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# Taking 'some' of the mimicry out of the adoption process: Quality management and strategic substitution

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**Taking ‘Some’ of the Mimicry Out of the Adoption Process:  
Quality-Management and Strategic Substitution**

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**Abstract**

Operations management scholarship has focused on reference-group adoption positively influencing focal-facility adoption; i.e., positive imitation parameters manifest due to the presence of mimicry and contagion. We instead argue that the incentive to adopt a quality-management system can be inversely related to reference-group diffusion. Our theoretical model formalizes the potential for strategic substitution and negative imitation parameters to be applicable in quality-management adoption. We compile a dataset of 2,895 facility-level observations that allows for three different industry-level reference groups; i.e., domestic industry, domestic exporters and foreign exporters. When undertaking probit estimations that do not account for appropriate fixed effects, we find positive imitation parameters which support the presence of mimicry and contagion. Yet when accounting for fixed effects, the imitation parameters turn negative in line with the presence of strategic substitution. Furthermore, the negative influence of reference-group adoption on focal-facility adoption is robust across the three reference groups.

*Key words:* adoption, quality management, standards, mimicry, contagion

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## 1. Introduction

The adoption of internationally-recognized quality certifications, e.g., ISO 9000 and ISO 14000, across the globe by millions of firms and facilities over the last three decades has spurred a great deal of literature in the management sciences—see the reviews by Corbett (2006), Corbett and Yeung (2008), and Heras-Saizarbitoria and Boiral (2013). A number of these studies have focused on the internal and external performance effects of adopting these standards (e.g., Terziovski et al. 2003, Dowell et al. 2000, Martinez-Costa et al. 2009, Levine and Toffel 2010, Singh et al. 2011, Gray et al. 2015). For instance, a number of studies (e.g., Hendricks and Singhal 2001, Corbett et al. 2005) find that quality-management standards contribute positively to financial performance. Yet since Anderson et al.'s (1999) pioneering study, understanding the forces which lead to the adoption and diffusion of quality-management standards has been central to this research endeavor. Factors such as organizational size, firm age, government mandates, customer pressure, supply chains and export considerations (Corbett and Kirsch 2001, Vastag 2004, Corbett 2006) have all been considered instrumental in explaining the decision of a particular plant or facility to incur the sizeable costs in order to seek and obtain a quality-management system.

Yet one of the central tenets of the quality-management adoption literature has been that peer pressure matters when it comes to a focal organization's decision to obtain an internationally-recognized quality certification (Vastag 2004). The idea that pressure builds on an organization as reference-group organizations increasingly adopt can be traced back to Bass's (1969) seminal contagion model. A number of scholars (e.g., Corbett 2006, Albuquerque et al. 2007) followed Bass's insights and considered adoption behavior to be a contagion process where higher levels of reference-group adoption convey more evidence with respect to a standard's benefits. Other scholars (e.g., Guler et al. 2002, Boiral 2003, Delmas and Toffel 2004, Delmas and Montes-Sancho, 2011), however, have been heavily influenced by institutional theories from sociology (i.e., DiMaggio and Powell 1983) where mimetic behavior – the copying of competitors in order to maintain legitimacy – is considered a fundamental driver of an organization's need to conform to an industry standard. Moreover, priors regarding the presence of mimetic behavior have also penetrated mainstream operations management (OM) scholarship (e.g., Naveh et al. 2004, Vastag 2004, Corbett and Yeung 2008, Gao et al. 2010, Gray et al. 2015). Yet whether diffusion processes are driven by contagion or mimetic behavior, the basic insight under both approaches is that a focal organization's probability of adopting a quality-management standard increases with reference-group adoption.

Despite the preponderance of studies holding that homogeneity exists in organizational decisions with respect to quality-management adoption, Delmas and Toffel (2004) ponder the presence of forces that might lead to heterogeneity in adoption decisions. In fact, King et al. (2005) point out that the quality-management adoption literature has tended to downplay strategic considerations in adoption decisions by emphasizing the salience of mimetic, as well as coercive and normative, forces. Yet as Banker et al. (1998,

p. 1192) surmise, an “analysis and discussion of quality management in a competitive environment must ... be predicated by a precise understanding of the nature of competition that exists between firms”. Bulow et al. (1985) set out that organizational investments – and a quality-management system is an investment – in the context of strategic competition can be characterized by strategic complementarity (where the decisions of organizations mutually reinforce one another), but also by strategic substitution (where the decisions of organizations mutually offset one another). Thus, when fully taking into account Ketokivi and Schroeder’s (2004) observation that quality-management practices are adopted and implemented for strategic reasons, one must call into question the premise that mimetic- and contagion-like behavior are universally at play in the diffusion process. In fact, Athey and Schmutzler (2001) show that strategic substitution tends to be more appropriate when investments precede product-market competition (which is the case for quality-management investments) and when competitors are not so farsighted (which will be the case the further along an industry is on the S-curve). The potential importance of strategic considerations is also highlighted by the amount of empirical literature which has indicated that later adopters of quality-management systems do not elicit the same performance benefits as early adopters (e.g., Marion Viadiu et al. 2006, Lo and Chang 2007, Benner and Veloso 2008, Gao et al. 2010); thus, certification tends to become an ineffective strategy when an organization’s competitors begin to adopt the quality-management standard. Yet despite these misgivings with regard to the universal effectiveness of quality standards and the neglect of strategic implications, the basic notion of mimicry and contagion has – to the best of our knowledge – not been called into question.

With this manuscript, we aim to question the prevailing notions in the management science literature with regard to adoption pressures for a quality-management system unequivocally building for a focal organization when its reference-group peers increasingly adopt the standard. Instead of mimicry and contagion being at play in these adoption processes, we argue for the opposite; i.e., that the incentive to adopt a quality-management standard is inversely related to the diffusion of these standards within a competitor reference group. In essence, the pre-existing literature has considered the adoption of quality-management standards to be best characterized by a type of strategic complementarity where it behooves a focal organization to adopt, the more its reference group has adopted. We instead contend that quality-management standards may at times be best characterized as strategic substitutes where it behooves a focal organization to not adopt, the more its competitor reference group has adopted. Thus, our main contention is in direct contrast to the prevailing notions that mimicry and contagion are universally at play in the diffusion of internationally-recognized quality certifications.

In order to support our contention that the adoption of quality-management systems by organizations is often best characterized by strategic substitution and not by strategic complementarity, we first formulate a standard model of oligopoly competition between organizations that incorporates the strategic

decision to seek a quality-management certificate. When considering the incentive to invest in quality-management certification, we formally set out how a focal organization's incentive to adopt a standard can decrease when competitor organizations adopt the standard. Empirically, we follow the advice of Corbett and Kirsch (2001) and Marimon et al. (2010) to employ industry-level data when factoring the impact of reference-group adoption on focal-facility adoption. In particular, we compile a dataset composed of 2,895 facility-level observations based on the 2009 World Bank Enterprise Surveys in Indonesia, Vietnam and Philippines; and we estimate the impact of industry-level adoption (188 4-digit ISIC industries) on a focal facility's probability of adopting a quality-management system. Our empirical approach is flexible with regard to the appropriate industry-level definition of a competitor-peer group, as we consider the adoption levels of three different reference groups: the domestic industry, domestic exporters and foreign exporters in the same 4-digit industry. When undertaking probit estimations that do not account for country-specific, industry-specific and export-destination-specific fixed effects, we find positive imitation parameters in line with the literature's prevailing finding in support of contagion and mimetic behaviors. Yet once we follow Gupta et al.'s (2006) advice to employ more advanced multivariate statistical techniques when accounting for the appropriate fixed effects, the imitation parameters turn negative in line with the presence of strategic substitution. Furthermore, the negative influence of reference-group adoption on focal-facility adoption is robust across the three reference groups.

## **2. Literature Review**

Motivated by the foundational works of Dimaggio and Powell (1983) and Abrahamson (1996), a number of scholars (e.g., Guler et al. 2002, Boiral 2003, Delmas and Toffel 2004, Delmas and Montes-Sancho, 2011) have analyzed the spread of quality standards from the sociology-based institutional perspective where adoption decisions are subject to coercive, mimetic and normative pressures—pressures which ultimately lead to similar practices diffusing across organizations, industries and countries. According to this view, organizations seek legitimacy and status in adopting a quality-management system and are much less motivated by a rational search for efficiencies. It is the concept of mimetic isomorphism – where organizations mimic the practices of successful organizations which have adopted a quality-management system – which we would like to examine in detail with our analysis. The premise behind mimicry is that firms (or better said, plants and facilities) do not implement quality-management systems due to the actual merits; but instead, they adopt the standard because competitor and peer organizations have done so. For instance, while early adopters of quality management might do so for efficiency rationales, Westphal et al. (1997) find that later movers simply adopt in order to enhance legitimacy. As Abrahamson (1996) argues, it is best to consider such diffusion of management practices to be akin to fads and fashions.

The literature within operations management has been substantially influenced by these institutional theorists in attempting to understand the remarkable diffusion of quality-management certifications across the globe over the last thirty years. Namely, a number of scholars (e.g., Naveh et al. 2004, Vastag 2004, Gao et al. 2010, Gray et al. 2015) have been influenced by the institutionalists by also holding that competitive mimicry might be at play in the adoption process. It is important to highlight, however, that some scholars posit rational-actor based motivations as residing behind the presence of mimetic-like behavior. For instance, Ketokivi and Schroeder (2004) assume that mimickers are strictly economically motivated when benchmarking the certification decisions of reference groups. In addition, Albuquerque et al. (2007) consider adoption behavior to be a contagion process where the social interaction in a market eventually leads to a focal facility adopting once a minimum “evidentiary” threshold has been reached with diffusion in a reference group. Nevertheless, Corbett and Yeung’s (2008, p. 1) observation that “recent research has uncovered the role of social factors, rather than considerations of economics or efficiency, in driving certification decisions” underscores how these institutional ideas with regard to mimicry have penetrated the quality-management adoption literature.

While sociology-based views regarding mimicry in adoption processes have taken hold to a degree in the literature explaining the adoption of quality standards, it is worth highlighting Ketokivi and Schroeder’s (2004) observation that the assumptions of rationality and profit maximization represent the cornerstones of OM research. As they underscore, mimicking other actors – instead of carefully analyzing the various contingencies – can be viewed as managers engaging in “stopping thinking” (Ketokivi and Schroeder 2004, p. 73). Whether managers are efficiency or legitimacy seeking becomes quite important when one recognizes that late adopters often do not obtain the same benefits from a quality-management system that early adopters generally obtain. For instance, Gray et al. (2015) find that early adopters tend to have better process compliance as compared to non-certified plants. Benner and Veloso (2008) find that early adopters obtain larger performance benefits than later adopters; and they further observe that “the increased sales that may initially arise from the quality signal ... are likely to fade as more of an organization’s competitors are also certified” (2008, p. 615). Thus, there appears to be a realization in the literature that the benefits of adopting a quality-management system dissipate as the standard diffuses in a particular geographic and industrial context (e.g., Marimon Viadiu et al. 2006, Lo and Chang 2007, Benner and Veloso 2008, Gao et al. 2010).

In order to reconcile the fact that early adopters manifest superior performance outcomes as compared to later adopters, a number of scholars ascribe different managerial motivations to early and later adopters. In essence, there appears to be a common understanding that follows Westphal et al.’s (1997) insight regarding early adopters exhibiting rationality while later adopters tend to be focused on legitimacy and symbolic rationales (e.g., Boiral 2003, Naveh et al. 2004, Delmas and Montes-Sancho 2011, Gao et al.

2010, Gray et al. 2015). While mixed notions regarding the rationality of managers at different stages of the S-curve may suffice in sociology-based discourses (after all, mimetic forces must be relaxed at some point in this discourse, as otherwise managerial innovations would never occur in the first place), such duality in the basic assumptions concerning managerial behavior would seemingly be unappealing in operations management. Ketokivi and Schroeder (2004) share our uncomfortableness with the notion that early adopters ‘think’ while later adopters tend to ‘stop thinking’ by simply mimicking their peers and competitors. These mixed notions regarding managerial rationality also provide an ‘assumption patch’ to explain a reality where later movers might continue to adopt despite negligible performance outcomes. Moreover, this ‘assumption patch’ has seemingly forestalled any questioning of the basic concept of mimicry or contagion. After all, if the benefits of obtaining an internationally-recognized quality certificate decrease when the standard diffuses throughout a particular industrial sector, then rationally-minded managers will be less likely to adopt the standard as the adoption costs (which are by no means trivial) begin to outweigh the adoption benefits.

The roots of this focus in the adoptions literature on positive imitation parameters (i.e., contagion and mimetic behavior) may go back to the influence of Bass’s (1969) seminal work and the subsequent marketing models (e.g., Gatignon et al. 1989, Neelamegham and Chintagunta 1999, Kumar and Krishnan 2002) that were employed in order to explain the diffusion of new products to consumers. While consumer products can involve positive demand-side externalities (e.g., the incentive to have a phone builds as more peers join the network) which gives rise to positive imitation parameters, consumer products do not generally involve negative demand-side externalities (e.g., the consumption of a product by one individual does not negatively affect another individual). Yet, these contagion-like processes from marketing were employed to understand the diffusion of quality-management systems by OM scholars (e.g., Corbett 2006, Albuquerque et al. 2007); even though, organizations – which invest in quality standards – are fundamentally different than consumers. Namely, organizations engage in strategic competition where investments can be characterized both by strategic complementarity (which would give rise to positive imitation parameters) and by strategic substitution (which would actually give rise to negative imitation parameters). While a number of scholars (e.g., Delmas and Toffel 2004, Ketokivi and Schroeder 2004, King et al. 2005, Benner and Veloso 2008) have cautioned that the strategic implications of quality-management standards have been neglected in the adoptions literature, this has yet to lead to any questioning of the basic notions regarding the presence of mimicry and contagion. Throughout the management sciences, the adoption of quality-management standards is considered to be best characterized by a type of strategic complementarity where the decisions of organizations mutually reinforce one another. Yet the contention that we are attempting to build here is that quality-management standards may at times be best characterized as strategic substitutes where the decisions of organizations mutually offset.



While the above lays out how there may be scope for strategic substitution when it comes to the diffusion of internationally-recognized quality standards, the contention that strategic substitution is relevant in the adoption process contradicts a good amount of empirical work which finds a positive relationship between an organization's propensity to adopt a standard and the diffusion of that standard amongst a competitor reference group (e.g., Ketokivi and Schroeder 2004, King et al. 2005, Albuquerque et al. 2007, Delmas and Montes-Sancho 2011, Husted et al. 2016). That said, much of that pre-existing empirical work tends to be at a relatively broad level of analysis (e.g., country-level diffusion of standards). By taking such a broad approach, it makes it difficult to control for common causes of standard adoption amongst related organizations which in turn might lead to spurious causal inferences with regard to the presence of mimicry and contagion. Manski (1993) terms this the reflection problem in his classic article, as it is extremely challenging to infer whether average behavior in a reference group influences the behavior of individuals that comprise the group due to substantial identification issues. In particular, the presence of omitted constructs – where individuals in the same group tend to behave similarly since they have similar characteristics and face similar institutional environments – makes it quite challenging to identify the sought after peer effects: i.e., where the propensity of an individual to behave in some way varies with group behavior.

While identification might be improved by following the recommendations of Corbett and Kirsch (2001) and Marimon et al. (2010) to move the level of analysis to the industry sector, common causes of adoption still persist at the industry level. These common causes affect the adoption behavior of all organizations in a particular sector, and can in turn lead to spurious causal inferences with respect to the presence of mimetic behavior. In particular, industry associations (Terlaak and King 2007), industry-specific government regulations (Heras-Saizarbitoria et al. 2010), trade organizations and professional societies (Corbett 2006), and even the rhetoric taking place in an industry (Boiral 2007) have all been identified as factors which contribute to quality-management certification throughout a sector. Moreover, these sector-level factors – which enhance both the probability of a focal organization's adoption and the probability that the standard diffuses widely in the relevant reference group – are often not fully controlled for in empirical studies of quality-certification adoption. Accordingly, that positive relationship between a focal organization's propensity to adopt and the industry's adoption rate (i.e., that relationship which has been considered to support mimicry and contagion) might very well be spurious in the sense that this positive imitation parameter is driven by salient yet omitted constructs. In fact, one study that we were able to identify that captures a number of common causes via both controls and industry fixed effects (i.e., Terlaak and King 2007) does indeed find evidence in favor of negative imitation parameters; though, the relevance of this finding was not discussed extensively since industry adoption was simply a control variable in this study. We turn now to our theoretical model which formally generates the potential

presence of strategic substitution when it comes to the adoption of internationally-recognized quality certifications.

### 3. Theoretical Model and Main Proposition

The seminal diffusion model presented by Bass (1969) is truly a contagion model as it takes its mathematical inspiration from the epidemic-outbreak processes in epidemiology. Accordingly, the modelling frameworks that follow Bass (e.g., Gatignon et al. 1989, Neelamegham and Chintagunta 1999, Kumar and Krishnan 2002 Albuquerque et al. 2007) have tended to neglect strategic elements by focusing on contagion-like processes. Under such processes, Bass (1969, p. 216) notes that “the pressure [is simply] increasing for later adopters with the number of previous adopters”. Yet in order to formalize the potential for strategic substitution to be applicable when characterizing the adoption decisions of organizations, we present a simple model of quality-management adoption in the context of strategic competition.<sup>1</sup> In particular, we employ a widely-used oligopoly model of strategic competition between organizations; i.e., the Cournot model. After introducing the base model of quantity competition in differentiated brands, we extend the model to incorporate quality-management certification decisions. With the above structure, we can measure the incentives for organizations to invest in quality standards given the adoption decisions of competitors and thus generate a formal proposition that motivates our empirical testing. The aim here is not to model the full complexity of the adoption decision, but to highlight the mechanism which can give rise to strategic substitution and negative imitation parameters.

#### 3.1 A Benchmark Model of Strategic Competition

Consider two organizations producing differentiated brands; i.e., brand 1 and brand 2. Variables  $q_1$  and  $q_2$  denote the respective quantities sold by each organization, and  $p_1$  and  $p_2$  are the respective prices for the brands. The system of indirect demand functions for the two brands takes the form:

$$p_1 = \alpha_1 - \beta q_1 - \gamma q_2 \text{ and } p_2 = \alpha_2 - \gamma q_1 - \beta q_2, \quad (1)$$

where  $\alpha_1$ ,  $\alpha_2$ ,  $\beta$ , and  $\gamma$  are all strictly positive coefficients. We make the assumption that the demand coefficients satisfy:

$$\beta > \gamma \text{ and } \frac{\gamma}{2\beta} < \frac{\alpha_1}{\alpha_2} < \frac{2\beta}{\gamma}.$$

The first part of the assumption implies that altering the quantity produced for a focal brand involves a stronger ‘own-effect’ on the brand’s price as compared to altering the quantity of the competitor-brand. The second part of the assumption is not very restrictive as it does not rule out different demand intercepts for the two brands; i.e., both  $\alpha_1 > \alpha_2$  and  $\alpha_1 < \alpha_2$  are possible. Instead, it simply places a limit on how far

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<sup>1</sup> A more general model could allow for either strategic complementarity or strategic substitution depending on the model’s primitives (see the discussion in Athey and Schmutzler 2001).

apart the coefficients can be while still supporting an equilibrium where both organizations produce positive outputs and maintain non-negative profits.

Let  $f_1$  and  $f_2$  denote the organizations' respective fixed costs—a cost that is independent of output level. Assuming zero marginal costs, each organization  $i$  chooses its production level  $q_i$  in order to solve the following profit-maximization problem:

$$\max_{q_i} p_i q_i - f_i = (\alpha_i - \beta_i - \gamma q_j) q_i - f_i, \quad (2)$$

where  $p_i$  was substituted from (1), and  $i, j = 1, 2$  ( $i \neq j$ ). In solving these profit-maximization problems (2), the Nash-Cournot equilibrium output levels are given by:

$$q_1 = \frac{2\alpha_1\beta - \alpha_2\gamma}{4\beta^2 - \gamma^2} \text{ and } q_2 = \frac{2\alpha_2\beta - \alpha_1\gamma}{4\beta^2 - \gamma^2}. \quad (3)$$

The restrictions on the demand coefficients ensure that  $q_1 > 0$  and  $q_2 > 0$ ; and by substituting (3) into (2), the equilibrium profit levels are given by:

$$\pi_1 = \frac{\beta(2\beta\alpha_1 - \gamma\alpha_2)^2}{(4\beta^2 - \gamma^2)^2} - f_1 \text{ and } \pi_2 = \frac{\beta(2\beta\alpha_2 - \gamma\alpha_1)^2}{(4\beta^2 - \gamma^2)^2} - f_2. \quad (4)$$

Here, we assume that the fixed costs of the organization (to be analyzed in the next section) are sufficiently small in order to maintain non-negative profit levels.

### 3.2 Incorporating Quality-Management Certification into Strategic Competition

In order to factor how the equilibrium outcomes are affected by strategic adoption behavior, we must incorporate quality-management certification into the model. First off, obtaining an internationally-recognized quality system represents a non-trivial task for organizations, as adoption costs have been estimated to range from fifty-thousand up to one-million dollars (Potoski and Prakash 2005, Delmas and Montiel 2009). Thus, we hold that each organization can obtain a quality-management system by making an investment (I)—a quality-management adoption cost.<sup>2</sup> Organizations, however, reap benefits when they obtain quality standards. Anderson et al. (1999) point out that quality-management standards represent a credible signal of process quality that distinguishes the adopter from uncertified competitors; and a number of scholars have followed this insight by observing how standards can reduce the transaction costs and information asymmetries faced by customers (e.g., Terlaak and King 2006, Clougherty and Grajek 2008, 2014, Gopal and Gao 2009, King and Toffel 2009, Singh et al. 2011) and ultimately lead to increased sales (Hendricks and Singhal 1997). In line with these works and Banker et al.'s (1998) modelling of quality in strategic competition, we hold that an organization can enhance the value of its brand with customers by  $\sigma$  when adopting a quality-management system; i.e., certification provides a quality signal which makes buyers willing to pay an additional amount ( $\sigma$ ) for the product.

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<sup>2</sup> The model could be easily extended to allow firm-specific investment costs which could reflect later adopters facing a lower adoption cost than early adopters.

In order to obtain interior equilibria where all firms have positive sales in this revised setting, our previous assumption should be slightly modified so that:

$$\frac{\gamma}{2\beta} < \frac{\alpha_1}{\alpha_2 + \sigma} < \frac{\alpha_1}{\alpha_2} < \frac{\alpha_2 + \sigma}{\alpha_2} < \frac{2\beta}{\gamma}.$$

Moreover, the fixed costs in the profit functions (2) can be interpreted as the adoption cost involved with obtaining a quality-management certification. Formally, for each organization  $i = 1, 2$ ,

$$f_i = \begin{cases} I & \text{if the organization invests in quality certification} \\ 0 & \text{if the organization does not invest in quality certification.} \end{cases} \quad (5)$$

With these revisions to the benchmark model, the next sub-section formulates the strategic decision and characterizes the organizational incentives to invest in quality-management certification.

### 3.3 Measuring the Strategic Incentive to Adopt Quality Management

Table 1 displays a two-organization certification investment game in normal form. The normal-form game described in the table can be easily solved for the equilibrium number of firms (none, one firm, or both) investing in quality-management certification. The solution depends on the magnitude of the adoption cost parameter,  $I$ , as lower adoption costs will clearly enhance the likelihood of adoption. Since the novelty of our contribution resides in empirically estimating the incentives to invest in quality-management certification given the investment decision of a competitor organization, we proceed directly to the characterization of these investment incentives (i.e., the adoption incentive) instead of displaying the Nash equilibria for the strategic adoption game.

The following definitions “quantify” the incentives of the two organizations to invest in quality-management certification:

**Definition.** *The incentive of an organization to invest in quality-management certification is the change in profit resulting from taking this investment given the investment decision taken by the competing organization. More precisely,*

(a) *If organization 2 does not invest, the incentive for organization 1 to invest is:*

$$\Delta\pi_1(\text{Not}) \equiv \pi_1(\text{Invest}, \text{Not}) - \pi_1(\text{Not}, \text{Not}).$$

(b) *If organization 1 does not invest, the incentive for organization 2 to invest is:*

$$\Delta\pi_2(\text{Not}) \equiv \pi_2(\text{Not}, \text{Invest}) - \pi_2(\text{Not}, \text{Not}).$$

(c) *If organization 2 invests, the incentive for organization 1 to invest is:*

$$\Delta\pi_1(\text{Invest}) \equiv \pi_1(\text{Invest}, \text{Invest}) - \pi_1(\text{Not}, \text{Invest}).$$

(d) *If organization 1 invests, the incentive for organization 2 to invest is:*

$$\Delta\pi_2(\text{Invest}) \equiv \pi_2(\text{Invest}, \text{Invest}) - \pi_2(\text{Invest}, \text{Not}).$$

Using the equilibrium profit levels displayed in table 1 and the above definition, we can compute the

incentive levels to invest in a quality-management standard given that the competing organization does not adopt a quality standard. They are as follows:

$$\Delta\pi_1(Not) = \frac{4\beta^2\sigma(2\beta\alpha_1 - \gamma\alpha_2 + \beta\sigma)}{(4\beta^2 - \gamma^2)^2} - I \text{ and } \Delta\pi_2(Not) = \frac{4\beta^2\sigma(2\beta\alpha_2 - \gamma\alpha_1 + \beta\sigma)}{(4\beta^2 - \gamma^2)^2} - I. \quad (6)$$

Similarly, the incentive levels to invest in a quality-management standard given that the competing organization has already adopted a quality standard are as follows:

$$\Delta\pi_1(Invest) = \frac{4\beta^2\sigma[2\beta\alpha_1 - \gamma\alpha_2 + \sigma(\beta - \gamma)]}{(4\beta^2 - \gamma^2)^2} - I \text{ and } \Delta\pi_2(Invest) = \frac{4\beta^2\sigma[2\beta\alpha_2 - \gamma\alpha_1 + \sigma(\beta - \gamma)]}{(4\beta^2 - \gamma^2)^2} - I. \quad (7)$$

In the above strategic setting, a focal organization's incentive to invest in quality-management certification is greater if the competing organization has not invested as compared to the situation where the competing organization has invested in quality management. Put formally,  $\Delta\pi_i(Not) > \Delta\pi_i(Invest)$  for each organization  $i = 1, 2$ . While the condition supporting this *a priori* is immediately satisfied when  $\alpha_1 = \alpha_2$  (i.e., organizations start out with symmetric demand for their brands), we should note that this finding is general enough to also hold for demand differences with either  $\alpha_1 > \alpha_2$  or  $\alpha_2 > \alpha_1$  so long as the difference between the two intercepts is bounded to allow positive output levels. These formal results suggest that strategic substitution mechanisms increase in salience with industry-level adoption, as it increasingly behooves a focal organization to not adopt a quality-management system when competitors have already adopted such a system. Accordingly, our main result can be set out as follows:

**Proposition.** *The incentive for a focal organization to adopt a quality-management system decreases as competitor organizations adopt the quality-management system.*

## 4. Methods

### 4.1 Sampling and Data Coverage

Our data derive from the World Bank's 2009 Enterprise Surveys for business operations in Indonesia, Vietnam and Philippines which provides detailed facility-level information on manufacturing organizations.<sup>3</sup> The three country-level surveys were chosen as they include the necessary data in order to create variable constructs that identify the predictions from our theoretical model: i) whether a facility is quality-management certified or not, ii) the adoption levels of different industry-level reference groups (i.e., the domestic industry, domestic exporters and foreign exporters). In addition, the World Bank surveys for these three countries uniquely involve measures regarding which country represented the principal export destination for the particular facility—a measure which will be crucial for identification purposes. The World Bank surveys also provide detailed data on the economic activities of these facilities which

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<sup>3</sup> The Enterprise Surveys also contain information on 'retail' and 'other' industries, but those non-manufacturing industries do not contain information on exports and export destinations—an important part of our regression specification and a salient element of our identification strategy.

allows for the creation of a number of controls. Besides detailed information on key variable constructs, the advantage of these surveys is that they were conducted using a (stratified) random sampling, which allows obtaining unbiased estimation results for the population of facilities in Indonesia, Vietnam and Philippines. Details of the sampling procedure can be found in the survey implementation notes published by the World Bank.<sup>4</sup> To the best of our knowledge, no other World Bank survey involves such a unique and rich data source for studying these questions.

Our choice to analyze quality-management certification in Indonesia, Vietnam and Philippines was also informed by the status of these three countries as later adopters of quality-management systems. For instance, Hudson and Orviska's (2013) study of transition economies – which are laggard with respect to West European nations – found that 35.4% of the manufacturing facilities in these nations had adopted an internationally-recognized quality certificate. Furthermore, the adoption rate ranged from 10% to 50% across the thirty transition economies which they studied. When we consider the survey responses for the manufacturing facilities in our sample by country (see table 2), we see that Indonesia represents an evident laggard nation with an adoption rate of 13.3%, Vietnam is further along the diffusion process with an adoption rate of 28.8%, and the Philippines represents the leader amongst this group with an adoption rate of 32.7%. While these three countries exhibit some heterogeneity with respect to where they are in the diffusion process, it is important to point out that none of them illustrate quality-certification penetration rates that would indicate their being at the end of the diffusion process. Instead, our sampled countries appear to be in what is referred to as the semi-institutionalization stage where mimetic behavior is supposed to be most salient (Tolbert and Zucker 1983, Delmas and Montes-Sancho 2011). In line with these priors, later movers are thought to typically conform to external pressures by either copying their competitors for the sake of legitimacy (e.g., Naveh et al. 2004, Gray et al. 2014) or because they are exposed to more evidence with respect to the usefulness of a standard (e.g., Albuquerque et al. 2007).

Accordingly, our choosing Indonesia, Vietnam and Philippines as the context to study the adoption decisions of manufacturing facilities was deliberate as this is indeed where mimetic and contagion forces would seemingly be most evident. Choosing these three particular countries was also informed by the received wisdom in the literature that geographic proximity matters in adoption. Delmas and Montes-Sancho (2011) point out that it is nearby peers experiencing similar economic conditions which are customarily benchmarked. In this vein, Albuquerque et al. (2007) move beyond the customary approach to consider the influence of domestic adoption pressure (e.g., the proportion of firms within a domestic industry which have adopted a standard) on a focal firm's adoption decision by showing that cross-country imitation parameters can also be positive for geographically close nations. As they state, "the strong

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<sup>4</sup> Please see <http://www.enterprisesurveys.org/methodology> for those details.

impact of geographic distance suggests that firms in neighboring countries have a greater tendency to observe and share information about management practices” (Albuquerque et al. 2007, p. 464).

With the above rationales behind sample choice in mind, we have a total of 2,895 facility-level observations across Indonesia, Vietnam and Philippines. Table 3 illustrates the distribution of these 2,895 observations across the three countries and across ten broad manufacturing-sector categories; though, we should note that the estimation samples drop in size with the introduction of control variables and fixed effects. While the table provides a basic breakdown of the observations by country and manufacturing sector, our empirical analysis breaks down the manufacturing sectors further into 4-digit ISIC product categories. For instance, table 3 broadly captures the food sector; yet within this broad sector, some of the different 4-digit categories include “production, processing and preserving of meat and meat products”, “processing and preserving of fish and fish products”, “processing and preserving of fruit and vegetables”, and “manufacture of vegetable and animal oils and fats”. Since the surveys include information on which 4-digit category accurately reflects the main product of a given facility, we have a total of 188 4-digit ISIC product categories upon which to build our variable constructs. In particular, we compile adoption levels for the different reference groups (i.e., the domestic industry, domestic exporters and foreign exporters) at the 4-digit industry level. As already alluded to, such precision in measuring the adoption patterns of standards at the industry level is essential if we want improve upon country-level studies and detect specific patterns in the adoption of quality-management systems.

## 4.2 Variable Constructs

Our main variable of interest – the dependent construct – is whether or not a focal facility has adopted a quality-management system; i.e., the response to the World Bank survey question of “Does this establishment have an internationally recognized quality certification?”. While the survey allows for different responses concerning the facility’s 2008 certification status (see table 2 for the breakdown in answers), we follow the precedent of Hudson and Orviska (2013) and consider both ‘yes’ and ‘still in process’ as responses which affirmatively indicate that a facility has adopted a quality-management system.<sup>5</sup> Table 2 shows that 648 (142 in Indonesia, 212 in Vietnam and 294 in Philippines) out of the 2,895 facilities in our sample are quality certified according to this definition.

Hudson and Orviska (2013) also employed World Bank survey data in their study of adoption decisions by organizations in transition economies, and they interpreted this measure as indicating whether the ISO 9000/14000 set of standards has been adopted. They point out that interviewees were given instructions that “If there is need for clarification, some examples are: ISO 9000, 9002 or 14000”. In

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<sup>5</sup> We also employed a more strict measure of certification (simply using ‘yes’ as an affirmative answer) and the empirical results are almost identical when this alternative measure is employed.

addition, Hudson and Orviska show a rough correspondence at the country level between the survey's measure of adoption and the normalized number of ISO 9000 and 14000 standards across the different countries in their sample. Yet that rough correspondence involves a good deal of variation which suggests that some respondents may also view other approaches to quality-management control (e.g., Total Quality Management, and Six Sigma) as fitting the surveyed criteria. While we see the potential for the standards referred to in the World Bank survey as being ISO standards to a considerable extent, we think it best to conservatively refer to these standards in line with the survey question; i.e., it is simply the respondents' determination as to whether the facility has "an internationally recognized quality certification".

In order to test the essence of our theoretical model, we require information on the adoption rate of the appropriate competitor reference group for our focal manufacturing facilities. We will focus on the other facilities which share the same 4-digit ISIC code; yet, there still remains a good bit of scope for different peer groups being relevant for a focal facility within that 4-digit industry. Accordingly, we will consider the adoption levels of three different reference groups: 1) the domestic industry, 2) domestic exporters in the industry, and 3) foreign exporters in the industry.

First, we start with the most common conceptualization in the literature (e.g., Delmas and Toffel 2004, King et al. 2005, Terlaak and King 2007) as to what is the appropriate reference group; that is, the proportion of domestic facilities in the same 4-digit industry which have adopted a quality-management system.<sup>6</sup> This rate for domestic-industry adoption (hereafter referred to as domestic-industry-adoption) essentially captures how far along is a focal facility's domestic industry in the diffusion process. As previously indicated, the adoption literature generally finds a positive coefficient estimate for this variable construct – what can be referred to as an imitation parameter – in support of mimetic and contagion processes driving the certification decisions of organizations; though, we of course are instead hypothesizing that the prevailing relationship is actually negative.

Beyond the standard benchmark of domestic industry adoption is the understanding that exporting firms face particular pressures to adopt standards in order to open up international markets. International buyers face greater transactions costs and information asymmetries, and quality-management certification can alleviate these barriers and be conducive to trading relationships (e.g., Hudson and Jones 2003, Terlaak and King 2007, Clougherty and Grajek 2008, 2014). It is no surprise then that Corbett (2006) finds exporters in later-adopting regions to generally be the first to seek quality-management certification. Thus, there appears to be a common understanding in the diffusion literature that a 'role equivalence in trade' effect exists, as exporters are particularly conscious of the decisions made by other exporting facilities (Guler et al. 2002, Delmas and Montes-Sancho 2011). Moreover, the intuition in the literature is again mimetic as organizations will adopt the same practices as their export competitors, since not adopting

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<sup>6</sup> With this, and subsequent, measures, we do not include the focal facility in calculating industry adoption rate.



would disadvantage the focal organization in competition and lead to eroded market share and reduced profitability (Delmas and Montes-Sancho 2011). We measure then the proportion of exporting-domestic facilities in the same 4-digit industry which have adopted a quality-management system.<sup>7</sup> This rate of quality-management adoption for domestic exporters (hereafter referred to as domestic-exporter-adoption) essentially captures for a focal exporting facility how far along are its domestic-industry exporting peers in the diffusion process. As previously indicated, the adoption literature generally posits a positive imitation parameter for this variable construct in support of mimetic and contagion processes driving the certification decisions of exporting organizations; though, we are again hypothesizing that the prevailing relationship is instead negative.

In competing for export markets, organizations face competition not only from domestic rivals but also from foreign rivals situated in the same industry sector. Albuquerque et al. (2007) point out that cross-country contagion channels exist as a share of domestic certifications will certainly be attributed to the adoption levels in geographically nearby nations. In this vein, Terlaak and King (2007) note that information about a practice should more easily disperse among organizations that are located in geographic proximity. Moreover, a number of scholars (e.g., Guler et al. 2002, Albuquerque et al. 2007, Delmas and Montes-Sancho 2011) find support for the number of certificates in a focal country being positively related to the number of certificates in those countries which compete with the focal country. We measure then the proportion of foreign-exporting facilities in the same 4-digit industry which have adopted a quality-management system.<sup>8</sup> This rate of quality-management adoption for foreign exporters (hereafter referred to as foreign-exporter-adoption) essentially captures for a focal exporting facility how far along are its foreign-industry exporting peers in the diffusion process. For example, the foreign peers for a focal Indonesian facility in the “processing and preserving of fruit and vegetables” sector would consist of the exporters in the Philippines and Vietnam that share the same 4-digit industry.<sup>9</sup> As with the above reference groups, the adoption literature generally posits a positive imitation parameter for this variable construct in support of mimetic and contagion processes driving the certification decisions of exporting organizations; though, we are instead hypothesizing that the prevailing relationship is negative.

While the above represent our explanatory variables of principal interest, it behooves us to factor a number of different control constructs that conform to the pre-existing literature concerning what drives

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<sup>7</sup> This variable construct is set to zero if the focal facility is not exporting, as we desire to capture the effect of quality-management diffusion throughout exporting peers on a focal exporting facility—so not the effect of quality-management diffusion throughout exporting facilities on a focal non-exporting facility.

<sup>8</sup> Akin to the domestic-exporter-adoption variable, this variable is set to zero if the focal facility is not exporting. As before, we want to identify the effect of quality-management diffusion throughout foreign-exporting peers on focal exporting facilities and not on focal non-exporting facilities.

<sup>9</sup> Foreign exporters are limited to the facilities observed in our sample, i.e. the facilities in Indonesia, Vietnam and Philippines. Yet given the geographic and economic proximity of these three countries, we believe this to be a useful – if not exhaustive – foreign reference group.

organizational adoption of quality-management standards so as to yield stronger causal inferences. First, Naveh et al. (2004) rightly point out that a large infrastructure of third-party auditors, registrars and consultants is necessary if a quality-management system is to be taken up by organizations and work effectively. For instance, the ISO 9000 quality-management system requires twice yearly visits by independent third-party auditors (Naveh and Marcus 2005) and these visits can last from two to three days (Boiral 2003). Thus, we compiled data regarding the geographic availability of certification bodies (which are in charge of conducting audits and issuing certificates) in the vicinity of each and every facility in our sample. In particular, we gathered information on the location of every single certification body and every sampled manufacturing facility in each of our three countries. We also gathered information on which particular industry sectors each and every certification body was deemed competent in issuing a certificate. Based on this information, we calculated the number of available certification bodies within a two-hour driving distance from the manufacturing facilities in our sample (hereafter referred to as certification-bodies).<sup>10</sup> We expect this control variable to be positively correlated with facility-level adoption, as in line with all standard models of competition, the costs involved with obtaining certification would seemingly decrease with the number of nearby certification bodies.

In addition to the above, we were able to employ the World Bank survey data in order to yield additional control constructs that might be salient with respect to organizational adoption of quality-management systems. First, the finding that large facilities tend to more readily adopt quality-management systems is arguably the most dominant finding in the empirical literature on standard adoption (Terlaak and King 2007, Levine and Toffel 2010); thus, we control for the focal facility's size via its total domestic sales in 2008 (hereafter referred to as domestic-sales). Second, a focal facility may benefit by being part of a larger firm, as the quality-management standard could provide a price premium across a larger number of products. There may also be efficiencies involved with obtaining standards for a set of facilities in a firm; thus, we control for whether or not the focal facility is part of a multi-plant firm (hereafter referred to as multi-plant-firm). Third, quality-management standards have been found to diffuse upstream via global supply chains (e.g., Corbett 2006); thus, we control for whether or not the focal facility mostly produces intermediate goods (hereafter referred to as intermediate-goods-producer). Fourth, exporters are generally the first to seek certification due to the extensive benefits of quality-management standards in foreign markets (Anderson et al. 1999, Christmann and Taylor 2001, Corbett 2006); thus, we control for whether or not the facility is an exporter (hereafter referred to as exporter). Fifth, the degree to which exporters sell abroad can further incentivize standard adoption as an exporter's size can both enhance the benefits and ease the costs of adoption (Vastag 2004, King et al. 2005, Gopal and Gao 2009); thus, we control for the

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<sup>10</sup> We used Google Maps services in order to calculate the distances between the focal plant and each competent certification body. We also experimented with alternative driving ranges – five and ten hour drives – and found no substantive changes in the results.

focal facility's export size via its total international sales in 2008 (hereafter referred to as export-sales). Sixth, the coercive pressure manifested by foreign buyers might mount over time; thus, we control for the number of years that the focal facility has been exporting (hereafter referred to as export-history). Seventh, multinational enterprises (MNEs) have been considered by many scholars (e.g., Christmann and Taylor 2001, Guler et al. 2002, Heras-Saizarbitoria et al. 2010) to be carriers of quality-management standards and norms as the vertical relationships within MNEs cement the need for certification (King et al. 2005); thus, we control for whether the exports of the focal facility are via a parent-to-subsidary relationship within an MNE (hereafter referred to as MNE-exports). Table 4 provides a short definition and descriptive statistics for all these variables employed in the empirical analysis.

### 4.3 Identification

We wish to identify the causal link between reference-group adoption and the probability that a particular facility will obtain quality-management certification. Empirically, we cast the probability of quality-management certification in the form of a standard index function model, in which the incentive levels  $\Delta\pi$  constitute the unobserved variable that drives the decision to invest in a quality-management system:

$$\Delta\pi = \theta'X + \epsilon, \quad (8)$$

where  $\theta'X$  is the corresponding index function – a linearized empirical equivalent of the incentive-to-invest functions (6) and (7) – and  $\epsilon$  is a normal iid error term. Vector  $X$  contains all of the variables which affect the incentive to invest in the quality-management standard and  $\theta$  is a vector of parameters to be estimated. In line with the standard index function model, we assume that whenever  $\Delta\pi > 0$  an organization decides to obtain a quality-management certificate ( $QM=1$ ); otherwise it remains uncertified ( $QM=0$ ). Thus, given the assumed normality of  $\epsilon$ , equation (8) can be estimated via a probit model,

$$Prob(QM = 1|X) = \Phi(\theta'X). \quad (9)$$

The probit model assumes that reference-group adoption rates conditional on all of the other covariates in  $X$  are independent of the focal firm's decision to invest in quality certification. If reference-group adoption is endogenous, then the conditional independence will be violated and the probit model will yield inconsistent coefficient estimates. Endogeneity may arise via two principal means: reverse causality and omitted-variable bias. We surmise that reverse causality is of little concern in our empirical context due to our dependent variable – the focal facility's decision to adopt an internationally-recognized quality certification – having a fundamentally different aggregation level as compared to our core independent variables; i.e., the three different reference-group adoption rates. The reference-group adoption rates comprise the certification decisions of all the facilities in a particular reference group (e.g., some 43 facilities on average in our domestic industries); thus, it is unlikely that a decision made by a single facility will significantly affect the certification choices made by an entire reference group.

Omitted-variable bias, however, poses a more serious challenge to our empirical approach. We would also add that omitted-variable bias poses a serious challenge to the pre-existing empirical literature which generally interprets the positive relationship between reference-group adoption and focal-organization adoption as supporting priors regarding mimicry and contagion. As we previously set out, a focal facility and the facilities in the reference group are likely to share a number of common causes and attributes that will be unobservable to the researcher. Moreover, these unobserved characteristics will affect both the certification choice of the focal facility and the certification choices of the reference-group organizations. For instance, food-safety concerns due to an outbreak of E.coli bacteria may make all food producers (both a focal facility and the reference group of food producers) more inclined to adopt internationally-recognized quality systems. Such industry-level omitted constructs pose a serious threat to causal inferences, as the positive relationship from a regression of reference-group adoption on focal-facility adoption might then simply be a spurious relationship that is driven by omitted constructs (Wooldridge 2002).

Industry-level omitted factors, however, do not represent the only omitted constructs which might lead to spurious causal inferences. It is well known, for instance, that certain countries provide extensive institutional support (e.g., Germany, Japan and Taiwan) that make it relatively easier for domestic organizations in those countries to obtain quality-management certifications (Corbett 2006). The presence of omitted ‘common causes’ of standard adoption at the country level may then reside behind the finding in the empirical literature that ISO 9000 adoption facilitates ISO 14000 adoption (e.g., Corbett and Kirsch 2001, Vastag 2004, Marimon Viadiu 2006). As Corbett and Kirsch (2001, p. 327) caution, this finding may simply indicate “that the drivers behind the two [standards] have significant overlap”; if the case, then that positive relationship between ISO 9000 diffusion and ISO 14000 diffusion may in fact be spurious in a causal sense. Furthermore, factors with respect to export destinations may also represent omitted constructs that lead to spurious causal inferences regarding the presence of mimetic and contagion behavior. In particular, organizations – as well as countries – will compete against each other in order to secure markets in third countries (Guler et al. 2002, Delmas and Montes-Sancho 2011). For instance, the presence of the European Union (EU) as the principal export market for competing organizations within a sector might generate a common-coercive push for all organizations to adopt quality-management standards in order to be eligible to export to the EU (Anderson et al. 1999, Guler et al. 2002). If such coercive pressures faced by all organizations attempting to export to a specific destination are not controlled for, then spurious causal inferences with respect to mimetic behavior might manifest in standard regressions of reference-group adoption on focal-facility adoption.

In order to control for these potential sources of endogeneity bias, we will introduce a series of three “fixed effects” into our probit-regression model. In particular, we will successively control for country-

specific, industry-specific, and export-destination-specific fixed effects in our probit estimations. We should be clear in that the factors which give rise to the salience of fixed effects have not been lost on the pre-existing literature. Employing export-destination-specific effects is, for instance, informed by the priors of Guler et al. (2002) where quality-standard adoptions result when organizations are competing for the same third-country export markets. Furthermore, King et al. (2005), Terlaak and King (2007), and Levine and Toffel (2010) represent adoption studies where industry-level fixed effects were properly employed in adoption equations. While these studies did not focus on mimetic or contagion processes, Terlaak and King's (2007) facility-level adoption study employed industry-adoption-rate as a control variable along with industry fixed effects. As already noted, we find it striking that they find some evidence in support of a negative relationship between industry adoption and a focal-firm's adoption probability. It is, nevertheless, fair for us to point out that the pre-existing literature has not completely recognized the importance of employing the appropriate fixed effects in a comprehensive manner in order to elicit unbiased estimates of imitation parameters. We turn now to our empirical results where employing country-specific, industry-specific and export-destination-specific fixed effects plays a fundamental role in uncovering the unbiased impact of reference-group adoption on a focal-facilities probability of adopting an internationally-recognized quality certification.

## 5. Empirical Results

We estimate the probit model – as captured by equations (8)-(9) – via the standard maximum likelihood approach. Table 5 reports the empirical results for six different estimations of the probit model. The six estimations reflect the fact that the first estimation does not control for any fixed effects when considering the impact of adoption in the base reference group (domestic-industry-adoption), whereas the subsequent three estimations sequentially add country-specific, industry-specific and export-destination-specific fixed effects in order to elicit non-spurious causal inferences. Furthermore, the last two probit estimations sequentially add the adoption rate for domestic exporting facilities (domestic-exporter-adoption) and the adoption rate for foreign exporting facilities (foreign-exporter-adoption) while fully controlling for all of the appropriate fixed effects. When considering the six estimations as a whole, the regression models appear to be well specified. Table 5 reports the log-likelihood functions for all six probit estimations which indicate that the models better fit the data when additional fixed effects and reference-group variables are added. McFadden's pseudo R-squared statistics also indicate substantial increases when moving from estimation (1) to estimation (6); i.e., when the estimations become more-fully specified. We also report a likelihood ratio chi-square test that rejects the null hypothesis that all of the coefficient estimates are equal to zero. As an aside, the empirical results in table 5 simply report the probit coefficients, as the sign of the reference-group effect (i.e., the sign of the imitation parameter) represents our principal interest. The

discussion below accordingly focuses on the table 5 results; nevertheless, table 6 reports the marginal effects from the same six probit estimations for completeness.

Since the six probit estimations are quite similar in structure and substance – outside of the above-noted alternations in the employment of fixed effects and reference groups – we discuss the results for the control variables as a whole before analyzing our variables of principal interest: i.e., the reference-group adoption rates. First, our count of third-party auditors within a two-hour driving distance (certification-bodies) carries the expected positive sign and is significant – at 1% and 5% levels – in all six probit estimations; thus, the presence of nearby certification bodies appears to facilitate certification. Second, our measure of facility size (domestic-sales) yields a positive coefficient estimate and is significant at the 1% level in all six probit estimations; thus, the results for our size construct are fully in line with the common finding in the adoption literature. Third, our measure of whether a facility is part of a larger firm with multiple facilities (multi-plant-firm) yields a positive coefficient estimate and is significant at the 1% level in all six probit estimations; thus, facilities embedded within larger firms tend to be more likely to adopt a quality-management certificate. Fourth, our measure of whether a facility is embedded within a supply chain by mostly producing intermediate goods (intermediate-goods-producer) is unique amongst the control variables as it is insignificant in all six probit estimations. Fifth, our measure of whether a facility exports (exporter) is positive in all six specifications and significant in the first three probit estimations at the 1% level; thus, we present some evidence that simply being an exporter enhances the probability of certification. Sixth, our measure of export size (exporter-sales) is positive and significant at the 1% level in all six probit estimations; thus, facilities with greater exposure to international markets tend to be more likely to adopt a quality-management certificate. Seventh, our measure of the number of years that the facility has been exporting (export-history) yields a positive coefficient estimate that is significant at the 1% level in all six probit estimations; thus, the length of exposure to international markets increases the probability that a focal facility will adopt a quality standard. Eighth, our measure of whether exports take place within an MNE (MNE-exports) is positive in all six specifications and significant in the first two probit estimations at the 5% level; thus, we present some evidence that being an exporter within an MNE enhances the probability of certification. As an aside, the tendency for the exporter and MNE-exports variables to manifest declining significance as the appropriate fixed effects are added suggests that these constructs are salient, but moreover, that the “fixed effects” control for a significant part of the unobserved heterogeneity in our econometric model.

Turning to the variables of principal interest, estimation (1) in table 5 provides empirical results for a probit model that does not control for any of the appropriate fixed effects; i.e., neither the country-specific, industry-specific, or the export-destination-specific effects are included in this base estimation. Interestingly, the coefficient estimate for the domestic-industry-adoption variable is both positive and

significant at the 1% level in this base model. This empirical result suggests that focal facilities are more likely to adopt a quality-management standard the more their domestic-industry peer group has adopted the standard. Accordingly, this result is in line with the prevailing finding in the adoption literature where evidence customarily supports the existence of contagion- and mimicry-type processes. Estimation (2) in table 5, however, introduces country-specific effects into the probit model in order to control for any common causes of certification at the country level. While the coefficient estimate for domestic-industry-adoption (the imitation parameter) remains positive and significant at the 1% level in this estimation, the size of the coefficient has dropped from 1.3 in estimation (1) to 1.14 in estimation (2). Accordingly, the introduction of the first appropriate fixed effect drops the size of the imitation parameter but still yields support for the presence of mimicry.

The sequential introduction of industry-specific fixed effects in estimation (3), however, yields empirical results that contradict with the notion that mimicry is present in these diffusion processes. In particular, the coefficient estimate for our variable of principal interest, domestic-industry-adoption, becomes negative and significant once we control for both country-specific and industry-specific effects. Strikingly, it appears that controlling for the omitted factors which affect all facilities in a particular sector plays a fundamental role in terms of reversing the sign of the imitation parameter. Once these common causes at the industry level are controlled for, the empirical evidence suggests that focal facilities are less likely to adopt a quality-management certificate the more their domestic-industry peer group has adopted the standard. Furthermore, the sequential introduction of export-destination specific effects in equation (4) yields more-sizable evidence that strategic substitution is at play, as the size of the coefficient estimate goes from -0.58 – and significant at the 5% level – in estimation (3) to -0.67 – and significant at the 1% level – in estimation (4). Accordingly, the introduction of the full set of appropriate fixed effects yields strong evidence in favor of a negative imitation parameter that contradicts the presence of mimicry and instead supports the presence of strategic substitution.

Considering the above results as a whole, it appears that properly estimating these regression equations is essential if the researcher desires to elicit unbiased imitation parameters. In particular, some countries will provide institutional support and other incentives which influence the certification decisions of all the facilities in a country, thus requiring the introduction of country-specific effects. Furthermore, different industries experience different incentives and pressures that represent common causes of adoption for all of the facilities in a sector, thus requiring the introduction of industry-specific effects. In addition, different host countries will manifest different mandates and requirements for firms attempting to export to these markets, thus suggesting the introduction of export-destination-specific effects. Without properly controlling for these important sources of heterogeneity, the imitation parameters derived from standard regression techniques will manifest substantial bias. For instance, our imitation parameters in estimations

(1) and (2) – the coefficient estimates for domestic-industry-adoption – manifest severe bias as they do not control for the appropriate industry-specific and export-destination-specific fixed effects. Once common-causes are controlled for via industry-specific and export-destination-specific effects, the imitation parameters in estimations (3) and (4) – the coefficient estimates for domestic-industry-adoption – begin to converge on the true relationship between peer-group adoption and focal-facility adoption. Put simply, the greater the extent of quality-management diffusion in a facility’s sector (i.e., the further along is the sector on the S-curve), the less likely is that facility to adopt the quality-management standard. This empirical evidence provides full support for our theoretical priors regarding the appropriateness of considering quality-management adoption to be best characterized by strategic substitution and not strategic complementarity.

While the first four probit estimations simply employ the base definition of a reference group (domestic-industry-adoption), restricting the analysis to domestic peers neglects the reality that some domestic facilities compete in foreign markets and these facilities will also face foreign competitors in these markets. Accordingly, we open up our analysis to account for two additional reference groups: a domestic-exporter reference group, and a foreign-exporter reference group. As already noted, these additional reference groups are deemed relevant for exporting facilities but not for non-exporting facilities; thus, by singling out domestic-exporter-adoption and foreign-exporter-adoption, we allow the adoption incentives for exporting facilities to be different as compared to non-exporting facilities. For instance, the impact of domestic-exporter-adoption on an exporting facility’s probability of adoption is on top of the domestic-industry-adoption effect, as the exporting facility faces competition and/or pressure from both reference groups while the non-exporting facility only faces competition and/or pressure from the domestic-industry reference group. Furthermore, foreign-exporter-adoption allows testing whether it is cross-border contagion – or strategic interactions – which potentially drive the adoption probabilities of focal facilities.

Estimations (5) and (6) in table 5 present the empirical results where the two additional reference groups are sequentially added to the probit estimations. Since the previous estimations established the appropriateness of employing all three fixed effects – i.e. country-specific, industry-specific and export-destination-specific effects – both estimations employ the full set of fixed effects. Estimation (5) simply adds the domestic-exporter-adoption reference group variable and the coefficient estimate for that additional reference group is both negative and statistically significant at the 1% level. Furthermore, the coefficient estimate for domestic-industry-adoption remains negative and significant – albeit at the 10% level – in this probit estimation. Estimation (6) represents the most fully-specified regression model as it includes all three fixed effects and the three reference groups. The foreign-exporter-adoption reference group variable in this probit estimation yields a negative coefficient estimate that is statistically significant



at the 5% level. Furthermore, both the domestic-industry-adoption and the domestic-exporter-adoption reference groups yield negative and statistically significant coefficient estimates – at the respective 5% and 1% significance levels – in this fully-specified probit estimation. Accordingly, these empirical results indicate that additional strategic-substitution type effects manifest for domestic facilities that export, as exporting facilities will be less likely to adopt a quality-management standard when both domestic-exporting and foreign-exporting facilities in their industry increasingly adopt an internationally-recognized quality certification. The presence of negative cross-country imitation parameters is in contrast to previous studies – completed at a more macro-level – that have supported the presence of cross-country contagion (e.g., Albuquerque et al. 2007) or mimicry (e.g., Guler et al. 2002).

## **6. Conclusion**

While a healthy amount of literature exists with regard to what drives organizations to adopt quality-management certification systems, King et al.'s (2005) observation – that the various factors explaining organizational adoption remain not so well known – still holds. As Corbett and Yeung (2008, p.1) underscore, “literally millions of organizations worldwide are directly impacted by such meta-standards [hence] it is surprising that not more scholarly research exists on most of these standards”. In particular, Heras-Saizarbitoria and Boiral (2013) argue that the deficiencies in the quality-management adoption literature are due in part to a poorly structured research agenda that does not take an appropriate incremental approach, which in turn leads to a lack of consensus regarding the main forces driving adoption. Accordingly, a number of operations management scholars have called for further investigation of this topic (e.g., Corbett and Kirsch 2001; Delmas and Toffel 2004, Naveh and Marcus 2005).

Motivated by these calls to more deeply investigate the actual drivers of internationally-recognized quality certifications and to do so in a structured manner, we set out here to question one of the few areas where there appears to be a consensus in the quality-management adoption literature: i.e., the universal presence of mimetic- or contagion-like processes. A great deal of literature holds – and empirically supports – that a focal organization's probability of adopting a quality-management standard tends to increase with reference-group adoption. We instead contend that the adoption of quality-management systems is often best characterized by strategic substitution: where the organizational incentive to adopt a quality standard is actually inversely related to the diffusion of these standards within a competitor reference group. Thus from both a conceptual and a methodological standpoint, we have called into question the notion that imitation parameters are invariably positive and invariably supportive of the presence of mimetic behavior.

Conceptually, we point out that the pre-existing literature on quality-management adoption has been heavily influenced by institutional theories from sociology (i.e., DiMaggio and Powell 1983) and by the

consumer-product diffusion models from marketing (i.e., Bass 1969). While the respective mimetic- and contagion-like processes which result from these theories can explain certain elements of the diffusion process, these approaches do not take into account that the adoption of a quality-management standard by an organization can actually reduce the incentive of a competitor organization to adopt the standard. In order to factor such processes, one must consider quality-management standards to be strategic-investment variables that are part of the competition taking place between organizations. A number of scholars (e.g., Delmas and Toffel 2004, Ketokivi and Schroeder 2004, King et al. 2005, Benner and Veloso 2008) have pointed out that the adoptions literature has neglected strategic elements. We take the next step by formally generating the proposition that an organization's incentive to adopt a quality-management system decreases with the diffusion of the standard amongst competitor organizations. By neglecting the potential for quality-management systems to be strategic variables, the quality-management adoption literature has made incorrect inferences with regard to the universal presence of positive imitation parameters. Put differently, the adoptions literature has mistakenly assumed that adoption pressures unequivocally build for a focal organization when its reference-group peers increasingly adopt the standard.

Methodologically, we point out that the pre-existing empirical literature on quality-management adoption has not fully addressed the challenges involved with inferring whether reference-group behavior truly influences the behavior of focal organizations. For one, a good deal of empirical work has been at the country level which makes it difficult to control for common causes of standard adoption amongst related organizations. While we follow the advice of Corbett and Kirsch (2001) and Marimon et al. (2010) to analyze reference-group diffusion at the industry level, there exist a number of industry-level common causes which affect the adoption behavior of all organizations in a sector. These common causes represent omitted-variable threats which can lead to spurious causal inferences concerning the presence of mimetic behavior. Motivated by Gupta et al.'s (2006) urging operations management scholarship to employ more advanced multivariate statistical techniques, we sequentially introduce a series of fixed effects (country-specific, industry-specific and export-destination-specific) in order to capture common causes of standardization when analyzing the impact of reference-group adoption on a focal facility's probability of adoption. When these fixed effects are not employed, our empirical results mirror the prevailing findings in favor of positive imitation parameters; i.e., our evidence supports the presence of mimicry and contagion in quality-management adoption decisions. Yet when the appropriate fixed effects are introduced into our probit estimations, the imitation parameters turn negative; i.e., our estimations manifest evidence which directly contradicts the presence of mimicry and contagion in adoption decisions.

While properly accounting for omitted variables via a set of fixed effects yields fundamentally different empirical results regarding the impact of domestic-industry adoption levels on a focal facility's probability of adopting a quality-management standard, we are open with respect to the appropriate

reference group for our manufacturing facilities. First, a focal-exporting facility may benchmark the decisions of the other exporting facilities in the same domestic industry (domestic-exporter-adoption). Second, a focal-exporting facility may benchmark the decisions of the foreign-exporting facilities in the same industry sector (foreign-exporter-adoption). When allowing for the adoption levels in these reference groups to affect a focal-facility's adoption probability while controlling for the all of the appropriate fixed effects, we find evidence for the presence of negative imitation parameters throughout all three reference groups; i.e., the adoption levels of the domestic industry, domestic exporters and foreign exporters all negatively influence a focal facility's probability of adopting a quality-management certificate. The presence of negative cross-country imitation parameters is quite interesting (i.e., the impact of foreign-exporter adoption) as previous empirical studies (e.g., Albuquerque et al. 2007) have found positive imitation parameters in support of cross-country contagion.

While we argue for the relevance of strategic substitution and the attendant negative imitation parameters when considering organizational adoption of quality-management systems, we should be careful to stress that there may be instances when strategic complementarity is at play and positive imitation parameters result. For instance, King et al. (2005) control for industry-level fixed effects and find ISO 14000 diffusion within an industry to positively influence focal-facility adoption. Their empirical analysis, however, takes place in a relatively early stage in the diffusion process; i.e., the fact that 1.53% of the facilities in their sample were certified suggests the relevance of Tolbert and Zucker's (1983) pre-institutionalization phase. Moreover, Delmas and Montes-Sancho (2011) observe that the received wisdom in the literature is that early-stage adopters tend to be less driven by mimetic behavior and more concerned about the standard's actual efficiency. Interestingly, our results – in combination with those of King et al. (2005) – suggest the opposite of conventional wisdom; instead, strategic complementarity may very well dominate in the early stages (giving rise to the King et al.'s (2005) positive imitation parameters) while strategic substitution begins to dominate once diffusion starts to take place in a sector (giving rise to the negative imitation parameters from our empirical analysis). Thus, we fully concur with King et al.'s (2005, p. 1103) caution to researchers with regard to “extrapolating discovered adoption patterns to all temporal periods of the adoption process”. Future empirical work should then pay careful attention as to the location of the empirical context along the diffusion process, and the relative strength of the strategic complementarity and strategic substitution mechanisms may very well vary over that temporal context.

Beyond the salient advice of King et al. (2005) to be mindful as to temporal placement in the diffusion process, we would hasten to add that researchers must also engage in careful econometric analysis if they desire to elicit unbiased inferences regarding the impact of reference-group adoption on organizational adoption. Thus, we strongly encourage empirical scholarship that considers what drives organizations to adopt quality-management systems; and we particularly encourage scholarship that considers the impact of

reference-group adoption on focal-facility adoption. Yet in attempting to infer whether reference-groups influence organizational decisions, the researcher must be conscious of omitted-variable threats, as unobserved factors exist which influence the adoption behavior of both the reference group and the focal organization. Moreover, these unobserved factors (i.e., common causes of standardization) can render biased estimates with regard to imitations parameters. Employing the appropriate fixed effects is one means to begin to deal with these omitted factors and converge on true estimates of peer effects in the diffusion of quality-management systems. The employment of instrumental variables represents an additional means to elicit unbiased imitation parameters; though, we would add that such an approach would still be aided by employing fixed effects. Accordingly, future empirical scholarship should control for the appropriate fixed effects when examining the relationship between reference-group adoption and focal-facility adoption. Our argument is not that strategic substitution will be universally at play when the appropriate fixed effects are controlled for; but instead, we would venture that researchers will find evidence for both strategic complementarity (i.e., positive imitation parameters) and for strategic substitution (i.e., negative imitation parameters).

From a normative perspective, the literature on quality-management systems has consistently cautioned managers to be judicious and deliberative when deciding whether to adopt these standards. A number of these cautions derive from the fact that later adopters do not generally reap substantial benefits from quality-management certification (e.g., Marion Viadiu et al. 2006, Lo and Chang 2007, Benner and Veloso 2008). For instance, Singh et al. (2011) caution managers to be careful when evaluating the utility of adopting a standard since performance benefits do not always manifest. Our empirical results suggest that managers are not nearly as status or legitimacy minded as previous scholarship has feared, as organizations appear to be far less likely to adopt a quality-management standard when that standard has diffused widely in a competitor-peer group. Thus, later adopters may indeed not get the same performance benefits as early adopters, but in turn adoption of quality-management certificates is far less likely to take place during the later stages of the diffusion process. In short, managers tend to be rational, as our results suggest that they are conservative with regard to adopting quality-management systems when these standards generally yield fewer performance benefits: i.e., when the standards have diffused widely amongst competitors.

Interestingly, Naveh et al. (2004) depart from the above norms regarding substantial performance benefits for early adopters and minimal performance benefits for later adopters. Namely, they do not find evidence in support of a first-mover advantage; thus, they hypothesize that performance benefits are based on the presence of learning: where first movers learn from themselves and second movers learn from the collective. These findings – like ours – are in line with a real decision being taken by second-mover managers. Both in their context and in ours, managers are not simply characterized by mimetic-like

behavior that contradicts the basic assumptions regarding rationality. Instead, the organizations which might be able to gain from adopting an internationally-recognized quality certification – maybe via being first or via learning – will go ahead and do so, while those organizations which cannot gain from adopting these standards decide to not incur the sizable adoption costs to become certified.

The literature on quality-management system adoption has certainly made substantial progress over the last two decades in understanding what drives organizational adoption of these standards. Despite this progress, two omissions – one conceptual and one methodological – in that literature stand out as contributing to widespread and incorrect inferences with regard to the applicability of mimetic- and contagion-like processes best characterizing the adoption behavior of organizations. Accordingly, the main contention of this manuscript is simple but important: to completely understand the driving forces behind organizational adoption of internationally-recognized quality certifications, one must control for the common causes that affect both reference-group and focal-facility adoption and one must factor the strategic competition and rivalry taking place between organizations. Once these conceptual and methodological issues are fully considered, the quality-management adoption literature will have to move beyond strict notions regarding the relevance of strategic complementarity and positive imitation parameters to also consider the presence of strategic substitution and negative imitation parameters.

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**Table 1. Strategic Adoption of Quality-Management Certification**

Organization 1		Organization 2	
		Invest	Not Invest
	Invest	$\pi_1(Invest, Invest), \quad \pi_2(Invest, Invest)$	$\pi_1(Invest, Not), \quad \pi_2(Invest, Not)$
	Not Invest	$\pi_1(Not, Invest), \quad \pi_2(Not, Invest)$	$\pi_1(Not, Not), \quad \pi_2(Not, Not)$

  

Organization 1		Organization 2	
		Invest	Not Invest
	Invest	$\frac{\beta[2\beta(\alpha_1+\sigma)-\gamma(\alpha_2+\sigma)]^2}{(4\beta^2-\gamma^2)^2} - I, \quad \frac{\beta[2\beta(\alpha_2+\sigma)-\gamma(\alpha_1+\sigma)]^2}{(4\beta^2-\gamma^2)^2} - I$	$\frac{\beta[2\beta(\alpha_1+\sigma)-\gamma\alpha_2]^2}{(4\beta^2-\gamma^2)^2} - I, \quad \frac{\beta[2\beta\alpha_2-\gamma(\alpha_1+\sigma)]^2}{(4\beta^2-\gamma^2)^2}$
	Not Invest	$\frac{\beta[2\beta\alpha_1-\gamma(\alpha_2+\sigma)]^2}{(4\beta^2-\gamma^2)^2}, \quad \frac{\beta[2\beta(\alpha_2+\sigma)-\gamma\alpha_1]^2}{(4\beta^2-\gamma^2)^2} - I$	$\frac{\beta[2\beta\alpha_1-\gamma\alpha_2]^2}{(4\beta^2-\gamma^2)^2}, \quad \frac{\beta[2\beta\alpha_2-\gamma\alpha_1]^2}{(4\beta^2-\gamma^2)^2}$

Note: The top part displays the notation used to denote firms' profit levels as functions of both firms' investment decisions. The bottom part displays the profit levels – equation (4) – modified for the pair of actions chosen by the firms.

**Table 2. Survey Responses and Number of Certified Facilities by Country**

Response	Indonesia	Vietnam	Philippines	Total
No	991	551	631	2173
Don't know	23	1	8	32
Still in process	14	11	17	42
Yes	142	212	294	648
Total	1,170	775	950	2,895
Adoption Rate	13.3%	28.8%	32.7%	23.8%

**Table 3. Number of Certifications and Sample Observations by Sector and Country**

Industry Sector	Indonesia	Vietnam	Philippines	Total
Food	26/185	39/119	28/129	93/433
Textiles	14/183	17/100	0/3	31/286
Garments	15/168	21/122	15/139	51/429
Chemicals	34/132	7/18	48/119	89/269
Plastics & rubber	20/149	14/31	61/175	95/355
Nonmetallic mineral	19/193	38/114	30/122	87/429
Basic metals	2/8	8/22	4/6	14/36
Fabricated metal products	7/23	27/100	7/14	41/137
Machinery and equipment	2/8	8/28	2/3	12/39
Electronics	1/5	14/20	83/133	98/158
Other manufacturing	16/116	30/101	33/107	79/324
Total	156/1,170	223/775	311/950	690/2,895

**Table 4. Variable Definitions and Descriptive Statistics**

Variable	Definition	Obs.	Mean	Std. Dev.	Min.	Max.
Facility-Adoption	Quality certified facility (0/1)	2863	0.24	0.43	0	1
Domestic-Industry-Adoption	Share of domestic certified facilities in the same 4-digit industry	2865	0.23	0.22	0	1
Domestic-Exporter-Adoption	Share of domestic-exporting facilities in the same 4-digit industry that are certified (0 for non-exporters)	2888	0.13	0.26	0	1
Foreign-Exporter-Adoption	Share of foreign-exporting facilities in the same 4-digit industry that are certified (0 for non-exporters)	2887	0.13	0.26	0	1
Certification-Bodies	Number of competent certification bodies within two-hour driving range	2895	1.81	1.79	0	6
Domestic-Sales	Total domestic sales in 2008 (millions of 2008 USD)	2577	8.01	185.25	0	9279
Multi-Plant-Firm	Facility is part of a larger firm (0/1)	2895	0.1	0.31	0	1
Intermediate-Goods-Producer	Produces mostly intermediate goods (0/1)	2866	0.23	0.42	0	1
Exporter	Whether the facility had a positive value of exports in 2008 (0/1)	2895	0.32	0.47	0	1
Export-Sales	Total value of exports in 2008 (millions of 2008 USD)	2577	7.13	161.69	0	7784
Export-History	Number of years since the commencement of exporting	2843	3.51	7.14	0	107
MNE-Exports	Exports occur due to parent-subsidiary relationship (0/1)	2872	0.1	0.3	0	1

**Table 5. Probability of Focal-Facility Adoption: Probit Estimation Results**

Dependent variable:	(1) Facility- Adoption	(2) Facility- Adoption	(3) Facility- Adoption	(4) Facility- Adoption	(5) Facility- Adoption	(6) Facility- Adoption
Domestic-Industry- Adoption	1.30*** (0.14)	1.14*** (0.15)	-0.58** (0.23)	-0.67*** (0.25)	-0.44* (0.26)	-0.58** (0.27)
Domestic-Exporter- Adoption					-0.79*** (0.25)	-0.71*** (0.26)
Foreign-Exporter- Adoption						-0.55** (0.26)
Certification- Bodies	0.11*** (0.02)	0.10*** (0.02)	0.06** (0.03)	0.06** (0.03)	0.05** (0.03)	0.05** (0.03)
Domestic-Sales	0.01*** (0.00)	0.01*** (0.00)	0.01*** (0.00)	0.01*** (0.00)	0.01*** (0.00)	0.01*** (0.00)
Multi-Plant-Firm	0.51*** (0.09)	0.53*** (0.09)	0.58*** (0.10)	0.60*** (0.10)	0.60*** (0.10)	0.59*** (0.10)
Intermediate-Goods- Producer	0.08 (0.07)	0.05 (0.07)	-0.04 (0.09)	-0.06 (0.09)	-0.04 (0.09)	-0.03 (0.09)
Exporter	0.53*** (0.10)	0.44*** (0.10)	0.60*** (0.12)	0.85 (0.89)	1.18 (0.89)	1.39 (0.91)
Export-Sales	0.01*** (0.00)	0.01*** (0.00)	0.02*** (0.00)	0.02*** (0.00)	0.02*** (0.00)	0.02*** (0.00)
Export-History	0.02*** (0.01)	0.02*** (0.01)	0.03*** (0.01)	0.03*** (0.01)	0.03*** (0.01)	0.03*** (0.01)
MNE-Exports	0.22** (0.11)	0.22** (0.11)	0.18 (0.12)	0.15 (0.13)	0.16 (0.13)	0.17 (0.13)
Country-specific effects	No	Yes	Yes	Yes	Yes	Yes
Industry-specific effects	No	No	Yes	Yes	Yes	Yes
Export-destination- specific effects	No	No	No	Yes	Yes	Yes
Log-likelihood	-1072.2	-1062.7	-938.7	-900.3	-895.4	-893.2
Pseudo r-square	0.227	0.234	0.302	0.311	0.314	0.316
LR chi-square	629.3***	648.3***	811.9***	810.7***	820.5***	825.0***
DF	(9)	(11)	(101)	(135)	(136)	(137)
Observations	2500	2500	2422	2372	2372	2372

Standard errors in parentheses,

\* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%.

LR is the Likelihood ratio; and DF is the degrees of freedom in the likelihood ratio chi-square test.

Coefficient estimates for country, industry, and export-destination fixed effects not reported for brevity.

**Table 6. Probability of Focal-Facility Adoption: Marginal Effects from the Probit Estimations**

Dependent variable:	(1) Facility- Adoption	(2) Facility- Adoption	(3) Facility- Adoption	(4) Facility- Adoption	(5) Facility- Adoption	(6) Facility- Adoption
Domestic-Industry- Adoption	0.40*** (0.04)	0.34*** (0.04)	-0.17** (0.07)	-0.19*** (0.07)	-0.12* (0.07)	-0.15** (0.07)
Domestic-Exporter- Adoption					-0.22*** (0.07)	-0.19*** (0.07)
Foreign-Exporter- Adoption						-0.15** (0.07)
Certification- Bodies	0.03*** (0.01)	0.03*** (0.01)	0.02** (0.01)	0.02** (0.01)	0.01** (0.01)	0.01** (0.01)
Domestic-Sales	0.003*** (0.00)	0.003*** (0.00)	0.003*** (0.00)	0.003*** (0.00)	0.003*** (0.00)	0.003*** (0.00)
Multi-Plant-Firm <sup>d</sup>	0.18*** (0.03)	0.18*** (0.03)	0.19*** (0.04)	0.20*** (0.04)	0.20*** (0.04)	0.19*** (0.04)
Intermediate-Goods- Producer <sup>d</sup>	0.02 (0.02)	0.02 (0.02)	-0.01 (0.02)	-0.02 (0.02)	-0.01 (0.02)	-0.01 (0.02)
Exporter <sup>d</sup>	0.17*** (0.03)	0.14*** (0.03)	0.18*** (0.04)	0.13 (0.31)	0.60* (0.31)	0.26 (0.33)
Export-Sales	0.003*** (0.00)	0.003*** (0.00)	0.004*** (0.00)	0.004*** (0.00)	0.004*** (0.00)	0.004*** (0.00)
Export-History	0.005*** (0.00)	0.006*** (0.00)	0.007*** (0.00)	0.08*** (0.00)	0.007*** (0.00)	0.007*** (0.00)
MNE-Exports <sup>d</sup>	0.07* (0.04)	0.07** (0.04)	0.06 (0.04)	0.04 (0.04)	0.05 (0.04)	0.05 (0.04)
Country-specific effects	No	Yes	Yes	Yes	Yes	Yes
Industry-specific effects	No	No	Yes	Yes	Yes	Yes
Export-destination- specific effects	No	No	No	Yes	Yes	Yes
Observations	2500	2500	2422	2372	2372	2372

Marginal effects calculated at the mean value of the dependent variables,

Standard errors in parentheses,

\* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%,

<sup>d</sup> Marginal effect for discrete change of dummy variable from 0 to 1.

Coefficient estimates for country, industry, and export-destination fixed effects not reported for brevity.

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