Novelties
Estimator	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS
Predicted innovation output	0.041*	0.090***	0.065*	0.184	0.175	0.172	0.046***	0.064***	0.057***
	(0.021)	(0.032)	(0.034)	(0.220)	(0.207)	(0.290)	(0.016)	(0.023)	(0.021)
Size (log # emp.)	0.099***	0.091***	0.096***	0.117***	0.121***	0.123***	0.087***	0.087***	0.087***
	(0.013)	(0.013)	(0.014)	(0.039)	(0.037)	(0.038)	(0.011)	(0.011)	(0.011)
Foreign owned	0.656***	0.636***	0.649***	0.508***	0.521***	0.520***	0.484***	0.477***	0.486***
	(0.058)	(0.059)	(0.058)	(0.132)	(0.133)	(0.131)	(0.043)	(0.044)	(0.043)
Domestic exporter	0.290***	0.260***	0.281***	0.102	0.126	0.111	0.175***	0.167***	0.177***
	(0.041)	(0.044)	(0.043)	(0.090)	(0.087)	(0.095)	(0.029)	(0.030)	(0.029)
East Germany	-0.207***	-0.211***	-0.207***						
	(0.029)	(0.029)	(0.029)						
Industry fixed effects (3 digit)	yes	yes	yes	yes	yes	yes	yes	yes	yes
Constant	yes	yes	yes	yes	yes	yes	yes	yes	yes
Observations	2,292	2,292	2,292	806	806	806	2986	2986	2986
Log-likelihood	-2079.239	-2077.195	-2079.287	-940.611	-940.639	-940.854	-2739	-2739	-2740
R^2	0.364	0.365	0.364	0.3234	0.3233	0.3230	0.266	0.266	0.266
Wald test (Industry fixed effects)	5.94***	5.98***	5.99***	27.88***	40.16***	43.72***	377.05***	403.74***	244.05***

Notes: Marginal effects; robust standard errors; CIS 2006-2008

Table 10: Innovation and Productivity in Manufacturing Enterprises, 2006-2008

Country	**Germany**			**Ireland**			**UK**		
	Productivity Equation (Dependent variable = Turnover/Employees)								
Dependent variable	Process innovation	Organisational innovation	Marketing innovation	Process innovation	Organisational innovation	Marketing innovation	Process innovation	Organisational innovation	Marketing innovation
Estimator	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS
Predicted innovation output	0.093**	0.116**	0.316***	0.242	0.161	0.210	0.070***	0.068***	0.075***
	(0.045)	(0.049)	(0.073)	(0.243)	(0.210)	(0.337)	(0.021)	(0.022)	(0.028)
Size (log # emp.)	0.089***	0.091***	0.091***	0.111***	0.116***	0.127***	0.080***	0.075***	0.085***
	(0.016)	(0.015)	(0.012)	(0.041)	(0.039)	(0.035)	(0.012)	(0.012)	(0.011)
Foreign owned	0.644***	0.647***	0.567***	0.509***	0.533***	0.539***	0.494***	0.478***	0.496***
	(0.059)	(0.058)	(0.062)	(0.133)	(0.132)	(0.132)	(0.043)	(0.044)	(0.043)
Domestic exporter	0.286***	0.286***	0.186***	0.103	0.129	0.119	0.183***	0.175***	0.185***
	(0.041)	(0.041)	(0.049)	(0.089)	(0.087)	(0.094)	(0.028)	(0.029)	(0.028)
East Germany	-0.207***	-0.208***	-0.211***						
	(0.029)	(0.029)	(0.029)						
Industry fixed effects (3 digit)	yes	yes	yes	yes	yes	yes	yes	yes	yes
Constant	yes	yes	yes	yes	yes	yes	yes	yes	yes
Observations	2,292	2,292	2,292	806	802	808	2,986	2,990	2,990
Log-likelihood	-2079.081	-2078.494	-2072.191	-940.478	-936.450	-943.480	-2737	-2742	-2744
R^2	0.364	0.364	0.368	0.3236	0.3240	0.3238	0.267	0.276	0.275
Wald test (Industry fixed effects)	5.73***	5.94***	6.35***	45.41***	46.19***	19.88***	1683.18***	666.67***	347.8****

Notes: Marginal effects; robust standard errors; CIS 2006-2008