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The engagement in standardization activities
A firm level analysis of formal and company standardization

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Abstract

Policy-makers recognize standardization as a useful tool for competitiveness. However, not all firms are engaged in the standardization process. Moreover, the attitude of firms towards standardization within the company has not yet been investigated in a large quantitative study. Distinguishing between external formal standardization (e.g. participating in CEN, ISO) and internal company standardization (e.g. elaboration of company standards), this paper aims to cover this gap and contribute to on-going research about the factors explaining the standardization attitude of firms. A multinomial logit model is implemented to investigate simultaneously the choice of standardization strategies with respect to internal and external dimensions. The econometric analysis has been performed on a dataset representative of the whole economy obtained from merging Luxembourgish Community Innovation Survey 2010 and the list of firms contributing to Luxemburgish Standardization Institute. The set of covariates includes the firm's features (e.g. size, group status and exports), perceived competition (e.g. price competition), innovation-related activities (e.g. cooperation, R&D activities and qualified employment) and industrial sectors. The analysis shows many interesting patterns. For example, firms operating in a market with uncertain future technological trajectories are considerably more likely to engage in standardization activities, *ceteris paribus*. Interestingly, size shows a reverse U shape relationship with internal standardization strategies suggesting that above a threshold, internal standardization only is not enough to satisfy firms' needs but that external standardization is needed. Policy makers aiming to increase the engagement of firms in standardization activities can easily profile firms that are more likely to join standardization process. Additionally, results suggest focusing particularly on education of employees to increase participation to external standardization.

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Introduction

Standards are important for economic activity because they perform some fundamental functions such as interoperability, quality assurance, information and measurement. (see, for example, David and Greenstein 1990; Swann 2000; Blind 2004). Standardization, the process to develop the standards, is recognized by policy-makers as a useful tool for competitiveness. European commission recognize standardization and standards as an important driver for competitiveness and growth (EU Commission 2008, n. 133). Indeed, acting as a bridge between research, innovation and markets, standardization can support the priorities settled in Horizon 2020 (CEN-CENELEC, 2012). Scholars often regard standardization as a tool to facilitate coordination among economic players (e.g. Farrell and Saloner 1988; Farrell and Simcoe, 2012) or a tool to persuade end users to adopt a firm's specific technology (e.g. Lerner and Tirole 2006). However, despite the generally recognized benefits of standards and standardization, not many firms are engaged in standardization activities. Recent data show that only 11% of a representative sample of Dutch firms participates in a formal standardization process (Blind et al., 2012). Participating in a formal standardization process can require considerable resources. These resources are particularly scarce for SMEs (De Vries et al., 2009; Blind and Mangelsdorf, 2013; Le Gall and Prager, 2011). Moreover, the standards resulting from the formal standardization process are not excludable from competitors. A company not participating in the process can benefit from the standards without the cost of the standardization (i.e. free riding). Nevertheless, standards development is an important phenomenon. In 2000, at least 40,000 experts are involved in international standardization organizations (Mattli and Büthe, 2003). Considering the economic impact of standards and standardization, a better understanding of the firm decision to participate in the standardization process is necessary. Investigating the benefits of participation into formal standardization, Wakke and Blind (2012, pag. 345) call for more investigation and clearly points that *"several studies highlight the economic benefits of standards, while the benefit of taking part in standardization remains a rather unexplored mystery to date."* Along with participation into standardization activities outside the firm (e.g. to join formal standardization committees), standardization can play an important role as well within the company (e.g. Hesser, et al., 2007). Company standardization can refer to standardization and formalization of procedures, such as marketing (Vrontis et al., 2009) or products and services (e.g. Tether et al., 2001). Despite internal standards being probably considerably more numerous than formal standards, company standardization is an under researched topic (de Vries and Slob, 2009). In particularly, no study quantitatively has investigated standardization within the company in a large sample representative of the economy. Distinguishing between external formal standardization (e.g. participating in CEN, ISO) and internal company standardization (e.g. elaboration of company standards), this paper aims to cover this gap and contribute to on-going research about the factors explaining standardization attitude of firms.

This research argues that company standardization and external standardization are not disconnected activities and they are related with the same firm attitude towards standardization. Simons & de Vries (2002, p. 31, as quoted in Slob and De Vries, 2002) define company standardization as "standardisation within a company, including its positioning towards external standardisation". This definition clearly evokes a relationship between internal and external standardization. More precisely, the study jointly investigates the attitude of Luxembourgish firms to participate in a formal standardization process (i.e. national mirror committees, European and International technical committees) and their engagement in company standardization. Luxembourg offers particularly suitable settings for this study because Luxembourgish firms are paying no fees to join national technical committee. Therefore, the standardization attitude of the firm is not affected by the fees structure of the national standardization institute. Moreover, the Luxembourgish Community Innovation Survey 2010 offers representative information on firm characteristics and on the internal standardization activities. In line with a previous qualitative study on the profile of standardization players in Luxembourg (Riillo, 2013), the final goal of this study is to shed light on participants in the formal standardization process and internal standardization activities that can be used by policy-makers to provide adequate support to the standards setters. The rest of the paper is organized as follows: a brief literature review presents the main results of previous studies in Section 2. Section 3 describes the data for the analysis. Section 4 discusses the factors influencing the engagement in standardization. The model is presented in Section 5 and the results of the analysis are presented in Section 6. The paper concludes with some final remarks.

1. Review of previous studies

Compared to the importance of standards in modern economy, the research on the propensity of firms to joint formal process of standardization is relatively scarce. However, in the last decade, some researchers (particularly numerous are the contribution of Knut Blind) have been investigating quantitatively the characteristics of firms participating in standardization process[1]. This section is dedicated to reviewing the main results of these studies. In the French manufacturing sector, Haudeville and Wolff (2004) find evidence that market structure and competition of the sector and firm specific characteristics (e.g. size, export activities, R&D expenditures and patent) have a positive impact on the decision of jointing standardization process. Considering the standardization as a particular form of R&D collaboration, Blind (2006) develops and tests some hypotheses about the decision of German manufacturing companies to participate in standardization processes at a national, European and international level. The author finds evidence that large companies are more likely to join standardization committees than small companies, due to economies of scale. The cost of participating in standardization activities is rather a fix cost and SMEs can face several barriers before benefiting from standards and standardization (de Vries et al., 2009). Moreover, R&D expenses and exports intensity present an inverted U-shape relationship with participation decision. This result suggests that a certain absorptive capacity (Cohen and Levinthal, 1990) is needed to benefit from participating in the formal standardization process. The intensity of exports follows a similar pattern of R&D expenditure[2]. Blind and Mangelsdorf (2008) focus on service companies in Germany and confirm that company size, the export activities, and R&D expenditures are all important drivers of participation in standardization activities. Interestingly, the competition environment appears to have no impact at conventional statistical level of significance. Blind and Thumm (2004) investigate a small sample of European firms and find evidence that patent intensities of companies are negatively related with the likelihood to join standardization processes. Moving from the Knowledge Bases View (e.g. Grant, 1996), Blind and Mangelsdorf (2013) investigate empirically participation in standardization as a particular type of "alliance. More precisely, the authors study the participation of German SMEs (i.e. less of 500 employees) of electrical engineering and machinery industry to national, European and international standardization process. The inverted U shape relationship between R&D and the likelihood to join standardization process is confirmed. SMEs aim to access to the knowledge of other firms participating to technical committees (i.e. external knowledge) but high R&D performers are reluctant to participate in standardization to prevent disclosing their knowledge. The relevance of incoming knowledge spillovers and the negative correlation with the patent portfolios confirm the importance to access external knowledge. Interestingly, the competition appears to have no impact at the conventional statistical level of significance. Gauch and Blind (2010) investigate open innovation as a driver for participation on a sample of the participants of 5th European Framework Program (e.g. firms, research institute). In their data, the authors find that different modes or the extent of knowledge sourcing activity have no impact on the likelihood of firm participation. While all researches previously presented were based on ad hoc survey, with possible respondent bias towards larger companies, the recent study of Blind et al., (2012) is based on the representative sample of the whole Dutch economy. The authors argue that standardization is one form of "alliance" and along the "open innovation" framework Chesbrough (2011) investigate the "openness" of the firm as important explanation of participation to standardization process. Results suggest that firms participate in standardization activity aiming to increase their own knowledge base. Moreover the analysis shows that firms cooperating with different actors are more likely to join standardization. The authors conclude that standardization represents a specific form of collaborative knowledge-sharing and knowledge-creating strategy. It is important to notice that all reviewed studies share the same econometric model. The general framework is the qualitative response model that links the probability that an event occurs and a set of factors (Greene, 2012). The dependant variable is binary, meaning that a firm participate or not participate. Some firm or sector characteristics (i.e. R&D intensity) are the proxy of the hypothesis that authors draw from the theory and want to test. Other covariates are used as controls (i.e. firm turnover). Since participation to standardization is voluntary, the random utility choice as presented by Greene (2012) is a possible interpretation of the model implemented in

[1] First empirical papers investigate product standardizations (Link, 1983; Lecraw, 1984). Blind (2002) and Wakke (2010) investigate participation in formal standardization at sector level in manufacturing and services, respectively.

[2] Interestingly, less productive companies are more inclined to join standardisation processes, probably because attracted by knowledge spillovers related with standardization process.

previous studies. If the expected benefits (e.g. influencing the market through the standards) are higher than the costs (e.g. fees, time) firms decide to participate. Each independent variable is related with the expected utility of the choice increasing the benefits and/or reducing the costs associated with the event. For example, compared to smaller firms, large firms can have both lower standardization costs per employees and both higher possibility to influence the standards according their vested interest. Some of the underlying hypotheses of the qualitative response model are that all firms are aware of the opportunity of standardization and that their behaviour is aiming to maximize their utility. The current study adopts the qualitative response model implemented in previous studies and extends it to the case of multiple standardization strategies.

2. The data

The quantitative analysis is performed on a dedicated dataset obtained from two Luxembourgish data sources. One source is the exhaustive list of firms participating in a formal standardization process from ILNAS (Institut Luxembourgeois de la Normalisation, de l'Accréditation, de la Sécurité et qualité des produits et services). ILNAS represents Luxembourg within international standardization organisations (e.g. CEN, ISO). The other source of data is the Luxembourgish Community Innovation Survey - CIS 2010 - that is a representative sample of Luxembourgish economy. The CIS survey collects information about firms' characteristics, the market and innovation activities. This survey is the main data source for measuring innovation in Luxembourg and in Europe. The survey is made of two parts: first part is common to all European Countries; the second part is country-specific. The CIS 2010 for Luxembourg includes some questions about technical standards. One of these dedicated questions allows for investigating the attitude of Luxembourgish firms toward standardization in a sample representative of the whole economy. Indeed, question J1 reads as: "During the three years 2008 to 2010, did your enterprise use any of the following methods to stimulate new ideas or creativity among your staff?" - Participating in technical committees or working groups on the elaboration of standards". Firms can answer "yes" or "no" to the question[1]. To the extent that participation in technical committees for the elaboration of standards is a good proxy for attitude towards standardization, this variable, jointly with the information about participation to external formal standardization, enables us to empirically distinguish between the four standardization strategies, in the years 2008-2010.

[1] I acknowledge that the answer to this question is self-reported and the coding of this question can be to some extent questionable. Nevertheless, the question is at least a good approximation of the attitude of firm standardization. While other CIS questions are asked only to innovating firms, it is important to note that all firms have to answer this question.

3. Factors influencing the engagement in standardization

This section presents the factors influencing the engagement in standardization that are implemented in the econometric analysis.

3.1 Size

Compared to smaller companies, large companies have more resources (e.g. financial and human) dedicated to standardization activities in both absolute and relative terms. Moreover, larger firms are in a position to influence the standardization process more easily toward their desired direction. However, small firms can benefit more from knowledge spillover associated with formal standardization activity, and therefore can be more likely to participate in formal standardization. Waguespack and Fleming (2009) find that start-ups participating in an open standards community are more likely to be receiving funding from investors. Moreover, cases of small firms considerably influencing the contents of standards are reported in literature (de Vries, 2006). From an internal point of view, the higher degree of standardization and formality can serve better the needs of larger firms than small firms. Moreover, larger firms can more easily explode economies of scale due to internal standardization. However, if achieving an agreement is easier when there are less people involved, then the cost associated with internal standardization should be lower for small than larger forms. Empirically, all previous studies presented in the literature review have detected a positive relationship between external standardization and size. In the model, company size is measured by the number of employees. The research enhances current understandings explicitly testing for a nonlinear relationship between size and innovation.

3.2 International market

Companies that are active in multiple international markets prefer one international standard rather than several national standards. Moreover, larger is the market the firm operate, larger are the potential economies of scale of a common standard. Therefore, to prevent fragmentation and effectively influence the standardization process, firms active in intentional markets are more likely to undertake standardization process at internal and external level. Previous studies (e.g. Blind, 2006; Blind et al., 2012) control the relationship between exports and participation to standardization activities. In this research, export is measured with a dichotomous variable having a value of “1” if the firm is exporting.

3.3 Group Status

Along with the size, a more complex organization requires a higher level of formalization and standardization. Therefore, being part of a group increases the likelihood to undertake standardization activities especially at an internal level, as shown by de Vries et al., (2006). Some cases of different branches of the same group that coordinate their efforts to successfully influence international standards and the global market are reported in literature (Riillo, 2013). In the analysis, firms can belong to foreign group, to national group or no group. The use of this variable is new in literature and a positive relationship between being part of a group and standardization can be expected.

3.4 Sectors

All previous empirical studies report that companies participating in standardization activities are highly heterogeneous in terms of economic activity. To detect sectorial specificities, two digits Nace code dummies are used in the analysis. The definition of sectors is reported in the annex.

3.5 Competition

The hypothesis of a correlation between competition and standardization (or voluntary product standards) is often advanced in literature (e.g. Link, 1983) but clear pattern was not detected between participation in standardization process in more recent work (Blind et al., 2012). Investigating the relationship between standardization activities and different types of competition, this analysis refines previous studies. More precisely, a series of dummy variables measures for self-reported sources of competition: threats from new competitors, products obsolescence, uncertain technological development, price competition and quality competition.

3.6 Innovation related activities

R&D and Cooperation

Most scholars investigated the relationship between standardization and innovation-related activities find at least a positive correlation (e.g. Blind and Mangelsdorf, 2013). R&D expenditures are often interpreted as "absorptive capacity" (Cohen and Levinthal, 1990) which are positively related to a propensity to participate in standardization activities (Blind et al., 2012) at least up to certain threshold (Blind and Mangelsdorf, 2013). It is important to point out that services are less likely to report R&D investment (Miles, 2007) and a large percentage of small and service firms are reporting no R&D expenditures (Rammer et al., 2009). In this sense, R&D behaviour is probably better captured by a categorical variable than a continuous variable. For this reason, R&D expenditures are codified as a binary variable[1]. The "openness" of firms, measured as cooperation with other players (e.g. research institute, suppliers), is positively related to a propensity to join standardization activities (Blind et al., 2012). Moreover, the co-operation of alliance and firms play an important role during standards settings (e.g. Leiponen, 2008) and in R&D coordination (Baron et al., 2011). In this analysis, co-operation is defined as a dummy variable having value 1 if the firm is engaged in at least one innovation cooperation, otherwise it is zero. With respect to the rest of previous studies, this analysis investigates whether "openness" and "absorptive capacity" have jointly a stronger effect on the propensity of standardization activities. In other words, the model accounts for firms with no R&D activities and no cooperation, only R&D, only cooperation and firms jointly performing R&D and running any cooperation.

Patenting

Many standardization organizations require disclosure of relevant patents during the standardization process. This can possibly reduce the likelihood of firms to participate in standardization activities. Blind and Thumm (2004) investigating a small sample of European firms finds evidence that patent intensities of companies are negatively related to the likelihood to join standardisation processes. Similar results are confirmed in the case of SMEs in a more recent study (Blind and Mangelsdorf, 2013). However, essential patents (i.e. that must be used to comply with the standard) can be really valuable (Shapiro, 2001). Patents disclosed during standardization process are more likely to be cited after standardization (Rysman and Simcoe, 2008). However, only a small percentage of all firms adopt a patenting strategy and service services are less likely to report patenting behaviour (Félix, 2007). In this sense, as Luxembourgish economy is dominated by services, patenting behaviour is probably better captured by a categorical variable than a continuous variable. That is, patenting is codified as a binary dummy.

Education

Qualitative studies (e.g. Jakobs and Procter, 2001; Demortain, 2008) suggest that highly qualified and often scarce personnel have to devote considerable time in order to influence standardization activity. However, this hypothesis was not tested in previous large studies. In the current analysis, the education of labour force is codified as categorical variable. More precisely, the empirical analysis accounts for firms with 0-9% of employees with high education, with 10-49% and with more of 50%.

[1] Firms not performing any innovation activity are not asked about intramural R&D expenditures or innovation cooperation, therefore, for these firms, R&D expenditures and cooperation activities are, technically, missing values and not zero. However, it is reasonable that firms with any innovation activity are neither investing in R&D nor in innovation cooperation, therefore the missing values are set at zero.

4. The model

This research models the choice of standardization alternatives on the basis of the firm attitude to standardization activities. More precisely, each firm can undertake one of these four alternatives: No standardization activity (p00); only internal (p10); only external (p01); both internal and external (p11). The four possible strategies can potentially be ordered: zero standardization activity, one standardization activity and two standardization activities suggesting a model for ordinal outcomes[1]. However, considering that external standardization is difficult and it requires some prior *"standardization capacity"*, it is unlikely that a firm active in external standardization is not benefiting simultaneously from internal standardization. Therefore, as the exact order of the four standardization strategies is partially questionable, a nominal outcome model is preferred, in line with the suggestion of Long and Freese (2006, p. 223)[2]. The selected model is the multinomial logit that is described by Greene (2012, pp. 763-766)[3]. In general, assuming that there are k categorical outcomes and — without loss of generality — let the base outcome be 1. The probability that the response for the j^{th} observation is equal to the i^{th} outcome is:

$$p_{ij} = \Pr(y_j = i) = \begin{cases} \dfrac{1}{1 + \sum_{m=2}^{k} \exp(\mathbf{x}_j \boldsymbol{\beta}_m)}, & \text{if} \quad i = 1 \\ \dfrac{\exp(\mathbf{x}_j \boldsymbol{\beta}_i)}{1 + \sum_{m=2}^{k} \exp(\mathbf{x}_j \boldsymbol{\beta}_m)}, & \text{if} \quad i > 1 \end{cases}$$

where x_j is the row vector of observed values of the independent variables for the j^{th} observation and β_m is the coefficient vector for outcome m. In our analysis, k is equal to four (the four standardization strategies).

[1] In this sense, the model could be interpreted as a sort of "standardization maturity model".
[2] Long and Freese suggest "In general, if you have concerns about the ordinality of the dependent variable, the potential loss of efficiency in using models for nominal outcomes is outweighed by avoiding potential bias" Moreover, the parallel regression assumption that is behind the order model is empirically rejected, as shown in Section 6.
[3] A possible alternative could have been Bivariate Probit. However, statistically, Bivariate probit can be considered a special case of Multinomial logit, via parametric restriction (Weeks and Orme 1999, Di Tommaso and Weeks, 2000; Poirier and Kapadia 2012). The model of bivariate probit without Independence of irrelevant alternatives hypothesis provides comparable results with the multinomial logit, as shown in annex.

5. The quantitative analysis

With respect to the dependent variable of the model, almost 31% of firms are engaged in internal standardization activities only and 2% of firms are engaged in both internal and external standardization process, as shown in Table 1. Two considerations are important. First, ILNAS started its operations in 2008 and many firms cannot be aware or have underestimated the standardization opportunities in Luxembourg. Second, the comparable investigation on Dutch economy, with a much more standardization tradition, reports that almost 11% of firms are participating in formal standardization process (Blind et al., 2012). As suspected, no firm is engaged in external innovation only. Additional descriptive statistics are provided in annex.

Table 1: Standardization activities

Strategy	Standardization activities	Weighted population	%
p00	none	1 004	66.7
p01	only external	0	0.0
p10	only internal	475	31.5
p11	both	26	1.8
	Total	1 505	100.0

The econometric estimates of the multinomial logit reveal several interesting patterns suggesting that the same covariate can impact differently the standardization strategy, as shown in Table 2[3]. As a check for robustness, an ordered Logit model with the same specification was fitted to empirically test the parallel regression assumption that is underlying the order model. The significant test statistic (adjusted Wald test F (22, 614) =36.70, Prob > F =0.000) provides evidence that the parallel regression assumption has been violated jointly by all covariates[4]. This result increases the confidence of the appropriateness of the multinomial logit[5]. Table 2 reports the coefficient of the estimated multinomial logit and Table 3 reports the average marginal effects[6]. Results show that employment is generally positively related with all standardization strategies. Having strategy p00 as reference outcome (i.e. no standardization activities), the propensity of implementing strategy p11 (i.e. both internal and external standardization activity) linearly increases with size. The average marginal effect of employment on probability of engaging both internal and external standardization has a p-value of 0.104. Interestingly, the relationship between size and internal standardization (i.e. p10) appears as a reversed U-shape as shown in Figure 1. Compared with strategy p00, the propensity of p11 increases with size; it achieves the maximum when a firm has almost 250 employees. The interpretation is that above a threshold, internal standardization only is not enough to satisfy a firm's needs and firms include external standardization activities in their strategy. As a check for robustness, the model was fitted using different specifications of size (i.e. natural logarithm of employment, without interaction effect, with 5 categorical dummies)[7]. Coefficients of other covariates do not differ significantly. With respect to the international market variable, despite previous results, exporting Luxembourgish firms are not more likely to engage in standardization activities. A possible explanation is that Luxembourg is a small country with a very open economy. As expected, being part of a group (both national and international), increases the likely internal standardization activities. However, group status is not correlated with strategy p11[8]. With respect to sectors of economic activities, it appears that, compared to the manufacturing sector, utilities, trade and financial firms are more likely to perform internal standardization activities. Luxembourg firms engaged in utilities and transport are really unlikely to be engaged in external standardization activities (both sector dummies have a negative average marginal effect with p-value of 0.11). Even if standards are particularly relevant for ICT, in our sample, ICT firms are not more engaged into standardization activities.

[3] Results of more parsimonious specifications are reported because of space limitation but they are available upon request.

[4] The model was fitted implementing the gologit2 ado-file (Williams, 2006) to account for sample design weights.

[5] Formal tests for the assumption of independence of irrelevant alternatives (i.e. "choice between two alternative outcomes is unaffected by what other choices are available") of multinomial Logit are not recommended due to unreliable results (Long & Freese 2006; Cheng & Long 2007). In this case the problem is acerbated due to use survey data and sample weights.

[6] Mostly due to the non-linear aspects of the model, pseudo R2 of logit model cannot be directly compared with R2 calculated for linear models. The literature proposes different pseudo R2 as rough measure of fit for model with dichotomous dependent variable. Considering that for logit model, generally speaking, values of pseudo R2 greater than 0.15- 0.20 are very good in the absence of an appropriate experimental design (Scarpa and Greene, 2005 p. 104), the reported R2 (0.204) is considered as good indication of model adequacy.

[7] Regressions coefficients are not included in this paper because of space limit, but are available upon request. Categorical variables are defined as: 10-19; 20-49; 50-99; 100-249; +250.

[8] Test that group measures are jointly not influential (P00 vs. P11) is not rejected F (2, 634) = 1.41 Prob. > F = 0.2442

As a check for robustness, the model was fitted using different specifications of sectors (i.e. excluding utilities and transport, re-classification of sector according their technological intensity)[1]. Coefficients of other covariates do not differ significantly. Table 2 and Table 3 show that a refined analysis of types of competition contributes to shed light on the driving force of a standardization strategy. Uncertainty in future trajectory of technology increases the likelihood of standardization activities, both internal and external (average marginal effect of p00 vs. p11 has a p-value of 0.12). Considering that standardization is often a tool of market coordination and participation in formal external standardization allows for a better forecasting of the future and possible influences on market trends, a possible interpretation is that standardization (both internal and external) is more valuable when technological trajectories are uncertain. Moreover, the results show that if competition is characterized by high obsolescence of product and services (i.e. outdated product), the probability of internal standardization decreases, the external and internal is not affected. While it is unlikely that a firm is going to invest in internal standardization when its products are going to be outdated, the external standardization can possibly foresee and partially mitigate the obsolescence process. The test, that competition measures are jointly not influential, is rejected for both equation p00 vs. p10 and p00 vs. p11[2]. With respect to innovation-related activities, surprisingly only the importance of patenting is significantly related to an internal standardization process suggesting that the invention process (patent and positive R&D expenditures) is correlated with standardization process. Innovation related activities do not increase the likelihood of Luxembourgish firms to engage in external standardization.[3] However, firms with a higher percentage of educated labour force are considerably more likely to engage in both internal and external standardization. A possible explanation is that while internal standardization strategies can be performed without high educated employees, the participation to formal external standardization process requires considerable expertise: firms need a large share of educated people to participate and contribute in standardization process[4].

[1] Regressions coefficients are not included in this paper because of space limit, but are available upon request. In line with Blind et al., (2012), the reclassification is done distinguishing between high and low tech sector and low and knowledge intensive sector (Eurostat 2009).
[2] Test results are F (5, 631) = 2.60 prob. > F = 0.0244 for p00 vs. p10 and F (5, 631) = 2.48 Prob. > F =0.0308 for p00 vs. p11
[3] The result for the test that innovation related measures are jointly not influential is F(4, 632) = 1.22, Prob. > F = 0.2995 for p00 vs. p11
[4] The result for the test that education of labour force measures are jointly not influential is not rejected F (2,634) = 1.58 Prob. > F = 0.2071 for p00 vs. p10

Table 2: Multinomial Logit estimates

			Strategies	
	VARIABLES	p00	p10	p11
Size	Empl.		0.003***	0.004**
			(0.001)	(0.002)
	Empl.^{2}		-6.99e-07**	-7.89e-07
			(3.49e-07)	(5.59e-07)
International Market	Intern. market		-0.11	0.77
			(0.30)	(0.85)
Group Status	No group		base	base
	Nat. group		0.86***	1.49
			(0.30)	(1.03)
	Int. group		0.65**	0.07
			(0.30)	(1.11)
Sectors	Manufacturing		base	base
	Utilities		1.74***	-14.14***
			(0.56)	(0.94)
	Trade		0.78*	-0.46
			(0.41)	(1.00)
	Transportation		0.42	-14.91***
			(0.39)	(1.18)
	ICT		0.19	-0.97
			(0.45)	(0.89)
	Financial		1.71***	-0.70
			(0.46)	(2.24)
	Professionals		0.36	-1.63
			(0.57)	(1.51)
Competition	New comp.		-0.20	-0.50
			(0.25)	(0.81)
	Outdated Product		-0.62**	-0.82
			(0.28)	(0.91)
	Tech. uncertainty		0.82***	1.63**
			(0.27)	(0.67)
	Price		-0.44	0.00
			(0.42)	(0.75)
	Quality		0.44	-0.51
			(0.40)	(0.67)
Innovative activities	Cooperation		-0.18	-0.31
			(0.51)	(1.20)
	R&D		0.41	0.17
			(0.35)	(0.99)
	Cooperation # R&D		1.07	1.43
			(0.69)	(1.41)
	Patent		1.31***	0.55
			(0.42)	(0.71)
Labour force education	0-9%		base	base
	19-49%		-0.31	2.39***
			(0.35)	(0.92)
	+ 50%		0.28	3.55***
			(0.41)	(1.09)
Constant			-2.26***	-7.04***
			(0.49)	(1.73)
Observations		636		
Pseudo R-squared		0.204		
Population size		1505		

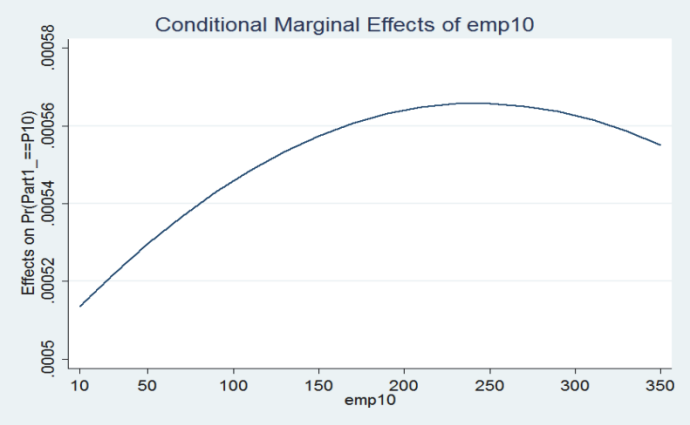
Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 3: Average Marginal effect

	VARIABLES	(p00 vs. p10) dy/dx	(p00 vs. p11) dy/dx
Size	emp10	.0004***	.00004
		(0.01)	(0.104)
International Market	Intern. market	-0.02	0.01
		(0.66)	(0.29)
Group Status	No group		
	Nat. group	0.14**	0.02
		(0.02)	(0.35)
	Int. group	0.11**	-0.00
		(0.04)	(0.82)
Sectors	Manufacturing	Base	base
	Utilities	0.34***	-0.04
		(0.00)	(0.11)
	Trade	0.13**	-0.02
		(0.05)	(0.43)
	Transportation	0.08	-0.04
		(0.17)	(0.11)
	ICT	0.04	-0.02
		(0.56)	(0.33)
	Financial	0.32***	-0.03
		(0.00)	(0.39)
	Professionals	0.07	-0.03
		(0.44)	(0.26)
Competition	New comp.	-0.03	-0.01
		(0.48)	(0.63)
	Outdated Products	-0.10**	-0.01
		(0.03)	(0.54)
	Tech. uncertainty	0.13***	0.02
		(0.01)	(0.12)
	Price	-0.08	0.00
		(0.30)	(0.72)
	Quality	0.08	-0.01
		(0.21)	(0.37)
Innovative activities	Cooperation	0.01	0.00
		(0.84)	(0.77)
	R&D	0.10*	0.00
		(0.08)	(0.77)
	Patent	0.25***	-0.00
		(0.00)	(0.75)
Labour force education	0-9%	base	base
	19-49%	-0.06	0.02*
		(0.29)	(0.05)
	+ 50%	0.03	0.04*
		(0.68)	(0.07)
Observations		636	
Population size		1505	

Robust P-values in parentheses *** p<0.01, ** p<0.05, * p<0.1; Note: dy/dx for factor levels is the discrete change from the base level

Figure 1 Conditional marginal effect of employment on adopting an internal strategy only



6. Final Remarks

Moving from some theoretical considerations and previous empirical studies, this paper shed some lights on the reasons that are driving the firm's choice of different standardization strategies. Leveraging upon a unique database, the analysis is the first to distinguish between no standardization activities, internal only, external only and both internal and external standardization activities. The results underline the difficulties that firms, especially small and with low skilled employees, face to engage in standardization activities. The fact that firms are more likely to join standardization when there is uncertainty about future technologies, can be interpreted as a further evidence of the interplay of standardization and innovation when a new market and technological paradigm is rising, as shown by Blind and Gauch (2009) for nanotechnologies. However, almost surprisingly, the "openness" of firms and some innovation activities is not confirmed by the example of Luxembourg. When interpreting this result, it is important to consider that Luxembourg is a small open service economy and service standardization has not achieved the importance comparable with standardization for manufacturing. Moreover, the national standardization institute only recently started its activities. Despite these particularities, the result of the study are useful for policy makers to profile firms that are more likely to participate in standardization or more generally more engaged on standardization. For example, policy makers aiming to increase participation in standardization activities need to pay particularly attention to education issues, including standardization education. Future research including a cross-country comparison can increase our understanding of standardization activities. Finally, identifying and investigating the drivers of firm standardization strategies, this research poses the question: which standardization strategy pays off the most? The answer is left for future investigations.

References

Baron, J., **Ménière**, Y. and **Pohlmann**, T., (2011). R&D coordination in standard setting organizations: The role of consortia. In 2011 7th International Conference on Standardization and Innovation in Information Technology, SIIT 2011. Berlin.

Blind, K. (2002). Driving forces for standardization at standardization development organizations. Applied Economics, 34(16), 1985–1998.

Blind, K. (2004). The economics of standards: theory, evidence, policy, Edward Elgar Publishing.

Blind, K. (2006). Explanatory factors for participation in formal standardisation processes: Empirical evidence at firm level. Economics of Innovation and New Technology, 15(2), 157–170.

Blind, K. and **Gauch**, S. (2009). Research and standardisation in nanotechnology: evidence from Germany. The Journal of Technology Transfer, 34(3), 320–342.

Blind, K. and **Mangelsdorf**, A. (2008). Driving Factors For Service Companies To Participate In Formal Standardization Processes : An Empirical Analysis. In Paper presented at the "Knowledge for Growth" Conference, 7-9 July 2008. Stuttgart 25, 26 September.

Blind, K. and **Mangelsdorf**, A. (2013). Alliance Formation of SMEs: Empirical Evidence From Standardization Committees. IEEE Transactions on Engineering Management, 60(1), 148–156.

Blind, K. and **Thumm**, N. (2004). Interrelation between patenting and standardisation strategies: empirical evidence and policy implications. Research Policy, 33(10), 1583–1598.

Blind, K., **Vries**, H.D. and **Mangelsdorf**, A., (2012). External Knowledge Sourcing and Involvement in Standardization - Evidence from the Community Innovation Survey. In 2012 IEEE International Technology Management Conference, ITMC 2012 , art. no. 6306399. 1–9.

CEN-CENELEC, (2012). CEN-CENELEC Position Paper on Horizon 2020. Available at http://www.cencenelec.eu/News/Policy_Opinions/PolicyOpinions/PPhorizon2020.pdf

Cheng, S. and **Long**, J.S., (2007). Testing for IIA Multinomial Logit Model. Sociological Methods & Research, 35(4), 583–600.

Chesbrough, H., (2011). Open Services Innovation: Rethinking Your Business to Grow and Compete in a New Era, Jossey-Bass.

Cohen, W.M. and **Levintha**l, D.A., (1990). Absorptive capacity: a new perspective on learning and innovation. Administrative science quarterly, 35(1), 128–152.

EU commission (2008). COM 133 - Communication From The Commission To The Council, The European Parliament And The European Economic And Social Committee: Towards an increased contribution from standardisation to innovation in Europe -.

David, P. and **Greenstein**, S., (1990). The Economics Of Compatibility Standards: An Introduction To Recent Research. Economics of Innovation and New Technology, 1(1), 3–41.

de Vries, H.J., (2006). Standards for business: How companies benefit from participation in international standards setting. IEC, Geneva, Switzerland available at http://www.iecchallenge.org/papers/pdf_iecchallenge/vries.pdf

de Vries, H.J. and **Slob**, F.J.C. (2009). Best Practice in Company Standardization. In Lee I., ed. Selected Readings on Information Technology and Business Systems Management. IGI Global.

de Vries, H.J., **Slob**, F., J.C. and **Zuid-Holland**, V.G., (2006). Best Practice in Company Standardization. International Journal of IT Standards and Standardization Research, 4(1), 62–85.

de Vries, H.J., Knut **Blind** K., **Mangelsdorf** A., **Verheul** H. and **van der Zwan** J. (2009). SME access to European standardization: Enabling small and medium-sized enterprises to achieve greater benefit from standards and from involvement in standardization, Rotterdam, the Netherlands. Available at: http://www.normapme.eu/public/uploads/files/SME%20Access%20Report%2020090821.pdf

Demortain, D., (2008). Standardising through concepts: the power of scientific experts in international standard-setting. Science and Public Policy, 35(6), 391–402.

Di Tommaso ML, Weeks M (2000) Decision Structures and Discrete Choices: An Application to Labour Market Participation and Fertility. DAE Working Papers n. 00-09, University of Cambridge, Cambridge, UK.

Eurostat, (2009). "High-technology" and "knowledge based services" aggregations based on NACE Rev. 2, available at: http://epp.eurostat.ec.europa.eu/cache/ITY_SDDS/Annexes/htec_esms_an3.pdf

Farrell, J. and **Saloner**, G., (1988). Coordination Through Committees and Markets. RAND Journal of Economics, 19(2), 235–252.

Farrell, J. and **Simcoe**, T., (2012). Choosing the rules for consensus standardization. The RAND Journal of Economics, 43(2), 235–252.

Félix, B., (2007). Innovative enterprises and the use of patents and other intellectual property rights Statistics, available at http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-SF-07-091/EN/KS-SF-07-091-EN.PDF

Gauch, S. and **Blind**, K. (2010). Open innovation as driver for participation in standardization. In 15th EURAS Annual Standardization Conference – Service Standardization – Lausanne, 1 – 2 July, 185–201.

Grant, R., (1996). Toward a knowledge-based theory of the firm. Strategic management journal, 17(Special issue winter), 109–122.

Greene, W.H., (2012). Econometric Analysis (7th Edition), Prentice Hall.

Haudeville, B. and **Wolff**, D., (2004). Enjeux & déterminants de l'implication des entreprises dans le processus de normalisation. Revue d'économie industrielle, 108(1), 21–40.

Hesser, W., **Feilzer**, A. and **De Vries**, H., (2007). Standardisation in Companies and Markets, Helmut-Schmidt-Universität, Universität der Bundeswehr Hamburg; Auflage: 2., überarb. u. stark erw. Aufl.

Jakobs, K. and **Procter**, R., (2001). The Making of Standards : Looking Inside the Work Groups. Communications Magazine, IEEE, 39(4), 102–107.

Le Gall, F. and **Prager**, M., (2011). Participation of SMEs in Standardization. ETSI white paper No.6.

Lecraw, D.J., (1984). Some economic effects of standards. Applied Economics, 16(4), 507–522.

Leiponen, A.E., (2008). Competing Through Cooperation: The Organization of Standard Setting in Wireless Telecommunications. Management Science, 54(11), 1904–1919.

Lerner, J. and **Tirole**, J., (2006). A Model of Forum Shopping. The american Economic Review, 96(4), 1091–1113.

Link, A.N. (1983). Market structure and voluntary product standards. Applied Economics, 15(3), 393–401.

Long, J.S. and **Freese**, J. (2006). Regression Models for Categorical Dependent Variables Using Stata, Second Edition, Stata Press.

Mattli, W., and **Büthe**, T., (2003). Setting international standards. World Politics, 56(1), 1–42.

Miles, I. (2007). Research and development (R&D) beyond manufacturing: the strange case of services R&D. R&D Management, 37(3), 249–268.

Poirier D.J. and **Kapadia** D. (2012). Multivariate Versus Multinomial Probit: When are Binary Decisions Made Separately also Jointly Optimal? University of California, Irvine Working paper. Available at: https://www.economics.utoronto.ca/conferences/index.php/rcef/2012/paper/viewFile/373/132

Rammer, C., **Czarnitzki,** D. and **Spielkamp**, A. (2009). Innovation success of non-R&D-performers: substituting technology by management in SMEs. Small Business Economics, 33(1), 35–58.

Riillo C.A.F. (2013) Profiles and Motivations of Standardization Players. International Journal of IT Standards and Standardization Research, 11(2), 17-33.

Rysman, M. and **Simcoe**, T. (2008). Patents and the Performance of Voluntary Standard-Setting Organizations. Management Science, 54(11), 1920–1934.

Scarpa, R. and **Greene**, W.H. (2005) “Un breve excursus sull’analisi econometrica delle scelte discrete” in I modelli a scelta discreta per l’ analisi dei trasporti. E. Marcucci (ed), Roma, Italia. Carocci Editore.

Shapiro C. (2001). Navigating the Patent Thicket: Cross Licenses, Patent Pools, and Standard Setting” in Innovation Policy and the Economy, Volume 1, Jaffe, A.B., Lerner J. and Scott Stern S. eds. 119 – 150.

Simons, C.A.J. and **de Vries** H.J. (2002). Standaardisatie en Normalisatie. Deel 3: Innovatie en bedrijfsnormalisatie. Engineering Dossiers. Ten Hagen & Stam b.v., The Hague Haag, 54 pp.

Slob, F.J.C. and **de Vries**, H.J. (2002). Best Practice In Company Standardisation, (August 2002, 10). ERIM Report Series Reference No. ERS-2002-81-ORG. Available at SSRN: http://ssrn.com/abstract=371029

Swann, G.M.P. (2000). The economics of standardization: final report for Standards and Technical Regulations Directorate. Final Report for Standards and Technical Regulations Directorate Department of Trade and Industry.

Tether, B.S., **Hipp**, C. and **Miles**, I., (2001). Standardisation and particularisation in services: evidence from Germany. Research Policy, 30(7), 1115–1138.

Vrontis, D., **Thrassou**, A. and **Lamprianou**, I. (2009). International marketing adaptation versus standardisation of multinational companies. International Marketing Review, 26(4/5), 477–500.

Waguespack, D.M. and **Fleming**, L. (2009). Scanning the Commons? Evidence on the Benefits to Startups Participating in Open Standards Development. Management Science, 55(2), 210–223.

Wakke, P. and **Blind**, K. (2012). The Impact of Participation within Formal Standardization on Firm Performance. In M. Orviska and K. Jakobs, eds. Euras Proceedings 2012. Koisice, Slovakia, 345–362.

Wakke, P. (2010). Explanatory Factors for Service Standardization at National Standards Bodies : Empirical Evidence at Sector Level. In J.-C. Graz and K. Jakobs, eds. EURAS Proceedings. Lausanne, Switzerland, 383–394.

Weeks M. and **Orme** C. (1999). The Statistical Relationship between Bivariate and Multinomial Choice Models. DAE Working Papers n. 99-12. University of Cambridge, Cambridge, UK. Available at: https://www.repository.cam.ac.uk/bitstream/handle/1810/423/wp9912.pdf?sequence=1

Williams, R. (2006). Generalized Ordered Logit/ Partial Proportional Odds Models for Ordinal Dependent Variables. The Stata Journal, 6(1), 58–82.

Annex

Table 4: Descriptive statistics and variables definition

Description		Standardization strategies		
		p00	p10	p11
		No.	No.	No.
Number of employees 2010	Emp.10			
	10-19	48	9	10§
	20-49	376	128	
	50-99	335	161	
	100-249	157	72	
	+250	87	104	16
	Total	1,004	475	26
International market	mrkt_==1			
No exporting	0	229	87	26§
Exporting	1	775	388	
	Total	1,004	475	26
Group status				
No group	gp_in==0	575	137	26§
National group	gp_in==1	135	102	
Int. group	gp_in==2	294	236	
	Total	1,004	475	26

Description		Standardization strategies		
		p00	p10	p11
		No.	No.	No.
Industries				
C Manufacturing	nace_==2	777	401	
D E Utilities	nace_==3	14	16	
G Trade	nace_==6	221	78	
H Transportation	nace_==7	209	56	26§
J ICT	nace_==9	135	60	
K Financial	nace_==10	113	159	
M Professionals"	nace_==12	85	32	
	Total	1,004	475	26
Competition				
Influence from new competitors	mencon_==1			
No (low-no relev.)	0	439	245	15
Yes (medium-high)	1	565	230	12
	Total	1,004	475	26
Outdated Product	prodper_==1			
No (low-no relev.)	0	722	349	26§
Yes (medium-high)	1	282	125	
	Total	1,004	475	26
Technological developments are difficult to predict	techprev_==1			
No (low-no relev.)	0	712	268	26§
Yes (medium-high)	1	292	207	
	Total	1,004	475	26
Price competition	pricon_==1			
No (low-no relev.)	0	126	71	26§
Yes (medium-high)	1	878	403	
	Total	1,004	475	26
Quality competition	qualcon_==1			
No (low-no relev.)	0	153	66	26§
Yes (medium-high)	1	851	408	
	Total	1,004	475	26
C**ooperation and Intramural R&D**				
No cooperation. and No R&D (including missing)	co_==0 & rdcat==0	778	279	11§
Only R&D	co_==1	69	34	
Only cooperation	rdcat==1	109	80	15§
Both R&D and cooperation	co_==1& rdcat==1	48	81	
	Total	1,004	475	26
Patenting	propat_==1			
Importance of patent (low- no relev.)	0	953	389	17
Importance of patent (high - medium.)	1	51	85	10
	Total	1,004	475	26
Education(# empl. with min. a bachelor)				
0-9 %	ed==1	494	151	12§
10-49%	ed==2	277	140	
+ 50%	ed==3	233	184	14
	Total	1,004	475	26

§ Cells are merged for statistical secret issues, rounding can affects totals

Table 5: Multinomial logit estimations

	(1)			(2)			(3)			(4)		
VARIABLES	p00	p10	p11	p00	p10	p11	p00	p10	p11	p00	p10	p11
Emp10		0.00***	0.00***		0.00***	0.00**		0.00**	0.00**		0.00***	0.00**
		(0.00)	(0.00)		(0.00)	(0.00)		(0.00)	(0.00)		(0.00)	(0.00)
$Emp10^2$		-0.00*	-0.00		-0.00**	-0.00		-0.00	-0.00		-0.00**	-0.00
		(0.00)	(0.00)		(0.00)	(0.00)		(0.00)	(0.00)		(0.00)	(0.00)
Intern. market		0.21	0.97		0.11	0.78		-0.13	0.50		-0.11	0.77
		(0.30)	(0.88)		(0.31)	(0.86)		(0.31)	(0.88)		(0.30)	(0.85)
No group		-	-		-	-		-	-		-	-
Nat. group		1.06***	1.92*		1.08***	1.90		0.87***	1.74		0.86***	1.49
		(0.31)	(1.08)		(0.32)	(1.18)		(0.30)	(1.06)		(0.30)	(1.03)
Int. group		0.74***	0.49		0.80***	0.65		0.64**	0.48		0.65**	0.07
		(0.28)	(1.20)		(0.28)	(1.27)		(0.29)	(1.21)		(0.30)	(1.11)
Manufact.		-	-		-	-		-	-		-	-
Utilies		1.39***	-		1.46***	-		1.75***	-		1.74***	-
			13.02***			14.77***			14.98***			14.14***
		(0.47)	(0.61)		(0.52)	(0.85)		(0.55)	(0.87)		(0.56)	(0.94)
Trade		0.19	-1.15		0.29	-0.90		0.75*	-0.43		0.78*	-0.46
		(0.35)	(0.86)		(0.36)	(0.88)		(0.40)	(1.03)		(0.41)	(1.00)
Transport		-0.20	-		-0.08	-		0.45	-		0.42	-
			14.00***			15.23***			15.12***			14.91***
		(0.34)	(0.46)		(0.35)	(0.50)		(0.38)	(0.67)		(0.39)	(1.18)
ICT		0.26	0.28		0.11	0.00		0.43	0.43		0.19	-0.97
		(0.31)	(0.84)		(0.34)	(0.73)		(0.36)	(0.75)		(0.45)	(0.89)
Financial		1.21***	-0.05		1.27***	0.01		1.85***	0.69		1.71***	-0.70
		(0.36)	(1.60)		(0.37)	(1.83)		(0.40)	(1.79)		(0.46)	(2.24)
Professionals		0.53	-0.60		0.55	-0.24		0.57	-0.18		0.36	-1.63
		(0.42)	(1.16)		(0.42)	(1.21)		(0.52)	(1.26)		(0.57)	(1.51)
New compt.					-0.17	-0.45		-0.18	-0.46		-0.20	-0.50
					(0.24)	(0.86)		(0.25)	(0.91)		(0.25)	(0.81)
Outdat. prod.					-0.44	-0.47		-0.61**	-0.69		-0.62**	-0.82
					(0.27)	(0.93)		(0.28)	(0.96)		(0.28)	(0.91)
Tech. uncer.					0.76***	1.90**		0.80***	1.92***		0.82***	1.63**
					(0.26)	(0.78)		(0.27)	(0.70)		(0.27)	(0.67)
Price					-0.27	-0.05		-0.37	-0.02		-0.44	0.00
					(0.42)	(0.96)		(0.44)	(0.86)		(0.42)	(0.75)
Quality.					0.40	-0.74		0.46	-0.65		0.44	-0.51
					(0.39)	(0.70)		(0.40)	(0.68)		(0.40)	(0.67)
Coop.								-0.12	-0.49		-0.18	-0.31
								(0.49)	(1.21)		(0.51)	(1.20)
R&D								0.37	0.02		0.41	0.17
								(0.36)	(1.08)		(0.35)	(0.99)
Coop#R&D								1.02	1.66		1.07	1.43
								(0.68)	(1.51)		(0.69)	(1.41)
Patent								1.30***	1.33*		1.31***	0.55
								(0.40)	(0.70)		(0.42)	(0.71)
0-9%											-	-
10-49%											-0.31	2.39***
											(0.35)	(0.92)
+50%											0.28	3.55***
											(0.41)	(1.09)
Constant		-	-5.21***		-	-5.07***		-	-5.38***		-	-7.04***
		1.95***			2.11***			2.37***			2.26***	
		(0.31)	(0.88)		(0.45)	(1.58)		(0.48)	(1.61)		(0.49)	(1.73)
Observations		636			636			636			636	
Pseudo R-squared		0.125			0.150			0.192			0.204	
Weighed Pop.		1505			1505			1505			1505	

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 6: Sensitivity analyse: Average Marginal effects of alternative discrete choice model

		P10			P11		
	Variable	mprobit	mlogit	biprobit	mprobit	mlogit	biprobit
Size	emp10	0,000474	0,000524	0,000401	0,0000563	0,0000466	0,0000583
International Market	Intern. market	0,00688	0,00464	-0,00348	0,0127	0,0117	0,0213
Group Status	No group						
	Nat. group	0,111	0,110	0,0942	0,0307	0,0270	0,0563
	Int. group	0,130	0,130	0,123	-0,00435	-0,00333	0,00242
Sectors	Manufact.						
	Trade	0,128	0,136	0,113	-0,0271	-0,0242	-0,0068
	ICT	0,0310	0,0296	0,0268	-0,0310	-0,0281	-0,0236
	Financial	0,305	0,297	0,298	-0,0403	-0,0368	-0,0313
	Professionals	0,0557	0,0567	0,0446	-0,0408	-0,0377	-0,0281
Competition	New comp.	0,0221	0,0215	0,0309	-0,0088	-0,0075	-0,0141
	Outdated Products	-0,107	-0,105	-0,118	-0,0062	-0,0082	-0,0005
	Tech. uncertainty	0,120	0,117	0,116	0,0184	0,0199	0,0237
	Price	-0,0846	-0,0844	-0,0893	0,0078	0,00506	0,0124
	Quality	0,0509	0,0482	0,0522	-0,0152	-0,0179	-0,0190
Innovative activities	Coop.	-0,0262	-0,0284	-0,0275	0,00416	0,00382	0,00542
	R&D	0,0972	0,0994	0,0994	0,0048	0,0039	0,0047
	Patent	0,244	0,250	0,251	-0,0066	-0,0041	-0,0020
Labour force education	0-9%	-					
	19-49%	-0,0732	-0,0704	-0,0546	0,0214	0,0216	0,0163
	+ 50%	0,0477	0,0523	0,0649	0,0485	0,0467	0,0356

Note: estimates are performed excluding utilities and transports firms. Due to paucity of observation in this sector the multinomial probit has some difficulties to converge.