DOES RESOURCE VALUE INFLUENCE POST-ACQUISITION RESOURCE REDEPLOYMENT? EVIDENCE FROM THE MEDICAL DEVICE INDUSTRY

Martin C. GOOSSEN
Old Dominion University
Norfolk, Virginia
mgoossen@odu.edu

Louis MULOTTE
Tilburg University
Tilburg, The Netherlands
l.mulotte@tilburguniversity.edu

Shivaram DEVARAKONDA
Tilburg University
Tilburg, The Netherlands
s.v.devarakonda@tilburguniversity.edu

ABSTRACT

This study investigates how an acquirer reconfigures the resources of a target firm following a corporate acquisition. We consider this question by examining the patents owned by the target, which allows us to distinguish three possible reconfiguration modes: redeployment, divestiture, and expiration. We draw upon the innovation and market-for-patents literatures and claim that the value of the patent determines how the acquirer reconfigures it. Data on 2,317 patents, part of 187 acquisitions undertaken between 2000 and 2010 by 99 firms operating in the American medical device industry, show that an acquirer is more likely to redeploy an acquired patent when its internal value increases, whereas it is more likely to divest it when its external value increases. We also find that decreases in both the patent's internal and external values increase the likelihood of expiration, whereas increases in both the patent's internal and external values increase the likelihood of divestiture. Our study extends the acquisition, market-for-patents, and innovation literatures.

Keywords: Corporate acquisitions, resource reconfiguration, market-for-patents, redeployment, divestiture.

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INTRODUCTION

Research claims that the ability of firms to redeploy resources across businesses is a key driver of organizational performance (for a review, see Folta, Helfat, & Karim, 2016). Drawing upon this view, many scholars studying corporate acquisitions have highlighted the challenges associated with post-acquisition resource redeployment, defined as the amalgamation of the target's resources within the acquirer's resource base (Karim & Capron, 2016). By and large, this work suggests that post-acquisition resource redeployment, while stimulating acquisitions and enhancing their performance, is driven by a number of resource-level, firm-level, and transaction-level features (Anand, Capron, & Mitchell, 2005; Capron, Dussauge, & Mitchell, 1998; Capron, Mitchell, & Swaminathan, 2001; Graebner, Heimeriks, Huy, & Vaara, 2017).

At least two important issues around post-acquisition resource redeployment remain unaddressed. First, the extant literature has assumed that, in a given acquisition, all of the target's resources of a given type (R&D, manufacturing assets, marketing assets, etc.) are reconfigured in the same way and with the same intensity (e.g., Anand & Singh, 1997; Capron & Hulland, 1999). However, the resource-based view suggests that firms engage in acquisitions to access specific resources they cannot develop on a stand-alone basis (Ahuja & Katila, 2001; Puranam & Srikanth, 2007). As a result, we can expect acquirers to redeploy only some of the target's resources, even within a resource type. More research is thus needed about why acquirers commonly redeploy some resources within a given type and not others. Second, the extant literature has presumed the existence of a well-functioning market for all of the target's resources (Bergh, 1997; Capron et al., 2001; Xia & Li, 2013). Thus, it has assumed that an acquirer that does not redeploy a resource systematically divests it, and vice versa. However, the firm may not be able to find any buyer for a resource it does not redeploy, an option that research has not yet considered. We thus need more research on whether resources can be neither redeployed nor divested and how such resources are eventually reconfigured.

This study addresses these issues by examining the post-acquisition reconfiguration of one specific type of resource in target firms: their patents. Contrary to most organizational assets that are largely uncountable (manufacturing capacity, marketing skills, etc.), patents are assets that are individually identifiable. Focusing on patents thus enables us to examine individual reconfiguration decisions, which is not possible for assets that do not have similar levels of granularity. Further, the acquirer must decide for each of the target's patents whether it maintains its legal validity by periodically paying maintenance fees to the relevant patent offices (Ceccagnoli, 2009; Reitzig & Puranam, 2009). Thus, identifying the firm paying these maintenance fees allows us to disentangle three possible post-acquisition reconfiguration modes: 1) patent redeployment, i.e., the acquirer keeps the patent and sustains its validity by paying the maintenance fees, 2) patent divestiture, i.e., the acquirer sells the patent to another firm that sustains its validity, and 3) patent expiration, i.e., the acquirer terminates the legal validity of the patent by no longer paying the maintenance fees. Combining data on maintenance fee payments with data on patent ownership for each of the acquired patents helps us examine individual reconfiguration decisions. The expiration outcome also offers an opportunity to identify assets that are neither redeployed nor divested. Overall, we examine in this paper what an acquirer does with the patents of a target firm: which ones does it keep, which ones does it sell to other firms, and which ones does it let expire?

We start by highlighting that a core difference between the three reconfiguration modes considered relates to the firm having exclusive control over the patent. We then draw upon the innovation (Ceccagnoli, 2009; Chondrakis, 2016; King, Slotegraaf, & Kesner, 2008) and market-for-patents literatures (Arora, Fosfuri, & Gambardella, 2001; Benassi & Di Minin, 2009; De Marco, Scellato, Ughetto, & Caviggioli, 2017) and claim that whether an acquirer keeps exclusive control over a patent depends on its internal value —the extent to which it draws upon the patent in its own inventions— and its external value —the extent to which other firms use the patent as input to their inventions. Data on 2,317 patents that are part of 187 acquisitions undertaken between 2000 and 2010 by 99 firms operating in the American medical device industry show that an acquirer is more likely to redeploy an acquired patent when its internal value increases but it is more likely to divest a patent when its external value increases. We also find that decreases in both the patent's internal and external values increase the likelihood of expiration, whereas increases in both the patent's internal and external values increase the likelihood of divestiture.

This study makes several contributions. First, we extend work on post-acquisition resource redeployment (Folta et al., 2016; Karim & Capron, 2016). We show that acquirers do not redeploy all the intangible resources of their targets, but keep certain ones while divesting others and disposing of the remainder. We find that the choice between these options is driven by the extent to which the acquirer and other firms use the resource as an input to their inventions. Whereas acquirers divest intangible resources that are core to other firms' innovation efforts, they redeploy the intangible resources they are the most familiar with. We thus extend research on the drivers of technological acquisitions by highlighting that resource familiarity, rather than resource novelty, drive firms' acquisition decisions (Phene, Tallman, & Almeida, 2012; Puranam & Srikanth, 2007; Sears & Hoetker, 2014).

Second, our study contributes to the stream of the market-for-technology literature on patent trading (Benassi & Di Minin, 2009; De Marco et al., 2017). This work has focused on those firms that sell and buy patents on the market for patents (Figueroa & Serrano, 2019; Serrano, 2010;

Serrano & Ziedonis, 2018). Our study extends this line of inquiry by providing key insights on the role played by acquisitions on the supply of patents. We also show that acquisitions produce industry-level positive externalities by providing firms with (exogenous) opportunities to gain exclusive control over patents that are core to their innovation efforts.

Third, we contribute to the innovation literature. This work claims that firms innovate by combining internal and external technological resources (Barney, 1988; Chondrakis, 2016; Grimpe & Kaiser, 2010). We extend this view by showing that firms actually follow a real-option approach in their innovation strategy: first, they use intangible resources owned by other firms; second, they gain exclusive control over these resources by acquiring the firms owning them. Overall, this strategy allows firms to create a protected spot in technological space (Grimpe & Hussinger, 2014).

BACKGROUND

Post-acquisition resource reconfiguration

The corporate strategy literature defines post-acquisition resource redeployment as the amalgamation by the acquirer of the target firm's resources within its own resource base (Karim & Mitchell, 2000). This literature claims that such a mode of post-acquisition resource reconfiguration is a prime motive for corporate acquisitions and a prime driver of their performance (Anand et al., 2005; Capron & Hulland, 1999). The established literature has also identified multiple factors fostering post-acquisition resource redeployment. A first group of scholars has examined whether some resource types are more likely to be redeployed than others. For instance, Malki (1997) shows that intangible resources, such as knowledge and capabilities, are harder to redeploy than tangible resources, such as marketing and manufacturing assets. Capron et al. (1998) add that resources subject to market failures (e.g., R&D, manufacturing and marketing resources) are more likely to be redeployed than resources for which there exist well-functioning markets (e.g., managerial and financial resources). Other scholars show that post-acquisition resource redeployment is driven by target-to-acquirer features, notably by the extent to which the acquirer's resources and the target's resources complement each other. Several studies thus emphasize that acquisitions made by firms whose existing operations (and underlying resources) are related to the target firms' operations (and underlying resources) have a higher resource redeployment potential (Makri, Hitt, & Lane, 2010; Sears & Hoetker, 2014; Yu, Umashankar, & Rao, 2016). A last group of scholars highlights that post-acquisition resource redeployment is driven by the post-merger integration phase (for a review, see Graebner et al., 2017). For instance, Cording, Christmann, and King (2008) find that a greater degree of integration facilitates target-to-acquirer knowledge transfers. Symmetrically, Sarala and Vaara (2010) report that greater autonomy of the target reduces beneficial knowledge transfer.

Overall, the acquisition literature suggests that post-acquisition resource redeployment, while stimulating acquisitions and enhancing their performance, is driven by resource-level characteristics, target-to-acquirer features, and the post-merger integration processes used. Yet, this literature has overlooked two important aspects of the question. First, it has largely assumed that, in a given acquisition, all of the target's resources of a given type (R&D, manufacturing, marketing, managerial resources, financial resources, etc.) are reconfigured in the same way and with the same intensity. For instance, Capron et al. (1998) find that firms more frequently redeploy its target's R&D than its managerial and financial resources. However, anecdotal evidence suggests a more complex view, highlighting that, in most acquisitions, the acquirer eventually uses only some resources of the target, even within a given resource type (e.g., R&D). This also claimed by the Resource-based View when it suggests that firms undertake acquisitions in order to access the specific resources that would be too difficult, too time-consuming, too costly, or even impossible to obtain through other governance modes, including organic growth, arms' length market transactions, and collaboration (Capron & Mitchell, 2012). Scholars should thus adopt a more fine-grained view and for each acquisition examined, identify the precise resources that are eventually redeployed, even within a given resource type.

Second, the literature on post-acquisition resource redeployment has assumed that an acquirer is always able to divest all of the resources that it does not redeploy (e.g., Bergh, 1997; Capron et al., 2001). Research has thus assumed that a resource that is not redeployed is systematically divested and vice versa. Divestiture is therefore considered as the sole alternative to redeployment. Yet, this work has underestimated the possibility that there may be no demand on strategic factor markets for a particular resource, meaning that an acquirer might not be able to divest a resource it does not redeploy, simply because no one is willing to buy it. Scholars studying post-acquisition resource reconfiguration should thus take into account that there might not be a well-functioning market for all of the resources that an acquirer does not redeploy, which is likely to influence the reconfiguration mode chosen.

Resource reconfiguration options and exclusive control

To better understand how an acquirer reconfigures the resources of target firms, we focus on a particular type of resources: their patents. We assess the post-acquisition reconfiguration mode that the acquirer is using for each of the target's patents by capturing whether it has renewed its validity by paying the periodical maintenance fees or has transferred its ownership to another firm. This approach allows us to unambiguously capture three possible post-acquisition reconfiguration modes: patent redeployment, patent divestiture, and patent expiration. Patent redeployment refers to instances where the acquirer continues paying the patent's maintenance fees, whereas in patent divestiture the acquirer sells the patent to another firm that pays the maintenance fees (De Marco et al., 2017; Serrano, 2010). In patent expiration, the acquirer lets the patent expire by not paying the maintenance fees and the invention become a public good (Khanna, Guler, & Nerkar, 2018; Liu, 2014). These three reconfiguration modes differ according to who has exclusive control over the patent: patent redeployment allows the acquirer to keep exclusive control over the patent; patent divestiture transfers the exclusive control over the patent from the acquirer to another firm; in patent expiration no one has exclusive control over the patent, which makes the invention freely available to all.

The received patent literature emphasizes that exclusive control over a patent provides "protection advantages" in that it helps the patent owner create a legally-enforced protected spot in the technological space (Blind, Edler, Frietsch, & Schmoch, 2006; Somaya, 2012). First, a firm that owns the patents it uses in its R&D is less likely to see its products and processes imitated since exclusive patent control allows the patent owner to engage in legal actions against firms that are unduly using the patent (Tan, 2016). It is noteworthy that a firm may license patents owned by other firms but such a strategy is risky in nature (Fosfuri, 2006). Specifically, a firm that does not own the patents included in its inventions has little legal recourse against potential imitators since only patent owners can initiate patent infringement lawsuits (Bessen & Maskin, 2009). In parallel, a firm that is using another firm's patent is exposed to competitive action from the patent owner (Agarwal, Ganco, & Ziedonis, 2009; Tan, 2016): at best, the patent owner can force the patent user to (re)negotiate a potentially costly licensing agreement or ask for reciprocity and compel it to license back its own patents (Somaya, 2003); at worst, the patent owner can request a permanent legal injunction forcing the patent user to stop using the contested patent, thereby making its entire R&D investment worthless.

Second, having exclusive control over a patent prevents the patent owner's competitors from "inventing around" the patent (Ziedonis, 2004). Specifically, the patent literature notes that exclusive control over a patent makes it less attractive for the patent owner's rivals to develop technologies that are close to the focal patent as they would still require the right to use the underlying, earlier patents (Clarkson & Toh, 2010). Grimpe and Hussinger (2014: 1763) summarize this view, specifying that: "Since follow-up inventions need to involve a significant inventive step over the state of the art in order to qualify for patent protection, granted patents influence competition in product markets."

Overall, exclusive control over a patent provides the patent owner with a protected spot in its competitive environment by limiting imitation of the products and processes using the patent while creating a patent fence around its inventions (Blind et al., 2006; Somaya, 2012). We next theorize about how features of the target's patents influence the magnitude of such ownership-based protection benefits, eventually driving the acquirer's preferred mode of reconfiguration. In what follows, we address this matter by combining the innovation (Chondrakis, 2016; King et al., 2008) and market-for-patents literatures (Arora et al., 2001; Benassi & Di Minin, 2009; De Marco et al., 2017). Overall, we claim that a patent that has the potential to help the acquirer extract high protection benefits is more likely to be redeployed whereas a patent that may provide other firms with high protection benefits is more likely to be divested. We also claim that a patent that cannot generate protection benefits for anyone is more likely to be discarded via the expiration mode.

THEORY DEVELOPMENT

We next develop theory about the preferred reconfiguration mode for a given acquired patent by considering how its value influences the magnitude of the benefits that exclusive control over it may potentially provide. We define the value of a patent as *the extent to which it is used as an* *input to firms' R&D*. This definition allows us to identify the internal value and the external value of an acquired patent. The internal value of an acquired patent is the extent to which the *acquirer* uses it as an input to its invention activities whereas its external value is the extent to which it is used by *other firms*, beyond the acquirer and the target.

Internal value and post-acquisition redeployment

We claim that the extent to which a firm uses an acquired patent in its innovation efforts increases the magnitude of the protection advantages that exclusive control over it may produce. It follows that the internal value of an acquired patent is likely to increase the acquirer's propensity to favor the redeployment option over both the expiration option and the divestiture option.

Exclusive control over an acquired patent with a high internal value can generate important protection gains for at least three reasons. First, the internal value of a patent increases potential imitation costs. Research suggests that exclusive control over a patent allows the patent owner to use means of litigation if its products and processes using the patent are imitated (Tan, 2016). This means that an acquirer may lose more when it does not keep control over an acquired patent that is core to its innovation efforts (i.e., an acquired patent with a high internal value) because competitors can imitate its products and processes to a greater extent without bearing the risk of legal repercussions. Second, patent owners often take competitive actions against patent users by imposing cross-licensing agreements, asking for patent infringement claims payment, or pursuing product injunctions (Somaya, 2003; Tan, 2016). An acquirer that uses a patent extensively without owning it, is more likely to accept the patent owner's demands because it is integral to its operations. In turn, this may increase the motivation for a patent owner to engage into such adverse actions. To avoid such situations, the acquirer has a stronger incentive to keep control over an acquired patent with a high internal value. Third, exclusive control over a patent helps the owner build a "patent fence" around the innovations using the acquired patent (Ziedonis, 2004). The existence of such a fence becomes all the more crucial for an acquirer as the acquired patent's internal value increases since it prevents rivals from filing a patent close to an invention that is core to the acquirer's innovation. By keeping exclusive control over an acquired patent with high internal value, the acquirer can more effectively protect its spot in technological space and deter entry by competitors.

Overall, we claim that when the internal value of an acquired patent increases, the potential "protection" advantages associated with exclusive control also increase. This has a positive impact on the acquirer's likelihood of favoring the redeployment option over the expiration option and the divestiture option. It is worth noting that the divestiture and expiration options will prevent the acquirer from taking full advantage of a patent with a high internal value. In both cases the acquirer will be unable to benefit from the aforementioned ownership-based protection advantages. Even worse, should a divestiture be chosen, the new patent owner may itself enjoy the protection benefits discussed above, which will jeopardize the success of the acquirer's products and processes using the patent. Expiration of a patent means that the invention will be available to all, so that no one will be able to use it to protect against product imitation and secure a technological spot. Taken as a whole, we expect the likelihood of patent redeployment over both patent divestiture and patent expiration to increase as the acquired patent's internal value increases. Hence:

> *Hypothesis 1: The higher the internal value of an acquired patent, the higher the likelihood of patent redeployment.*

External value and post-acquisition divestiture

We next claim that the external value of an acquired patent also influences its post-acquisition reconfiguration mode. By definition, a high external value means that one or more firms, beyond the acquirer and the target, are extensively using the patent in their innovation efforts. Drawing upon the market-for-patents literature (Benassi & Di Minin, 2009; De Marco et al., 2017), we next argue that when the external value of an acquired patent increases, its demand on the market for patents also increases. In turn, a higher demand increases its market price, eventually increasing the acquirer's likelihood of favoring the divestiture option over both the expiration and redeployment options.

Specifically, when an acquired patent has a high external value, it means that it is extensively used by other firms in their R&D activities. In turn, each of the firms using the patent is likely to be willing to buy it. Indeed, we argued in our first hypothesis that by gaining exclusive control over a patent that is core to its innovation efforts, a firm can benefit from significant protection advantages. It follows that a patent's external value increases its demand on the market for patents (Hall, Jaffe, & Trajtenberg, 2005), thereby raising its market price (Arora & Nandkumar, 2012; Reitzig, 2003). Eventually, a higher price on the market for patents increases the financial gains that the acquirer may potentially obtain from patent trading, thereby increasing the attractiveness of the divestiture option. Both the redeployment option and the expiration option lead to a missed opportunity to earn immediate financial revenues from selling a sought-after patent on the market for patents. Overall, we expect the likelihood of patent divestiture over both patent redeployment and patent expiration to increase as the patent's external value increases. Hence:

Hypothesis 2: The higher the external value of the acquired patent, the higher the likelihood of patent divestiture.

Internal value, external value, and post-acquisition reconfiguration

We next consider how an acquired patent's internal and external values jointly influence the acquirer's preferred choice of post-acquisition reconfiguration mode. We first claim that decreases in both the patent's internal and external values increase the likelihood of expiration. Our first hypothesis states that a patent's internal value is positively related to redeployment. The crux of our argument is that an acquirer is likely to keep exclusive control over a patent that is core to its R&D activities, given the need to protect it and ensuing benefits. Our second hypothesis postulates that a patent's external value is positively related to divestiture. Our argument here is that other firms are likely to seek exclusive control over a patent that is core to their R&D activities, again given the need to protect it. This means that as a patent's external value increases, demand for it and thus its price on the market for patents rises, ultimately making divestiture an attractive option.

The combination of these arguments allows us to identify the mode of choice when an acquired patent has both a low internal value and a low external value. On the one hand, a low internal value means that the acquirer is not using the patent as an input to its innovation effort. There is thus no need to seek to protect it and, therefore, no justification for covering the patent maintenance fees (Khanna et al., 2018). On the other hand, a low external value means that other firms are unlikely to be motivated to get exclusive control over the patent to gain protection benefits. The demand for the patent on the market for patents thus decreases, which decreases its market price and thus decreases the attractiveness of the divestiture option. Overall, we suggest that neither redeployment nor divestiture is an attractive option when an acquired patent has both a low internal value and a low external value. This means that in such a case, the preferred reconfiguration mode is likely to be expiration. Hence:

> *Hypothesis 3: The lower the internal value and the lower the external value of the acquired patent, the higher the likelihood of patent expiration.*

The preferred reconfiguration mode for an acquired patent that has both a high internal value and a high external value poses an interesting situation. Such a patent has the potential to help the acquirer obtain high protection benefits (given its high internal value) and provides high financial gains on the market for patents (given its high external value). Because theory is uninformative as to the relative priority given by an acquirer between short-term financial gains from patent trading and longer-term but riskier innovation performance, we offer competing hypotheses.

On the one hand, the acquirer may prefer to keep exclusive control over a patent that is core to its innovation efforts, despite its being in high demand on the market for patents. Such a strategy will allow the acquirer to secure a protected spot in the technological space even though it will forego immediate revenues from patent trading, which are potentially high given the patent's importance for other firms' innovation efforts. In other words, redeployment will occur when the acquirer gives priority to protection benefits over revenues from patent trading. On the other hand, the acquirer may prefer to sell the patent that is in high demand on the market for patents. The high demand for it will generate significant revenues from patent trading. Nevertheless, this strategy has a downside since it prevents the acquirer from securing a protected spot in the technological space. This strategy is likely to be particularly risky given the patent's high internal value. Put simply, divestiture takes place when the acquirer gives priority to financial gains from patent trading over protection benefits.

One should note that the ownership-based protection benefits that the acquirer can obtain from redeploying an acquired patent with high internal value are not influenced by its external value since only the owner of a patent can protect from imitation the products and processes using it. Symmetrically, an acquired patent's internal value does not decrease the willingness of other firms to gain exclusive control over a patent that happens to be core to their own innovation efforts. This winner-takes-all logic suggests that an acquirer's revenues from patent trading do not influence the performance benefits yielded by the redeployment of patents and vice versa. When making reconfiguration decisions, acquirers thus favor one mode over the other on the basis of the relative priority they give to short-term financial revenues from patent trading versus longer-term innovation performance. Hence, the following competing hypotheses:

> *Hypothesis 4a: The higher the internal value and the higher the external value of the acquired patent, the higher the likelihood of patent redeployment.*

> *Hypothesis 4b: The higher the internal value and the higher the external value of the acquired patent, the higher the likelihood of patent divestiture.*

EMPIRICAL ANALYSIS

Setting and Sampling

We test our hypotheses in the medical device industry, which consists of firms that develop, manufacture, and market analytical equipment, surgical instruments, and correcting devices. Competition in the medical device industry is driven by the development and commercialization of new or improved products (Karim, 2006). In order to speed up new product development, established firms regularly acquire competitors – usually smaller firms or start-ups – to incorporate their technologies (Karim & Mitchell, 2000). Medical device firms also develop patent portfolios and rely on litigation to maintain their technological advantage and defend it against imitators (Brockhoff, Ernst, & Hundhausen, 1999). The acquisition intensity and reliance on patent protection make this industry a suitable setting for our study.

We started our data collection by identifying in SDC Platinum all acquisitions undertaken in the American medical device industry between 2000 and 2010. The sample is restricted to horizontal acquisitions: we thus ensured that both the acquirer and the target are operating in the medical device industry. The sample is also limited to American firms because we relied on USPTO data and firms predominantly apply for patents in their home region (De Rassenfosse, Dernis, Guellec, Picci, & de la Potterie, 2013). We eliminated partial acquisitions and acquisitions of business units or divisions because it is hard to identify the patents included in such deals

(Magelssen, 2020). Eventually, the use of these selection criteria yielded an initial set of 304 acquisitions undertaken by 160 firms.

For each of our sampled acquisitions, we collected the target firm's patents using data from ReedTech. First, we used *Patent Grant Bibliographic* data to link patents to firms by searching for the firm name in the patent assignee field. This source also provides the nature and type of patents as well as prior-art references. Second, we used *Patent Maintenance Fees* data to capture whether the patent's maintenance fees are paid or the patent has expired at various points in time. Third, we used *Patent Assignment* data to track any patent ownership changes. The patent assignment data contain records about inventors transferring the ownership of patents to firms, about creditor preferential claims on patents, and, more importantly, about patents being reassigned from one firm to another as a consequence of ownership changes.

We identified all patents granted to the target firms and tracked their assignment records over time. The sample is restricted to the patents owned by target firms that are 1) granted before the acquisition, 2) still valid at the moment of acquisition, 3) still owned by the target at time of the acquisition, and 4) under twelve years old. After applying these criteria and removing all acquisitions involving target firms that do not own any patent, our final sample consists of 2,317 patents involved in 187 acquisitions undertaken by 99 acquirers. We further retrieved data on the acquirer, target, and deal from SDC Platinum.

Dependent variable and analytical approach

Our dependent variable captures the post-acquisition reconfiguration mode used by the acquirer for each patent included in our sample. First, an acquirer may *Redeploy* an acquired patent, meaning that it has paid its maintenance fees to the patent office. Second, an acquirer can *Divest* an acquired patent by transferring the legal ownership to another firm, which has paid the maintenance fees to its own benefit. Third, an acquirer can choose to let the acquired patent *Expire* by not paying the maintenance fees. For each patent of the target firm, we tracked whether the acquirer redeploys it, divests it, or lets it expire using a five-year window after the acquisition. We chose this time window as renewal decisions for American patents reoccur every four years. It follows that at least one patent renewal decision is included in our observation period. Of the 2,317 patents considered, acquirers let 11% expire, divested 9.5%, and redeployed 79.5%.

Our analyses use multinomial logit regressions, which estimate the probability of each potential outcome against an excluded outcome (Gensch & Recker, 1979). We verified that our three outcomes are significantly different and respect the IIA condition (Hausman & McFadden, 1984; Small & Hsiao, 1985). We use *Expiration* as the baseline outcome in our analyses.

As in other non-linear models, we cannot easily interpret the coefficients of variables and particularly interaction terms in multinomial logit regressions (Hoetker, 2007; Wulff, 2015; Zelner, 2009). We thus follow Wiersema and Bowen's (2009) suggestion that average marginal effects (AME) are used for the interpretation of the findings. AME provide the marginal effect of a variable i.e., the change in probability of an outcome if the variable were to rise. They also give a confidence level for the marginal effects and can be computed over the entire range of observed values.

Independent variables

As mentioned above, we defined the value of a patent as the extent to which it is used as an input to firms' innovation output. Thus, we captured the value of a patent through prior-art citations made to the acquired patent by other patents. Prior-art citations are references to existing, patented inventions that are reused in the current invention (Jaffe, Trajtenberg & Fogarty, 2000; Trajtenberg, 1990). Despite their limitations (Corsino, Mariani, & Torrisi, 2019), prior-art citations are considered as a reasonable proxy for identifying the prior inventions used by firms in their current inventions (Gay & Le Bas, 2005). Prior-art citations have often been related to patent value as they positively correlate with private estimates of patent value, maintenance rates, and licensing potential (Harhoff, Narin, Scherer, & Vopel, 1999; Sampat & Ziedonis, 2005).

We defined the internal value of an acquired patent as the extent to which the acquirer uses it as an input to its innovation output. To build our *Internal value* variable, we first recorded the number of times the acquirer cites the acquired patent in its own patents before the acquisition date. The number of internal citations ranges from 0 to 52 with a mean of 1.84, so we applied a log-transformation to reduce skewness. In turn, the external value of a patent refers to the extent to which other firms use it as input to their innovation outputs. To build our *External value* variable, we first captured the number of citations that other firms – excluding the acquirer and target – make to the acquired patent in their own patents before the acquisition. The number of external citations ranges from 0 to 343 with a 23.2 average. We then log-transformed this number to reduce its skewness. Results remain similar when using raw numbers instead of log-transformed numbers.

Control variables

We used several patent-specific and deal-specific variables to control for factors that may explain the post-acquisition reconfiguration mode chosen for each of our sampled patents.

For the patent-specific variables, we controlled for the *Age of Patent*, measured by the number of years between its application date and the acquisition date. The *Claims on patent* variable, which is the number of claims on the patent, is a traditional proxy for the size of the invention (Lanjouw & Schankerman, 2004). *Patent figures* is the number of figures on the patent, which may increase its diffusion. *Technological breadth* captures the number of technological classes of the patent. We included the number of *Inventors*: a patent may be more difficult to understand for external parties when it is created by a larger team (Ganco, 2013). We controlled for the patent's *Obsolescence,* measured with the time elapsed between the patent's last citation and the acquisition date. The *Prior-art citations* variable captures the number of citations on the acquired patent to prior USPTO patents, i.e., the number of backward citations. The *Foreign citations* and *Non-patent citations* variables respectively measure the degree to which the patent incorporates foreign inventions and non-patented knowledge (e.g., scientific publications).

We included several deal-specific controls that may influence the chosen reconfiguration mode (Anand et al., 2005; Capron et al., 1998). *Deal industry proximity* captures the number of overlapping SIC digits between the acquired and the target. *Deal geographic proximity* is a dummy capturing whether the acquirer and the target are headquartered in the same U.S. state. *Deal patents* is the number of patents acquired in the deal. We controlled for the *Technological overlap* between the patent and the expertise of the acquirer, measured with the percentage of the acquirer's patents belonging to the same technological classes as the acquired patent.

RESULTS

Descriptive statistics and univariate analyses

Table 1 displays the descriptive statistics and the correlations. The correlations between the key variables, and between the key variables and all control variables, are within an acceptable range. Further, multicollinearity statistics do not indicate any issues. Table 2 depicts the distribution of the reconfiguration mode chosen for our sampled patents. We designed a 2×2 matrix based on the median of *Internal value* (low vs. high) and the median of *External value* (low vs. high) and counted the number of cases in each of the four quadrants. *Redeployment* is the dominant reconfiguration mode in each quadrant: the majority of the patents are thus redeployed. Yet, the fraction of patents that are redeployed, divested, and allowed to expire still varies considerably over the four quadrants. Further, this distribution is non-random, as indicated by Chi-square Goodness of Fit tests ($p<0.01$ for all reconfiguration modes).

The univariate analysis reveals interesting patterns. When *Internal value* rises from low to high, the likelihood of *Redeployment* increases, in line with H1. When *External value* goes from low to high, the likelihood of *Divestiture* also increases, in line with H2. Further, we can observe the highest proportion of *Expiration* when *Internal value* and *External value* are low, in line with H3. Symmetrically, the quadrant with a high *Internal value* and a high *External value* has the highest percentage of *Divestiture*, in line with H4b.

**** Insert Tables 1 & 2 about here ****

Multivariate analyses

Table 3 includes the results obtained through multinomial logit regressions. Several results on the control variables merit consideration (Models 1a-1c). *Deal patents*, *Technological overlap*, *Claims*, *Technological Breadth*, and *Inventors* increase *Redeployment* whereas *Deal industry similarity* and *Prior-art citations* decrease it. *Technological overlap*, *Age of patent*, *Claims on patent*, and *Patent figures* increase *Divestiture* whereas *Deal patents*, *Technological breadth*, *Inventors*, *Non-patent citations*, and *Obsolescence* decrease it. *Deal industry similarity, Prior-art citations* and *Obsolescence* increase *Expiration* whereas *Technological overlap, Claims on patent*, *Patent figures, Technological breadth* and *Foreign citations* decrease it.

**** Insert Table 3 about here ****

Hypothesis 1 predicts that *Redeployment* becomes more likely as *Internal value* rises. Model 2a-2c show that *Internal value* increases the likelihood of *Redeployment* (Model 2c: AME=0.046, p=.003), decreases the likelihood of *Expiration* (Model 2a: AME=-0.057, p=.000) and does not significantly influence the likelihood of *Divestiture* (Model 2b: AME=0.012, *p*=.101). In term of economic significance, the probability of a patent being redeployed increases with 3.9 percentage points if *Internal value* increases by one standard deviation. We visualized the average marginal effects in Figure 1a. *Internal value* has a positive effect on *Redeployment* and a negative effect on *Expiration* for the whole distribution of *Internal value*. *Internal value* is negatively related to *Divestiture* but the effect is insignificant at very high levels. Collectively, our findings bring strong support to H1.

We predicted in Hypothesis 2 that *Divestiture* becomes more likely as *External value* increases. Model 3 shows that *External value* increases the likelihood of *Divestiture* (Model 3b: AME=0.026, *p*=.000), decreases the likelihood of *Expiration* (Model 3a: AME=-0.031, *p*=.000) and does not significantly influence the likelihood of *Redeployment* (Model 3c: AME=0.005, *p*=.503). In term of economic significance, *Divestiture* increases by 3.6 percentage points when *External value* increases by one standard deviation. Figure 1b, which plots the average marginal effects, indicates that *External value* has a positive effect on *Divestiture* and a negative effect on *Expiration* for the whole distribution of *External value*. The effect of *External value* on *Redeployment* is insignificant for most of the distribution of *External Value*. Collectively, our results support H2.

Hypothesis 3 predicts that the likelihood of *Expiration* is the greatest when a patent has a low *Internal value* and a low *External value*. Ai and Norton (2003) assert that we cannot use regression coefficients or average marginal effects to interpret interaction terms in non-linear models. In line with their suggestion, we visualize the effect of *Internal value* on *Expiration* for patents with high vs. low *External value* (Fig. 1c) and the effect of *External value* on *Expiration* for patents with high vs. low *Internal value* (Fig. 1d). Figure 1c indicates that *Internal Value* has a negative impact on *Expiration;* it also shows that the magnitude of this negative impact increases as *External value* decreases. Symmetrically, Figure 1d reveals that *External Value* has a negative impact on *Expiration* and this is especially the case when *Internal value* is low. Overall, our findings indicate that the combination of a low *Internal* value and a low *External value* has the greatest impact on *Expiration*. Our Hypothesis 3 is thus supported.

Hypotheses 4a and 4b consider the preferred reconfiguration mode when a patent has a high *Internal value* and a high *External value*. Models 2c-3b indicate that the marginal effect of *External Value* on *Divestiture* (AME =.0567; 95%-confidence interval = [.034; .080]) is much larger than the marginal effect of *Internal Value* on *Redeployment* (AME= .033; 95%-confidence interval = [.024; .042]). This result provides initial support to H4b. We next plotted the corresponding average marginal effects (Fig. 1e-1h). *External value* decreases the magnitude of the positive impact of *Internal value* on *Redeployment* (Fig. 1e) whereas *Internal value* increases the negative effect of *External value* on *Redeployment* (Fig. 1f). In parallel, *External value* weakens the negative effect of *Internal value* on *Divestiture* (Fig. 1g). Perhaps even more strikingly, *Internal value* increases the magnitude of the positive impact of *External value* on *Divestiture* (Fig. 1h). Overall, the visualizations of the effects show that increases in both the patent's internal value and external value increase the likelihood of *Divestiture*, rather than the likelihood of *Redeployment*, thereby bringing support to our Hypothesis 4b.

We further visualized the expected probabilities of each reconfiguration mode as a function of the patents' *Internal Value* and *External Value* (using coefficients from Models 5a-5c). As predicted in H3, Figure 2a shows that the probability of *Expiration* is the highest (nearly 20%) for patents with a low *Internal value* and a low *External value*, but this probability decreases when either *Internal value* or *External value* increases. The lowest likelihood of *Expiration* is 3.9% when patents have a high *Internal value* and a high *External value*. Figure 2b visualizes the likelihood of *Divestiture*: the likelihood of *Divestiture* increases as *External value* increases, as predicted in H2. Figure 2c emphasizes that *Internal value* increases the probability of *Redeployment*, as predicted in H1. When combined, Figures 2b and 2c indicate that a high *Internal value* and a high *External value* increase the likelihood of *Divestiture* and decrease the likelihood of *Redeployment*, in line with H4b.

*** *Insert Figures 1a-1h about here* ***

*** *Insert Figures 2a-2c about here* ***

Robustness checks

We conducted several robustness checks (results are available from the authors upon request). First, we used alternative measures for our independent variables. In our main results, our independent variables are log-transformed counts; results remain virtually similar when using raw count numbers or when using dummies based on median cut-off points. Results are also virtually the same after log-transforming all skewed control variables, even though this transformation increases pairwise correlations. We further controlled for the value of the patent to the target firm – and not the acquirer – by including in the dependent variable the number of forward citations (before the acquisition) made by the target. This alternative measure did not affect our results. We also considered the prior-art citations on the acquired patent itself as it could indicate internal value to the acquirer. In separate tests, we added patent prior-art citations to the acquirer to the independent variable for internal value and as an additional control variable: these citations increase the probability of *Redeployment* while the predicted effects remain unchanged.

Second, we used alternative econometric techniques. We started by interpreting the findings using marginal effects at the mean (MEM). The magnitude, direction, and significance levels of these findings are similar to the main results. We also repeated the analyses using logistic regressions predicting either *Redeployment* or *Divestiture*. The results regarding *Divestiture* show a positive effect of *External value* and an insignificant impact of *Internal value* whereas the results on *Redeployment* show a positive effect of *Internal value* and a negative effect of *External value*. These findings largely confirm our main results.

Third, we controlled for the potential non-independence of observations. We started by clustering the standard errors by the acquirer; we also added dummy variables for the individual acquirers. Both these models yield results similar to our main regressions. We also created all patent-outcome dyads to perform a conditional logistic regression adding fixed effects for patent-specific and option-specific characteristics. The use of the relative value for each option as predicting variable yielded results that are in line with our main findings. Overall, our robustness tests bring further support to our hypotheses.

Mechanism checks

Hypothesis 1 claims that an acquirer becomes more likely to redeploy an acquired patent as its internal value increases. The crux of our argument is that the protection advantages of exclusive control over a patent increase with the extent to which the acquirer uses it in its R&D activities. It is noteworthy that the magnitude of such protection advantages is also likely to depend on the extent to which the acquirer uses the acquired patent in multiple units, departments, and R&D programs. We therefore repeated the analysis replacing our *Internal value* variable with two other variables: the *Number of acquirer inventors citing the patent* and the *Number of acquirer technological classes citing the patent*. These variables assess the breadth of acquirer's activities using the acquired patent. Results are available from the authors upon request. Both variables significantly increase the likelihood of *Redeployment*. This confirms that the extent to which a patent is core to the acquirer's innovation efforts increases the likelihood of *Redeployment* (H1).

Further, we claim in our Hypothesis 2 that the likelihood of *Divestiture* increases with the patent's *External value*. Our argument here is that the extent to which a patent is core to the innovation of other firms (beyond the acquirer and the target) increases its demand and price on the market for patents. In turn, we measured a patent's *External value* with its number of non-self forward citations (the total number of citations to the acquired patent minus the number of citations made by the acquirer and by the target). It is worth noting that a patent's price on the market for patents is likely also to be driven by the number of firms that are willing to buy it. This means that an acquirer's likelihood of divesting a patent should also increase with the number of firms citing it. We thus replaced our *External value* variable with a variable capturing the *Number of firms citing the patent*. Results are available from the authors upon request. Expectedly, this variable has a positive and significant impact on *Divestiture* while not affecting *Redeployment*. This confirms our core argument that the decision of an acquirer to divest a patent is driven by the demand for the patent on the market for patents (H2).

Post-hoc analyses

As a final analysis, we examined in detail the reconfiguration mode chosen for acquired patents that have a high *Internal value* and a high *External value* (H4). Our main analyses indicated that in such an instance, acquirers are less likely to redeploy the patent and instead choose to reap immediate financial gains by divesting it (H4b). We thus expected that an acquirer is even more likely to divest such key patents when it requires financial resources: in such an instance, immediate financial revenues becomes even more crucial. We next proxied an acquirer's need for financial resources by the *Deal's size* and by the *Firm's profitability*.

First, we computed the ratio of deal value to acquirer's assets, split the sample by the median, and re-ran the analyses. Results are available from the authors upon request. In the subsample limited to smaller acquisitions, the *Internal value * External value* interaction increases *Redeployment* and decreases *Divestiture*. In the subsample limited to larger acquisitions, the effect of the interaction term is similar to what we obtained in our main analyses: it decreases *Redeployment* and increases *Divestiture*. Graphs plotting the average marginal effects confirm the direction, magnitude, and significance of these effects. It follows that an acquirer is likely to divest patents that have a high *External value* and a high *Internal value* when the deal's relative size is large. Conversely, when the deal is small, the acquirer tends to give priority to longer-term innovation performance over immediate financial revenues from patent trading.

Second, we computed the return-on-sales profitability ratio of the acquirer, split the sample on the median, and re-ran the analyses. Results are available from the authors upon request. The subsample limited to underperforming firms produces results that are similar to our main results: the *Internal value * External value* interaction term increases *Divestiture* and reduces *Redeployment*. Yet, the interaction term reduces the likelihood of *Divestiture* in the subsample limited to acquirers performing above average. When depicted, the average marginal effects confirm these opposite outcomes.

Overall, these post-hoc analyses show that an acquirer's propensity to divest a highly-demanded patent (high *External value*) that is also core to its innovation output (high *Internal value*) is increased by the firm's need for financial resources, which we estimated by the deal's relative size and the firm's profitability. This means that the financial situation of acquirers determines the priority given to short-term financial revenues from the market-for-patents (*Divestiture*) versus longer-term imitation protection advantages (*Redeployment*).

DISCUSSION

We examined in this study how acquirers reconfigure the patents of target firms. Drawing upon the innovation and market-for-patents literatures, we claimed, and found evidence, that the acquired patents' internal and external values drive the way in which acquirers reconfigure them. Data on 2,317 patents, part of 187 acquisitions undertaken in the American medical device industry, show that an acquirer is more likely to redeploy an acquired patent when its internal value increases; it may thus gain exclusive control over technological elements that are core to its innovation efforts, thereby being able to create a legally-enforced protected spot in the technological space. We also find that an acquirer is more likely to divest a patent when its external value increases since this reconfiguration mode will help the acquirer obtain significant revenues on the market for patents. We also find that the joint effect of a low internal value and a low external value increases the likelihood of expiration while the joint effect of a high internal value and a high external value increases the likelihood of divestiture.

We extend the acquisition, market-for-technologies, and innovation literatures. First, we contribute to several facets of the acquisition literature. We develop research on post-acquisition resource redeployment (Folta et al., 2016; Karim & Capron, 2016) by showing that not all intangible resources of target firms are amalgamated within the resource base of acquirers, even within a given resource type. Rather, acquirers keep resources that are deemed to be valuable internally, divest resources that are valuable to others, and simply let resources that they have both a low internal value and a low external value perish. This means that acquirers redeploy intangible resources they are familiar with, instead of unfamiliar ones. We thus show that gaining exclusive control over identified technologies, instead of accessing unknown ones, is the driving force behind the post-acquisition reconfiguration process. We also contribute to the work on the drivers of acquisitions. The Resource-based View claims that firms undertake acquisitions to access resources that are too difficult, too time-consuming, or even impossible to develop on a standalone basis (Capron & Mitchell, 2012). Our study suggests a complementary view, showing that acquirers redeploy their target's technologies as inputs to their innovation process. Thus, acquirers may not undertake acquisitions with the objective of learning new technologies, but rather having control over already-known technologies. Eventually, acquirers may enjoy a legally-enforced protected spot in the technological space.

Perhaps even more strikingly, our study also puts forth a novel view on the benefits of acquisitions that adopts the industry as the unit of analysis. The traditional literature focuses on the benefits of the acquisitions for the focal acquirers (see a review, see Haleblian, Devers, McNamara, Carpenter, & Davison, 2009). Our view suggests that acquisitions also yield industry-level positive externalities by providing firms with opportunities to buy patents on the market that are core to their innovation efforts. We thus emphasize that acquisitions can also be seen as exogenous shocks, which allow all firms operating in an industry to acquire crucial resources on strategic factors markets.

Second, we contribute to the stream of the markets-for-technology literature that focuses on patent trading (Serrano, 2010; Serrano & Ziedonis, 2018). This line of inquiry has primarily examined which firms sell and buy patents. For instance, Figueroa and Serrano (2019) find that relative to large firms, small firms both sell more and buy more patents on the market for patents. Our study extends this literature by highlighting the role played by acquisitions on the supply of patents. We show that acquirers are not interested in all of the target firms' patents and tend to divest the patents that have the highest demand, even if they are valuable for them. We also highlight that a market may not exist for all patents as acquirers do not divest all non-redeployed patents, but let some of them expire. As these patents do not differ in other characteristics (such as their technological class or the number of claims), it may indicate some illiquidity in the market for patents (Gambardella, Giuri, & Luzzi, 2007). Our study explains, at least partly, where those patents come from. We show that when a patent has a low internal value and a low external value, the acquirer tends to terminate its legal validity by not paying the maintenance fees. The patent ends up being neither redeployed not divested but freely available to all.

Third, we extend the innovation literature. Research highlights that acquisitions may help firms access external knowledge elements, which will be later recombined with internally-developed knowledge elements (Barney, 1988; Phene et al., 2012). Our study shows that firms acquire targets to gain exclusive control over knowledge elements that they have been previously using in their R&D efforts. Thus, we may describe firms' innovation strategy through a real-option lens. Firstly, in their R&D efforts firms use patented technologies owned by other firms. Secondly, they seek to gain control over such knowledge elements by acquiring the firms that own them. Our study thus suggests that recombination of target firms' technology by the future acquirer can already happen before the acquisition itself (see also Chondrakis, 2016). Specifically, we highlight that acquisitions do not help firms recombine patents *per se* but allows firms to gain control over patents they have already used in their recombination efforts. This view extends the traditional view of how firms use acquisitions in their innovation efforts, which is based on the recombination of internal and external knowledge elements.

We also extend work on firms' innovation trajectories (e.g., Christensen, 1997; Wu, Wan, Levinthal, 2014). We found that a patent that has both a high internal value and a high external value is likely to be divested, and not redeployed as one might expect. This means that firms often give priority to the short-term financial gains they may obtain from selling a sought-after patent even if the patent may be beneficial for their longer-term technological performance. We found that this is especially the case when firms have important financial needs. Extant research claims that firms' innovation trajectories result, at least partly, from the redeployment of external technological elements (e.g., Henderson & Clark, 1990). We extend this view by showing that firms' innovation trajectories also result from the elimination of newly-acquired technological elements for pure financial gains, even if they had the potential to generate ownership-based protection benefits. We thus provide evidence that firms may be more opportunistic in their innovation trajectories than traditionally assumed since they are likely to sell highly-demanded patents, despite their potential role on innovation performance. This logic is akin to what underlies player trades among sport clubs: clubs often sell their best players on the transfer market despite their crucial role in obtaining major trophies (Barden & Mitchell, 2007). In both cases, short-term financial revenues outweigh the longer-term but riskier operational performance.

Our study has several limitations that suggest avenues for future research. First, we only considered the medical device industry. Even though we do not believe that industry specificities drive our results, research needs to examine whether our results hold in other industries. Second, we only considered one type of intangible resources: USPTO patents. The results are probably even more pronounced for European patents that have considerably higher maintenance fees, although this should be explored empirically. Third, we welcome research on the antecedents of the post-acquisition reconfiguration of intangible assets. In this study, we focused on the value of patents, defined as the extent to which firms are using them as inputs to their innovation output. Research could consider other drivers of post-acquisition reconfiguration processes, including competitive pressures, legal requirements and antitrust concerns, employee-level dimensions. Fourth, research needs to examine how acquirers actually use the patents they previously obtained through acquisitions. While one can expect that they will cite the patents they redeployed (i.e., patents with a high internal value), it would be interesting to examine whether they also cite the patents they divested for financial gains (i.e., patents with a high internal value and a high external value). Lastly, we focused on the redeployment of acquired patents. Research could explore whether and how firms (re)deploy internally-developed patents, including how their internal and external values influence the reconfiguration options.

In conclusion, in this study we examined the factors influencing the target-to-acquirer reconfiguration of intangible resources following a corporate acquisition. We studied this question by focusing on the patents of the target firm, which allowed us to distinguish three potential reconfiguration modes: patent redeployment, patent divestiture, and patent expiration. Our main results are that an acquirer is more likely to redeploy an acquired patent when its internal value increases whereas it is more likely to divest it when its external value increases. Overall, we provide novel insights on post-acquisition reconfiguration processes. The findings speak to the acquisition, market-for-patents, and innovation literatures.

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TABLES

Table 1 – Descriptive statistics and pairwise correlations

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
(1) Expiration	1.000																	
(2) Divestiture	-0.114	1.000																
(3) Redeployment	-0.693	-0.637	1.000															
(4) Internal value	-0.140	0.104	0.033	1.000														
(5) External value	-0.185	0.082	0.084	0.382	1.000													
(6) Deal patents	0.018	-0.189	0.124	-0.086	-0.008	1.000												
(7) Deal industry similarity	0.021	0.054	-0.055	0.057	-0.113	0.009	1.000											
(8) Deal geographic proximity	-0.039	0.143	-0.073	0.122	-0.018	-0.221	0.069	1.000										
(9) Age of patent	0.038	-0.048	0.006	0.062	0.420	0.123	0.058	-0.062	1.000									
(10) Claims on patent	-0.151	0.070	0.067	0.170	0.210	-0.044	0.075	0.026	0.039	1.000								
(11) Patent figures	-0.108	0.173	-0.042	0.274	0.261	-0.056	0.053	0.201	-0.079	0.142	1.000							
(12) Technological breadth	-0.117	-0.088	0.155	0.016	0.285	0.052	-0.149	-0.086	0.044	0.024	0.197	1.000						
(13) Inventors	-0.061	-0.035	0.073	0.148	0.168	-0.058	-0.062	0.113	-0.076	0.143	0.303	0.245	1.000					
(14) Prior-art citations	-0.055	0.046	0.009	0.285	0.199	-0.069	0.063	0.088	-0.142	0.118	0.316	0.317	0.261	1.000				
(15) Foreign citations	-0.088	0.037	0.041	0.346	0.265	-0.043	0.071	0.129	-0.056	0.107	0.295	0.266	0.306	0.755	1.000			
(16) Non-patent citations	-0.055	-0.029	0.064	0.230	0.200	-0.044	0.059	0.039	-0.014	0.142	0.162	0.127	0.210	0.467	0.567	1.000		
(17) Technological overlap	-0.106	0.127	-0.010	0.238	0.086	-0.168	0.136	0.222	-0.076	0.084	0.225	0.086	0.114	0.154	0.190	0.115	1.000	
(18) Obsolescence	0.080	-0.090	0.003	0.003	0.205	0.095	0.112	-0.056	0.697	0.054	-0.085	0.022	-0.028	-0.004	0.046	0.074	-0.048	1.000
Mean	0.110	0.095	0.795	0.452	2.344	39.88	3.622	0.127	3.769	20.80	8.829	10.92	2.573	31.58	4.796	5.172	1.846	2.383
S.D.	0.313	0.293	0.403	0.848	1.366	32.72	0.489	0.333	2.793	17.01	9.639	15.12	1.488	44.31	10.60	12.39	5.226	1.567
Min	0.000	0.000	0.000	0.000	0.000	1.000	2.000	0.000	0.003	1.000	0.000	1.000	1.000	1.000	0.000	0.000	0.000	0.016
Max	1.000	1.000	1.000	3.970	5.841	114.0	4.000	1.000	11.98	285.0	94.00	96.00	11.00	413.0	110.0	133.0	60.42	11.02

Table 2 – Univariate statistics

		External value	
		Low (≤ median)	High (> median)
Internal value	Low (≤ median)	Expired: 16.26% Divested: 8.74% Redeployed: 75.00%	Expired: 10.85% Divested: 9.96% Redeployed: 79.20%
	High (> median)	Expired: 3.90% Divested: 3.41% Redeployed: 92.68%	Expired: 3.08% Divested: 12.97% Redeployed: 83.96%

Table 3 – Multinomial regression analysis

Outcome:		Model 1a Expiration	Model 1b Divestiture	Model 1c Redeploy.	Model 2a Expiration	Model 2b Divestiture	Model 2c Redeploy.	Model 3a Expiration	Model 3b Divestiture	Model 3c Redeploy.	Model 4a Expiration	Model 4b Divestiture	Model 4c Redeploy.	Model 5a Expiration	Model 5b Divestiture	Model 5c Redeploy.
Deal patents	coeff.		-0.027***	0.003		-0.027***	0.003		-0.027***	0.003		-0.027***	0.003		-0.029***	0.004
	(s.e.)		(0.004)	(0.002)		(0.004)	(0.002)		(0.004)	(0.002)		(0.004)	(0.002)		(0.005)	(0.002)
	[a.m.e.]	[0.000]	[-0.002***]	[0.002***]	[0.000]	[-0.002***]	[0.002***]	[0.000]	[-0.002***]	[0.002***]	[0.000]	[-0.002***]	[0.002***]	[0.000]	[-0.002***]	[0.002***]
Deal industry similarity	coeff.		-0.100	-0.271+		-0.063	-0.235		0.104	-0.130		0.115	-0.120		0.118	-0.109
	(s.e.)		(0.212)	(0.149)		(0.213)	(0.150)		(0.217)	(0.152)		(0.217)	(0.153)		(0.218)	(0.153)
	[a.m.e.]	[0.023+]	[0.011]	[-0.033+]	[0.019]	[0.011]	[-0.030+]	[0.010]	[0.016]	[-0.026]	[0.009]	[0.016]	[-0.025]	[0.008]	[0.015]	[-0.023]
Deal geographic proximity	coeff.		0.565+	0.375		0.584+	0.402		0.671*	0.407		0.703*	0.430+		0.604+	0.439+
	(s.e.)		(0.303)	(0.249)		(0.303)	(0.250)		(0.306)	(0.250)		(0.306)	(0.250)		(0.309)	(0.250)
	[a.m.e.]	[-0.035]	[0.017]	[0.018]	[-0.037+]	[0.017]	[0.020]	[-0.037+]	[0.022]	[0.015]	[-0.039+]	[0.023]	[0.016]	[-0.039+]	[0.015]	[0.024]
Technological overlap	coeff.		0.482***	0.451***		0.367***	0.337***		0.428***	0.397***		0.354***	0.322***		0.354***	0.326***
	(s.e.)		(0.103)	(0.103)		(0.095)	(0.095)		(0.097)	(0.097)		(0.092)	(0.091)		(0.092)	(0.092)
	[a.m.e.]	[-0.040***]	[0.006***]	[0.034***]	[-0.030***]	[0.005***]	[0.025**]	[-0.035***]	[0.005***]	[0.029***]	[-0.028***]	[0.005***]	[0.023**]	[-0.028***]	[0.005***]	[0.024**]
Age of patent	coeff.		0.110*	0.017		0.087+	-0.002		-0.068	-0.082*		-0.070	-0.085*		-0.084	-0.086*
	(s.e.)		(0.050)	(0.034)		(0.051)	(0.035)		(0.058)	(0.040)		(0.057)	(0.040)		(0.058)	(0.040)
	[a.m.e.]	[-0.002]	[0.007*]	[-0.005]	[-0.001]	[0.007*]	[-0.006]	[0.007*]	[0.000]	[-0.007]	[0.007*]	[0.001]	[-0.008+]	[0.007*]	[-0.001]	[-0.007]
Claims on patent	coeff.		0.054***	0.049***		0.051***	0.047***		0.044***	0.042***		0.043***	0.041***		0.042***	0.040***
	(s.e.)		(0.008)	(0.007)		(0.008)	(0.007)		(0.008)	(0.007)		(0.008)	(0.007)		(0.008)	(0.007)
	[a.m.e.]	[-0.004***]	[0.001**]	[0.004***]	[-0.004***]	[0.001*]	[0.003***]	[-0.004***]	[0.000]	[0.003***]	[-0.004***]	[0.000]	[0.003***]	[-0.003***]	[0.000]	[0.003***]
Patent figures	coeff.		0.065***	0.019		0.063***	0.019		0.048***	0.008		0.049***	0.009		0.046**	0.010
	(s.e.)		(0.014)	(0.013)		(0.014)	(0.013)		(0.014)	(0.013)		(0.014)	(0.013)		(0.014)	(0.013)
	[a.m.e.]	[-0.002+]	[0.004***]	[-0.002]	[-0.002+]	[0.003***]	[-0.001]	[-0.001]	[0.003***]	[-0.002+]	[-0.001]	[0.003***]	[-0.002+]	[-0.001]	[0.003***]	[-0.002]
Technological breadth	coeff.		-0.037*	0.039***		-0.034*	0.042***		-0.057**	0.030**		-0.055**	0.033**		-0.061***	0.033**
	(s.e.)		(0.017)	(0.011)		(0.017)	(0.011)		(0.018)	(0.010)		(0.018)	(0.011)		(0.018)	(0.010)
	[a.m.e.]	[-0.003**]	[-0.005***]	[0.008***]	[-0.003**]	[-0.005***]	[0.008***]	[-0.002*]	[-0.006***]	[0.008***]	[-0.002*]	[-0.006***]	[0.008***]	[-0.002*]	[-0.006***]	[0.008***]
Inventors	coeff.		-0.271***	-0.052		-0.282***	-0.062		-0.291***	-0.065		-0.297***	-0.071		-0.273***	-0.071
	(s.e.)		(0.079)	(0.055)		(0.079)	(0.055)		(0.080)	(0.056)		(0.080)	(0.056)		(0.080)	(0.056)
	[a.m.e.]	[0.006]	[-0.017***]	[0.010+]	[0.007]	[-0.017***]	[0.010]	[0.007]	[-0.017***]	[0.010]	[0.008]	[-0.017***]	[0.009]	[0.008]	[-0.015**]	[0.007]
Prior-art citations	coeff.		-0.005	-0.008**		-0.006	-0.009**		-0.005	-0.008**		-0.006	-0.009**		-0.003	-0.009**
	(s.e.)		(0.004)	(0.003)		(0.004)	(0.003)		(0.004)	(0.003)		(0.004)	(0.003)		(0.004)	(0.003)
	[a.m.e.]	[0.001**]	[0.000]	[-0.001**]	[0.001**]	[0.000]	[-0.001**]	[0.001**]	[0.000]	[-0.001**]	[0.001**]	[0.000]	[-0.001**]	[0.001**]	[0.000+]	[-0.001***]
Foreign citations	coeff.		0.056**	0.044*		0.049*	0.039*		0.043*	0.039*		0.041+	0.035+		0.028	0.037+
	(s.e.)		(0.022)	(0.019)		(0.022)	(0.020)		(0.021)	(0.019)		(0.022)	(0.019)		(0.022)	(0.019)
	[a.m.e.]	[-0.004*]	[0.001]	[0.003]	[-0.004*]	[0.001]	[0.002]	[-0.003*]	[0.001]	[0.003]	[-0.003+]	[0.001]	[0.002]	[-0.003+]	[0.000]	[0.003*]
Non-patent citations	coeff.		-0.015	0.004		-0.013	0.005		-0.020	-0.001		-0.019	0.001		-0.025+	0.001
	(s.e.)		(0.013)	(0.010)		(0.013)	(0.010)		(0.013)	(0.010)		(0.013)	(0.010)		(0.013)	(0.010)
	[a.m.e.]	[0.000]	[-0.001*]	[0.002]	[0.000]	[-0.001+]	[0.002]	[0.000]	[-0.001*]	[0.001]	[0.000]	[-0.001*]	[0.001]	[0.000]	[-0.002**]	[0.002+]
Obsolescence	coeff.		-0.442***	-0.169**		-0.405***	-0.136*		-0.352***	-0.102+		-0.337***	-0.084		-0.347***	-0.078
	(s.e.)		(0.096)	(0.057)		(0.096)	(0.057)		(0.100)	(0.058)		(0.100)	(0.058)		(0.101)	(0.058)
	[a.m.e.]	[0.017**]	[-0.022***]	[0.004]	[0.014**]	[-0.021**]	[0.007]	[0.011*]	[-0.019**]	[0.008]	[0.009+]	[-0.019**]	[0.010]	[0.009+]	[-0.020**]	[0.011]

Internal value	coeff.					**0.733*** **	**0.646*** **					**0.479***	**0.531** **		**-0.330**	**0.649*** **
	(s.e.)					**(0.195)**	**(0.175)**					**(0.199)**	**(0.176)**		**(0.278)**	**(0.194)**
	[a.m.e.]				**[-0.057***]**	**[0.012]**	**[0.046**]**				**[-0.045**]**	**[0.000]**	**[0.045**]**	**[-0.048**]**	**[-0.064***]**	**[0.112***]**
External value	coeff.								**0.655*** **	**0.333*** **		**0.623*** **	**0.289*** **		**0.708*** **	**0.227** **
	(s.e.)								**(0.099)**	**(0.070)**		**(0.103)**	**(0.071)**		**(0.120)**	**(0.087)**
	[a.m.e.]							**[-0.031***]**	**[0.026***]**	**[0.005]**	**[-0.027***]**	**[0.026***]**	**[0.001]**	**[-0.023**]**	**[0.036***]**	**[-0.012]**
Internal value x	coeff.														**0.427***	**-0.204**
External value	(s.e.)														**(0.171)**	**(0.140)**
	[a.m.e.]													**[0.013]**	**[0.043***]**	**[-0.055***]**
Constant			0.532	1.818**		0.701	1.937***		0.927	1.973***		1.000	2.058***		0.847	2.049***
			(0.810)	(0.570)		(0.814)	(0.574)		(0.822)	(0.572)		(0.824)	(0.576)		(0.829)	(0.577)
Observations		2,317	2,317	2,317	2,317	2,317	2,317	2,317	2,317	2,317	2,317	2,317	2,317	2,317	2,317	2,317
Chi2		466.8	466.8	466.8	485.7	485.7	485.7	512.6	512.6	512.6	523.8	523.8	523.8	574.9	574.9	574.9
Log-likelihood		-1268	-1268	-1268	-1258	-1258	-1258	-1245	-1245	-1245	-1239	-1239	-1239	-1214	-1214	-1214

Standard errors in parentheses
Average marginal effects in brackets
*** p<0.001, ** p<0.01, * p<0.05, + p<0.1

FIGURES

Figure 1 – Plots of average marginal effects (A.M.E.)

Figure 1a – Effect of *Internal value* on the reconfiguration mode

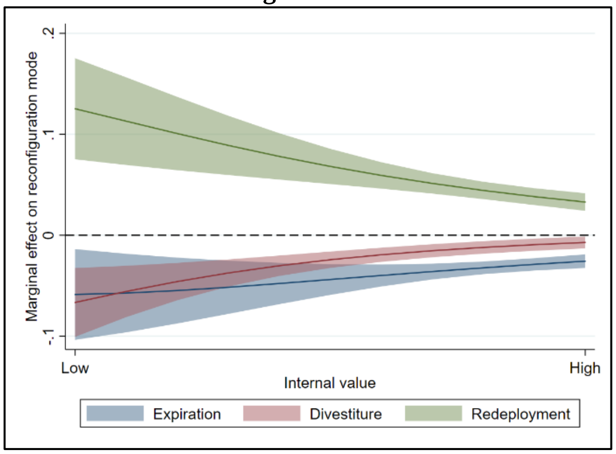

Figure 1b – Effect of *External value* on the reconfiguration mode

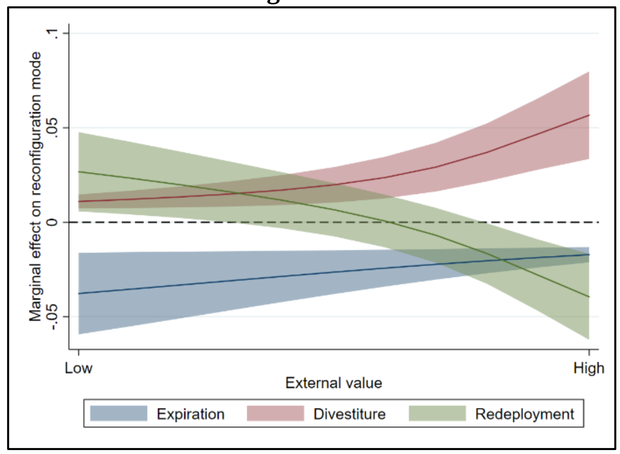

Figure 1c – Effect of *Internal value* on *Expiration*

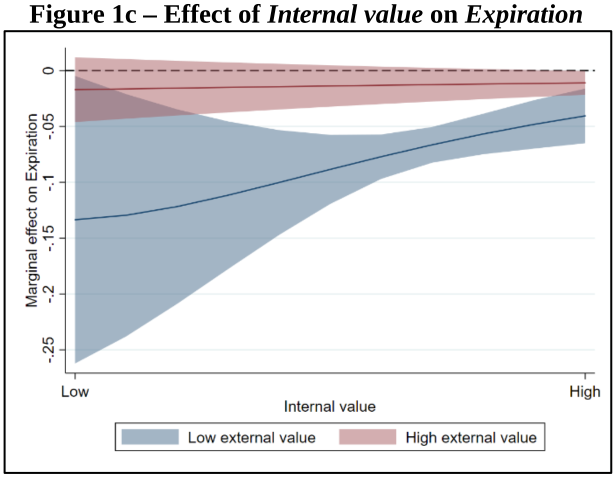

Figure 1d – Effect of *External value* on *Expiration*

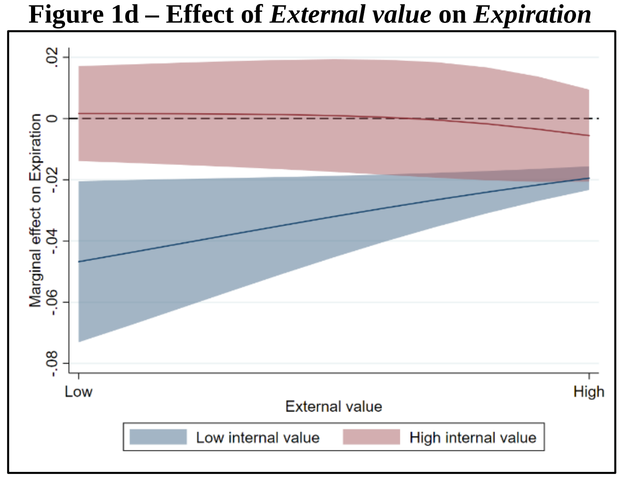

Figure 1e – Effect of *Internal value* on *Redeployment*

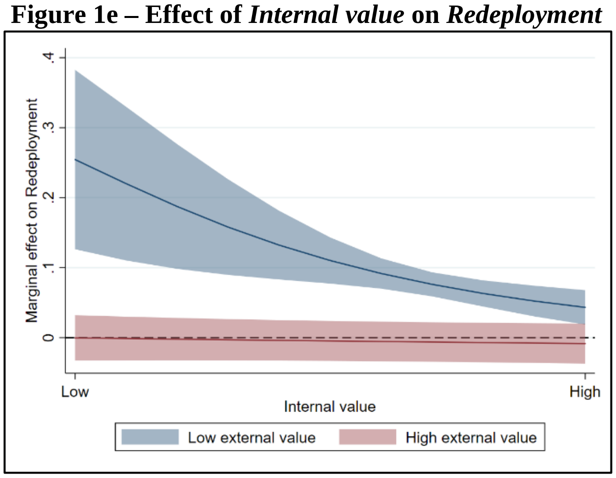

Figure 1f – Effect of *External value* on *Redeployment*

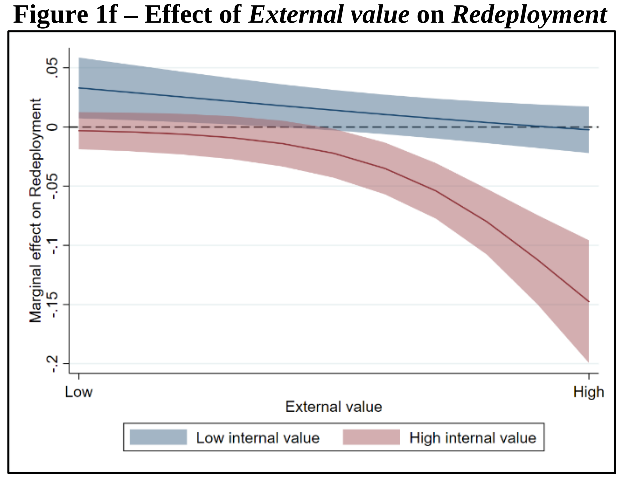

Figure 1g – Effect of *Internal value* on *Divestiture*

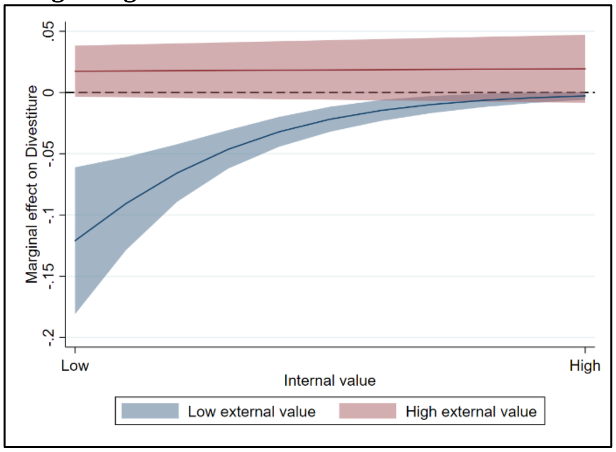

Figure 1h – Effect of *External value* on *Divestiture*

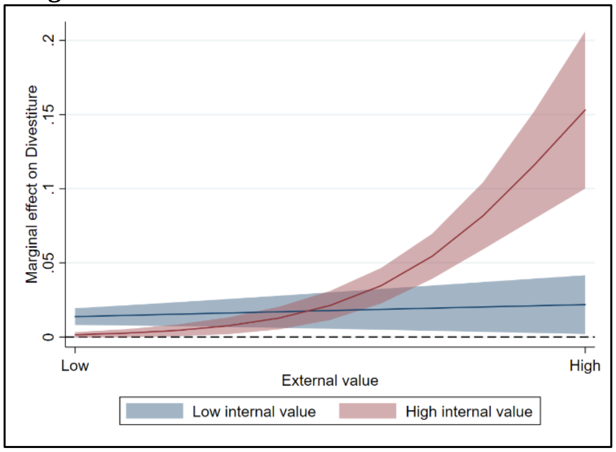

Figure 2 – Plots of probabilities

Figure 2a – Likelihood of Expiration

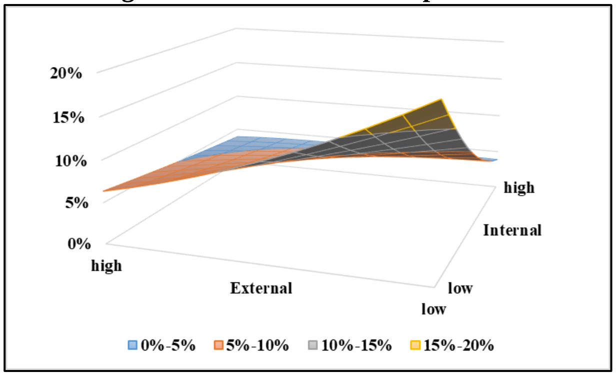

Figure 2b – Likelihood of Divestiture

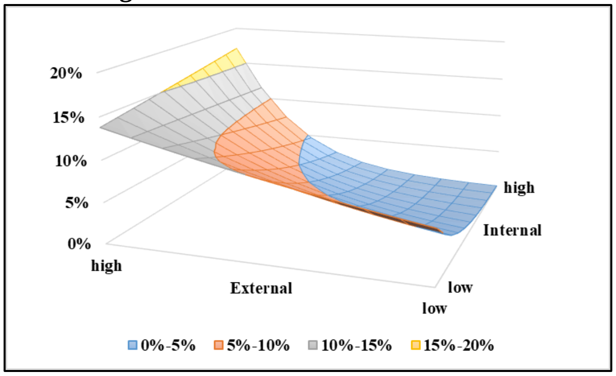

Figure 2c – Likelihood of Redeployment