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LEARNING-BY-BEING-ACQUIRED: POST-ACQUISITION R&D TEAM REORGANZIATION AND KNOWLEDGE TRANSFER

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INTRODUCTION

In horizontal acquisitions, post-acquisition integration of the acquiring and acquired operations is required to assure coordination and mutual learning between the two previously separated entities, and thus is a fundamental, yet very challenging process to realize the acquisition's potential for value creation (e.g., Jemison & Sitkin, 1986; Pablo, 1994; Zollo & Singh, 2004). The literature on post-acquisition integration highlights two main conflicting effects of the integration process: a coordination effect that by aligning procedures, goals and authority between acquiring and acquired firms' knowledge workers facilitates acquiring firms to leverage the acquired firms' knowledge base (e.g., Graebner, 2004; Puranam, Singh, & Zollo, 2006; Puranam & Srikanth, 2007), and a loss of autonomy effect which hinges mostly on acquired inventors through the disruption of their existing routines and motivations (e.g., Paruchuri et al., 2006; Puranam & Srikanth, 2007). In this study, we propose that social identity and self-categorization theories (e.g., Tajfel, 1974; Tajfel, 1979; Tajfel & Turner, 1979; Tajfel & Turner, 1986) complement the coordination-autonomy perspective and help explaining further the impact of post-acquisition integration on acquired inventors.

The extent to which acquired inventors leverage the knowledge base of the acquiring firm in their post-acquisition patenting activity, as reflected by backward patent citations (e.g., Almeida & Kogut, 1999), is an important, yet unexplored, post-acquisition outcome of acquired inventors. While it is central that acquired inventors stay after the acquisition and continue to innovate, it is also desirable that they will generate innovation that combines their technological knowledge with knowledge and capabilities of the acquiring firm. Accordingly, in this study we investigate the effect of the post-acquisition reorganization of R&D teams—i.e. a crucial integration action that triggers a self-recategorization process among acquired inventors—on the extent to which knowledge of acquiring inventors flows to and is leveraged by acquired inventors after the acquisition. We also investigate how the effects of R&D team reorganization on knowledge transfer is moderated by individual characteristics of acquired inventors before the acquisition– i.e. their innovation ability compared to the one of acquiring inventors and their in-group collaboration strength.

Our empirical analysis is based on the patenting activity of 3,625 acquired inventors who continue to work within the new firm after the acquisition (Kapoor & Lim, 2007; Paruchuri et al., 2006) and 25 horizontal acquisitions of sizable firms in medium- and high-tech industries. We construct our sample implementing the coarsened exact matching (CEM) technique and

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empirically test our arguments applying a difference-in-differences setup in a longitudinal data setting.

THEORY AND HYPOTHESES

Social Identity, Social Categorization and Post-Acquisition R&D Team Reorganization

Social identity is the extent to which individuals categorize themselves and others in a group. Specifically, social identity theory (SIT) and self-categorization theory (SCT) suggest that individuals identify themselves to be members of specific groups on the basis of categories capturing ingroup similarities and intergroup differences (e.g., Tajfel, 1974; Tajfel, 1979; Tajfel & Turner, 1979; Tajfel & Turner, 1986). Previous work has recognized that the merging of acquired and acquiring firms requires the employees of both organizations to abandon their pre-acquisition group identity and initiate a recategorization process leading to the development of a new superordinate group identity (Amiot, Terry, & Callan, 2007; Haunschild, Moreland, & Murrell, 1994; Terry, Carey, & Callan, 2001; van Knippenberg et al., 2002).

An inventor's ability to unlock the post-acquisition innovative potential stemming from the realization of knowledge transfer depends on the capacity of his/her R&D team to encourage the coordinated exchange of knowledge, materials, and reciprocal inputs with other team members. Post-acquisition R&D team reorganization creates stronger and more frequent connections between acquired and acquiring inventors, fosters more efficient communications between them and enhances the coordination of their inventive activity (Ranft & Lord, 2002). On the other side, R&D team reorganization may expose acquired inventors to sense of anger and loss, anxiety, lack of motivation, confusion and uncertainty (for a review, see Cartwright, 2012; Seo & Hill, 2005). Thus, R&D team reorganization would raise negative feelings and emotions in acquired inventors who, ultimately, are likely to limit their propensity to leverage the acquiring inventors' knowledge after the acquisition. Since the full realization of coordination cannot occur without identity (Kogut & Zander, 1996) that is also an important determinant of knowledge transfer (Kane et al., 2005), we propose that drawing on SIT and SCT helps to understand the balance between the effects of coordination and autonomy on the transfer of knowledge from acquiring to acquired inventors.

We argue that the post-acquisition creation of teams with both acquired and acquiring inventors is an integration action inducing reorganized acquired inventors to conceive a new group categorization that weakens outgroup biases and triggers positive attitudes toward former outgroup people (i.e., acquiring inventors). First, the simple reassignment of an acquired inventor into a team with acquiring inventors is likely to make the distinction between acquired and acquiring inventors less salient. Second, R&D team reorganization promotes acquired inventors' transformation of their categorized representations of 'us'—acquired inventors—and 'them'—acquiring inventors—to a more inclusive category of 'we' (Haunschild et al., 1994). Accordingly, the creation of a new group of acquiring and acquired inventors performing a collective task brings former outgroup members under the umbrella of a new social identity (Gaertner & Dovidio, 2000). Third, R&D team reorganization favors the inclusion of outgroup members and the creation of a new identity also because it fosters connections and communication between acquired and acquiring inventors. Thus, we suggest that:

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Hypothesis 1: The extent of acquired inventors' leverage of the acquiring inventors' technological capabilities is greater after the acquisition if post-acquisition integration involves the reorganization of R&D teams of the acquired and acquiring firms.

We expect that the benefits of post-acquisition R&D team reorganization generated by the adoption by acquired inventors of a new social identity are not uniform across acquired inventors, and crucially depend on characteristics of the team members that affect the recategorization process. We claim that two pre-acquisition characteristics of acquired inventors are especially important: their innovation ability relative to that of their acquiring peers and their in-group collaborative strength.

Multiple Identities and the Moderating Effect of Acquired Inventors' Relative Innovation Ability

Group members with high relative individual ability show multiple identities—an individual's simultaneous membership in multiple groups—and are better able to switch to a new social identity (cf. Ellemers, 1993; Shih, Sanchez, & Ho, 2010; Shih, Young, & Bucher, 2013). We expect that acquired inventors who in the pre-acquisition period show a higher ability to innovate compared to their acquiring peers—a condition that gives them a relative standing within their peers in the acquiring organization—will perceive a high level of compatibility with acquiring inventors. In this situation, high-ability acquired inventors experience perceptions of continuity between the old and the present identity, so that survival threats are minimized (for a discussion of identity continuity, see van Knippenberg et al., 2002; van Leeuwen, van Knippenberg, & Ellemers, 2003). Conversely, if low-ability acquired inventors perceive little compatibility with the acquiring inventors, they are less likely to adjust to the social identity of the new reorganized team. Thus, we propose that:

Hypothesis 2: Under conditions of R&D team reorganization, the higher the acquired inventors' pre-acquisition innovation ability relative to the acquiring inventors, the greater the extent of acquired inventors' leverage of the acquiring inventors' technological capabilities after the acquisition.

Group Identification and the Moderating Effect of Acquired Inventors' In-group Collaborative Strength

We expect that acquired inventors with higher levels of in-group collaborative strength (i.e., those who had repeated collaborations with other inventors within the acquired firm prior the acquisition) will show higher levels of identification with their pre-acquisition groups and, therefore, a slower adaptation to the new social identity triggered by R&D team reorganization.

Group members with strong group identification are more suspicious about changes in group membership that can threaten their social identity; thus, they develop solid feelings of attraction among group members (cohesion) and are motivated to preserve the group from external threat (Haunschild et al., 1994). Along these lines, the extent of the in-group collaborative activity of acquired inventors expresses the extent of their relationships with the rest of the acquired inventors. As acquired inventors who have developed extensive in-group collaborations have resilient shared values, practices and norms, the homogeneity of these

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attributes between acquired inventors also reflects a strong in-group identification (cf. Doosje, Ellemers, & Spears, 1995). In turn a strong identification limits the exchange of knowledge between in-group and out-group members given the resistance to change practices, norms and values of in-group members (Nag, Corley, & Gioia, 2007). Therefore, we suggest that:

> *Hypothesis 3: Under conditions of R&D team reorganization, the higher the acquired inventors' pre-acquisition in-group collaborative strength, the lower the extent of acquired inventors' leverage of the acquiring inventors' technological capabilities after the acquisition.*

METHOD

The sample consists of 3,625 acquired inventors working in 25 firms resulting from horizontal acquisitions undertaken in medium and high-tech industry by large firms headquartered in the European Union (EU) during the 1987-2001 period. Information about the horizontal acquisitions is based on data collected as part of a research project promoted by the DG Research of the European Commission (FP5 project, Contract No. ERBHPV2-CT-1999-13: "Mergers and Acquisitions and Science and Technology Policy"). Data were collected during face-to-face interviews with those who were in charge of or actively participated in the implementation of the acquisition process (in most cases the Vice-President for strategy or corporate development and the Vice-President for R&D or the Chief Technology Officer). We use this information to operationalize the R&D team reorganization and other deal-level control variables used in our empirical exercise. The second source of data is the *Patent Network Dataverse* database that builds on the United States Patent and Trademark Office (USPTO) and includes information regarding the identification of disambiguated names of individual inventors registered at the U.S. utility patents for the period 1975−2010 (Li et al., 2014). We use patent information to compute the dependent variable and other individual and firm level characteristics.

The dependent variable, *knowledge transfer*, is measured as the cumulative number of citations that each acquired inventor makes to the acquirer firm's patents (e.g., Almeida & Kogut, 1999). We look at the backward citations of the patents produced by the acquired inventors to identify if they draw from knowledge and technological capabilities produced by the acquirer firm. The dependent variable is computed based on the five years before the acquisition and the five years after the acquisition. In order to test the hypothesized relationships we operationalize the following variables. The variable *R&D team reorganization* is a dummy that takes value 1 if R&D teams of both the acquiring and the acquired firms have been reorganized after acquisition. The variable *inventor's relative innovation ability* is the cumulative number of patents of the focal acquired inventor divided by the cumulative average number of patents of all active inventors in the acquirer firm in the pre-acquisition time period. We capture the *inventor's in-group collaborative strength* as the number of unique ties (other inventors) with who the focal inventor had repeated (at least two) collaborations before the acquisition. We control for a number of individual- and acquisition-level characteristic. Specifically, we control for the divergence between the acquired inventor's expertise and the acquired firm's stock of knowledge; the heterogeneity of the knowledge inventors have accumulated in different technological fields within the five year prior to the acquisition; a set of variables capturing other post-acquisition integration decisions (e.g., replacement of acquired R&D top manager); the overall level of integration of systems, products and procedures after the acquisition; general

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characteristics of the deal and of the firms involved in the deal (e.g., acquisition motivations, technology similarity, previous technological links).

To test the effect of post-acquisition R&D team reorganization on *knowledge transfer* we apply a difference-in-differences setup and compare before and after the acquisition the rate of capability leverage by acquired inventors involved in R&D team reorganization (*treatment group*) with that of inventors who were not exposed to R&D team reorganization (*control group*). For both groups we observe the longitudinal changes in the extent to which they draw from the acquirer's knowledge, based on information referring to the pre- and post-acquisition periods. In order to implement this empirical strategy, we rely on the Coarsened Exact Matching (CEM) technique to estimate the ATT (average treatment effect on the treated) concerning inventors knowledge transfer. Among the 3,625 individual inventors, 1,781 belong to the treatment group and 1,844 to the control group. Given that we are not using a one-to-one matching solution, we employ *CEM weights* to compensate for the differential strata size (Blackwell et al., 2009). The treatment and control groups were matched based on inventor tenure, star inventor, inventor's last patenting, number of pre-patents and the period in which the acquisition happened.

The difference-in-differences approach exploits the fact that we observe the leverage of the acquiring firm's stock of knowledge by the acquired inventors (i.e., knowledge transfer) not just in the post-acquisition period but also in the period that precedes it. Although the post-acquisition differences in the treatment and control groups confound inherent differences between the two groups, we can partially disentangle these effects by reducing the imbalance between the two groups based on "observables" and tracking them in the pre- and post-acquisition periods. We use the following equation to implement this logic:

$$\begin{aligned} Knowledge\ transfer_{j,t} = f(&\psi_R Treatment_j + \psi_{RP} Treatment_j \times post\ acquisition_{j,t} \\ &+ \psi_P post\ acquisition_{j,t} + \psi_x X_j + \delta_{t-preacquisition(j)} + e_{j,t}) \end{aligned} \quad (1)$$

For each inventor *j* whose R&D team is reorganized after acquisition, the dummy variable *treatment group* takes value 1 and value 0 if the inventor belongs to the control group. In this model, ψ_R captures the systematic differences between the treatment and control groups that exist before the acquisition. The interaction term *treatment* × *post-acquisition* should capture the net effect (net of the average acquisition effect) that the treatment has on the treated group. Based on our theoretical argumentation, the coefficient of interest, ψ_{RP}, should be positive and significant. The final variable *post acquisition* takes value 1 for both the treatment and control groups only when observed in the post-acquisition period. Therefore, ψ_P consists of the *counterfactual* in the knowledge transfer for the post-acquisition period in the case R&D team reorganization has not happened.

As a first step of the analysis, we evaluate whether previous results can be replicated using our data. Accordingly, we considered patenting productivity as dependent variable, run a difference-in-differences estimation, and confirmed a negative effect of post-acquisition integration on acquired inventors' productivity (Paruchuri et al., 2006; Puranam & Srikanth, 2007). To test our hypotheses, we then focus on *knowledge transfer* as dependent variable. The difference in differences value is positive and statistically significant ($p<0.01$). This finding lends preliminary support for hypothesis 1. The rest of the analysis consists of estimating a negative binomial model using a difference-in-differences setup. The analysis is conducted at the

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inventor-period level—each inventor is observed and recorded both in the pre- and the post-acquisition period. We model unobserved heterogeneity at the inventor level with random effects. The results confirm our hypotheses: the coefficient of *treatment* is positive and significant ($p<0.01$); the coefficient of the interaction *inventor's relative innovation ability* × *treatment* is positive and significant ($p<0.01$); the coefficient of the interaction *inventor's ingroup collaborative strength* × *treatment* is negative and significant ($p<0.01$). It can also be noted that the coefficient of the variable *post-acquisition* is negative and significant ($p<0.01$). This result is aligned with previous work suggesting that acquisitions are generally detrimental for inventors' innovative behavior (Kapoor & Lim, 2007). We ruled out potential alternative explanations by estimating our models also with inventor-level fixed effects, adding deal dummies, and allowing the other integration related variables to vary in the pre- and post-acquisition periods.

CONCLUSIONS

Our study contributes to extend the work on post-acquisition integration at the individual-level of analysis. Scholars have found that the decline in the patenting activity after acquisition observed at the firm-level (Hitt et al., 1991) is associated with a decline in patenting at the individual level (Kapoor & Lim, 2007). Moreover, the negative effect on acquired inventors' productivity is worsened by structural integration and varies based on individual characteristics (Paruchuri et al., 2006). We confirm the negative effect of post-acquisition integration on acquired inventors' productivity. However, we go a step further and suggest that the understanding of the effects of post-acquisition integration on acquired inventors is incomplete if we refrain from complement predictions from the coordination-autonomy perspective with those suggested by the social identity approach. Accordingly, consistently with both the coordination-autonomy perspective and the social identity approach, we find that the adaptation to new routines, norms and values is time consuming. Acquired inventors may underestimate the amount of extra learning necessary to effectively take on the new shared mental models, indeed the convergence on new routines develops out of salient shared experiences (Nelson & Winter, 1982). This is likely to explain the direct negative effect on the overall productivity of the focal inventor. On the other hand, the emergence of a new collective identity induced by the R&D team reorganization is likely to weaken that sense of disruption, resentment, and hostility that aggravates the working conditions of acquired inventors who, consequently, show greater propensity to learn from their acquiring peers when R&D team reorganization takes place. In line with arguments drawn from SIC and SCT, we also show that acquired inventors with high relative innovation ability will be better able to switch to the new social identity stemming from the recategorization triggered by the R&D team reorganization. On the other hand, analyzing the ingroup collaborative strength prior to the acquisition we suggest that acquired inventors who have developed strong group routines in the acquired firms through their repeated collaborations will show a slower adaptation to the new social identity triggered by R&D team reorganization.

We hope this work will encourage future research to further examine how other post-integration actions affect transferring knowledge between acquiring and acquired inventors and expand the boundaries of the social identity approach to provide a more complete explanation of the effect of post-acquisition integration on acquired inventors' outcomes.

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