THE COMPARATIVE RELEVANCE OF RESOURCE HETEROGENEITY AND RESOURCE MOBILITY TO STRATEGIC MANAGEMENT

Rogerio S. Victer, Fairleigh Dickinson University
rvicter@fdu.edu

ABSTRACT

The objective of this paper is to offer a refined understanding of the relationship between resource and performance. Drawing from the resource-based theory (RBT) of competitive advantage, this study compares the relative relevance of core resource characteristics to the implementation of strategic activities. This approach provides an important clarification of the best managerial path towards differential performance. Should managers focus primarily on pursuing resource heterogeneity or preventing resource mobility? Results generated by this study point to the fact that resource heterogeneity has a greater impact over performance than resource mobility. The paper concludes that strategies focused on raising barriers to imitation are comparatively less relevant than strategies focused on promoting innovation.

INTRODUCTION

The resource-based theory (RBT) of competitive advantage recommends managers to identify and acquire critical resources capable of generating sustainable competitive advantage. According to RBT, managers are expected to accumulate resources that are both valuable and rare (Coff et al., 2006). In practice, accomplishing this managerial task comprises different implementation activities. Managers are required to gain access to critical resources as well as to increase barriers to their dissemination. RBT shows that strategic management consists of two fundamentally independent but complementary resource-oriented activities: one activity supports value creation whereas the other precludes value erosion. Yet we still do not know which one of these activities is the most strategic for business firms. Should managers focus primarily on pursuing resource heterogeneity or preventing resource mobility?

The current paper intends to address this core question as a way to reaffirm the relevance of RBT to the strategic management discipline. However, instead of measuring how much a critical resource influences competitive advantage, which has been the main approach adopted in this research tradition (Newbert, 2007), the main objective of the present study is to compare and contrast the performance relevance of different characteristics of the same resource. This allows RBT to be more specific and useful to management, instead of being an abstract theoretical model with little practical relevance (Priem & Butler, 2001). In order to accomplish this objective, the paper proposes to revisit the RBT theoretical framework as a condition to better explain the subtleties underlying the relationship between resource and performance.

Suggestion for change focus on a single argument: the main factor explaining superior performance is not *resource identity* but *resource attribute*. Differently from most studies in this tradition, this paper advocates that it is not the resource itself but some of its key economic traits that actually generate differential benefits to firms (Markman et al., 2004; Newbert, 2008; Victer, 2014). The managerial task relies on the ability to recognize those resources that are strategic (Barney, 1986) and also, and possibly more importantly, on the ability to quantify which aspects of the resource are the most relevant to practice. This approach goes beyond the traditional task of identifying the characteristics resources must possess (Barney & Arikan, 2001) in order to objectively rank them according to their respective influence on business outcomes. Having a clear indication on which resource attributes are the most relevant to performance increases the overall effectiveness of a firm's strategy, since managers can tailor their actions towards leveraging existing resources or developing new resources with the appropriate profile.

The formal comparison of resource attributes is not only relevant to managerial practice, but also to theory development as well. Given the complexity involved in the operationalization of foundational constructs, RBT has had difficulties in consolidating its academic relevance (Markman et al., 2004). Empirical measurements of core variables as well as their inter-relationships are part of a broader process of theory development. In order to be academically relevant, RBT must clarify the criteria in which strategic resources can be assessed according to separate and independent conditions (Priem & Butler, 2001). In this respect, the empirical agenda serves to enhance the appropriateness of the conceptual model as the reflection of a synthetic theory, thereby generating a more precise understanding of the nature and magnitude of the relationship between resource and performance.

In order to measure and compare the relative relevance of resource attributes to performance, we rely on data generated by the AIDS/HIV pharmaceutical industry and adopt technological knowledge embedded in drugs as a proxy for a strategic resource. Technological knowledge is a particularly critical resource in science-based industries (e.g., pharmaceutical, chemistry, and information technology). Access to technological knowledge is the precondition for any pharmaceutical firm to commercialize a drug. Technological knowledge is an example of a case in which the resource is not homogeneous. There are many kinds of technological knowledge and they differ from each other in the manner they resolve a problem or propose a solution for a particular challenge. Results generated by this study corroborate the assumption that technological knowledge is a highly differentiated resource and point to the fact that some knowledge characteristics are more relevant to outcomes than others. This empirical evidence suggests that the most effective way to generate a sustainable competitive advantage is to promote sources of resource heterogeneity instead of preventing sources of resource mobility.

THEORY

The reason a resource contributes to a firm's competitive position is related to its characteristics (Collis & Montgomery, 1995). Managers need to be able to identify which traits of the resource

most influence the process of gaining and sustaining competitive advantage. A resource is not a homogeneous, undifferentiated construct. Variation occurs even within the same class of a key resource. Consequently, the predictor of performance is not the resource *per se*, but its core relevant attributes. This is because the strategic relevance of a resource partly reflects changes in evolutionary forces and temporal conditions within particular industries (Aragon-Correa & Sharma, 2003; Polidoro & Toh, 2010; Sirmon et al., 2007). The resource is not relevant in absolute terms, but contingent to environmental constraints. Resource attributes might gain or lose relevance depending on the results of a complex dynamic competition happening both at the factor and product markets.

The difference in approach might be subtle, but is quite relevant to the theoretical project. Instead of assuming that the resource is strategic due to its inherent value and long-term rareness, the theory builds more precision by highlighting the conditions in which a resource becomes relevant. It clarifies the reason why the resource is important by defining specific paths in which value is created and sustained. Therefore, the research interest is not to isolate the resource from the context of its application as done in traditional RBT studies. On the contrary, what matters the most is the understanding of the functionality of the resource in a given historical condition. A resource becomes strategic to the degree in which its characteristics improve or deteriorate performance of end products according to its availability as well as its ability to meet expectations of end consumers.

This specific approach does not refute the core assumption of RBT. Actually, it intends to strengthen it through the clarification of the means by which the resource influences performance. Although the original idea was based on the principle that valuable and rare resources are those that give the firm competitive advantage, here we suggest that a resource gains strategic relevance in the proportion of being valuable and rare. The major consequence resulting from this reasoning is to consider resources' relevance more flexible and contingent. Not only the environment affects the valuation process, but managers can also exert influence on firm's resource profile. Management can choose alternative strategic actions on how to best leverage a particular resource attribute. As part of this process, it is essential that firms constantly assess the relevance of resources according to situations in which they are or are not relevant to business outcomes.

Traditional RBT defines resources as valuable when they enable a firm to implement strategies that improve its efficiency and effectiveness or when they exploit opportunities or neutralize threats (Barney, 1991). In the same line of reasoning, RBT defines resources as rare when they are not possessed or controlled by others, simply because firms implementing similar strategies would be unable to differentiate their outcomes (Barney, 1991). This way of thinking generates a binary model of competitive advantage in which the strategic resource either present or absent. Here our task is to suggest a less trivial model by focusing on the variation in strategic relevance of a critical resource. This means that we give more attention to the *degree of relevance*, instead of assuming *absolute relevance* of a resource. The methodological implication is to be less focused on measuring the direct relationship between resource and performance and more

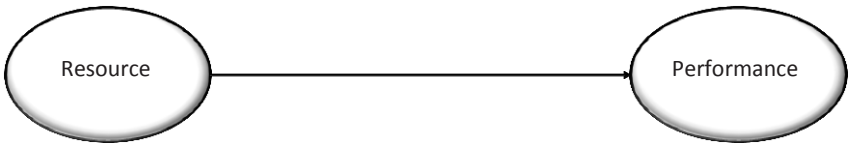
concerned with measuring how the resource becomes relevant to performance through the mediation of its core attributes. This means that performance is conditioned by the attributes of heterogeneity and immobility.

This subtle difference is illustrated in *Figure 1* below, which depicts the difference between the received and the proposed approach in RBT. In one, the resource is assumed to be heterogeneous and immobile, which allows it to influence performance; while in the other, a resource is strategic only in the degree to which its attributes of heterogeneity and immobility are relevant to performance. The model applied in the current paper promotes the latter, less popular approach. In line with this rationale, we suggest two core propositions based on RBT classical arguments regarding the heterogeneity and immobility of resources. The propositions are articulated in such a way as to incorporate fundamental dichotomy between creation and erosion of value, such that:

Proposition #1: *Resource heterogeneity increases performance*.

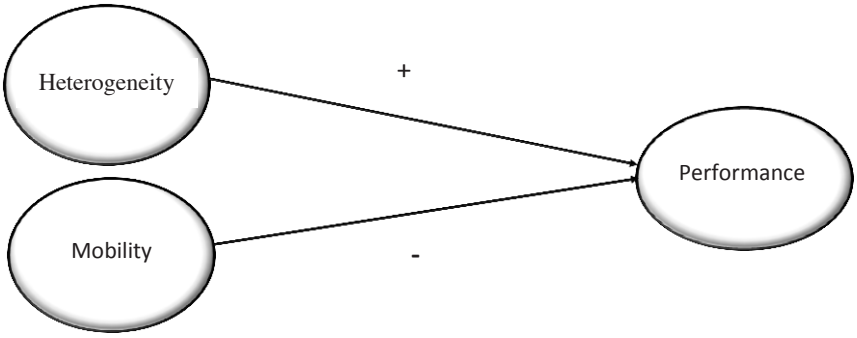
Proposition #2: *Resource mobility decreases performance*.

a) Received Model



Heterogeneous and Immobile

b) Proposed Model



Resource

FIGURE 1. COMPARISON BETWEEN THE RECEIVED AND THE PROPOSED RBT MODEL

HYPOTHESES

Both heterogeneity and mobility are complex notions. They require multiple empirical constructs to capture their aggregated influence on performance. Here we suggest measuring each one of them through the combination of three distinct measurable dimensions. Heterogeneity is measured by *distinctiveness*, *maturation*, and *integration*. These dimensions represent ways in which there is a process of generation of value to the end consumer. Mobility is measured by *commonness*, *diffusion*, and *replacement*. These dimensions represent ways in which there is a process of erosion of value in the eyes of the end consumer. Each one of these separate dimensions delineates a basic hypothesis relevant to the relationship between the resource and performance.

Resource Heterogeneity

Resources are not only unevenly distributed across firms, but they are also differentiated according to their usefulness in creating value to customers (Sirmon et al., 2007). The notion that resources are heterogeneous is derived from the fact that the same resource can be unique in specific and diverse ways. Resource heterogeneity reflects variation in the resource profile or composition sufficiently relevant to affect outcomes. Even the same resource might have different production levels (Ricardo, 1817), which generates the notion of superior resources (Peteraf, 1993). We suggest three ways to capture the path how resources gain the attribute of heterogeneity, as follows:

1. Distinctiveness

A critical resource generates value essentially by having a direct functional application in the resolution of a problem relevant to the end consumer (Christensen & Raynor, 2003). Resources embedded in products are effective due to their technical competence in achieving a particular objective. It carries with it a particular methodology to deal with a trouble. Even the same resource can have multiple intrinsic distinctions on how to deal with a challenge. From this perspective, it is important to recognize the existence of different kinds of the same resource, such that:

Hypothesis #1: *Variations of the same resource have distinct influence on performance*.

2. Maturation

Heterogeneity of the same resource is further magnified through modifications and improvement in the resource's functionalities. The strategic element here is not necessarily to create a new resource, but to better perfect the already established methodology for action. This process is made possible by the result of learning and experience. A new generation of a resource has potentially the opportunity to magnify its original benefits or minimize its shortcomings. Consequently, the continuous development of a resource creates additional advantages to the end

consumer. This means the ability to overcome weaknesses in previous resource characteristics and improve particular effects, such that:

Hypothesis #2: *A new generation of the same resource has a positive effect on performance*.

3. Integration

Resource functionality can be also improved through the combination of distinct variations of the same resource. Bundles of resources of the same class can also generate an additional portion of value because of the effect of complementarity. Combining resources together in the same integrated design is a way to enhance overall effectiveness of the end product. This form of combination can be potentially performed by the customer during the consumption process. Each end consumer has the ability to customize products to his or her own particular tastes or needs. Yet firms can promote combination of resources during the manufacturing and delivery stages of the value chain, thereby generating value through convenience and speed of use. Additional sophistication and complexity of formulation can even make the integration of resources by the consumer unfeasible for practical reasons. As a result, the integration of different resources as part of the product design can potentially increase performance through simple addition or more complex synergistic interactions. Therefore, we suggest that:

Hypothesis #3: *The combination of different kinds of the same resource has a positive effect on performance*.

Resource Mobility

The proliferation of a critical resource neutralizes its intrinsic value. Increasing accessibility to valuable resources affect the relative attractiveness of the products in which they are embedded. Mobility is not an absolute dimension of the resource, but a derived one which is affected by the nature of competition in the factor market. The quantity of players possessing or controlling similar resources ultimately affects the resource's relative value. The notion that resources are mobile (or conversely sticky) serves as a metaphor to represent how much a critical resource can be captured simultaneously by many players operating in the same market. If the resource is tangible, one can imagine an actual process of spatial distribution of the resource. If the resource is intangible, one should consider that resources are distributed only figuratively through a process of cultural or cognitive transmission. Many different processes can underlie the actual effect of a resource's increasing accessibility to direct or indirect rivals. We suggest three ways to capture the paths how resources gain the attribute of mobility, as follows:

4. Commonness

A product's performance advantage highly depends on the rarity of its underlying resources. Even functionally relevant resources needs to be exclusive, unique, or "one of a kind" as a condition for being valuable (Barney, 1991). If the same resource is shared by numerous existing rivals, then this resource, although intrinsically efficient and useful, is unlikely to generate performance differentials or any other type of business-related advantage. Relevant but common resources are, at best, simple sources of competitive parity, such that:

Hypothesis #4: *The number of products based on the same kind of resource has a negative effect on performance*.

5. Diffusion

Imitation by rival firms is the most common threat to the relevance of a particular resource class. Imitation from rivals dissipates the economic relevance of the resource applied in products. The critical resource circulates and gets diffused, reducing its uniqueness or originality even in case of property rights. The complexity and specificity of critical resources also tend to play a relevant role as barriers to imitation (McEvily & Chakravarthy, 2002). They basically increase resource stickiness by increasing the costs of transferring resources across organizational boundaries. We can assume that the temporal flow of resources across firms generates a particular pattern of replication and adoption, affecting the speed in which competition introduces new products with the same existing resource.

Hypothesis #5: *The age of the resource has a negative effect on performance*.

6. Replacement

In addition to imitation, another relevant aspect of the resource's mobility attribute is the impact generated by substitutes. In addition to direct rivalry, resources are also confronted with the threat of replacement. This means that an existing product applying a specific resource faces competition not only from products based on the same resource, but also from those products built on alternative kinds of the same resource, but with similar benefits. In fact, the dominance of any particular resource carries with it a threat of replacement, because a problem to be solved requires a solution independent of the method of solving it (Schumpeter, 1934). Even when rivals cannot perfectly imitate a firm's critical resource, they can often create alternatives with compatible functionality. Substitution can sometimes be even more detrimental to incumbents than imitation or direct rivalry, because it threatens not only the product, but also a firm's existing resource profile (Polidoro & Toh, 2010).

Hypothesis #6: *The number of products using alternative kinds of the resource has a negative effect on performance*.

METHODOLOGY

In order to measure the relationship between these resource attributes and performance, we rely on empirical data generated by branded drugs commercialized in the AIDS/HIV pharmaceutical industry. Technological knowledge embedded in drugs is used as a proxy for a critical resource. The data is organized as a panel data set (Hsiao, 1986) of global sales of antiretroviral drugs along a decade (1999-2008). The distinctiveness of the panel data applied here is that it contains complete measures of each drug's market trajectory. Consequently, there is a favorable condition for clarification of underlying causal interrelationships between the independent variables and the dependent variable through the application of a time series methodology (Finkel, 1995). The

panel data covers 26 different brands or approximately 90% of all branded drugs commercialized during the selected period. Technological knowledge is subject to patent and, therefore, should be considered useful, non-trivial, and unique. Consequently, technological knowledge can be assumed to be a valuable and immobile resource (de Carolis, 2003). However, the most relevant research issue here is not whether firms having access to patented technological knowledge have a competitive advantage over firms without access to it, since this is in fact a pre-condition for commercialization of a final pharmaceutical product. Rather, what matters the most for the purpose of this study is to learn how different technological knowledge generate distinct levels of product efficiency. Ultimately, the main question is: which knowledge attributes are the most important? We suggest capturing performance through the market value of a product as represented by *log* of global sales per year, and operationalize the attributes of knowledge through drugs' mechanisms of action (MOA). According to the National Institute of Allergy and Infectious Diseases (NIAID 2012), there are six major types of drugs used to treat HIV patients. These drugs are grouped by how they interfere with steps in the virus replication. They are Nuclear Reverse Transcriptase Inhibitors (NRTI), Non-Nuclear Reserve Transcriptase Inhibitors (NNRTI), Protease Inhibitors (PI), Fusion or Entry Inhibitors (EI), and Integrase Inhibitors (II). New MOAs have been discovered recently, but since they were not applied in drugs available in the market before 2009, they are not formally considered in the analysis.

Knowledge attributes are operationalized as follows:

a) *Distinctiveness* is captured through a categorical variable representing the underlying MOA of a drug;
b) *Maturation* is captured through a categorical variable representing whether the MOA underlying a drug is from the first or second generation;
c) *Integration* is captured through a categorical variable representing whether the drug is composed on one or more MOA;
d) *Scarcity* is captured through a continuous variable representing the number of drugs using the same MOA;
e) *Diffusion* is captured through a continuous variable representing the age of the MOA applied by a drug; and
f) *Replacement* is captured through a continuous variable representing the number of drugs using alternative MOAs.

In order to control for the uniqueness of each drug product and any other relevant influence on product's market value, the model also controls for the brand-specific effect and for the systematic temporal effect. The brand-specific effect captures everything related to the product that is not directly related to the mechanism of action adopted by the embedded technological knowledge, such as the quality of a particular biological or chemical compound as well as the effectiveness of the marketing campaign, among other potentially relevant aspects that are specific to a particular brand. In addition, any other relevant effect influencing the market value of a drug is captured through the auto-correlation of the residuals. The model adopts a first-order autoregressive methodology (*AR-1*), which lies in the assumption that disturbances on residuals are considered to depend only on its own previous value (the Markov property) and a random,

"white noise" component. The coefficient of the autocorrelation of the residual (ρ) reflects the aggregated influence of other potentially relevant and persistent factors influencing the performance of drugs that is not directly controlled by the adopted independent variables. This procedure also serves to correct biases generated by the non-stationary nature of the panel data according to the Prais-Winston procedure (Wooldridge, 2002).

RESULTS

Figure 2 displays the coefficient of determination (R^2) for partial models as a way to analyze each separate hypothesis. Based on these results, hypotheses #1, 2, 3, and 5 are accepted, while hypotheses #4 and 6 are rejected. *Exhibit 1* displays the result for the full model, which also corroborates main findings, even when all variables are considered simultaneously. Before discussing more details, it is important to highlight that, given that sales is *log*-transformed, but variables representing knowledge attributes are not, interpretation of the results requires a relatively simple transformation. We can easily interpret the regression coefficient in an *OLS model* as the expected change in log of the dependent variable with respect to a one-unit increase in the independent variable, holding all other variables at a fixed value. The natural way to do this is to exponentiate the regression coefficient, since exponentiation is the inverse of a logarithm function.

Below we discuss main results:

- ***Distinctiveness (Hypothesis #1):*** The first hypothesis is accepted, since the model considering the effect of MOA distinctiveness in product performance is statistically significant with a coefficient of determination (R^2) of 5.71% (at $p < .05$). This test confirms that MOAs applied in drugs differs from each other. A more detailed analysis of the result in the full model allows the conclusion that NRTI and II are not significantly different from each other, but PI, NNRTI and EI are. NNRTI are expected to generate less 96% of sales than NRTI, PI less 94%, and EI less 92%, assuming all other variables are controlled. On the other side, II is expected to generate similar levels of sales than NRTI. This result suggests that drugs based on NRTI and II are the most effective ones;

- ***Maturation (Hypothesis #2):*** The second hypothesis is also accepted. The model considering the effect of different generations of MOA is statistically significant with a R^2 of 15.31% (at $p < .001$). Results indicate that the second generation is significantly higher than the first generation. The model estimates that a new version of MOA is likely to generate an increase of sales in order of more than 510%. This is an indication that once a new generation of MOA is launched, drugs adopting it tends to capture market share quickly;

- ***Integration (Hypothesis #3):*** The third hypothesis is also accepted. The model considering the effect of the number of MOA in the same drug is statistically significant with a R^2 of 4.97% (at $p < .005$). Results indicate that multi-MOA drugs are likely to generate 380% more sales than drugs using a single MOA. This result seems to corroborate the idea that

incorporating multiple compounds in the same drug design generates considerable more value in the eyes of the patient (and/or physician) than drugs with just one compound;

- ***Commonness (Hypothesis #4)*:** The fourth hypothesis is rejected, since the number of existing products, products applying the same MOA, is not statistically significant. The intercept of the partial model is significant, indicating that the unconditional geometric average of an HIV drug is $337 million. This overall average does not significantly change with the increase (or decrease) of an additional competing resource of the same kind, indicating that direct MOA rivalry is not a relevant condition to change expected market performance of a HIV drug;

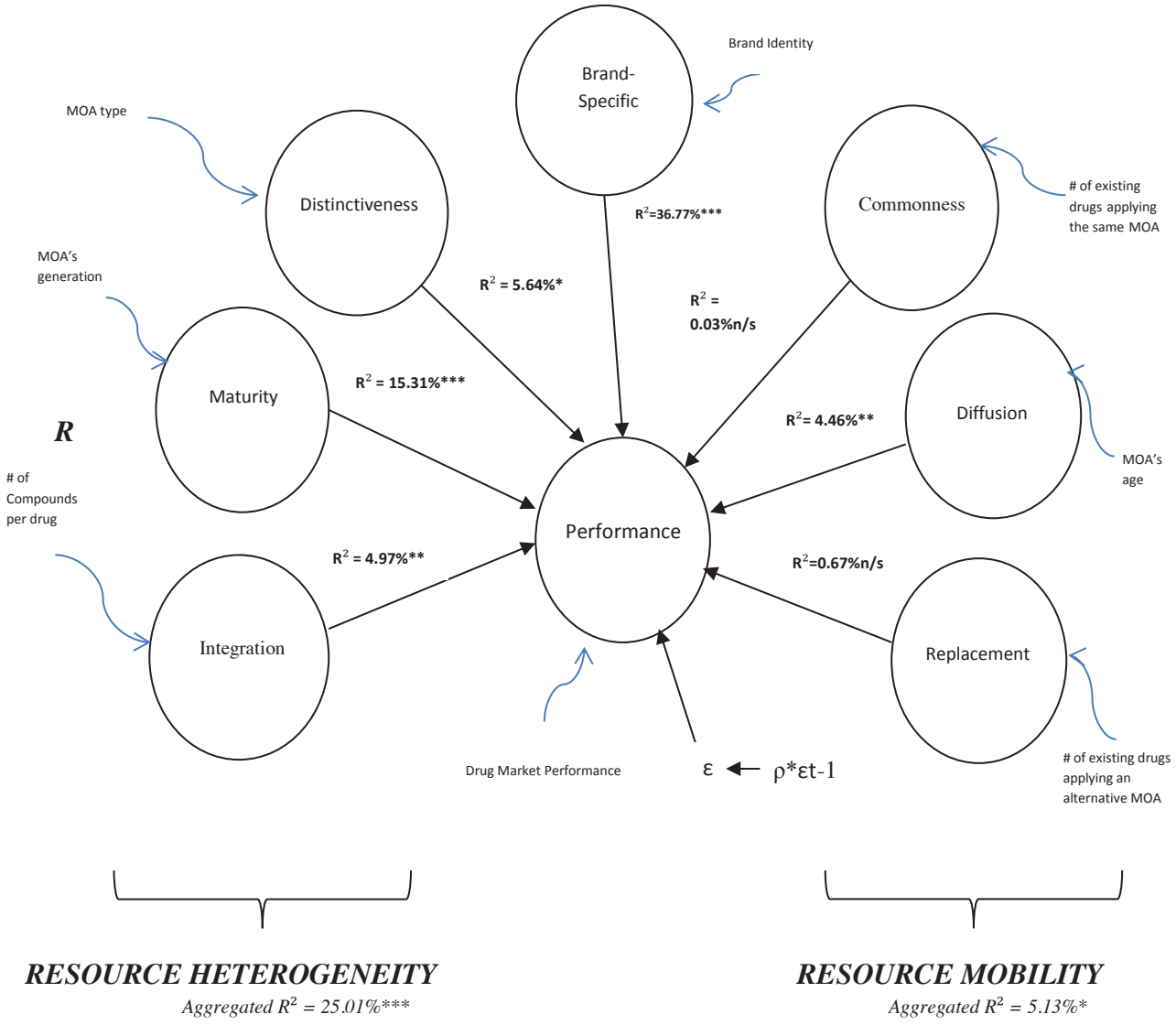


FIGURE 2. COEFFICIENT OF DETERMINATION PER CONSTRUCT/HYPOTHESIS

EXHIBIT 1. RESULTS FOR THE FULL MODEL

Variables	Coefficient	Std Error	Level of Significance
DISTINCTIVENESS			
NRTI (Constant)	9.33	0.78	0.000
PI	-3.04	0.62	0.000
NNRTI	-3.49	0.72	0.000
EI	-2.63	0.87	0.003
II	-0.33	0.52	0.721
MATURATION			
2nd Generation	1.81	0.52	0.001
INTEGRATION			
Multi-MOA	1.57	0.54	0.004
COMMONNESS			
Rivals	0.01	0.03	0.722
DIFFUSION			
Age of MOA	-0.20	0.03	0.004
REPLACEMENT			
Substitutes	-0.01	0.02	0.722
DRUG-SPECIFIC			
Kalestra	n/a		
Norvir	2.38	0.77	0.003
Reyataz	2.09	0.75	0.006
Sustiva	3.71	0.79	0.000
Viracept	0.76	0.73	0.297
Atripla	-3.13	0.91	0.001
Combivir	-0.27	0.75	0.714
Crixivan	1.48	0.73	0.044
Entriva	-1.31	0.53	0.015
Epivir	0.39	0.53	0.460
Epzicom	0.55	0.81	0.496
Fuzeon	-0.78	0.73	0.916
Invirase	0.33	1.23	0.786
Isentress	omitted		
Lexiva	1.37	0.75	0.070
Prezista	1.98	0.83	0.019
Rescriptor	-1.19	0.81	0.145
Retrovir	-1.73	0.65	0.009
Selzentry	omitted		
Trivizir	-0.86	0.76	0.259
Truvada	omitted		
Videx	-0.56	0.52	0.284
Viramune	omitted		
Viread	omitted		
Zerit	-0.58	0.49	0.284
Ziagem	omitted	0.78	0.000
# of Observations	**184**		
R^2	**0.6902*****		
ρ	**0.6188**		

Note: Some coefficients are omitted due to collinearity; n/a not applicable

- ***Diffusion (Hypothesis #5):*** The fifth hypothesis is accepted. The model considering the effect of MOA age is statistically significant with a R^2 of 4.46% (at $p < .005$). This variable's coefficient is -0.1925, meaning that a drug is expected to decrease sales in the order of 17% for every additional year in the life cycle of a MOA, possibly as the result of new entries of generics, which is not precisely measured due to the lack of available information. However, it is important to highlight that the estimated constant for this model is rather large ($44 billion of dollars);

- ***Replacement (Hypothesis #6):*** The sixth hypothesis is not accepted, since the number of existing substitutes, or the number of products applying a different MOA than product *i* in year *t*, is not statistically significant. This means that the expected performance level of a HIV drug is unlikely to change simply because a new substitute resource enters the AIDS pharmaceutical industry.

The aggregation of all six knowledge-based variables generates an equivalent R^2 of 32.25% (at $p < .001$) as displayed in *Exhibit 1* above. This means that they are capable of explaining a third of the variance of drug sales. When controlled by drug-specific effect, the consolidated R^2 double to 69.02%. Nine out of the 26 brands in the sample are significantly different from each other, whereas 17 are not. The magnitude of ρ is also high at the level of .62, showing strong degree of auto-correlation of the residuals during the period under consideration. Focusing on the six main variables of interest for this study, it is possible to assert that the most relevant knowledge attribute is maturation. It is followed by distinctiveness, integration, and diffusion. In aggregate, we can conclude that resource heterogeneity, with an aggregated R^2 of 25.01% (at $p < .001$), is more important that resource mobility, with an aggregated R^2 of 5.01% (at $p < .05$).

DISCUSSION

The objective of this paper is to better understand the complexities of the relationship between resource and performance. The study intends to support both theory development and managerial practice. From a theoretical perspective, the paper suggests a model in which the relationship between resource and performance is contextualized to a particular competitive condition within a given industry. Unlike previous papers in the RBT tradition which assumes that a resource (or its accumulate stock) have a direct effect on performance, this paper examines how distinct resource attributes contribute to performance differentiation within a historical situation. This approach has the potential of refining the original RBT assumption: it shows that it is not the resource, but certain characteristics of the resource that ultimately impacts performance outcomes. Consequently, the paper points to the relevance of the conditions that make a resource relevant to performance either of products or firms. This approach clarifies critical paths in which a resource can generates differentiated performance.

The main consequence of this theoretical perspective is to support an alternative version explaining how performance differentiation is possible in a competitive market. It shows that the

same critical resource might have distinct levels of efficiency according to the industrial circumstances. A resource is not either strategic or non-strategic for the firm; rather the resource becomes more or less strategic as the consequence of a competition occurring between different kinds of the same resource. Resource attributes might gain and loose relevance over time. This shows the impact that management can have in the positioning of firms from a practical perspective. Understanding the conditions in which knowledge affects performance has a direct implication to managerial decision making and execution. One of the consequences of focusing research attention on the attributes of the resource instead of focusing on the resource itself is to emphasize the relevance of implementation activities. This approach is particularly appealing to strategic management, because it allows the firm to intentionally manage and even design its resources according to particular historical needs. The specific relevance of a resource attribute informs management on the best stream of action.

Effective strategies are directly related to managerial processes which are oriented towards either promoting value creation or preventing value erosion. Firm's quest for competitive advantage motivates managers to focus on strategic actions oriented towards effectively leveraging resources. Here we have learned which resource attributes are the most relevant in the AIDS/HIV pharmaceutical industry. Empirical results indicate that the characteristics of knowledge captured by the attributes of heterogeneity (i.e., distinctiveness, maturation, and integration) are more relevant to performance than the attributes of mobility (e.g. commonness, diffusion, and replacement). This empirical evidence suggests that competitive advantage is essentially generated through the systematic improvement of the functionality of technological knowledge. Data-based evidence on the AIDS pharmaceutical industry in the beginning of the 21st Century suggests that the most effective way to generate a sustainable competitive advantage is to stimulate sources of resource heterogeneity. Although the flow of resource is also relevant phenomenon, promoting knowledge heterogeneity is considerably more relevant than preventing knowledge mobility. This result seems to diminish the relevance of strategies anchored in raising barriers to imitation comparatively to strategies anchored in promoting innovation. Although diffusion of the same resource certainly depreciates competitive advantage, as the accumulated process of new entries, it is the modification of the resource that is the most relevant factor generating changes in product outcomes.

Although this paper helps to distinguish which resource characteristic is the most relevant to performance, innumerable questions still remains unanswered regarding the reason underlying this phenomenon. Why is resource mobility less relevant than resource heterogeneity? We might start addressing this question by assuming that there are in fact many potential reasons for this finding. One potential explanation is to consider that it is not the number of rivals that really matters to performance, but their quality in pursuing effective strategies. In this respect, more important than the amount of rivalry is the particular design of each rival product. This phenomenon is being captured here through the brand-specific effect, which in fact explains a considerable amount of sales variance. The low magnitude of the effect generated by resource mobility might also be explained through the nature of the industry or its existing life cycle. This is particularly relevant to the AIDS pharmaceutical industry that deals with a new and fast expanding disease based on a virus that can mutate in response to medications. In this case,

results could not be easily generalized to other pharmaceutical sectors or other industries. Another possibility is that the selected variables representing resource mobility are not measured appropriately, which might indicate an inefficient process of measurement. The lack of data on specific generics drugs introduced during the period being covered by the analysis, especially in developing countries such as India, South Africa, and Brazil, might represent a major flaw in the current dataset. However, we argue that measuring the effect of new entries can be done successfully through the dimension of time flow. Although this means to accept a certain degree of simplification, it also promotes a powerful construct based on the depreciation or "aging" of the resource - even for an intangible and non-rival resource as technological knowledge. Knowledge aging might be in fact a more robust construct than a direct measure of competitiveness simply because it is more important to account for the net effect of resource mobility in this particular case than to account for the gross effect of separate factors in particular years.

A good example for that is the case of the brand Atripla that managed to gain market share very quickly, although it is composed of already existing MOAs. In this particular case, the performance of the brand is generated by a process involving both knowledge heterogeneity (i.e., integration of MOAs) and knowledge mobility (i.e., application of existing MOA). In other words, it is possible to say that Atripla is the consequence of a simultaneous process of imitation and improvement. This example shows the sophistication of the phenomenon being measured, since imitation might also involves some form of design improvement (McEvily & Chakravarthy 2002). By measuring the dimension of commonness through time flow allows a methodological procedure to discount for unnecessary variability of the data and directly deal with the aggregated effect of overall MOA devaluation and value erosion. Future studies will have to revisit these issues in more detail and provide additional evidence on the complex dynamics affecting the relationship between resource and performance.

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