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# Implementation of High-Tech Acquisitions: Investigation on CEO turnover and structural form through various relatedness measurements

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Abstract

Determining proper level of exerted coordination and delegated autonomy is highlighted as a challenge for acquirers in post-acquisition literature, as mostly there is a trade-off between either. In high-tech acquisitions the challenge exacerbates as technology transfer requires high level of coordination while on-going development requires high level of autonomy. Here we showed by joint investigation on the decision related to CEO retention (vs. replacement) and structural form in post-acquisition, that acquirer does not necessarily need to exert coordination at the expense of loss of autonomy and vice versa in high-tech acquisitions. This study is based on empirical analysis of 386 acquisitions of small high-tech firms between 2001 and 2005.

Jelcodes:M21,L21

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## Abstract

Determining proper level of exerted coordination and delegated autonomy is highlighted as a challenge for acquirers in post-acquisition literature, as mostly there is a trade-off between either. In high-tech acquisitions the challenge exacerbates as technology transfer requires high level of coordination while on-going development requires high level of autonomy. Here we showed by joint investigation on the decision related to CEO retention (vs. replacement) and structural form in post-acquisition, that acquirer does not necessarily need to exert coordination at the expense of loss of autonomy and vice versa in high-tech acquisitions. This study is based on empirical analysis of 386 acquisitions of small high-tech firms between 2001 and 2005.



**Keywords:** *High-tech acquisition; CEO turnover; Post-acquisition integration*

## Introduction

Internationalization of R&D and external sources of innovation in form of acquisition rather than internal development (Capron & Mitchel, 2012) is a common practice among large firms to substitute their incompetent resources with more competent sources as well as synergy creation through bundling the innovative artefacts in form of final product, patent and prototype of the acquired company (from now on Target) with their existing resources such as marketing, manufacturing and sales (Ahuja & Katila, 2001).

Regardless of the motivation behind the acquisition and potential gains, acquirer is responsible to manage target, as a newly bought unit in post-acquisition (Haspeslagh & Jemison, 1991). Improper post-acquisition implementation result in acquisition failures in terms of performances and realizing the potential gains (King, Slotegraaf, & Kesner, 2008). There are two main important dimensions in decisions related to acquisition implementation in front of the acquirer: structural form of the target after the acquisition (separated subsidiary vs. integration) and keeping the top managers, mainly CEO after the acquisition or not (CEO turnover (Haspeslagh & Jemison, 1991). These two dimensions are investigated separately by scholars in post acquisition studies. However, they cannot be investigated disjointly, because the choice of structural integration might affect directly on whether the target CEO stays or not. In addtition, target CEO's replacement might affect directly on the choice of structural form after the acquisition. Rooted from the work of Thompson (1967), structural integration equates to coordination and separation equates to autonomy. So acquirers face with the dichotomy of delegating autonomy or exerting tight coordination . On the other hand, CEO retention brings autonomy to the target while keeping to some extent coordination known as soft coordination (Graebner, 2004).

Therefore, acquirers are not facing with a dichotomy of autonomy coordination. They may delegate autonomy to the target through separation while keeping the CEO as a coordinator. When the target is a high-tech firm, the role of autonomy becomes more significant as facilitator of innovation (Puranam, Singh, & Zollo, 2006). On the other hand, the tacit knowledge embedded inside human capital of target requires high level of coordination to transfer into the acquirer (Ranft & Lord, 2000).

One of the common factor in determining level of autonomy and coordination is degree of relatedness between acquirer and target (Coff, 1999; Capron, 1999; Datta, Pinches, & Narayanan, 1992). In general the higher relatedness results in the higher level of coordination and lower level of autonomy (Makri, Hitt & Lane, 2010) .

This paper aims at jointly investigating on the effect of several dimensions of relatedness on structural form and CEO replacement or retention. The empirical setting is based on a collected sample of 386 acquisitions of small high-tech firms between 2001 and 2005. The main findings of this study reveals that in general product and skill relatedness makes acquirer more inclined with replacing the target CEO. Technological relatedness decreases the probability of CEO replacement. When there is a strategic interdependecies (component technology), acquirer prefers to structurally integrate the target. Finally there is an interplaying effect between strcutural integration and CEO replacement in general.

The main theoretical contributions of this paper are: first and foremost bringing two streams of literature together, as two dimensions share common determinants. Second, this paper contributes to the relatedness literature on post-acquisition by introducing another dimension of relatedness that has been ignored, namely skill relatedness. Finally the relatively larger empirical settings provide the opportunitiy to

test either the propositions which have been tested in a relatively small settings or hypothetized insights from qualitative studies.

## Theoretical Background

### Structural Integration vs. Separation

In acquisition implementation, one of the main aspects is related to structural decision. It involves mainly determining overall post-acquisition implementation strategy as the extent of structural integration vs. separation of the acquired organization (Puranam & Srikanth 2007; Puranam et al. 2009). Structural integration is perceived as a formal coordinating mechanism to foster efficient technological know-how between the two firms. It provides the opportunity to merge formerly separated organizational units (entities) into a unit in post-acquisition era (Pablo 1994; Ranft & Lord 2002; Schweitzer, 2005; Puranam et al, 2006; Puranam & Srikanth, 2007).

Puranam et al. (2009) suggested that whenever organizational interdependencies are necessary (and/) or prevalent, coordination is the formal organization choice of the acquirer coordination mechanism for the newly bought target. Structural integration enhances coordination capacity via defining common goals, procedures and authority between target and acquirer's employees in the newly merged unit (Haspeslagh & Jemison, 1991).

Structural integration has certain drawbacks. Integration may provoke disruption of target pre-existing routines, since it ends the target's autonomous existence. In high-technology acquisitions, structural integration may cause loss of autonomy of acquired inventors resulting in suppressed motivation and productivity (Paruchuri et al, 2006). Second, extensive integration implies common authority, routines and procedures. To become a part of such an integrated unit, target's established routines

and procedures have to be altered inevitably (Puranam et al, 2009). Such changes disturb valuable organizational routines, which resulted in current organizational capabilities (Ranft & Lord, 2002). Empirical studies have provided evidence in support of this view, structural integration on average damages innovation of the target. For instance, Paruchuri et al. (2006) and Kapoor and Lim (2007) found severe drop in the innovation productivity of acquired inventors when the acquired firm was integrated into the acquiring organization as opposed to being kept as a separate subsidiary. Ranft & Lord (2002) proposed ferequent communications in rich media such as face to face meetings reduce the pitfalls of coordination. Puranam & Srikanth (2007) found that prior experiences modifies the effect emerged by lack of autonomy but they did not find any significant effect on coordination. Schweizer (2005) proposed a form of hybrid solution, that different units of both firms integrate to various degrees.

In conclusion, the empirical studies indicate that structural integration through the acquirer and target operations' alignment, permanently alters target's organizational properties, affects its existing routines and destructs its innovative capabilities, at least in the short run. Integration, has paradoxical effect, on one side coordinatoin is a pre-requisite of integration and from the other side, coordination itself ruins autonomy as facilitator of innovation (Graebner, 2004; Puranam et al, 2006). Organizational approach to coordination such as cross product development and personnel rotations enable acquirer to cultivate existing innovations and developments from the target, while it harms autonomy of the target and directly deters the on-going innovations in the target (Haspeslagh & Jemison, 1991)

## CEO Replacement vs. Retention

In mergers and acquisition literature generally and in post M&A studies specifically, the role of the target's CEO attracts a lot of attention since the early studies such as Kitching (1967). The interest on CEO is originated from several important reasons rooted in resource based view (RBV): first, CEO as a source of human capital serves the firm in pre-acquisition era; from this stand they can continue creating value in post-acquisitions for the acquirer (Barney, 1991). In addition, as explained before post-acquisition implementation management require managerial resources and attention, which is both costly and time consuming for the acquirer. In this regard, target CEO would be a convenient alternative in outsourcing necessary transitional management (Walsh, 1989). Third, CEO retention is a strong signal to the target's employees to stay after the acquisition (Graebner, 2004). Alleviating employee's motivation to stay in post-acquisition is especially very important in two conditions; either the acquirer plans to make some lay-offs, in this situation usually the target top managers can smoothen the lay-off transition and moderate employees' survival guilt, or in case of small high-tech acquisitions that are highly knowledge intensive, departure of human capitals (in this case inventors, designers and scientists) may hamper the overall acquisition's performance in terms of innovation (Hussinger, 2010; Kapor & Lim, 2007). Fourth, there is usually information asymmetry between acquirer and target about target's capabilities and strategic resources (Buchholtz et al, 2003). Once more, in acquisition of small high-tech firms the tacit nature of the knowledge and technological capabilities are considerably high, and consequently the information asymmetry between acquirer and target is high as well (Ahuja & Katila, 2001). Keeping the target CEO after the acquisition help to regulate and coordinate the knowledge transfer from target to the acquirer, Graebner (2004) calls it "soft

coordinator" role. Finally, related to acquisition of small high-tech firms, usually top executives are themselves can be the source of human capital not only for their managerial skills as explained before, but also for their technical skills (Wulf & Singh, 2011). Many CEOs in small high-tech firms possess certain individual capabilities in terms of technical background, firm specific background (if they are founder of the company) and also in many cases they are inventors (for instance patent holders) as well (Buchholtz et al, 2003). These certain capabilities make them even more valuable compare to CEOs in non high-tech firms for the acquirer. If these individual decides to leave the firm after the acquisition they take away their tacit stacks of knowledge.

Although all the reasons aforementioned seem to be an eligible argument to keep the CEO after the acquisition of small high-tech firms, there is also a counter argument not to keep them. The argument is rooted in agency theory and market for corporate control. From shareholders' stand, if the top executive, specifically CEO of the firm shows poor performance, one mechanism to change the incompetent CEO is though merger with or acquisition by another firm (Walsh, 1988; Jensen & Meckling, 1976; Fama & Jensen, 1983). Although this argument seems valid only for established firms with more complex ownership structure compare to entrepreneurial firms in high-tech firms, relatively this arguments is valid for established non entrepreneurial small high-tech firms at least. So far what is delineated from the literature indicates that RBV endorses top executives retention while agency theory supports top executives' departure. Before finishing this section, it is worthy to quickly cover some empirical findings based on prior studies conducted in this area.

Empirical literature indicated that in post-acquisitions, often there are considerable changes in managerial structure of the target (Cannella & Hambrick, 1993; Buchholtz

et al, 2003). Walsh (1988) reported that US targets often lose about two-thirds of their CEOs in five years period after the acquisition. Related to market for corporate control, Zollo and Singh (2004) reported that CEO replacement does not improve post-acquisition performance, particularly for the targets with mediocre performance in pre-acquisition era. However as theory suggested, they found significant improvement in performance for low performing target firms. Canella & Hambrick (1993) differentiated between top executives according to their rank, and from resource based view; they reported that as CEOs (highest senior executive) are the most valuable managerial resource of the target, their departure negatively affect the post-acquisition performance. All in all, empirical studies demonstrate that CEO retention in post-acquisition implementation process modifies the negative impact of organizational changes (Graebner, 2004).

## Hypotheses

### Product Relatedness

Product relatedness is a measure of acquirer and target overlapping area of expertise (Coff, 1999). Cohen and Levinthal (1990) emphasized on the extent of shared knowledge and expertise to foster firm's absorptive capacity, communication, evaluation of new knowledge and expertise. From this stand when acquirer and target shares some degree of common expertise and knowledge base, acquirer has better assessment of target processes, operations and values (Kogut & Zander, 1992; Grant, 1996). In unrelated acquisitions, acquirer encounter to information asymmetry, and incapable of fully assessing the target even in pre-acquisition phase, therefore delegating autonomy would be a better choice for the acquirer (King et al, 2007).

Coff (1999) suggests that in unrelated acquisition structural acquisition is less likely. Datta and Grant (1990) reported that structural integration is a common choice of acquirer when acquisitions are highly related. Thus:

H1a: In acquisition of small high-tech firms, product relatedness between target and acquirer increases the likelihood of structural integration.

When relatedness is low, acquirer has limited knowledge of target business, respectively keeping the target CEO in charge would seem a better choice compare to assigning an external executive. On the other hand, when relatedness is high, information asymmetry between acquirer and target is low and target CEO is easily substitutable (Coff, 1999). Thus:

H1b: In acquisition of small high-tech firms, product relatedness between target and acquirer increases the likelihood of CEO replacement.

## Skill Relatedness

According to what previously hypothesized, product relatedness increases the likelihood of structural integration and CEO replacement. However, product relatedness cannot be considered as the only measure of relatedness between target and acquirer (See for example: Makri et al, 2010). Other dimensions of relatedness are the common knowledge (common ground) between the two firms (Paruchuri et al, 2006; Puranam et al, 2009). In acquisition of small high-tech firms, the value of the target relies on the human capital of the target (Kapoor & Lim, 2007). Human capital is embedded inside the employees' skills (Neffke & Cunning, 2013). Acquirer should retain target key personnel to obtain the human capital (Ranft & Lord, 2002 & Ahuja & Katila, 2001). For keeping the key personnel motivated, acquirer gives them autonomy and applies less formal way of coordination (Haspeslagh & Jemison, 1991). In the case of high level of skill relatedness between acquirer and target, the acquirer

does not need to give autonomy to the target to keep the target employees motivated, as the target employees more or less are substitutable with internal personnel and also in some cases acquirer pursues organizational efficiency through eliminating redundant human capital. Therefore in the case of acquisition with lower level of product relatedness but high level of skill relatedness the likelihood of structural integration increases. Therefore:

H2a: In acquisition of small high-tech firms, skill relatedness increases the likelihood of structural integration.

Similar to the discussion about likelihood of CEO replacement and product relatedness, information asymmetry between acquirer and target is less when skill relatedness is high. Also when acquirer is familiar with the target employees' human skills, acquirer can assess, evaluate the skills embedded in human capital and consequently the target is less dependent on target CEO. Therefore:

H2b: In acquisition of small high-tech firms, skill relatedness increases the likelihood of CEO replacement.

## Technological Relatedness

Technological relatedness as the third measure of relatedness between acquirer and target shows common ground between two firms (Puranam et al, 2009). As in technological firms, when two firms are familiar with each other's technological development then they develop a common knowledge and understanding (Chakrabarti et al, 1994). Common ground facilitates coordination between two firms' subunits when integrating of units is required to perform cross product development for example (Chaudhuri & Tabrizi, 1999). When there is a common ground between acquirer and target exists, formal choice of coordination becomes redundent. As stated by Puranam et al (2009), common ground makes reading blue prints, internal

documents and product development reports easier to understand when interaction between acquirer and target is necessary.

The common ground also increases the probability of soft coordination. Because, if hard coordinating mechanism is ruled out, then acquirer at least should exert some of level coordination for the separated unit. The best choice is target CEO to play the soft coordinating role. Hence, it is expected that:

H3a: In acquisition of small high-tech firms, technological relatedness decreases the likelihood of CEO replacement.

H3b: In acquisition of small high-tech firms, technological relatedness decreases the likelihood of CEO replacement.

## Interdependencies & Component Technology

Scott (1992) defined interdependencies as "the extent to which the elements upon which work is performed or the work processes themselves are interrelated so that changes in the state of one element affect the state of the others". Often task and domain interdependencies result into organizational interdependencies. In other words if two organizations have task's or domain's interdependencies, they become interdependent on one another. Task and domain interdependencies necessitate considerable level of communication, interaction and also coordination between two organizations (Iansiti, 1998).

Thomson (1967) suggested that whenever technical interdependencies existed, more resources should be spent on managing proper coordination between connected and interacted elements. In other words the higher the interdependency, the higher coordination is required.

Following this argument, in acquisitions when there is high interdependency between acquirer and target, coordination becomes an important feature. And therefore in this

case structural integration as hard coordinating mechanism becomes important (Puranam et al, 2009).

Following Puranam et al. (2009), it is conjectured that when there is a high degree of interdependence between the two firms, structural integration benefits the coordination of firms' activities, even at the expense of loss of autonomy. In small high-tech firm acquisition, usually interdependencies are technological. More specifically, when the target possesses a piece of technological component that either fits into the acquirer's current product (functionality enhancement) or is a vital piece for future product development, structural integration is more likely (Puranam et al, 2009). Additionally, tight and high degree of integration by enforcing formal coordination mechanism makes soft coordination stimulated by target CEO redundant and therefore, the chance of CEO retention becomes slender.

H4a: In acquisition of small high-tech firms, component technology increases the likelihood of structural integration.

H4b: In acquisition of small high-tech firms, component technology increases the likelihood of CEO replacement.

## Methodology

### Data Collection

The acquisition deals between 2001 and 2005 in high-tech sectors have been gathered from two databases namely: Zephyr and SDC Platinum. For data collection at this step the following criteria have been applied:

First, the acquirers were public firms. The targets however consist of both public and private firms. Second, All the target companies should actively operate in high-tech sectors at the time of acquisition. Here the definition of high-tech sectors conforms to the definition offered by OECD (1997) based on the demarcation between various

industries is numerated by SIC codes. Accordingly, a firm actively operates in one of the following sectors, are considered to be high-tech: Drugs (283), Computer and office equipment (357), Electronic and other electrical equipment and components except computer equipment (36), Instruments (38) and Software programming (737). Third, the final stake of the acquirer in the target after the completion of the deal is 100%.

Forth, the population includes transactions that both the acquirer and target's country of origin are located either in USA or Europe. There are various constructs for defining organizational size (Damanpour, 1992). In this study the definition of size for target companies (which considered as being small) and the acquirer (which considered as being large) are based on number of employees. Accordingly, the targets and acquirers should employ respectively less than 500 and more than 1000 personnel at the time of acquisition.

In order to understand the events related to the acquisition between acquisition announcement and effective date, the related news in the published online journals, daily newspapers and professional industrial magazines are used. Lexis Nexis is the database chosen to retrieve related news. These pieces of articles contain valuable information about the motivations behind the acquisition, top executives personal information and reflections about the acquisition from target and acquirer, as well as the acquirer's further decision related to formal organizational structure and CEO of the target entity in post-acquisition era. In total, for 576 acquisitions, related news was collected. Considering codification for different variables, the final sample includes 386 transactions.

## Dependent Variables

Since this empirical is designed to investigate on two dimensions of structural form and CEO replacement/retention, the following procedure was applied to construct the measures:

**Structural Form (tar_integ):** the acquirer's decision related to structural form revolves around two alternatives of separation or integration. After the acquisition, the acquirer should decide whether to treat the target entity (entities) as separate subsidiary (subsidiaries) with respect to its focal organization or integrate the target entity (entities) into its existing organizations. In this database the variable is integration. It is a binary variable which zero represents separation and one represents integration. Two methods applied here to codify this variable from the news:

1. *Acquirer's official announcements*: the news usually include acquirer's official announcement for the structural status of the target. Top executives of the acquirer (mostly CEO) announce the acquirer's official decision with regard to the structural form.
2. *Deal's description*: the deal's description in the news often covers the operational details of the transaction including the future formal structure of the target, lay-offs and etc.

**CEO Replacement/Retention (ceo_rep)**: similar to the structural form the acquirer should appoint managing directors for the target in post-acquisition if it is decided to keep the target entity as a separate subsidiary.

Two methods applied here to codify this variable:

1. *Acquirer's official a*nnouncements: similar to the structural form, the acquirer's officials state explicitly that they would appoint new person as the

managing director for the target or keep the CEO of target after the acquisition in charge.

2. *Target CEO's reflection:* the target CEO's official reflection about the acquisition when available. These reflections are in two different formats: either the CEO has positive futuristic insight about the deal mainly pointing out future potential benefits of the deal for her and her company's growth, or the CEO would announce that she will leave the company after the acquisition.

## Independent Variables

**Product relatedness (prod_rel):** It is calculated as the overlap between the product codes assigned to target and acquirer. Following Puranam & Srikanth (2007) and Puranam et al. (2006), the extent of overlap was calculated as the number of 3-digit SIC codes common to acquirer and target divided by the total number of product codes assigned to target. The assigned SIC codes for both target and acquirer are collected from SDC Platinum and Zephyr.

**Skill Relatedness (skill_rel):** Based on the work of Neffke & Cunning (2013) skill relatedness between two industries is measured through a flow of human capital from one industry to the other. The index was generated based on observing Swedish labor market mobility between 2004 and 2007 across industries. If the index is bigger than one then skills required for both industries are highly related. If the index is equal or less than one then it is not related to one another.

**Technological relatedness (tech_rel):** it is constructed based on correlation between acquirer's technological patent portfolio five years prior to the acquisition and target SIC codes. For constructing this variable we followed Dushnitsky & Leon (2005) by using Silverman (2002) concordance matrix. Initially, for each acquirer a patent

portfolio five years prior to the acquisition based on four digir codes was constructed. Then corresponding SIC codes for each codes are collected which results into an array of potential SIC codes for the acquirer. Technological relatedness is measured as number of common SIC codes between target and the acquirer's IPC corresponding SIC codes divided by total number of target SIC codes.

**Component:** To assess whether certain target's technology is considered as component technology for the acquirer, similar to Puranam et al (2009) we relied on the news related to the acquisitions. If the news mentions that the acquirer is interested to obtain certain target's technology to add to their existing product (enhancement) or new product, then the variable is equal to 1, otherwise 0.

**Control Variables**

**High-tech experience (ln_hitechexp):** Serial acquirers or acquirers with considerable record of acquisitions may develop certain capabilities in managing their post-acquisition implementation processes (Lubatkin, 1987). In this study, we control for the experience effect based on Porrini (2004) and Haleblian & Finkelstein (1999) argument acquisition experience on focal acquisition. To construct the measure initially all acquisitions conducted by the acquirer in the last five years prior to the focal acquisition are collected and divided into two categories of high-tech and non-high-tech acquisition experience. In high-tech experience we include only acquisitions of targets in the following industries: Drugs (283), Computer and Office Equipment (357), Electronic and other electrical equipment and components except computer equipment (36), Instruments (38) and Computer programming (737). It is expected that high-tech acquisition experience may be more relevant for experiential learning and building of acquisition capabilities for small high-tech firm acquisitions.

The experience is collected from three major sources namely: Mergerstat, SDC Mergers & Aqcuisitions and Corpfin Worldwide.

**Cross Border:** It is a dummy variable to control for geographical and cultural distance between acquirer and target. The greater distance between acquirer and target reduces the likelihood of structural integration and CEO replacement (Angwin, 2001; Kissin & Herrera, 1990). Cross Border is equal to 1 if acquirer and target does not belong to the same continent, and zero otherwise. The information related to the country that the company's headquarter is registered to, are collected from SDC Platinum and Zephyr.

**Alliance:** Prior collaboration between acquirer and target in terms of alliance may affect the focal acquisition implementation process (Porrini et al, 2004). We may expect that an existing alliance through pre-established coordination links makes the necessity of structural integration for tight coordination less significant. Therefore, we control for prior alliance with a binary variable. It is equal to one if the existence of alliance between two companies prior to the focal acquisition is reported in Lexis Nexis.

**Target age (ln_tar_age):** The age of the target is a suitable measure to assess its maturity. From this stand integration of a young small firm compare to mature small firm would be different. Similarly CEO of small young firm is different from small mature firm. In this paper, we use natural logarithm of the age. The age is calculated as difference between target foundation year and the acquisition completion year. The data related to the company's foundation year is retrieved from Orbis and SDC platinum.

**Relative Size (rel_size)**: it is measured by target's total number of employees to the acquirer's total number of employees at the time of acquisition (Haleblian &

Finkelstein, 1999). The information related to the number of employees was gathered from SDC Platinum and Orbis.

**Target quality (tpatent):** It is a binary control to measure the quality of the target by considering whether the target has a patent prior to the acquisition or not (Puranam et al, 2009).

**Time & Industries:** To acknowledge differences between the high tech industries in the estimations and also considering the time effect the binary controls both for industry based on primary SIC code and year based on announcement year is added to the model. Table 1 summarizes the variable descriptions.

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Insert Table 1 about here

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Since dependent variables and some of the independent variables are codified based on the acquisition's related news, to check for the data validity, a random sample based on 100 observations was generated. Two independent researchers codified the variables for the random sample and the correlation between their codifications and the sample codification was over 90%. In addition, the CVs of CEOs were collected from Linkedin and Capital IQ, to check whether the individual stayed or left after the acquisition. The correlation between codified variable and CV based variable was 90%. Finally, by checking the list of subsidiaries of the acquirer and the legal status of the target in Orbis for this sample in 2012, the correlation between codified variable of structural integration and Orbis generated variable is 79%. By removing the acquirers that they have been acquired themselves and or got bankrupt along the way till 2012, the correlation figure improves to 90%.

## The Model

To test the hypotheses in this paper bivariate probit model is applied, because both dependent variables are binary and also the proposed hypotheses are articulated jointly. This model is a generalization of the probit model based on the joint correlation of error terms of estimation the dependent variables.

The corresponding error term for each dependent variable $u_i$ consists of two parts namely: common parts to both errors denoted by $n_i$ and a specific part unique for each error denoted by $\varepsilon_i$. Therefore

$u_{1i} = n_i + \varepsilon_{1i}$

$u_{2i} = n_i + \varepsilon_{2i}$

Due to the common parts of the error terms, they are interrelated to one another. The probable correlation between the error terms suggested that the following joint density function of the error terms:

$$\Phi(u_1, u_2) = \frac{1}{2\pi\sigma_{u1}\sigma_{u2}\sqrt{1-\rho^2}} \exp\left[-\frac{1}{2}\left(\frac{u_1^2 + u_2^2 - 2\rho u_1 u_2}{1-\rho^2}\right)\right]$$

Where $\rho$ is a correlation factor between the two errors of $u_{i1}$ & $u_{i2}$ . If $\rho$= 0 the two errors are independent, thus the two equations can be estimated separately.

If $\rho \neq 0$ the two errors are correlated, the probability of one will depend on the probability of the other; the two equations are dependent and they should be estimated jointly.

By denoting $Y_1$ to structural integration and $Y_2$ to ceo replacement, the general probit model for each variables are:

$$Y_1^* = X_1\beta_1 + u_1$$
$$Y_2^* = X_1\beta_1' + u_2$$

Where

$$Y_1 = \begin{cases} 1 & \text{if} Y_1^* > 0 \\ 0 & \text{otherwise} \end{cases} \qquad Y_2 = \begin{cases} 1 & \text{if} Y_2^* > 0 \\ 0 & \text{otherwise} \end{cases}$$

For this paper, the bivariate model is clustered over acquirers to increase robustness of the result. In the dataset there are multiple records of the same acquirer that practiced serial acquisitions in one period or in multiple periods. By clustering the estimation over the acquirer, we mitigate the effect of acquirer's general corporate policy toward the acquisitions for structural form and CEO retention or replacement in case of repeated acquirer in the model.

## Results

Table 2 shows grouping of independent variables based on the dependent variables. In the sample, in 268 acquisitions target CEOs stayed and in 118 acquisitions target CEOs were replaced after the acquisition. In 104 acquisitions, the acquirer integrated target and in 282 acquisitions the acquirer kept the target as separated unit. Comparing the mean of product relatedness for CEO retention (0.69) is lower than the corresponding value for replacement (0.83). Similarly, product relatedness mean value for structural integration (0.78) is higher than mean value for structural separation (0.72). This initial statistics confirm our hypothesis (H1a) and (H1b) that product relatedness increases the probability of structural integration and CEO replacement. Also the initial statistics confirm similar studies on product relatedness such as Wulf & Singh (2011), Datta & Grant (1990) and Zollo & Singh (2004). Technological relatedness mean difference on CEO replacement and retention does not show any difference between CEO replacement and retention, the mean for structural integration (0.3) is higher than separation (0.24). These initial findings on technological relatedness do not confirm H2a and H2b. Skill relatedness mean difference between CEO replacement (4.41) and retention (3.64); the mean difference

on structural integration (4.31) is higher than separation (3.71). The results initially confirm our H3a and H3b that skill relatedness increases both probability of structural integration and CEO replacement. Finally, component technology in our sample results in 51 cases of CEO retention and 27 cases of replacement. Additionally, in 43 cases the targets was structurally integrated.

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Insert Table 2 about here
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Table 3 shows the correlation matrix to check for multicollinearity. The correlation between product and skill relatedness is high (over80%) therefore, in estimations we separated model specification for estimating each variable.

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Insert Table 3 about here
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Table 4 and 5 shows estimations separately on ceo_rep and tar_integ to check for the robustness of the results later with the bivariate model.

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Insert Table 4 & 5 about here
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The bivariate probit models shown in Table 6, illustrates that the estimations for testing the hypotheses H1 to H3. Model 7 estimated the joint probability of tar_integ and ceo_rep on control variables. Among the proposed controls, high-tech experience (ln_hitechexp) has significant effect on probability of structural integration and CEO replacement at $P<0.01$. Also cross_border as expected decreases the probability of structural integration and CEO replacement respectively at $P<0.05$ and $P<0.1$. Similarly tpatent, increases significantly the probability structural integration and CEO replacement at respectively $P<0.1$ and $P<0.05$. Also relative size increase the probability of CEO replacement ($P<0.05$) while does not show significant effect on structural integration. The correlation $\rho$ on the joint probability of the model is 0.4191 and significant ($P<0.01$).

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Insert Table 6 about here

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The second model, Model 8, estimated variables product relatedness (prod_rel), technological relatedness (tech_rel) and component. Congenial with our expectation, product relatedness increases significantly the probability of CEO replacement ($P<0.05$). In addition, product relatedness increases the likelihood of structural integration but not significantly. Therefore, we confirm H1a and reject H1b. tech_rel decreases the probability of CEO replacement (0.01) while it does not decrease significantly the probability of structural integration. The result confirms H3a and not H3b. Component as expected, significantly increases the likelihood of structural integration ($P<0.01$). Also it increases the likelihood of CEO replacement but not significantly. The results on component confirm H4b and does not confirm H4a. The correlation $\rho$ on the joint probability of the model is 0.4094 and significant ($P<0.01$). Model 9, substitutes prod_rel with skill_rel. Skill relatedness increases the probability of CEO replacement ($P<0.05$) and does not have significant effect on structural integration. Thus, we confirm H3a and the result cannot support H3b. The estimation shows the same result for component and technological relatedness. The correlation $\rho$ on the joint probability of the model is 0.4017 and significant ($P<0.01$). The correlation sign and significance level across all three estimations confirm our insight on interplaying effect of strutural integration and CEO replacement. From positive sign of the correlation it is inferable that when acquirer structurally integrate the target, it is more likely that target CEO alse departs in post-acquisition.

Table 7 shows the marginal effect of each dependent variables on the joint probability of both dependent variable. Product relatedness decreases the joint probability of CEO retention and target separation by 12.09 % ($P<0.05$) . It does not have any significant effect on joint probability of CEO retention and target integration. On the

contrary it increases the probability of CEO replacement regardless of separation or integration respectively by 7.88% and 6.31% (P<0.1). Skill relatedness decreases significantly joint probability of CEO retention and separation (P<0.1). This measure also increases significantly joint probability of CEO replacement and inetgration (P<0.1). Nevertheless, when CEO is not replaced and target is structurally integrated or when is CEO is replaced while target is structurally integrated, skill relatedness does not have any significant effect. Technological relatedness increases the joint probability of CEO retention and separation (p<0.01). In addition, it decreases the joint probability of CEO replacement and integration (p<0.05). In the other conditions, it does not have any significant effect. Component has significant effect on increasing the probability of structural integration regardless of CEO retention or replacement (p<0.01). Also it decreases significantly the probability of separtion and CEO retention (p<0.01), while it does not show any significant effect when CEO is replaced. Figure 1 also depicts the summary of joint probability and marginal effects.

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Insert Table 7 & Figure 1 about here
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## Discussion & Conclusion

The main interesting finding of this paper is showing the interplaying effect of two post-acquisition implementation dimensions namely: structural integration as a form of integration and CEO replacement or retention as a form of TMT turnover. As stated earlier these two dimensions have been studied separately and belong to different streams of literature (See for example: Walsh, 1988 & 1989; Wulf & Singh, 2011; Cannella & Hambrick, 1993 and Buchholtz et al, 2003 for TMT turnover and Pable, 1994; Datta et al, 1992; Ranft & Lord, 2002 and Puranam et al, 2009 for integration). This paper brings new insight to both literatures by showing that first and

foremost, the two dimensions shares common determinants. Acquirer prior experience, cross border acquisitions increases both probability of structural integration and CEO replacement. Second, the bivariate estimation also indicates that when acquirers decide to structurally integrate the target it is more likely that the CEO is also replaced. This interplaying effect also contributes to studies on post-acquisition implementation process that focus on autonomy and coordination (See for example: Zollo & Singh, 2004; Graebner, 2004; Puranam et al, 2009; Datta & Grant, 1990). Borrowing soft coordination mechanism notion from Graebner (2004) and hard coordination mechanism concept based on the work of Thompson (1967) and later advanced by Puranam et al (2009), we focused on the joint probability of dimensions as different coordination mechanism. This paper showed that applying one mechanism make the other mechanism redundant. The choice of mechanism is based on the necessary level of coordination and autonomy as stated by Haspeslagh & Jemison (1991), and therefore focusing only on one dimension does not provide the full picture of post implementation strategies of acquirers as we showed in the joint probability and we will elaborate further in this section.

We took a special scope on relatedness between the acquirer and target in acquisition of small high-tech firms. By taking the notion of Coff(1999) on relatedness as overlapping expertise and shared knowledge between two firms (here acquirer and target), this paper contributes to relatedness and post-acquisition literature (See for example: Zaheer et al, 2012; Ranft & Lord, 2000; Makri et al, 2010; Capron, 1999 and Coff, 1999) by introducing new measure for relatedness between human capital of two firms, skill relatedness and also constructing an alternative to technological relatedness to capture the value for industries with weaker appropriability regime that

patents are not customary in small firms. The main findings on relatedness are presented in the following:

Product relatedness between acquirer and target increases the probability of CEO replacement which confirms the studies conducted by (Buchholtz et al, 2003; Wulf & Singh, 2011; Zollo & Singh, 2004; Walsh, 1989 & 1988). When acquirer and target shares common expertise in product-industry sector, acquirer not only has acceptable level of overall knowledge on target's operation and business, but also acquirer is more likely to gain synergies from economic of scale and removing redundancies (Zollo & Singh, 2004; Datta et al, 1992) including managerial resources. Our study does not show any significant result on increasing the probability of structural integration similar to Puranam et al (2009). Additionally, by joint probability study of both dimensions together, we can conclude that when product relatedness is high, acquirers prefer to have certain level of coordination but not necessarily at the expense of removing autonomy as when acquirer for any given reason does not replace the target CEO, structural integration is not an alternative to exert tight coordination.

Our finding on second measure, skill relatedness, shows that skill relatedness has similar impact of product relatedness to CEO replacement. Skill relatedness increases the probability of CEO replacement and it does not show any significant effect on increasing the probability of structural integration. This initial finding suggests that when human capital in both firms shares common knowledge and skills, the acquirer does not depend on target CEO to coordinate and facilitate knowledge transfer from target to acquirer. Nevertheless, the joint probability of structural integration and CEO replacement shows that, when acquirer decides to keep target as a separate unit, still target CEO is a strong candidate to manage the separate unit in spite of high skill

relatedness. In other words, skill relatedness does not make target's managerial resources so much redundant when it comes to soft coordinating role. This is in contrast with the result obtained from joint probability for product relatedness. When acquirer is familiar with target's business and daily operation, the redundancy of managerial resources is so much that even soft coordination would not make the acquirer to keep the CEO in case of allowing the target to continue operating as a separate entity.

The third measure, technological relatedness decreases the probability of CEO replacement. This confirms our argument that when acquirer has a common ground with the target, coordination would be less costly for the acquirer. Therefore, target CEO can play soft coordinating role. The joint probability of CEO replacement and structural integration, show that if acquirer decides to structurally integrate the target, then hard coordination makes soft coordination redundant when there is a common ground between two firms. This result is consistent with product and skill relatedness.

Finally, in acquisition of small high-tech firms, structural integration is a dominant practice when component technology as a form of interdependency exists. This study confirms the findings of Puranam et al (2009). In addition, the results indicate that acquirers apply hard coordination mechanism when the interdependency is high which makes CEO retention as a soft coordinator redundant to the acquirer. More interestingly, considering the joint probability of two dimensions, it becomes evident that acquirers also can replace the target CEO to increase the coordination when there is a component technology while keeping the target as a separate unit to maintain some level of autonomy. It is inferable, that in case of interdependencies, if acquirer cannot structurally integrate target for instance because the acquisition is a cross border or destroying autonomy is detrimental, an alternative solution is replacing the

target CEO to manage the newly bought unit more aligned with acquirer's requirements.

This study has certain limitations which also lead into some suggestions for feature studies. First, we have only focused on CEO replacement or retention as the highest rank senior executive of the firm, however it would be interesting to extend this study further to include top management team replacement or retention as a whole or the effect of certain top executive replacement or retention. As an example based on the work of Cannella & Hambrick (1993), other than CEO, top executive involved in R&D activities such chief technology officer (CTO) are also interesting for the acquirer to keep. Respectively, it is interesting to study the interplaying effect of other TMT members replacement or retention and structural form. Similarly, the same argument holds for integration. This study, like Puranam et al (2009), takes into account only two forms of integration (structural integration vs. separation). However integration choices are not bounded into total separation or full integration, hybrid approaches (Schweizer, 2005) also is practical. Therefore, another future area of investigation can be studying the interplaying effect with more general form of integrations. Additionally in the interplaying study, it is interesting to study deeper. Particularly it is interesting to investigate that in case of CEO replacement while keeping the newly bought unit separated, who is in charge of the unit. Whether someone from target takes the position or someone from outside is in charge. Finally, in this study we did not differentiate between CEOs based on their individual characteristics, skills and capabilities. Essentially in small high-tech firms, it is likely that CEOs may inherit certain specific human capital such as technological know-how and technical skills. More specifically some CEOs are also founder of the company or

patent holders, and acquirer may perceive these individuals as key personnel, which increases the probability of their retention in post-acquisition. Thus it is interesting to disentangle the effect of these CEOs from professional CEOs when studying replacement and retention.

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TABLE 1: VARIABLE DESCRIPTIONS

| Variable | Definition | Symbol |
|---|---|---|
| CEO Replacement | It is equal to 1 if target CEO leaves the company after the acquisition, and 0 otherwise. | ceo_rep |
| target structural integration | it is equal to 1 if the acquirer structurally integrates the target after the acquisition, and 0 if the acquirer leaves the target as a separate subsidiary. | tar_integ |
| skill relatedness | It is measured as total number of predicted devided by observed human capital mobility from industry i to j. | skill_rel |
| product relatedness | it is measured as total number of common SIC codes between target and acquirer in the third digit divided by total number of target assigned SIC codes. | prod_rel |
| component | It is equal to 1 if the acquirer intends to integrate a technological artifact of the target to its current product portfolio or ongoing product development, and 0 otherwise. | component |
| technological relatedness | it is measured as total number of common SIC codes between target and correspeonding acquirer's IPC family class divided by total number of target assigned SIC codes. | tech_rel |
| experience | It is the natural logarithm of total number of acquirer's prior experience in high-tech sectors, five years prior to the acquisition. | hitechexp |
| target quality | It is equal to 1 if the target has patent prior to the acquisition, and 0 otherwise. | tpatent |
| cross border | It is equal to 1 if target and acquirer are headquartered in different countries, and 0 otherwise. | cross_border |
| target age | It is the natural logarithm of target age in terms of years between the foundation year and acquisition year. | ln_tar_age |
| relative size | It is equal to target number of employees divided by the acquirer number of employees at the time of acquisition. | rel_size |
| alliance | It is equal to 1 if the acquirer and target has an alliance before the acquisition, and 0 otherwise. | alliance |
| electrical equipments | It is equal to 1 if the target company's primary SIC code starts with 36, and 0 otherwise. | el_equipment |
| drugs | It is equal to 1 if the target company's primary SIC code starts with 283, and 0 otherwise. | drugs |
| computer office equipment | It is equal to 1 if the target company's primary SIC code starts with 357 , and 0 otherwise. | comp_office |
| instruments | It is equal to 1 if the target company's primary SIC code starts with 38, and 0 otherwise. | instruments |
| software | It is equal to 1 if the target company's primary SIC code starts with 737, and 0 otherwise. | software |
| year dummies | It is equal to 1 if the acquisition announced in specific corresponding year between 2001 and 2005, and 0 otherwise. | yrdummy1-5 |

TABLE 2: THE GROUPING OF THE VARIABLE BASED ON DEPENDENT VARIABLES

| Variables | CEO Retention (N=268) | CEO Departure (N=118) | Structural Separation (N=282) | Structural Integration (N=104) |
|---|---|---|---|---|
| Product Rel. | 0.69 | 0.83 | 0.72 | 0.78 |
| Technological Rel. | 0.21 | 0.21 | 0.24 | 0.3 |
| Skill Rel. | 3.64 | 4.41 | 3.71 | 4.31 |
| Component | 51 | 27 | 43 | 35 |

TABLE 3: CORRELATION MATRIX

| | Mean | S.D. | Min | Max | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. ceo_rep | 0.31 | 0.46 | 0 | 1 | 1 | | | | | | | | | | | | | | | | | | | | | |
| 2. tar_integ | 0.27 | 0.44 | 0 | 1 | 0.231 | 1 | | | | | | | | | | | | | | | | | | | | |
| 3. prod_rel | 0.73 | 0.41 | 0 | 1 | 0.145 | 0.074 | 1 | | | | | | | | | | | | | | | | | | | |
| 4. skill_rel | 3.87 | 2.66 | -4.61 | 5.39 | 0.135 | 0.101 | 0.819 | 1 | | | | | | | | | | | | | | | | | | |
| 5. tech_rel | 0.21 | 0.39 | 0 | 1 | 0.006 | -0.149 | 0.135 | 0.125 | 1 | | | | | | | | | | | | | | | | | |
| 6. component | 0.2 | 0.4 | 0 | 1 | 0.044 | 0.203 | 0.066 | 0.08 | -0.086 | 1 | | | | | | | | | | | | | | | | |
| 7. alliance | 0.22 | 0.41 | 0 | 1 | -0.013 | 0.001 | -0.083 | -0.053 | -0.057 | 0.386 | 1 | | | | | | | | | | | | | | | |
| 8. tpatent | 0.57 | 0.5 | 0 | 1 | 0.159 | 0.059 | 0.088 | 0.097 | 0.256 | 0.062 | 0.035 | 1 | | | | | | | | | | | | | | |
| 9. ln_hitechexp | 2.14 | 1.08 | 0 | 4.74 | 0.106 | 0.159 | 0.107 | 0.13 | -0.049 | 0.087 | 0.137 | 0.016 | 1 | | | | | | | | | | | | | |
| 10. cross_border | 0.28 | 0.45 | 0 | 1 | -0.122 | -0.141 | 0.02 | 0.037 | 0.17 | 0.02 | 0.006 | -0.09 | 0.032 | 1 | | | | | | | | | | | | |
| 11. ln_tar_age | 2.45 | 0.74 | 0 | 4.77 | -0.045 | -0.126 | -0.09 | -0.087 | 0.173 | -0.11 | -0.013 | 0.053 | -0.099 | 0.122 | 1 | | | | | | | | | | | |
| 12. rel_size | -4.29 | 1.83 | -9.83 | -0.16 | 0.044 | -0.022 | 0.081 | 0.067 | 0.022 | -0.133 | -0.194 | 0.129 | -0.395 | -0.1 | 0.176 | 1 | | | | | | | | | | |
| 13. drugs | 0.1 | 0.3 | 0 | 1 | 0.151 | -0.107 | 0.116 | 0.083 | 0.478 | 0.024 | 0.05 | 0.171 | -0.03 | 0.023 | 0.021 | -0.093 | 1 | | | | | | | | | |
| 14. software | 0.6 | 0.49 | 0 | 1 | -0.045 | 0.185 | 0.056 | 0.093 | -0.635 | 0.173 | 0.101 | -0.316 | 0.134 | -0.134 | -0.326 | -0.022 | -0.411 | 1 | | | | | | | | |
| 15. el_equipment | 0.14 | 0.35 | 0 | 1 | -0.041 | -0.093 | -0.178 | -0.179 | 0.322 | -0.11 | -0.106 | 0.111 | -0.111 | 0.117 | 0.205 | 0.096 | -0.135 | -0.495 | 1 | | | | | | | |
| 16. instruments | 0.12 | 0.32 | 0 | 1 | -0.031 | -0.093 | 0.06 | 0.045 | 0.066 | -0.122 | -0.076 | 0.154 | -0.061 | 0.1 | 0.262 | 0.044 | -0.122 | -0.446 | -0.147 | 1 | | | | | | |
| 17. comp_office | 0.04 | 0.2 | 0 | 1 | 0.003 | 0.02 | -0.1 | -0.115 | 0.171 | -0.072 | -0.016 | 0.077 | 0.007 | -0.071 | -0.009 | -0.043 | -0.07 | -0.255 | -0.084 | -0.076 | 1 | | | | | |
| 18. yrdummy1 | 0.15 | 0.35 | 0 | 1 | 0.014 | 0.081 | 0.036 | 0 | 0.053 | 0.067 | 0.03 | 0.092 | -0.202 | -0.009 | -0.018 | 0.092 | 0.008 | -0.055 | -0.039 | 0.011 | 0.173 | 1 | | | | |
| 19. yrdummy2 | 0.16 | 0.37 | 0 | 1 | 0.052 | -0.055 | 0.053 | 0.033 | -0.015 | -0.006 | -0.076 | 0.02 | -0.044 | -0.046 | -0.097 | 0.147 | -0.027 | 0.048 | 0.03 | -0.069 | -0.019 | -0.178 | 1 | | | |
| 20. yrdummy3 | 0.12 | 0.32 | 0 | 1 | 0.004 | 0.052 | -0.007 | -0.021 | 0.044 | -0.042 | 0.002 | -0.009 | -0.011 | -0.009 | 0.063 | 0.095 | 0.119 | -0.083 | 0.063 | -0.031 | -0.035 | -0.15 | -0.157 | 1 | | |
| 21. yrdummy4 | 0.22 | 0.42 | 0 | 1 | -0.166 | -0.044 | -0.042 | -0.015 | 0.015 | -0.083 | -0.074 | -0.048 | -0.028 | 0.044 | 0.079 | -0.012 | -0.076 | -0.06 | 0.071 | 0.077 | 0.014 | -0.221 | -0.232 | -0.194 | 1 | |
| 22. yrdummy5 | 0.36 | 0.48 | 0 | 1 | 0.092 | -0.014 | -0.025 | 0.002 | -0.07 | 0.055 | 0.099 | -0.036 | 0.214 | 0.009 | -0.024 | -0.233 | 0.001 | 0.111 | -0.098 | -0.001 | -0.101 | -0.307 | -0.323 | -0.271 | -0.399 | 1 |

TABLE 4: BASIC ESTIMATION OF CEO REPLACEMENT

| VARIABLES | Model 1 | Model 2 | Model 3 |
|---|---|---|---|
| prod_rel | | 0.446** | |
| | | (0.204) | |
| tech_rel | | -0.660*** | -0.682*** |
| | | (0.246) | (0.249) |
| skill_rel | | | 0.0730** |
| | | | (0.0350) |
| component | | 0.114 | 0.126 |
| | | (0.197) | (0.197) |
| alliance | -0.132 | -0.156 | -0.170 |
| | (0.171) | (0.185) | (0.186) |
| tpatent | 0.296** | 0.293* | 0.280* |
| | (0.151) | (0.155) | (0.154) |
| ln_hitechexp | 0.182** | 0.171** | 0.172** |
| | (0.0751) | (0.0755) | (0.0766) |
| cross_border | -0.322* | -0.285* | -0.292* |
| | (0.169) | (0.172) | (0.173) |
| ln_tar_age | -0.0594 | -0.0371 | -0.0429 |
| | (0.107) | (0.112) | (0.111) |
| rel_size | 0.0765* | 0.0756* | 0.0791* |
| | (0.0408) | (0.0422) | (0.0424) |
| drugs | 0.585 | 0.566 | 0.581 |
| | (0.375) | (0.388) | (0.383) |
| software | -0.0393 | -0.518 | -0.549 |
| | (0.320) | (0.350) | (0.347) |
| el_equipment | -0.0191 | -0.0764 | -0.0825 |
| | (0.381) | (0.377) | (0.372) |
| instruments | -0.0516 | -0.425 | -0.424 |
| | (0.411) | (0.409) | (0.405) |
| year dummies | YES | YES | YES |
| Constant | -0.359 | -0.263 | -0.163 |
| | (0.505) | (0.543) | (0.523) |
| $R^2$ | 0.0822 | 0.1029 | 0.1036 |
| Observations | 386 | 386 | 386 |
| Log likelihood | -218.1 | -213.2 | -213.0 |
| DF | 14 | 17 | 17 |
| Chi2 | 35.13 | 44.08 | 44.87 |

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

TABLE 5: BASIC ESTIMATION OF STRUCTURAL INTEGRATION

| VARIABLES | Model 4 | Model 5 | Model 6 |
|---|---|---|---|
| prod_rel | | 0.139 | |
| | | (0.196) | |
| tech_rel | | -0.325 | -0.362 |
| | | (0.294) | (0.298) |
| skill_rel | | | 0.0424 |
| | | | (0.0333) |
| component | | 0.702*** | 0.696*** |
| | | (0.183) | (0.183) |
| alliance | -0.184 | -0.447** | -0.441** |
| | (0.172) | (0.187) | (0.187) |
| tpatent | 0.288* | 0.243 | 0.238 |
| | (0.160) | (0.162) | (0.163) |
| ln_hitechexp | 0.223** | 0.231** | 0.227** |
| | (0.0924) | (0.0972) | (0.0967) |
| cross_border | -0.403** | -0.443** | -0.448** |
| | (0.190) | (0.185) | (0.186) |
| ln_tar_age | -0.117 | -0.0950 | -0.0915 |
| | (0.106) | (0.110) | (0.111) |
| rel_size | -0.00242 | 0.0118 | 0.00974 |
| | (0.0489) | (0.0507) | (0.0507) |
| drugs | -0.483 | -0.584 | -0.617 |
| | (0.519) | (0.557) | (0.554) |
| software | 0.331 | -0.0364 | -0.0926 |
| | (0.359) | (0.382) | (0.387) |
| el_equipment | -0.138 | -0.233 | -0.235 |
| | (0.415) | (0.425) | (0.423) |
| instruments | -0.228 | -0.405 | -0.451 |
| | (0.430) | (0.452) | (0.450) |
| year dummies | YES | YES | YES |
| Constant | -1.116* | -0.947 | -0.963* |
| | (0.569) | (0.590) | (0.577) |
| $R^2$ | 0.0988 | 0.1318 | 0.1347 |
| Observations | 386 | 386 | 386 |
| Log likelihood | -202.7 | -195.3 | -194.6 |
| DF | 14 | 17 | 17 |
| Chi2 | 37.52 | 54.39 | 55.38 |

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

TABLE 6: THE BIVARIATE ESTIMATIONS

| | Model 7 | | Model 8 | | Model 9 | |
|---|---|---|---|---|---|---|
| VARIABLES | ceo_rep | tar_integ | ceo_rep | tar_integ | ceo_rep | tar_integ |
| prod_rel | | | 0.454** | 0.148 | | |
| | | | (0.203) | (0.198) | | |
| tech_rel | | | -0.680*** | -0.336 | -0.701*** | -0.378 |
| | | | (0.250) | (0.298) | (0.251) | (0.303) |
| skill_rel | | | | | 0.0733** | 0.0432 |
| | | | | | (0.0347) | (0.0334) |
| component | | | 0.118 | 0.705*** | 0.131 | 0.699*** |
| | | | (0.193) | (0.184) | (0.193) | (0.184) |
| alliance | -0.146 | -0.180 | -0.164 | -0.447** | -0.179 | -0.440** |
| | (0.170) | (0.170) | (0.180) | (0.188) | (0.180) | (0.188) |
| tpatent | 0.308** | 0.277* | 0.307** | 0.227 | 0.296* | 0.222 |
| | (0.151) | (0.161) | (0.155) | (0.163) | (0.155) | (0.164) |
| ln_hitechexp | 0.182** | 0.228** | 0.168** | 0.237** | 0.170** | 0.232** |
| | (0.0767) | (0.0927) | (0.0769) | (0.0974) | (0.0780) | (0.0967) |
| cross_border | -0.315* | -0.407** | -0.278 | -0.446** | -0.285 | -0.451** |
| | (0.170) | (0.188) | (0.174) | (0.183) | (0.174) | (0.184) |
| ln_tar_age | -0.0678 | -0.121 | -0.0497 | -0.0984 | -0.0533 | -0.0944 |
| | (0.107) | (0.107) | (0.112) | (0.111) | (0.111) | (0.111) |
| rel_size | 0.0776* | -0.000125 | 0.0776* | 0.0145 | 0.0803* | 0.0127 |
| | (0.0408) | (0.0493) | (0.0423) | (0.0512) | (0.0425) | (0.0511) |
| drugs | 0.603 | -0.486 | 0.571 | -0.575 | 0.593 | -0.607 |
| | (0.381) | (0.525) | (0.393) | (0.562) | (0.388) | (0.559) |
| software | -0.0228 | 0.322 | -0.518 | -0.0493 | -0.543 | -0.107 |
| | (0.328) | (0.369) | (0.357) | (0.395) | (0.351) | (0.400) |
| el_equipment | -0.0106 | -0.147 | -0.0711 | -0.235 | -0.0657 | -0.232 |
| | (0.388) | (0.423) | (0.382) | (0.433) | (0.376) | (0.432) |
| instruments | -0.0480 | -0.252 | -0.433 | -0.425 | -0.429 | -0.471 |
| | (0.420) | (0.438) | (0.415) | (0.466) | (0.410) | (0.465) |
| Year dummies | YES | YES | YES | YES | YES | YES |
| Constant | -0.348 | -1.087* | -0.223 | -0.925 | -0.136 | -0.936 |
| | (0.510) | (0.580) | (0.546) | (0.601) | (0.529) | (0.588) |
| arthro | 0.4191*** | | 0.4094*** | | 0.4017*** | |
| | (0.0974) | | (0.0978) | | (0.0979) | |
| Observations | 386 | 386 | 386 | 386 | 386 | 386 |
| Log likelihood | -411.5 | -411.5 | -399.8 | -399.8 | -399.3 | -399.3 |
| DF | 28 | 28 | 34 | 34 | 34 | 34 |
| Chi2 | 86.09 | 86.09 | 108.6 | 108.6 | 108.4 | 108.4 |

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

TABLE 7: THE JOINT PROBABILITY MARGINAL EFFECTS

| | Pr(ceo_rep=0 & tar_integ=0) | Pr(ceo_rep=0 & tar_integ=1) | Pr(ceo_rep=1 & tar_integ=0) | Pr(ceo_rep=1 & tar_integ=1) |
|---|---|---|---|---|
| prod_rel | -0.1209** | -0.021 | 0.0788* | 0.0631* |
| | (0.0603) | (0.0357) | (0.0421) | (0.0335) |
| skill_rel | -0.0229** | -0.0001 | -0.1054 | 0.0123** |
| | (0.0101) | (0.0006) | (0.056) | (0.0057) |
| tech_rel | 0.2014*** | 0.0112 | -0.1056* | -0.1047** |
| | (0.0812) | (0.0531) | (0.0563) | (0.0456) |
| component | -0.1488*** | 0.1119*** | -0.0521 | 0.0889*** |
| | (0.0516) | (0.0362) | (0.0438) | (0.0289) |

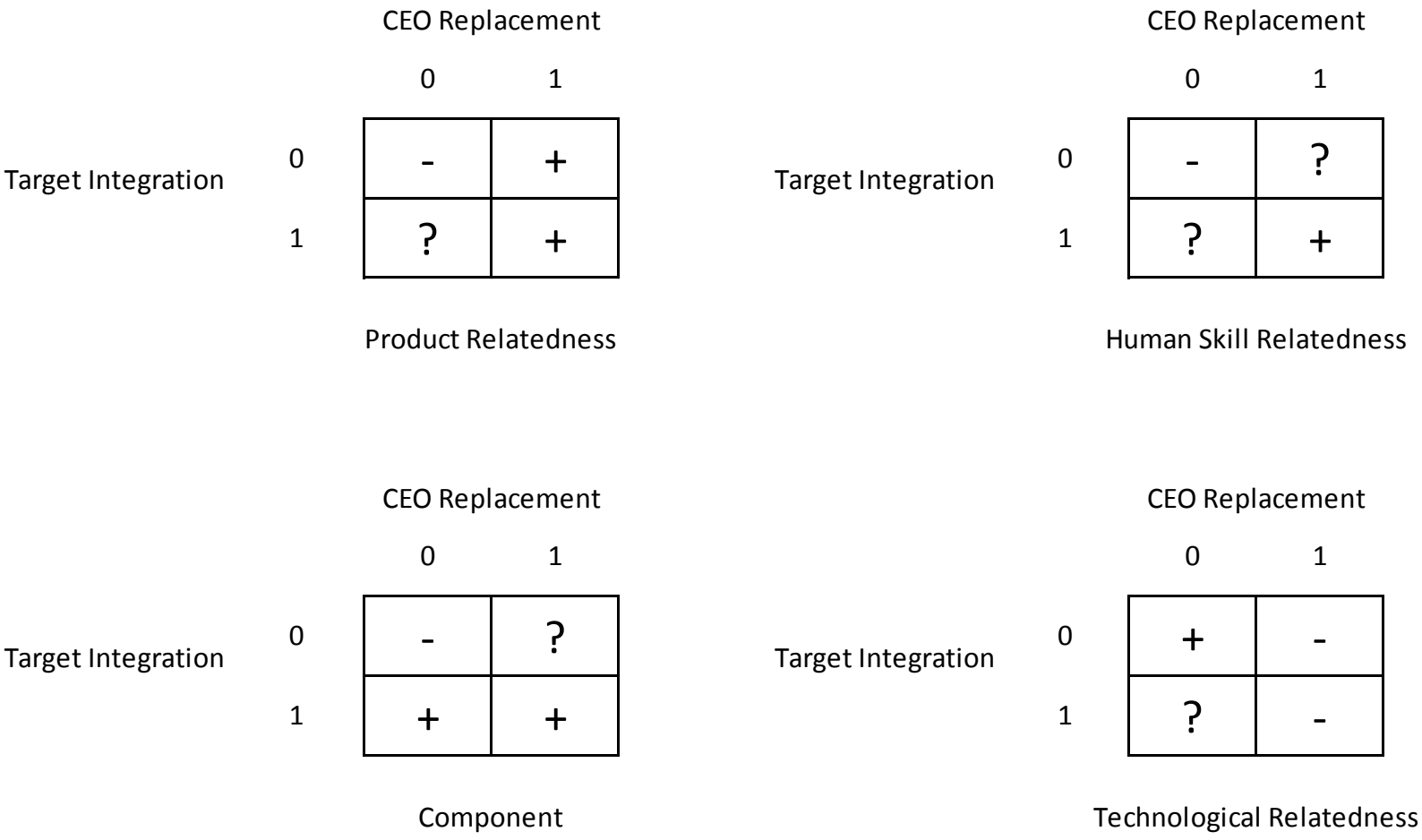


FIGURE 1: THE INTERPLAYING EFFECT