Management Science

Publication details, including instructions for authors and subscription information:
http://pubsonline.informs.org

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To cite this article:
Santiago Mingo (2013) The Impact of Acquisitions on the Performance of Existing Organizational Units in the Acquiring Firm: The Case of an Agribusiness Company. Management Science 59(12):2687-2701. http://dx.doi.org/10.1287/mnsc.2013.1727

MANAGEMENT SCIENCE
Vol. 59, No. 12, December 2013, pp. 2687–2701
ISSN 0025-1909 (print) | ISSN 1526-5501 (online)

http://dx.doi.org/10.1287/mnsc.2013.1727

The Impact of Acquisitions on the Performance of Existing Organizational Units in the Acquiring Firm: The Case of an Agribusiness Company

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Companies frequently expand their production capacity through the acquisition of new organizational units. This study analyzes how the performance of existing units is affected by the acquisition of another unit. The research focuses on three mechanisms: managerial distraction, resource transfer, and knowledge sharing. These mechanisms are studied in the context of existing units and acquired units with different levels of proximity and similarity between them. Using a detailed data set from an agribusiness company, empirical analysis shows that after an acquisition event there is a temporary decrease in the performance of existing units that are geographically proximate to the acquired unit. Data analysis also shows that after an acquisition event there is an increase in the performance of existing units that have similar characteristics to the acquired unit. In this latter case, the rate of increase in performance diminishes over time. This research demonstrates that the acquisition of an organizational unit can have differing dynamic effects on different parts of the organization.

Key words: corporate strategy; acquisitions; mergers; intraorganizational performance; managerial distraction; resource transfer; knowledge sharing
History: Received September 26, 2010; accepted January 27, 2013, by Bruno Cassiman, business strategy. Published online in *Articles in Advance* May 7, 2013.

1. Introduction

Acquisitions are a popular business strategy that can be used to increase the size of a firm (Ahuja and Katila 2001, Bresman et al. 1999, Capron and Mitchell 2012). These can generate intra- and intertemporal economies of scope because some resources and capabilities can be shared among multiple business units, both contemporaneously and over time (Helfat and Eisenhardt 2004, Singh and Montgomery 1987). Despite the importance and popularity of acquisitions, our understanding of this complex phenomenon is still limited (Barkema and Schijven 2008, King et al. 2004, Larsson and Finkelstein 1999). Acquisitions frequently fail to create value for the acquiring firm and are, typically, a mixed blessing for the owners of acquiring companies (Agrawal et al. 1992, Capron and Pistre 2002, Kaplan and Weisbach 1992, King et al. 2004, Morck et al. 1990, Weber and Camerer 2003). Given the importance of improving the capability to create value through acquisitions, the academic literature has focused on firm-level outcomes (King et al. 2004). According to Haleblian et al. (2009), the majority of acquisition research has focused on U.S. publicly traded companies using mainly archival data, which has limited scholars' abilities to dig deeper into the phenomenon. The mechanisms that take place *inside* the acquiring firm during and after an acquisition have received little attention (Haspeslagh and Jemison 1991, Jemison and Sitkin 1986). More specifically, empirical research has been slow to identify factors that affect *postacquisition performance* (King et al. 2004).

The increase in firm size as a result of acquisitions augments the difficulties of managing an organization (Shaver and Mezias 2009). A firm expanding its number of organizational units through acquisitions faces the complex task of integrating these units to the rest of the organization (Cartwright and Cooper 1996, Hitt et al. 2001). The purchase of new units disrupts the operation of the acquirer's existing units in ways that are not easily understood. Adding a new unit to the rest of the organization involves a complicated redeployment of resources and restructuring (Capron 1999, Capron et al. 1998, Karim 2006, Karim and Mitchell 2000). Even though there are some studies that report changes in the performance of existing units after the occurrence of an acquisition, their focus is not on this phenomenon (Schoar 2002). Instead of focusing on mechanisms and processes, most of the acquisition literature has centered on the benefits of synergies and on how to implement acquisitions successfully (Shaver and Mezias 2009). It still remains

unclear which mechanisms operate after an acquisition event and how they affect performance across the firm.

This paper explores how the acquisition of another unit affects the postacquisition performance of *existing units in the acquiring firm.* More specifically, I propose three different mechanisms to explain the effects of an acquisition on the postacquisition performance of an existing unit: managerial distraction in an existing unit due to tasks related to the integration process of the acquired unit, resource transfer from an existing unit to the acquired unit also during the integration process, and knowledge sharing between an existing unit and the acquiree. These mechanisms are studied in the context of existing units and acquired units with different levels of proximity and similarity between them. This work also deals with the dynamics of performance during the postacquisition integration period,[1] going beyond the static approach commonly used in acquisition studies. Methodologically, I use an operational measure of performance at the unit level of analysis, which offers a more direct way of capturing the effects of an acquisition across different parts of the organization compared with conventional financial performance metrics. This study can have important implications for managerial practice: understanding how existing organizational units are affected by the acquisition of a new unit is crucial when a company is planning to expand its production capacity. To test the theoretical arguments presented, I use a detailed data set from a Brazilian agribusiness company that has made multiple acquisitions in the last decades.

2. Theoretical Framework

The integration of a newly acquired unit to the rest of the organization requires a significant amount of effort and resources (Cartwright and Cooper 1996, Yunker 1983). Certainly, the immediate postacquisition period can generate multiple disruptions across the acquiring firm (Ahuja and Katila 2001, Barden 2012). For example, using a database containing factory-level information for a sample of manufacturing companies, Schoar (2002) found that firms diversifying through acquisitions experience an overall net reduction in productivity right after the acquisition event. More specifically, the author finds that existing factories are the ones that experience a drop in performance when these acquisitions occur. From another standpoint, the postacquisition period can also bring benefits to some parts of the company. For instance, some units might be able to quickly benefit from different types of synergies (Larsson and Finkelstein 1999).

2.1. Managerial Distraction, Resource Transfer, and Geographic Proximity

Integrating newly acquired units to the rest of the organization requires a substantial amount of effort and can be very demanding (Barkema and Schijven 2008, Larsson and Finkelstein 1999). This should affect existing units because some of them might participate actively in the execution of these integration efforts. This is especially true in the absence of a corporate-level function in charge of implementing the operational aspects of the integration process. After an acquisition, a unit that is actively participating in the integration efforts is likely to shift its attention from the unit's normal operations to the newcomer. Integrating a new organizational unit is a complex task that requires considerable management time and attention that could be allocated to other purposes (Barkema and Schijven 2008, Hitt et al. 1990, Shaver 2006). For instance, acquisitions can take away the time and attention that internal development and innovation require from managers (Hitt et al. 1991, Vermeulen and Barkema 2001). Studies have also found that the absorption of managerial energy during the integration process can have a negative impact on the postacquisition innovation output of the acquiring firm (Ahuja and Katila 2001). Previous work has shown that managers can focus on a limited number of issues at a time (Ocasio 1997, 2011). As Ocasio (1997, p. 203) put it, "Limited attentional capacity for nonroutine activities by organizational decision-makers implies that alternative issues will compete for his or her selective attention, energy, and effort." Thus, postacquisition managerial distraction could significantly damage the performance of existing units involved in the integration process (Greve 2008, Schoar 2002).

Assuming that existing units are being managed effectively and performing well, different kinds of resources to support the integration efforts should flow from them to the acquiree. As Capron et al. (1998, p. 654) put it, "A business can expand the use of strong firm-specific resources by acquiring a competitor and then redeploying resources to the target." Human capital, equipment, and raw materials are tangible resources that could be transferred to the newcomer. For example, transferring employees from an existing unit to the acquiree could create a disruption in the supplier unit that can temporarily lower its performance (Kacmar et al. 2006). Sharing resources with the incoming unit—a process that could also be considered as a type of resource transfer from the existing unit to the acquiree—can translate into a decrease in performance too. For example, some

[1] The term *postacquisition integration period* refers to the period of time during which the actual integration of the acquired unit to the rest of the organization takes place (Barkema and Schijven 2008).

existing units might have to share access to suppliers, labor markets, distribution networks, and product markets. Certainly, the process of sharing resources can disrupt the normal operations of an existing unit that is participating actively in the integration process (Gupta and Govindarajan 1986). It is important to note that resources can also be transferred *from* an acquired unit *to* the existing unit. However, the potential benefits to the existing unit should take longer to materialize—positive performance effects, if any, are expected to appear *after* the disruption associated with the acquisition event is over. Therefore, at least during the postacquisition integration period, the negative performance effects attributable to the transfer of resources from the existing unit to the acquired unit should tend to prevail over the potential benefits that could be linked to resources obtained from the acquiree.

Acquisitions do not necessarily have the same effects on the different organizational units owned by a company. Different factors associated with an existing unit and acquired unit could potentially exacerbate the occurrence of managerial distraction and resource transfer during the postacquisition integration period. One of these factors is the *geographic proximity* between an existing unit and the acquired unit. Geographic proximity is important because acquisitions have significant effects on the spatial configuration of a firm that owns multiple organizational units (Chakrabarti and Mitchell 2013, Green 1990, Ragozzino and Reuer 2011). Certainly, among the different units owned by an organization, an existing unit that is geographically close to a recently acquired unit is a natural candidate to provide managerial support and resources during the integration phase. First, proximity facilitates personal contact between managers and personnel from two different units. This personal contact is crucial to provide effective managerial assistance to the acquiree. Second, resources can be moved or shared more easily between two units if the units are geographically close. For example, transferring an employee to a neighboring unit might avoid relocating her family. It is also more likely that equipment will be lent by existing neighboring units rather than by those located farther away. In short, an existing unit that is geographically close to the acquiree is expected to bear most of the "costs" associated with managerial distraction and resource transfer during the integration process.

The negative impact of managerial distraction and resource transfer, which affects existing units that are geographically proximate to the acquired unit, is experienced mostly during the postacquisition integration period. Once the acquiree is fully integrated into the company—losing its "newcomer status"—this negative effect should gradually disappear. For example, the existing organizational unit will slowly replace or recover the human capital lost to the acquiree. Some employees that were transferred to the new unit might return to their previous positions. The draining of resources stops, and the managerial costs of leading and monitoring the integration efforts disappear as the attention of managers returns to their own unit. Summarizing, I argue that an existing unit located close to a recently acquired unit experiences a temporary decrease in its performance during the postacquisition integration period as a result of the presence of managerial distraction and resource transfer.

Hypothesis 1A (H1A). *After the acquisition of a new unit that is geographically proximate to an existing unit, the existing unit experiences a decrease in its performance that can be linked to managerial distraction in the existing unit and resource transfer from the existing unit to the acquired unit.*

Hypothesis 1B (H1B). *After the acquisition of a new unit that is geographically proximate to an existing unit, the existing unit's decrease in performance that can be linked to managerial distraction and resource transfer disappears over time.*

2.2. Knowledge Sharing and Similarity

Organizational knowledge is crucial to develop competitive advantage (Kogut and Zander 1992, Tsai 2001). Studies have recognized the important role that knowledge movements play during the acquisition process (Ahuja and Katila 2001, Bresman et al. 1999). In this paper, intraorganizational knowledge sharing refers to the process through which a focal organizational unit is affected by the combination of experiences from the focal unit and another unit (Argote and Ingram 2000). The ability to share knowledge between organizational units has been associated with higher levels of organizational performance. Previous research has empirically shown the benefits of knowledge sharing within an organization. Through a meta-analytic study, Van Wijk et al. (2008) found that knowledge sharing increases both performance and innovativeness. Organizational units that have easier access to new knowledge developed by other units can produce more innovations and enjoy superior performance and competitive advantage (Argote and Ingram 2000, Gupta and Govindarajan 2000, Schulz 2001, Tsai 2001). Therefore, it is not surprising that the procurement and transfer of knowledge within firms has become an important topic in strategy and organization research (Tortoriello et al. 2012, Van Wijk et al. 2008).

One factor that has a significant impact on the postacquisition occurrence of knowledge sharing

between an existing unit and the acquiree is *similarity*. New knowledge brought by an acquiree does not necessarily have the same effects throughout the organization (Tsai 2002). Some units might be more naturally able than others to successfully share knowledge between them. The degree of similarity or relatedness between two units is crucial if they want to share knowledge expeditiously and successfully (Cantwell 1989, Meyer 2004). Similar units can learn from each other's experiences more easily because relatedness reduces the cognitive leaps that interunit learning requires (Ahuja and Katila 2001, Barden 2012). Adams and Jaffe (1996) examined the transfer of knowledge across facilities within a firm. In their empirical study of the chemical industry, they found that higher technological distance—or a lack of technological relatedness—between the company's research lab and an industrial facility leads to lower factory-level productivity. They attribute this lower productivity to a more inefficient transfer of knowledge stemming from technological differences. Cultural similarity is another important factor that affects knowledge sharing. Differing cultural aspects across different units within an organization can obstruct knowledge sharing between them (Van Wijk et al. 2008). Extending these results to the case of acquisitions, Finkelstein and Haleblian (2002) showed empirically that, consistent with theories on positive transfer of industry knowledge, similarity of industrial environments in acquirers and targets is positively associated with acquisition performance.

Sharing knowledge inside an organization is not trivial, especially when knowledge is complex and tacit (Kogut and Zander 1992, Szulanski 1996, Tsai 2001). Hansen's (1999) empirical study showed that weak interunit ties help in the search for knowledge in other subunits but impede the transfer of complex knowledge between them, which tends to require strong ties that are easier to achieve between similar counterparts. In his empirical study of eight companies, Szulanski (1996) found that sharing, cooperation, and intimacy between two comparable organizational units facilitates the transfer and sharing of complex and tacit best practices. Similarity also increases the probability that knowledge will be useful and successfully absorbed by the recipient (Hansen 2002). The more effective knowledge sharing that is associated with relatedness can facilitate and accelerate the achievement of synergies, which are crucial to increase postacquisition performance (Larsson and Finkelstein 1999, St. John and Harrison 1999). Thus, it is easier for an existing unit to realize the benefits of knowledge sharing with an acquiree if the two units have similar characteristics. In other words, a considerable level of similarity might be needed to benefit from knowledge sharing during the postacquisition integration period. Even though this study is not focused on the effects of acquisitions on the acquiree, it is important to note that the discussion above also applies to the acquired unit; that is, the acquiree can also benefit from knowledge sharing. Moreover, the discussion does not exclude the possibility that knowledge sharing might also take place between an existing unit and an acquiree that are *dissimilar.* However, any potential benefits should take a lot more time to materialize than in the case of similar units. Thus, it is very likely that these potential benefits will emerge *after* the end of the postacquisition integration period.

Regarding the dynamics of the effects, I argue that knowledge sharing between an existing unit and a similar acquiree has "diminishing returns" over time. The availability of new knowledge to be shared and combined between similar units decreases as time goes by—redundant and less pertinent knowledge starts to be exchanged. As the overlapping of the knowledge bases of source and recipient gets higher, the benefits of knowledge sharing become less important and new knowledge is developed at a slower rate (Cummings and Teng 2003, March 1991). Thus, even though similarity might accelerate and streamline the postacquisition knowledge sharing process, saturation is probably reached at an earlier point in time. Summarizing, knowledge sharing between an existing unit and a similar acquired unit generates an increase in the performance of the existing unit during postacquisition integration period. Additionally, the rate of increase in performance diminishes over time; that is, a *diminishing increase* should be observed.

Hypothesis 2A (H2A). *After the acquisition of a new unit that is similar to an existing unit, the existing unit experiences an increase in its performance that can be linked to knowledge sharing between the existing unit and the acquired unit.*

Hypothesis 2B (H2B). *After the acquisition of a new unit that is similar to an existing unit, the existing unit's rate of increase in performance that can be linked to knowledge sharing diminishes over time.*

3. Research Setting

The sugarcane sector is one of the most important in Brazilian agriculture.[2] Brazil has been a major producer of sugarcane since the 1700s. Today, it is the number-one sugarcane producer in the world—sugarcane plantations occupy more than seven million hectares. Sugarcane is used to produce sugar and ethanol fuel, which are commercialized both in

[2] For more detailed information about the sugarcane sector in Brazil, go to the website of the Brazilian Sugarcane Industry Association (UNICA): http://www.unica.com.br.

domestic and international markets. Sugarcane factories also produce electricity—which can be sold to the grid—using bagasse, a by-product of sugarcane processing. An important milestone in the life of the industry occurred in the 1970s, when the Brazilian government established the National Alcohol Program (*Proálcool*). Amid high oil prices, the program was crucial in the development of the ethanol fuel industry. During the last decades, some important technological developments have occurred, such as genetic improvements of sugarcane varieties, the mapping of the sugarcane genome, harvest mechanization, and industrial automation. In the 1990s, the deregulation of the sugarcane sector and Brazilian agriculture in general led to substantial changes in the competitive landscape and structure of the industry. Since then, acquisitions have played a prominent role in the evolution of the industry.

This study focuses on a sugarcane company that owns multiple units located in Brazil's center-south region.[3] In the last decades, the company has made numerous acquisitions. Many interesting opportunities have been available as a result of the deregulation of the sector and the high level of fragmentation in the industry. The empirical analysis combines information about these acquisitions with a unique data set containing detailed agricultural and industrial records for each of these units. During the period under study (1998–2006), the company followed a strategy of acquisition growth as opposed to organic growth. The focus was on acquiring new units rather than investing in new greenfield projects.

In this study, a *unit* comprises the processing factory and its adjacent plantation. Therefore, the operational performance of the (whole) unit takes into account the agricultural and industrial phases of production. Sugarcane companies owning both the processing factory and a nearby plantation are very common in Brazil. Also, for agricultural reasons, the sugarcane harvested from a unit's plantation must be processed in a nearby factory right after being harvested. In other words, sugarcane is not accumulated for later processing, and it is rarely transferred to a factory belonging to a different unit—this keeps a certain level of independence in the performance between units and across time within a multiple-unit firm.

To understand the appropriateness of the setting, it is relevant to discuss some features of the postacquisition integration process. After the acquisition of a new sugarcane unit, headquarters' top executives make important decisions to start integrating the new unit to the rest of the company. Interestingly, whereas headquarters can play a coordinating role during the integration process, existing units can handle the actual execution of the different tasks needed to integrate the acquired unit. This interplay between coordination and execution makes this setting particularly attractive, especially because existing units can participate actively during the "operative" part of the integration process. Because the focus of this study is on existing units rather than acquired ones, it is also important to mention a few aspects about the corporate–unit relationship. A critical feature of this relationship is the high level of independence that sugarcane units can have in managing their operations. The nature of the agricultural and manufacturing processes allows making most of the operative decisions at the unit level. On the other hand, headquarters can handle the more strategic decisions—for example, the decision to make a significant investment in expanding the production capacity of a unit.

Anecdotal evidence suggests that proximity and similarity are linked to the occurrence of the mechanisms—managerial distraction, resource transfer, and knowledge sharing—during the postacquisition integration period. Existing sugarcane units that are geographically proximate to a recently acquired unit tend to suffer most from postacquisition managerial distraction and resource transfer. Also, similarity between an existing sugarcane unit and a recently acquired unit appears to facilitate and accelerate knowledge sharing between them. The following example helps to illustrate how the mechanisms can be connected to proximity and similarity: unit A, which is financially weak and poorly managed, is acquired. The closest existing unit at the time of the acquisition is unit B; the distance between the two units is around 30 km (19 miles). Following the acquisition, headquarters asks the agricultural manager of unit B to start making frequent trips to unit A to assist it with the growth phase of the sugarcane. These trips continue throughout the harvest season. As a result, unit B's agricultural manager spends less time with its own plantation during the critical harvest period. Another issue that affects unit B's harvest is the lending of equipment to unit A. The lending of equipment leads to delays in unit B's harvest, also affecting performance.[4] Finally, there is transfer of human capital from the existing unit to the acquiree, including a couple of agricultural and industrial technicians. At the same time, unit A and

[3] Most of the sugarcane produced in Brazil comes from the center-south region. The states that are part of the center-south region are Espírito Santo, Goiás, Minas Gerais, Mato Grosso, Mato Grosso do Sul, Paraná, Rio de Janeiro, Rio Grande do Sul, Santa Catarina, and São Paulo.

[4] Harvesting of sugarcane at a proper time is necessary to realize maximum weight of the millable canes produced with the least possible field losses.

another existing unit, unit C, start communicating with each other. However, the interaction between these two units is of a different nature. Even though they are separated by more than 200 km (124 miles), they have a very similar type of soil and topography. Given these commonalities, unit A and unit C start exchanging knowledge about sugarcane varieties[5] and agricultural techniques. This exchange leads to the generation of new ideas on how to improve the productivity of their plantations.

4. Data and Methods

As mentioned earlier, the data come directly from the company's records. Different sources are used, such as agricultural information, industrial and production data, organizational information, and historical and geographic data. The statistical analyses are based on a panel of units that contains a total of 492 monthly observations spanning the period 1998–2006. It is important to note that the harvest season for sugarcane usually starts around April and ends sometime in December; the period between the two harvests is called the *interharvest.* Since sugarcane processing only occurs during harvesting, operational performance can only be measured during these months. I dropped the observations for the first and last month of each harvest because they are usually noisy, and harvesting does not necessarily take place during the whole month.

4.1. Dependent Variable

Production yield is the operational performance variable and is measured in kilograms of sucrose produced per ton of sugarcane harvested. Lower values of *Production yield* mean that the unit is producing less output per ton of sugarcane harvested. The quality of the sugarcane grown and the effectiveness of industrial processing will determine the amount of sucrose produced. Production yield is especially susceptible to the implementation of successful agricultural practices, which are usually acquired through experience, learning, and knowledge coming from both inside and outside the unit. To facilitate the interpretation of the results using percentages, this variable is entered as ln(*Production yield*) in the regression models; the histogram of this variable is close to a normal distribution.

It is important to note that the production yield of a sugarcane unit is a sensitive measure that can experience significant variations throughout the harvest season. To handle this issue, the data set has a monthly structure. In these units it is crucial to take into account, on a monthly basis, the different factors that affect performance. The most important of these is weather conditions, which can change unexpectedly from one month to the next. For example, throughout the harvest season, the sucrose content of sugarcane—a critical factor affecting performance—can change very quickly depending on the amount of rainfall. Changes in agricultural management, such as how the cultivation and harvesting of sugarcane are performed, can also have quick and significant effects on a unit's operational performance. For example, increases or decreases in the speed of harvesting, changes in the order of harvesting of the different plots in the sugarcane plantation, and changes in the harvesting method (manual or mechanical) can all lead to quick variations in production yield.

4.2. Independent Variables

Proximity is an independent variable that measures the overall geographic proximity between an existing unit and all the units acquired by the company during a time period. *Proximity* is operationalized as the sum of all the dyadic proximities between a focal existing unit and each of the units acquired during a time period—*dyadic proximity* is defined as the inverse of the geographic distance between two units. Therefore, the higher the number of units acquired during a time period and the higher the geographical closeness of those acquired units to the focal existing unit, the higher the value of *Proximity* for this focal existing unit. More details about the procedure used to calculate this variable can be found in the appendix. I use driving distance to measure the geographical distance between units—in this research setting, the most important way to move between units is ground transportation using highways. The highest driving distance between two units was 531 km (330 miles) and the lowest was 21 km (13 miles).

Similarity is an independent variable that measures the overall operational similarity[6] between an existing unit and all the units acquired by the company during a time period. *Similarity* is defined as the sum of all the dyadic attribute similarities[7] between a focal existing unit and each of the units acquired during a time period—*dyadic attribute similarity* is the inverse of the

[5] The sugarcane variety is the pivot around which the entire production system revolves. Sugarcane cultivation starts with choosing an appropriate variety for the agroclimatic zone and soil type.

[6] Operational similarity is the extent to which a unit has operational attributes and characteristics that are comparable to the ones of another facility. Different observable operational attributes can be used to assess the level of operational similarity between two facilities: production capacity, raw materials, manufacturing processes, equipment and technologies, products, and unit age. More generally, any attribute that can be associated with the operational configuration of a unit can potentially be used to measure operational similarity.

[7] The dyadic attribute similarities are standardized before adding them (more details can be found in the appendix).

"attribute distance" between two units for a particular attribute (e.g., production capacity of a unit). Therefore, the higher the number of units acquired during a time period and the higher the operational similarity of those acquired units to the focal existing unit, the higher the value of *Similarity* for this focal existing unit. More details about the construction of this variable can be found in the appendix. I use different *agricultural* and *industrial* attributes to compare the different units. The agricultural attributes included are (1) multiple factors related to soil type and (2) the size of the sugarcane plantation. In the case of industrial characteristics, the attributes included are (1) the sugarcane processing capacity of the factory, (2) the types of products (sugar, ethanol, and electricity) and maximum production capacity for each of them, and (3) the age of the facility.

To effectively capture the effects associated with the acquisition of a new sugarcane unit, the values of *Proximity* and *Similarity* change at the start of the next harvest season following an acquisition and remain constant until the end of the harvest. The values of *Proximity* and *Similarity* are 0 during a particular harvest if no acquisitions occurred in the previous harvest or interharvest period. Interestingly, almost all acquisitions formally took place during interharvest periods.

The independent variables defined below are used to explore the dynamics of the impact of proximity and similarity on operational performance. They provide a simple and effective way to analyze the evolution of performance in existing units during the postacquisition integration period.

Number of harvests since the last geographically close acquisition indicators: Five binary variables are used to indicate the number of harvests that have taken place since the last geographically close acquisition. I assume that a *geographically close acquisition* takes place when the proximity between the acquiree and the focal unit is in the 85th percentile[8]—all the proximities between the units of the company are considered. In this particular case, the 85th percentile corresponds to approximately 80 km (50 miles), which should be a manageable distance for a day trip. The five categories are as follows:

- *first harvest since the last geographically close acquisition* indicator (*1HCA*),
- *second harvest since the last geographically close acquisition* indicator (*2HCA*),
- *third harvest since the last geographically close acquisition* indicator (*3HCA*),
- fourth harvest since the last geographically close acquisition indicator (*4HCA*), and
- *five or more harvests since the last geographically close acquisition* indicator ($5+HCA$).

Number of harvests since the last similar acquisition indicators: Five binary variables are used to indicate the number of harvests that have taken place since the last similar acquisition. I assume that a *similar acquisition* takes place when the similarity between the acquiree and the focal unit is in the 85th percentile[9]—all the similarities between the units of the company are considered. The five categories are as follows:

- *first harvest since the last similar acquisition* indicator (*1HSA*),
- *second harvest since the last similar acquisition* indicator (*2HSA*),
- *third harvest since the last similar acquisition* indicator (*3HSA*),
- *fourth harvest since the last similar acquisition* indicator (*4HSA*), and
- *five or more harvests since the last similar acquisition* indicator ($5+HSA$).

4.3. Control Variables

The control variables included in all the specifications are described below.

The *First harvest after being acquired* is an indicator variable equal to 1 if the observation corresponds to a harvest right after the unit was acquired. This control variable is included to take into account the abnormal nature of the first harvest of a unit that was just acquired. For example, important investments to upgrade the technology or make other improvements might occur especially at this time.

The *Age of a unit* can be a relevant factor affecting performance. The year of foundation is used to calculate the unit's age—the year of foundation is subtracted from the year of the observation. To reduce skewness, I use the logarithm of the unit's age.

The *Level of harvesting mechanization* variable has a direct impact on the agricultural performance of a unit. It is defined as the percentage of the planted area of a unit that is harvested mechanically. The adoption of mechanization in harvesting has been steadily increasing in the Brazilian sugarcane sector. Given the recent adoption of this technology, it was not clear whether a positive or negative impact would be found in the analyses. According to experts and managers, finding a negative impact of mechanization on production yield would not be surprising. This is a new technology that requires time to master and works better with sugarcane varieties specifically designed for that harvesting technique. Many of the units transitioning from manual to mechanical harvesting had not planted these kinds of varieties yet.[10]

[8] The 85th percentile is equivalent to approximately 1.5 standard deviations.

[9] The 85th percentile is also equivalent to approximately 1.5 standard deviations.

[10] I thank Ricardo Madureira for pointing this out.

Another control variable, *Area harvested*, is the amount of land harvested. This variable can also affect agricultural performance.

All models include unit indicators and month-year indicators. The month-year indicators consist of a set of dummy variables—one for each time period. These time indicators control for, among other things, general weather conditions across the region where the units are located. Additionally, I include harvest-month (ordinal number) dummies to indicate if the observation corresponds to the second, third, fourth, etc., month of the harvest.[11] In other words, if *Harvest-month-2nd* equals 1, the observation was during the second month of the current harvest. Harvests could start at different months for different units and years.

4.4. Statistical Estimation

The estimation method used is ordinary least squares (OLS) with panel-corrected standard errors (PCSE), which addresses problems of heteroskedasticity and cross-sectional correlation[12] (Beck 2001, Beck and Katz 1995, Greene 2008). The Stata command used to perform OLS regressions with panel-corrected standard errors is `xtpcse`. When computing the standard errors and the variance–covariance estimates, this statistical procedure assumes that the disturbances are heteroskedastic and cross sectionally correlated across panels. In our research setting, adjusting for cross-sectional correlation is especially important because of the spatial correlation and dependence between observations (Canina et al. 2005, Chung and Kalnins 2001). This means that in a period of time, the observations of some units are more correlated than with other units—for example, the correlation between the amount of rainfall in units 1 and 2 might be higher than the one between units 1 and 7. Therefore, including month-year indicators is not enough since this procedure controls for events that affect *all* the units equally during a time period. Naturally, the presence of cross-sectional correlation should be significant between units that are geographically close to each other—or in other words, units belonging to the same "geographic zone." We could be in the presence of autocorrelation if the company is acquiring facilities that are geographically close (or similar) to a particular unit because the performance of this existing unit during a previous harvest was high. Because the past performance of a unit is typically correlated with its future performance, previous performance could be correlated with the error term. As a robustness check, I run the regressions estimating heteroskedasticity-robust and autocorrelation-consistent (HAC) standard errors.

[11] Note that the *Harvest-month-1st* indicator is not included because, as I mentioned before, I dropped the first observation of each harvest from the data set.

[12] The term "contemporaneous correlation" is sometimes used instead of "cross-sectional correlation."

5. Results

Table 1 presents the descriptive statistics. Table 2 reports the correlation coefficients between the variables.

The correlation between *Proximity* and *Similarity* is positive and significant, which might explain why it is sometimes difficult to distinguish empirically between these two constructs. However, the correlation level justifies the need for treating these constructs separately (Cohen 1988). Both *Proximity* and *Similarity* are positively correlated with *Production yield*, and this positive correlation is significantly different from 0. Also, the performance of a unit tends to increase as the unit gets older and as the total number of units owned by the company gets higher. Surprisingly, the correlation between *Area harvested* and *Production yield* is not significantly different from 0. Finally, the *Level of harvesting mechanization* is positively correlated with performance.

Tables 3 and 4 report the results of the regressions. In Models 1 and 3 of Table 3, the coefficients on *Proximity* are all negative and significant, with p-values of less than 1%. Thus, the acquisition of a unit that is geographically close to an existing unit is associated with a lower performance level in the existing unit during the year after the acquisition. These results, which in this particular setting can be linked to managerial distraction and resource transfer, are consistent with H1A. According to Models 2 and 3, the coefficients on *Similarity* are always positive and significant. Thus, the acquisition of a unit that is operationally similar to an existing unit is associated with

Table 1 Descriptive Statistics

Variable	Mean	SD	Min	Max
Production yield (kg output/ton sugarcane)	138.011	11.277	105.390	173.130
Proximity	0.012	0.014	0	0.055
Similarity	0.107	0.029	0	0.178
1HCA	0.219	0.414	0	1
2HCA	0.085	0.278	0	1
3HCA	0.078	0.269	0	1
4HCA	0.052	0.223	0	1
5+ HCA	0.566	0.496	0	1
1HSA	0.252	0.434	0	1
2HSA	0.115	0.319	0	1
3HSA	0.089	0.284	0	1
4HSA	0.030	0.171	0	1
5+ HSA	0.514	0.500	0	1
Age of unit (years)	54.412	28.798	6	123
Level of harvesting mechanization	0.203	0.124	0	0.548
Area harvested (10^3 hectares)	15.319	11.382	1.042	66.263

Note. $n = 492$.

Table 2 Correlations

	Production yield	*Proximity*	*Similarity*	*Age of unit*	*Level of harvesting mechanization*	*Area harvested*	*Number of units owned by the company*
Production yield	1.000						
Proximity	0.103* (0.023)	1.000					
Similarity	0.175** (0.000)	0.480** (0.000)	1.000				
Age of unit	0.092* (0.041)	0.032 (0.473)	−0.162** (0.000)	1.000			
Level of harvesting mechanization	0.075+ (0.098)	0.147** (0.001)	0.279** (0.000)	−0.030 (0.509)	1.000		
Area harvested	0.022 (0.625)	0.068 (0.129)	−0.126** (0.005)	0.274** (0.000)	0.013 (0.768)	1.000	
Number of units owned by the company	0.310** (0.000)	0.289** (0.000)	0.389** (0.000)	0.083+ (0.064)	0.554** (0.000)	0.079+ (0.078)	1.000

Note. Significance levels are in parentheses.
$^{+}p < 0.1$; $^{*}p < 0.05$; $^{**}p < 0.01$.

a higher performance in the existing unit during the year after the acquisition. These results, in combination with anecdotal evidence linking similarity and knowledge sharing, are consistent with H2A.

Table 3 Impact of *Proximity* and *Similarity* on Performance

Dependent variable:	Model 1 ln(*Production yield*)	Model 2 ln(*Production yield*)	Model 3 ln(*Production yield*)
Proximity	−0.5184** (0.1887)		−0.6120** (0.1857)
Similarity		0.1650* (0.0822)	0.2772** (0.0838)
First harvest after being acquired	−0.0012 (0.0072)	0.0060 (0.0083)	0.0090 (0.0078)
ln(*Age of unit*)	0.0651** (0.0171)	0.0539** (0.0180)	0.0578** (0.0166)
Level of harvesting mechanization	−0.0893** (0.0238)	−0.0854** (0.0269)	−0.0862** (0.0239)
Area harvested	0.0012* (0.0006)	0.0015* (0.0006)	0.0009 (0.0006)
Unit indicators?	Yes	Yes	Yes
Month-year indicators?	Yes	Yes	Yes
Harvest-month (ordinal number) indicators?	Yes	Yes	Yes
Constant	4.3598** (0.0750)	4.3649** (0.0811)	4.3815** (0.0738)
Estimation method	OLS with PCSE	OLS with PCSE	OLS with PCSE
R-squared	0.70	0.70	0.71
Number of observations	492	492	492

Note. Below the value of each coefficient is the heteroskedasticity- and cross-sectional correlation-robust standard error, shown in parentheses.
$^{+}p < 0.1$; $^{*}p < 0.05$; $^{**}p < 0.01$.

The regression results showing the evolution of performance are presented in Table 4. The negative coefficients on *1HCA* in Models 4 and 6 show that during the first harvest following a geographically close acquisition, the performance of the existing unit is lower than in the base case. However, the effect is small and not significantly different from 0. Note that the base case occurs when $5 + HCA$ is equal to 1—that is, five or more harvests have taken place since the last geographically close acquisition. In the case of the dummy variable *2HCA*, the negative coefficients imply that during the second harvest following a geographically close acquisition, the performance of the existing unit is also lower than in the base case. This impact is large and significant with *p*-values below 1%. Based on Model 6, the performance of an existing unit during the second harvest after a geographically close acquisition is, on average, 3.3% lower than in the base case. The positive coefficients on *3HCA* and *4HCA* indicate that during the third and fourth harvests following a geographically close acquisition, the performance of the existing unit is higher than in the base case—although the positive change is small and not significantly different from 0. In sum, the performance of the existing unit after a geographically close acquisition experiences a negative hit during the first two harvests. This hit is especially significant during the second harvest. In the third and fourth harvests, the evidence shows a substantial recovery—performance is above the base case. These results are consistent with H1B; that is, the negative effect of a geographically proximate acquisition on the performance of an existing unit—which in this setting can be linked to the mechanisms of managerial distraction and resource transfer—tends to disappear over time. Figure 1 shows this trend graphically.

Table 4 Evolution of Performance After an Acquisition

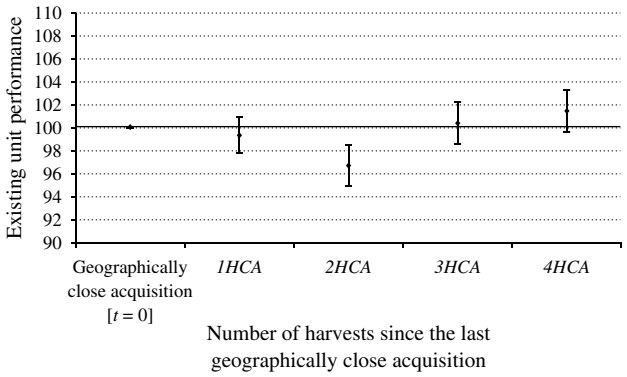
Dependent variable:	Model 4 ln(*Production yield*)	Model 5 ln(*Production yield*)	Model 6 ln(*Production yield*)
1HCA	−0.0046		−0.0065
	(0.0077)		(0.0079)
2HCA	−0.0322**		−0.0328**
	(0.0099)		(0.0091)
3HCA	0.0037		0.0041
	(0.0101)		(0.0093)
4HCA	0.0129		0.0147
	(0.0101)		(0.0092)
1HSA		0.0348**	0.0342**
		(0.0059)	(0.0060)
2HSA		0.0163*	0.0190*
		(0.0081)	(0.0079)
3HSA		0.0218*	0.0229*
		(0.0092)	(0.0090)
4HSA		0.0160	0.0053
		(0.0153)	(0.0157)
First harvest after being acquired	−0.0082	0.0133+	0.0048
	(0.0086)	(0.0075)	(0.0083)
ln(*Age of unit*)	0.0720**	0.0234	0.0373
	(0.0222)	(0.0196)	(0.0242)
Level of harvesting mechanization	−0.0948**	−0.0772**	−0.0826**
	(0.0259)	(0.0247)	(0.0249)
Area harvested	0.0017**	0.0033**	0.0034**
	(0.0006)	(0.0007)	(0.0007)
Unit indicators?	Yes	Yes	Yes
Month-year indicators?	Yes	Yes	Yes
Harvest-month (ordinal number) indicators?	Yes	Yes	Yes
Constant	4.2967**	4.4796**	4.4204**
	(0.0974)	(0.0847)	(0.1024)
Estimation method	OLS with PCSE	OLS with PCSE	OLS with PCSE
R-squared	0.71	0.71	0.72
Number of observations	492	492	492

Note. Below the value of each coefficient is the heteroskedasticity- and cross-sectional correlation-robust standard error, shown in parentheses.
$^{+}p < 0.1$; $^{*}p < 0.05$; $^{**}p < 0.01$.

Regarding similar acquisitions, the positive coefficients on *1HSA*, *2HSA*, and *3HSA* in Models 5 and 6 indicate that during the first, second, and third harvests after a similar acquisition, the performance of the existing unit is higher than in the base case. Note that the base case occurs when $5 + HSA$ is equal to 1. These effects are large and significant, with *p*-values below 5%. According to Model 6, the performance of an existing unit during the first, second, and third harvests after a similar acquisition is, on average, 3.4%, 1.9%, and 2.3%, respectively, higher than in the base case. The coefficients on *4HSA* are positive but not significantly different from 0. During the fourth harvest following a similar acquisition, the performance of the existing unit is slightly better than in the base case. However, because there are fewer units that have had four harvests without a similar acquisition occurring (see Table 1), the estimation of the coefficient on *4HSA* is less accurate. To sum up, the performance of an existing unit after a similar acquisition experiences an increase. Performance is significantly higher during the first three harvests following the acquisition. During the fourth harvest, the difference in performance relative to the base case is lower but still positive. The trend is that increases weaken and performance tends to stabilize over time. In other words, performance increases at a decreasing rate. These results are consistent with H2B; that is, an existing unit's rate of increase in performance after an operationally similar acquisition—which in this case can be linked to knowledge sharing—diminishes over time. Figure 2 presents these results graphically.

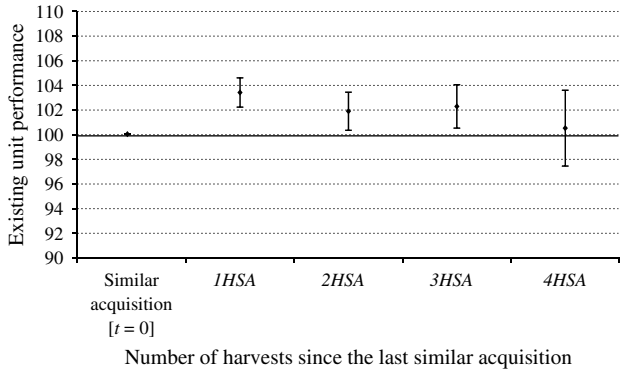
The results of the analyses of the evolution of performance can be used to give a sense of the economic significance that a geographically close or operationally similar acquisition has on performance. An acquisition defined as geographically close—in this case, the 85th percentile of all the proximities between units, which corresponds to approximately

Figure 1 Evolution of Performance After a Geographically Close Acquisition



Note. Error bars indicate 95% confidence interval.

Figure 2 Evolution of Performance After a Similar Acquisition



Note. Error bars indicate 95% confidence interval.

80 km—is associated with a decrease in operational performance of 3.3% during the second harvest after the acquisition event. On the other hand, an acquisition defined as operationally similar is associated with an increase of 3.4% in the performance of the existing unit during the first harvest after the acquisition. The magnitude of these numbers can be significant in terms of affecting the company's economic performance. The company is in a commodity business, where margins are typically low—small changes in efficiency can have a significant impact on financial results. A small decrease in the *Production yield* of a large unit can have an important effect on corporate revenues and profits. It is interesting to note that, in the Brazilian sugarcane sector, acquisitions have frequently occurred during economic downturns. In a commodity business such as this one, industry downturns are usually characterized by low commodity prices and very small operating margins. Therefore, during the periods when most acquisitions tend to occur, small increases or decreases in performance are more important than ever.

Regarding control variables, the coefficient on *First harvest after being acquired* is not significantly different from 0 in almost all models. It appears that there is nothing particularly important that only tends to occur during the first harvest of a unit that recently joined the company. The variable ln(*Age of unit*) comes up positive and significant in most of the models. This indicates that as a unit gets older, it tends to have a higher performance level. This could be indicating the presence of experience-curve effects. In the case of *Level of harvesting mechanization*, the coefficients are always significantly negative. According to the discussion in the previous section, this result is not surprising because the technology had been recently adopted. In most of the models, the coefficient on *Area harvested* is positive and significant. Finally, the *R*-squared values in all models are high, with an average around 0.7. This was also expected given the high number of indicators included.

5.1. Robustness Checks

When HAC standard errors are calculated for any of the models, very similar results were obtained and the interpretation does not change. I also repeated the analyses clustering the standard errors by harvest-unit—one cluster for each harvest in every unit. For example, one cluster would be the harvest for the year 2001 in a specific unit. Clustering the errors by harvest-unit allows taking into account the fact that there might be commonalities among all the monthly observations in a particular unit during a specific harvest. This procedure also yields very similar results.

Because the regressions in Table 3 take into account only acquisitions occurred in the previous harvest, they do not capture any lingering effects on the performance of acquisitions that occurred more than one harvest ago. To check for the presence of these effects, I added three additional lagged values of *Proximity* and *Similarity*. The interpretation of the results does not change.

The models shown in Tables 3 and 4 were also estimated using principal component analysis (PCA) to compute *Similarity*. PCA transforms a number of correlated variables—in this case, the attributes—into a smaller number of uncorrelated variables called principal components (Jolliffe 2002). Afterward, the scores obtained for the different components are combined to calculate *Similarity*. The results obtained by using this procedure were essentially the same. As an additional way to check the robustness of the *Similarity* measure, I used Mahalanobis distance[13] to calculate *Similarity*.[14] The interpretation of the results using Mahalanobis distance does not change either.

Finally, the results in Table 4 were also virtually the same if we assume that a close or similar acquisition takes place when the proximity or similarity between the acquiree and the focal unit is in the 75th–90th percentile range. In terms of geographic distance between units, the 75th and 90th percentiles for proximity are equivalent to distances of about 160 km (100 miles) and 40 km (25 miles), respectively.

6. Discussion and Conclusion

This paper studies the impact that acquisitions have on the performance of a company's existing units during the postacquisition integration period. The theoretical arguments revolve around three different mechanisms: managerial distraction in an existing unit due to tasks related to the integration process of the acquired unit, resource transfer from an existing unit to the acquired unit, and knowledge sharing between an existing unit and the acquired unit. These mechanisms are studied in the context of proximity and similarity. Empirical results support the view that managerial distraction and resource transfer can lead to a temporary decrease in the performance of existing units that are geographically proximate to the

[13] Mahalanobis distance can be used to measure distance—in my case, operational similarity—when there are multiple variables involved—in my case, attributes. This measure is interesting because, unlike traditional distance measures, it corrects for the variance of each variable and the covariance between variables (Mahalanobis 1936). In simple terms, the procedure consists of (1) transforming the data into standardized uncorrelated data and (2) calculating ordinary Euclidean distances for the transformed data. In other words, Mahalanobis distance calculates distances between subjects, taking into account the scale and correlation of the variables involved in the calculation.

[14] I thank an anonymous reviewer for suggesting this additional robustness check.

acquired unit. The results also support the view that knowledge sharing can lead to an increase in the performance of existing units that have similar characteristics to the acquired unit. In this latter case, the rate of increase in performance diminishes over time. These findings illustrate the complexity of the relationship between acquisition events and performance across the organization, demonstrating that the acquisition of an organizational unit can have differing dynamic effects on different parts of the organization.

By theorizing about the role of managerial distraction, resource transfer, and knowledge sharing, this work contributes to existing theoretical and empirical studies trying to understand postacquisition integration processes and their impact on organizational performance (Cartwright and Cooper 1996, Cording et al. 2008, Haspeslagh and Jemison 1991, Pablo 1994, Schoar 2002). As far as I know, previous literature on acquisitions has not focused on these three mechanisms from the point of view of existing organizational units in the acquiring firm. Another interesting contribution of this research is that it recognizes and theorizes about the adjustment costs and benefits across the firm during the process of integrating a recently acquired unit. In other words, this work sheds light on who wins and who loses within a firm after the occurrence of an acquisition event. Methodologically, the use of an operational measure of performance at the unit level of analysis is novel, offering a more direct way of capturing the effects of an acquisition across different parts of the organization. This research sets the stage for the use of network theory to understand the impact of an acquisition within the acquiring firm (Fleming et al. 2007; Gulati 1998; Uzzi 1996, 1997; Wasserman and Faust 1994). How acquisitions events affect the evolution and development of intraorganizational networks is an intriguing and important question. The interaction between acquisitions and the acquiring firm's network of organizational units can have both unique and significant effects on profitability and performance.

This work has many implications for business executives who are thinking about expanding their companies through acquisitions. First, managers need to understand that acquisitions are corporate-level decisions that affect organizational units *differently.* During an acquisition event, some existing units need more support from headquarters than others. Second, managers need to be cautious about how unit-level managerial distraction, resource transfer, and knowledge sharing during the postacquisition integration period affect the performance of existing units that are close or similar to the acquired unit. These three mechanisms are especially important in the case of horizontal acquisitions where the acquirer owns multiple organizational units that participate actively in the integration process. Finally, shorter- and longer-term effects must be distinguished. An acquisition program could make a lot of sense in the long run, but the effects during the period immediately following the acquisition event are not necessarily positive (Laamanen and Keil 2008). If an executive were acquiring units located close to existing ones,[15] a strategy to consider would be to try to acquire units that are close to large ones to cushion the potential postacquisition negative effects of managerial distraction and resource transfer on the performance of an existing unit. A manager might also want to acquire a unit that is similar to another unit to facilitate the exchange of knowledge and accelerate the realization of synergies. However, when acquiring units are similar to existing ones, managers should be careful about potential longer-term negative consequences, such as less innovation and declining access to new knowledge.

This study proposes an interesting connection between three mechanisms—managerial distraction, resource transfer, and knowledge sharing—and proximity/similarity. However, the mapping between these mechanisms and proximity/similarity does not offer an exhaustive answer to the problem of understanding the impact of acquisitions on the performance of existing units. On the one hand, the mechanisms could be linked to other factors. For example, the occurrence of postacquisition managerial distraction and resource transfer may be strongly connected to the size of the existing unit. On the other hand, proximity and similarity could be linked to other mechanisms that affect the postacquisition performance of an existing unit. For instance, an increase in the performance of an existing unit that is similar to an acquired unit could be associated with the fact that the existing unit is trying to establish its superiority because it feels threatened by a similar counterpart. Another limitation of this work is the lack of direct measurements for the mechanisms. Future studies should (1) try to measure the occurrence of the mechanisms more directly and (2) investigate alternative mechanisms and factors. Another limitation of this study relates to its generalizability: the data came from one company operating in a particular industry. In other industrial settings, the distinction between proximity and similarity, and the connections between these two factors and the mechanisms, might not be as meaningful. Finally, regardless of the actions taken to address endogeneity, some threats to the internal validity of the results might still

[15] Many different reasons can justify this strategy—for example, the possibility of reducing costs by sharing with the newcomer the distribution network operated by neighboring units.

be present. However, the data and estimation procedures used in this research help to address some of the methodological shortcomings present in previous studies (Chung and Kalnins 2001, Cording et al. 2008).

This work sheds light on some important processes that take place inside the firm after an acquisition event. I hope that the insights emanating from this study will inspire further research on these issues.

Acknowledgments

The author thanks Juan Alcacer, Lee Fleming, Diana Huidobro, Tarun Khanna, Richard Lai, Merlina Manocaran, Alejandra Manquilef, Will Mitchell, Michael Toffel, and Noel Watson, as well as seminar participants at the Harvard Business School, University of Miami, University of North Carolina at Chapel Hill, IESE Business School, IE Business School, and the INFORMS and Academy of Management conferences, for their valuable feedback. The author also thanks William Simpson and Xiang Ao from the Division of Research and Faculty Development, Harvard Business School. The author is especially grateful to Francisco Morales for his research assistance. Finally, the author thanks the department editor, Bruno Cassiman, and the associate editor and reviewers for their very helpful advice.

Appendix

This appendix describes the methodology used to measure proximity and similarity among organizational units. This methodology builds on the methods proposed by Johnson and Wichern (2008).

First of all, let us assume that there is a total of N units that could potentially be owned by a firm. The firm is founded at $t = 0$. Time is discrete. I define the binary variable T_{it} to indicate whether a unit was acquired at a certain point in time. That is,

$$T_{it} = \begin{cases} 1 & \text{if unit } i \text{ is acquired at time } t, \\ 0 & \text{otherwise.} \end{cases} \tag{1}$$

I define dyadic proximity p_{ij} between i and j as the inverse of the geographical distance d_{ij} between units i and j:

$$p_{ij} = \frac{1}{d_{ij}}. \tag{2}$$

Using the variables defined above, the proximity P_{ij} of unit j at time t is defined as

$$P_{jt} = \sum_{\substack{i=1 \\ i \neq j}}^{N} T_{it} p_{ij}. \tag{3}$$

In other words, P_{jt} is the sum of the dyadic proximities between unit j and each of the units acquired at time t. Therefore, the higher the number of acquisitions at time t, and the higher the geographical closeness of those acquisitions to unit j, the higher the value of P_{jt}.

The dyadic attribute similarity as_{ijk} between unit i and j for attribute k is defined as

$$as_{ijk} = \frac{1}{|a_{ik} - a_{jk}|}, \tag{4}$$

where a_{ik} and a_{jk} are the scores for attribute k for unit i and j, respectively. Note that this dyadic attribute similarity measure can only be used for attributes with continuous values. A different specification would be required for attributes that take, for example, dichotomous values.

I define the attribute similarity of unit j at time t for attribute k as

$$AS_{jkt} = \sum_{\substack{i=1 \\ i \neq j}}^{N} T_{it} as_{ijk}. \tag{5}$$

In other words, AS_{jkt} is the sum of the dyadic attribute similarities for attribute k between unit j and each of the units acquired at time t.

The final step is to use all the attribute similarity scores to arrive at a unique score for similarity S_{jt} of unit j at time t. Before doing that, I standardize the scores obtained for AS_{jkt} across units and time. This procedure allows me to combine all the scores per attribute into a single similarity score without introducing distortions associated with the different scales used to measure each of the attributes.

The standardized score for AS_{jkt} is

$$z_{AS_{jkt}} = \frac{AS_{jkt} - \mu_{AS_k}}{\sigma_{AS_k}}, \tag{6}$$

where μ_{AS_k} and σ_{AS_k} represent the mean and standard deviation of all AS_{jkt} scores, respectively, across units and time. I assume that there is a total of K attributes under consideration.

Finally, adding each attribute's standardized score, I obtain the similarity score for unit j at time t:

$$S_{jt} = \sum_{k=1}^{K} z_{AS_{jkt}}. \tag{7}$$

Analogously to the case of proximity, the higher the number of acquisitions at time t, and the higher the operational similarity of those acquisitions to unit j, the higher the value of S_{jt}.

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