Istanbul University Press

Istanbul Business Research, 51(2), 643-668
DOI: 10.26650/ibr.2022.51.904514
http://ibr.istanbul.edu.tr/
http://dergipark.org.tr/ibr

Istanbul Business Research

Submitted: 28.03.2021
Revision Requested: 28.04.2021
Last Revision Received: 07.05.2022
Accepted: 09.05.2022
Published Online: 22.09.2022

RESEARCH ARTICLE

The Dark Side of Firm Diversity: An Empirical Examination of the Impact of Firm Diversity on Resource Allocation Efficiency in Multidivisional Firms

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Abstract
There is a renewed debate about whether multidivisional firms allocate resources efficiently across their divisions. This paper contributes to the literature on this debate by developing and testing a conceptual framework that links resource allocation efficiency to three forms of firm-level diversity: diversity in industry-specific knowledge, diversity in industry-specific investment opportunities, and diversity in operations. Regression analysis of a large sample of multidivisional firms shows that resource allocation efficiency tends to decrease as diversity in either industry-specific knowledge or industry-specific investment opportunities increases. Moreover, it appears that the negative relationship between the diversity in industry-specific investment opportunities and allocation efficiency weakens and may even turn positive when the diversity in industry-specific knowledge is low. On the other hand, the diversity in operations does not appear to affect allocation efficiency. These results are robust to the potential bias due to sample selection. Combined with related theory, the results suggest that firm diversity could have either a detrimental or a positive effect on a firm's performance.

Keywords

Resource allocation efficiency, Firm diversity, Capital allocation, Internal capital markets, Multidivisional firms

Introduction

Ample evidence shows that most diversified multibusiness firms actively reallocate their capital resources across their business units (e.g., Lovallo, Brown, Teece, & Bardolet, 2020). In fact, capital resource allocation is a central managerial task because strategies such as investment in additional capacity and product or market development are implemented through decisions of resource allocation (Bower & Gilbert, 2005; Burgelman, 1983; Chandler, 1990; Levinthal, 2017; Maritan & Lee, 2017). Moreover, these decisions of resource allocation involve substantial amounts of capital expenditures. For instance, according to a survey of 2000 firms by Standard & Poor's, total global capital expenditures are expected to reach $3.7 trillion in 2021 (Williams, 2021, p. 4). These investment expenditures are made primarily by diversified firms with multiple divisions, each facing investment opportunities with hetero-

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To cite this article: Tag, M. N. (2022). the dark side of firm diversity: An empirical examination of the impact of firm diversity on resource allocation efficiency in multidivisional firms. *Istanbul Business Research, 51*(2), 643-668. http://doi.org/10.26650/ibr.2022.51.904514

genous potential for value creation. Hence, resource allocation decisions also involve critical trade-offs: allocating more to one division often means allocating less to other divisions (Sengul, Costa, & Gimeno, 2019; Stein, 1997). As such, the way multibusiness firms allocate their capital resources is critical to their ability to generate value. Thus, it is crucial to understand the conditions under which diversified multidivisional firms allocate resources efficiently, i.e., the conditions under which multidivisional firms direct capital resources toward high-yield divisions and away from low-yield divisions.

Extant research on the efficiency of resource allocation in multibusiness firms may be split into two factions. One faction emphasizes top decision makers' (i.e., a headquarters') expedient access to critical information about investment (i.e., resource allocation) alternatives. This ability enables the headquarters in a multibusiness firm to pick winner projects, i.e., channel resources from projects with poor prospects toward projects with brighter prospects of value creation (Gertner, Scharfstein, & Stein, 1994; Stein, 1997; Williamson, 1975). Some empirical works have shown that multidivisional firms in general tend to channel resources towards more profitable investment opportunities (e.g., Khanna & Tice, 2000; Maksimovic & Phillips, 2002; Matvos, Seru, & Silva, 2018) especially when external sources of capital are limited (Hann, Ogneva, & Ozbas, 2013; Kuppuswamy & Villalonga, 2016). This finding has been questioned by researchers in the other faction on the ground that agency cost, influence activity, and cognitive biases severely limit a headquarters' ability to identify and properly fund potentially valuable investment projects (e.g., Arrfelt, Wiseman, & Hult, 2013; Bardolet, Fox, & Lovallo, 2011; Bardolet, Brown, & Lovallo, 2017; Gertner, Powers, & Scharfstein, 2002; Glaser, Lopez-de-Silanes, & Sautner, 2013; Ozbas & Scharfstein, 2010; Rajan, Servaes, & Zingales, 2000). Overall, it appears that there is a debate about whether and when resource allocation in multidivisional firms is efficient.

This paper contributes to this literature by developing a conceptual framework that shows the conditions under which the limit on a headquarters' ability to pick 'winners' becomes binding. Specifically, the conceptual framework posits that i) diversity in industry-specific knowledge, ii) diversity in industry-specific investment opportunities, and iii) diversity in operations determine the extent to which a headquarters can benefit from its informational and control advantage. Thus, the efficiency of resource allocation in multidivisional firms would tend to vary with these modes of diversity. While there have been a few studies examining the relationship between one of these diversity modes and resource allocation efficiency, so far, there has not been any attempt to analyze their simultaneous impact on resource allocation efficiency in a multivariate framework.

I examine this framework by exploiting division-level capital expenditures data on a large sample of multidivisional firms obtained from Standard & Poor's. The empirical results contribute to the current debate on the efficiency of resource allocation in diversified firms by empirically showing that resource allocation efficiency tends to decrease as diversity in either industry-specific knowledge or industry-specific investment opportunities increases. Moreover, it appears that at lower levels of diversity in industry-specific knowledge, the negative relationship between resource allocation efficiency and diversity in industry-specific investment opportunities weakens. These results are robust to sample selection bias that has been present in much of the extant empirical literature on the strategy-performance relationship in the context of diversified firms. Overall, these results suggest that focused or related-diversified firms tend to allocate resources towards divisions with brighter investment opportunities.

Background Literature

Resource allocation by a headquarters generates costs as well as benefits. The Property Rights View (Grossman & Hart, 1986; Hart & Moore, 1990; Hart, 1995) provides a framework for understanding these costs and benefits. This view assumes that the financial structure of a firm determines decision rights over the assets of the firm. Unlike debt, equity provides its owners with control rights over assets. Thus, as the agent of equity owners, the headquarters of a firm enjoys complete control over assets, providing them with superior access to critical information about the profit potential of alternative resource allocation strategies. Moreover, unlike external capital providers, a headquarters has the authority to act upon its information on behalf of equity owners. Thus, the headquarters of a multidivisional firm has also stronger incentives relative to a debt financier to invest in collecting further information regarding the profitability of the current and potential asset deployment strategies (Gertner et al., 1994).

The preceding argument suggests that a headquarters, relative to external capital providers, is better equipped to channel resources towards divisions with brighter prospects. Several empirical studies provide evidence consistent with this argument. In one of the earlier large-sample studies, Maksimovic and Phillips (2002) found that multidivisional firms in the manufacturing industry increase investment in larger and more productive divisions faster than they do in smaller and less productive divisions. Studies using data from such specific settings as the pharmaceuticals (Guedj & Scharfstein, 2004), the discount retailing (Khanna & Tice, 2000), a large conglomerate in Europe (Glaser et al., 2013), and developing countries (Almeida & Wolfenzon, 2006; Almeida, Kim, & Kim, 2015), have also provided results suggesting that multidivisional firms allocate resources efficiently. Finally, Kuppuswamy and Villalonga (2016) show that the efficiency of resource allocation in diversified (multidivisional) firms increased significantly during the years surrounding the 2008 global financial crisis, a period characterized by limited sources of external capital. Most empirical evidence is nevertheless limited to specific industries or environment with underdeveloped institutions constraining external sources of capital.

While resource allocation in multidivisional firms has significant economic potential, it nonetheless creates a context for a costly influence activity—a lobbying process in which middle-level managers (i.e., divisional managers) with private information engage in costly quests for organizational rents, which may sway top managers' decisions toward inefficiency (Dean & Sharfman, 1996; Duchin & Sosyura, 2013; Milgrom, 1988; Meyer, Milgrom, & Roberts, 1992; Pfeffer, 1981). In the process of resource allocation, divisional managers compete with each other for resources because they have incentives to increase the size of their divisions, as a larger size increases their private benefits (Scharfstein & Stein, 2000). Therefore, they engage in all sorts of political maneuvering, including horse-trading, excessive lobbying, and selective communication of private information to increase their chances of obtaining more resources (Bower, 1970; Inderst & Klein, 2007; Ozbas, 2005; Wulf, 2009), engendering the so-called influence cost in the resource allocation process. Thus, divisional managers' incentives and actions could create a constraint on the effectiveness and efficiency of a headquarters' exercise of their control rights, i.e., the headquarters' "winner-picking" function. Empirical works provide evidence consistent with this argument. Examining resource allocation decisions at S&P 500 firms, Duchin and Sosyura (2013) found that CEOs favor divisional managers with whom they have social connections. Moreover, a few studies have shown that allocation to a division is associated with the division's influence and power within the firm (e.g., Glaser et al., 2013; Vieregger, Larson, & Anderson, 2017). These allocation inefficiencies are likely to increase in diversified firms operating in industries that are either unrelated or face various levels of investment opportunities (Gertner et al., 2002; Lamont & Polk, 2002; Ozbas & Scharfstein, 2010; Rajan et al., 2000).

Influence activity may not be the only source of inefficiency in the process resource allocation. Some researchers have suggested that as uncertainty surrounding a decision of resource allocation increases, managers may tend to use subjective and simplifying decision heuristics in their evaluations of alternative investment proposals (Jehiel, 2018; Shapira & Shaver, 2014). Using archival data on firms' resource allocation decisions, Arrfelt et al. (2013) found that simple cues, such as performance levels below and above aspirations, affect resource allocation decisions and the resultant efficiency of these decisions. Several recent studies have also found that decision makers' bias toward allocating resources evenly among investment alternatives is related to underinvestment in profitable divisions and overinvestment in unprofitable divisions (Bardolet et al., 2017; Bardolet et al., 2011; Gupta, Briscoe, & Hambrick, 2018). Overall, the preceding evidence suggests that the headquarters' informational advantage could be severely limited in environments characterized by high levels of uncertainty and complexity.

Hypotheses Development

The main proposition of this paper is that resource allocation efficiency is a function of the quality and efficacy of relevant information at the disposal of headquarters, everything else equal. To be precise, what is limited may not be information but rather the capacity of a firm to bring its information to bear on decisions of resource allocation (Simon, 1973). In other words, it is what Simon (1997) calls procedural rationality in the decision process which determines the efficiency of resource allocation decisions. In a similar vein, Chandler (1990) argues that modern diversified firms had rarely maintained their competitive positions unless the visible hand of their management permitted rapid entry into growing markets and divesting out of declining markets. Chandler maintains that this process of investment and divestment demanded the constant—yet limited—attention of management. Note that there may be relatively complete and high-quality information dispersed across lower levels of a firm's hierarchy. However, influence activities in a process characterized by bargaining for resources among divisional managers may limit the firm's capacity to process information, reducing the quality and efficacy of information at the top management level.

Mapping this abstraction to an empirically observable framework is challenging as neither the level of information asymmetry between managers nor influence cost are easily quantifiable. Given these challenges, the empirical literature has tended to link firm diversity (which creates fertile grounds for influence activities) to decisions of resource allocation. In this paper, I develop an empirical framework that links resource allocation efficiency to three modes of firm-level diversity: diversity in industry-specific knowledge, diversity in industry-specific investment opportunities, and diversity in operations. Below, I argue that each of these modes of diversity creates an organizational climate that encourages political behavior by divisional managers and spawns informational problems in the process of resource allocation, leading to inefficient resource allocation.

Diversity in Industry-Specific Knowledge

Industry-specific knowledge may be defined as the know-what and the know-how required to insightfully analyze and act upon information from a particular industry environment. This knowledge is instrumental in recognizing and ranking investment opportunities according to their potential profitability within an industry. Diversity in industry-specific knowledge (hereafter, K-diversity) refers to the differences in industry-specific skills, knowledge, and managerial logics held by the top and middle managers. In the process of resource allocation, top managers process information contained in divisional investment proposals, and then make judgments regarding the contribution of proposed investments to the overall corporate goal. Top managers usually have experience in various industrial environments. In general, however, they are less knowledgeable than middle managers about a specific industry

(Bower, 1970; March & Simon, 1958). Thus, there is an asymmetry in terms of industry-specific knowledge between the top and divisional managers, requiring top managers to rely on divisional managers' judgments in the process of resource allocation despite the elusive and sometimes inconsistent information across proposals. On the other hand, assuming they prefer larger capital budgets, divisional managers have strong incentives to exaggerate the prospects of their divisions. Indeed "…any manager worth having can produce numbers that will make a project look good" (Bower, 1970, p. 15). The cost of such exaggerations to divisional managers is inconsequential to the extent that divisional performance outcomes can be attributed to various sources. Essentially, when diversity in industry-specific knowledge increases, a headquarters loses its ownership (control) advantage, i.e., the ability to access critical information and pick winners based on this information. Thus, in the face of equivocal and inconsistent information, top managers' resource allocation decisions are likely to reflect a tendency toward allocating resources evenly across divisions (i.e., over-investing in unprofitable divisions and under-investing in profitable divisions), assuming that resources are limited. Such an allocation policy is relatively inefficient because the efficiency of allocation decisions could be improved by increasing (decreasing) the allocation to more (less) profitable divisions. Thus, I propose the following hypothesis:

Hypothesis 1: There is a negative relationship between resource allocation efficiency and K-diversity.

Diversity in Industry Specific Investment Opportunities

Divisions in a typical multidivisional firm face various industry-specific investment opportunities, each exhibiting a different potential for value creation (hereafter, Q-diversity, à la Rajan et al., 2000). Assuming that (capital) resources are limited, the efficiency principle requires that top management behaves in a "winner-picking" (Stein, 1997, p. 3) fashion when allocating capital resources among divisions. Thus, when Q-diversity increases, the likelihood of resource transfer among divisions increases, assuming that top managers have incentives to allocate resources to value-creating projects. On the other hand, top managers' tendency to pick winners creates a dynamic of competition for 'winning' more resources among divisions because divisional managers derive private benefits from more resources.

Competition for resources is likely to be destructive as Q-diversity increases. Since transfers among divisions are likelier and larger when divisions face diverse potentials, higher Q-diversity creates stronger incentives to compete over resources. In this process, managers waste their time and energy seeking rent and protecting their quasi-rents within the organization rather than performing their intrapreneurial duties. This problem worsens particularly when divisional managers expect bleak prospects for their divisions (Meyer et al.,1992; Ozbas, 2005; Scharfstein & Stein, 2000). Thus, relatively poorer divisions exaggerate their prospects to obtain more resources. Richer divisions also exaggerate to protect their resources from flowing to other divisions. Moreover, when managers spend excessive time on organizational rent-seeking, they are not only less likely to make useful decisions regarding their duties but also less likely to help top management correctly rank investment proposals. As a result, the top management's ranking of the investment proposals according to their potential value tends to be flawed, which, in turn, causes underinvestment in relatively more valuable investment projects and overinvestment in relatively inferior projects. This logic leads to the following hypothesis:

Hypothesis 2: There is a negative relationship between resource allocation efficiency and Q-diversity.

Diversity in Operations

Operating in multiple and diverse product markets (hereafter, O-diversity) increases the number and complexity of key managerial decisions. This, in turn, expands the volume and diversity of the information and knowledge requirements for effective coordination and decision making. On the other hand, the managerial skills and capabilities needed to effectively manage wide-ranging and larger operations grow at a rate slower than the rate of growth in product market scope. The discrepancy between the existing managerial capacity and the needed managerial services puts a strain on the top management's ability to effectively monitor and control increasingly disparate and less familiar businesses (Gerringer, Tallman, & Olsen, 2000). This attention-deficit creates governance inefficiencies (Feldman, 2016; Markides, 1992) and a lack of adaptability to environmental changes that might require, for instance, divestment from some industries and investment in emerging opportunities. Thus, a headquarters' advantage in resource allocation becomes limited and may even disappear when the diversity and amount of information needed for decision-making increase beyond what top management could handle efficiently (Natividad, 2013). This line of reasoning parallels Penrose's (1959) argument that successful expansion into new product markets necessitates versatile executive services. Thus, the managerial ability and technical services required for the planning, execution, and efficient operation of the enlarged firm scope establish a limit on profitable expansion. Similarly, both Barnard (1938) and Simon (1947) state that it is the coordination function of management (i.e., authoritative communication) that sets a limit on the profitable growth of a firm.

One could argue that there is a trivial need for coordination across divisions in highly diversified firms, as there are not many linkages among divisions. However, since capital resources are allocated on a competitive basis, there is competition for capital among divisions, which complicates and politicizes the resource allocation process. When O-diversity increases, the attention deficit described above creates a context where information could get distorted easily, leading to allocation inefficiencies. This discussion suggests the following hypothesis.

Hypothesis 3: There is a negative relationship between resource allocation efficiency and O-diversity.

Interaction Effects

It is quite possible that K-diversity interacts with the other two forms of diversity in its influence on resource allocation efficiency. This is because the mechanism through which either Q-diversity or O-diversity influences resource allocation efficiency is related to the information a headquarters needs to make efficient resource allocation decisions. More precisely, in a world of perfect rationality, increases in either Q- or O-diversity would not lead to information asymmetry between divisional and top managers. Put differently, when the industry-specific knowledge at the headquarters' level is complete, divisional managers will find it harder to exploit Q- or O-diversity and misrepresent information in their quest for a larger investment budget. Thus, when K-diversity decreases, we should observe a weaker (and possibly insignificant) negative relationship between resource allocation efficiency and either Q-diversity or O-diversity. Conversely, when the level of K-diversity increases, we might expect a stronger negative relationship between resource allocation efficiency and either Q-diversity or O-diversity. This logic leads to the following two interaction hypotheses.

Hypothesis 4: As K-diversity decreases, the negative relationship between Q-diversity and resource allocation efficiency gets weaker.

Hypothesis 5: As K-diversity decreases, the negative relationship between O-diversity and resource allocation efficiency gets weaker.

Data and Method

Data Sources and Sampling

In this study, I operationalize the multidivisional firm as a firm that reports financial data for at least two divisions, each having a distinct industry class at the 4-digit NAICS level. Thus, the population of firms operating in and providing financial data for at least two industry classes constitutes an appropriate setting for testing the hypotheses of this paper. To measure resource allocation and several other variables, I exploit data on divisional (segment-level) capital expenditures in multidivisional firms. Capital expenditure is generally defined as addition to property, plant, and equipment, excluding amounts arising from acquisitions. I use Standard and Poor's COMPUSTAT segment and industry files of the years 2002 and 2003 to collect data on divisional capital expenditures and other divisional- and firm-level financial variables.[1] This database contains data on 5963 publicly held and active firms. Of these firms, 1250 can be classified as multidivisional firms, after excluding those with at least one division in either the utilities or the financial industries. I also use the US Bureau of Labor Statistics' Occupational Employment Survey (OES) data to measure diversity in industry-specific knowledge. The OES database contains information on the distribution of occupational employment for 22 major occupations at the industry level. The occupational employment data are considered to be reliable indicators of the extent to which different types of knowledge, expertise, and know-how are required in an industry (Anand, 2004; Barbieri & Consoli, 2019; Coff, 2002; Farjoun, 1994; 1998). As I will explain below, the calculations of some of the measures used in this study require some industry-level benchmarks, which I estimate using data on stand-alone (single-business) firms.[2] Due to missing data on some firm-level variables and industry-level benchmarks, the measure of the dependent variable of this study is available only for 597 multidivisional firms. The numbers of observations on the remaining variables range from 597 to 1250.

The Dependent Variable

Analyzing the efficiency of resource allocation by a headquarters makes sense only when the headquarters somehow reallocates resources among divisions, i.e., transfers resources from one division to others. Thus, a measure of resource allocation efficiency must account for the transfers between divisions and whether the transfers are in the right direction. This paper uses Rajan et al.'s (2000) measure of "overall value added by allocation" as the measure of resource allocation efficiency. This measure exploits divisional capital expenditures data to measure resource allocation among divisions. Rajan et al. assume that the average of asset-weighted capital expenditures of single-business firms operating in the same industry as a division, i.e., the industry investment ratio, establishes a benchmark by which the division's assets-weighted capital expenditures, i.e., the divisional investment ratio, can be assessed to determine if a division's capital expenditures include resource transfers from (to) other divisions. Thus, the difference between the divisional investment ratio and the industry investment ratio would constitute a proxy for the level of transfer.[3] Following Rajan et al., I proxy the amount of resource transfer to (or from) a division as follows:

$$T_{ij} = IR_{ij} - IR_{ind}$$

where ij indicates division j of multidivisional firm i, where a division is defined at the 4-digit NAICS level. IR_{ij} is the divisional investment ratio, calculated by dividing divisional

1 While the data used for analysis may be considered relatively old, the validity of the conceptual framework of this paper does not depend on the timeframe of the data. That being said, a dataset with a longer timeframe would probably be more useful for more detailed and rigorous analysis.

2 Stand-alone (single-business) firms are those that report data for only one industry segment at a 4-digit NAICS level.

3 This logic has been adopted widely in the empirical literature on resource allocation.

capital expenditures by the beginning of year divisional assets. IR_{ind} is the industry investment ratio, calculated by taking the average investment ratio of all single business firms operating in the same 4-digit NAICS industry class as division *j*. A positive difference indicates inward transfer into division *j* from other divisions, whereas a negative value indicates outward transfer from division *j* to other divisions. Thus, *T* is a proxy for the direction rather than the efficiency of the transfer. A transfer would be efficient to the extent it is in the direction of divisions with valuable investment opportunities. To measure divisional investment opportunities, the literature, in general, relies on Tobin's *q* of single-business firms in the same industry as a focal division (e.g., Almeida et al., 2015; Arrfelt et al., 2013; Bardolet et al., 2017; Bardolet, Lovallo, & Rumelt, 2010; Lamont & Polk, 2002; Rajan et al., 2000; Shin & Stulz, 1998). Following the literature, I use the average Tobin's *q* of single business firms operating in the same industry as a focal division as a measure of divisional investment opportunities. The Tobin's *q* for a single-business firm is calculated as follows:

$$Tobin's\ q = \left(\frac{(\mathrm{A} + \mathrm{P} \times \mathrm{S}) - (\mathrm{E} + DT)}{\mathrm{A}}\right),$$

where *A* refers to the book value of total assets, *P* refers to the fiscal year-end stock price, *S* refers to the firm's number of outstanding shares, *E* refers to the book value of common equity, and *DT* refers to deferred taxes. Q_{ij}, my proxy for divisional investment opportunities, is then calculated by obtaining the asset-weighted average Tobin's *q* of all single-business firms operating in the same (4-digit NAICS) industry as a focal division. Assuming that an industry's average Tobin's *q* is a good proxy for divisional investment opportunities, and given the efficiency rule outlined above, the efficiency of resource allocation is measured as follows (Rajan et al., 2000):

$$Efficiency_i = \frac{\sum_{j=1}^{n} A_{ij} \times \left(Q_{ij} - \bar{Q}_{ij}\right) \times T_{ij}}{A_i},$$

where, *i* and j denote multidivisional firm and division, respectively. *Efficiency*, *A,* and *Q*, denote resource allocation efficiency, the book value of assets, and the value of investment opportunities, respectively. $\bar{Q}$ denotes the firm-level average investment opportunities (imputed Tobin's *q*), calculated by taking the asset-weighted average of all Q_{ij}. According to this measure, when Q_{ij} is larger than $\bar{Q}_{\text{ij}}$, a positive transfer creates value, whereas a negative transfer destroys value. This measure expresses the magnitude of value creation or destruction as a percentage of assets.

Explanatory Variables

K-diversity. I use the OES data on industry-level occupational employment percentages to measure K-diversity. The occupational employment percentages have been considered as proxies for both the extent and the type of occupational knowledge requirements in a particular industry. As such, these data have been used to measure knowledge-based diversity in research on diversifying mergers and acquisitions (e.g., Anand, 2004; Barbieri & Consoli, 2019; Coff, 2002). Following this literature, I argue that, in a multidivisional firm, divisional executives hold diverse knowledge to the extent that the divisions of the firm are in industries that are dissimilar in terms of their distributions of occupational employment percentages. Thus, dissimilarity in terms of occupational employment percentages across industries indicates dissimilarity in industry-specific knowledge.

To measure K-diversity, I first identify the occupational employment percentages for each of the 4-digit NAICS industry classes in which a multidivisional firm operates. Next, for each firm-occupation combination, I calculate the firm-level average employment percentage weighted by divisional assets, and then, take the Euclidean distance between this average and the occupational employment percentage at the industry (division) level. This Euclidean distance quantifies, for a given occupation, the difference in industry-specific knowledge between a division and the firm average. The overall firm-level K-diversity is, thus, equal to the sum of Euclidian distances between the division and the firm's occupational employment percentages, weighted by divisional assets weight and then summed over all divisions. Formally, the measure may be expressed as follows:

$$K\text{-}diversity_i = \sum_{j=1}^{n} w_{ij} \times \left[\sum_{k=1}^{K} \left| \left(\sum_{j=1}^{n} \left(w_{ij} \times ep_{ijk} \right) \right) - ep_{ijk} \right| \right],$$

where *i*, *j*, and *k* indicate firm, division, and occupation, respectively. Also, *w*, *n*, *K*, and *ep* refer, respectively, to divisional asset weight, total number of divisions, total number of occupations, and occupational employment percentage.

Q-diversity. This variable is defined as the disparity in the potential, or expected value, of investment opportunities across divisions. Following Rajan et al. (2000), I measure Q-diversity by calculating the coefficient of variation of the divisional *Q's*, as follows:

$$Q\text{-}diversity_i = \left[\frac{\sqrt{\sum_{j=1}^{n} \frac{\left(Q_{ij} - \bar{Q}_i\right)^2}{n-1}}}{\frac{\sum_{j=1}^{n} Q_{ij}}{n}} \right],$$

where, *i*, *j*, and *n* denote multidivisional firm, division, and the number of divisions respectively.

O-diversity. This variable is defined as the breadth of a multidivisional firm's product-market activities. I measure O-diversity using the unrelated component of the entropy index (see Palepu, 1985; Miller, 2006) as follows:

$$O\text{-}diversity_i = \sum_{j=1}^{n} P_{ij} \times \ln\left(1/P_{ij}\right),$$

where, i, j, and n denote multidivisional firm, division, and the number of divisions, respectively. P refers to the proportion of sales from division j defined at 2-digit NAICS code.[4]

Controls

While the estimation technique used in this paper may account for some unobserved firm heterogeneity, in my analysis, I control for two key influences: *firm size* and *excess capital* resources. Efficiency may vary with size because the resource allocation problem may be more complex in larger firms. I use the total number of divisions reported by the firm as a measure of firm size. Alternatively, a firm's total sales or assets can be used to measure firm size. However, note that the allocation problems discussed in this paper may not arise as much from a large asset (or sales) base, *per se*, as from a large number of divisions. That is, the allocation is likely to be much more complicated in a firm with many divisions even when its sales are low. Thus, I use the number of divisions (*divisions*) as a measure of firm size and expect that resource allocation efficiency goes down as the number of divisions increases. I also control for excess capital resources because the availability of capital may affect firms' investment behavior (Bentley & Kehoe, 2020). The measure of excess capital resources is based on the adjustment factor that Rajan et al. (2000) calculate to account for the possibility of excess resources available to multidivisional firms. The adjustment factor is calculated by weighting divisional transfer, T, by the beginning-of-year divisional asset weight and then summing over all divisions. I use the mean value of the adjustment factor in the sample as an index indicator for a firm's excess capital resources. So, the measure of excess capital (*excess capital*) takes the value of 1 if the adjustment factor is above its mean value, and 0 otherwise.

The Empirical Model and Estimation

To test the hypotheses of this study, I specify the following linear regression equation:

$$\begin{aligned} Efficiency_{it} = {} & \alpha_0 + \beta_1 K\text{-}diversity_{i,t-1} + \beta_2 Q\text{-}diversity_{i,t-1} + \beta_3 O\text{-}diversity_{i,t-1} \\ & + \beta_4 (K\text{-}diversity \times Q\text{-}diversity)_{i,t-1} + \beta_5 (K\text{-}diversity \times O\text{-}diversity)_{i,t-1} \\ & + \beta_6 divisions_{i,t-1} + \beta_7 excess\ capital_{i,t-1} + e_{it} \end{aligned}$$

The dependent variable of this study is not observed for all multidivisional firms making up the sampling frame. As such, the firms that appear in my analysis sample may be syste-

4 To reduce the effect of outliers in the data and increase the linearity of the explanatory variables, both Q-diversity and O-diversity were transformed using the natural log transformation. K-diversity was transformed using the square root transformation. Also, whereas the dependent variable was measured using the end-of-fiscal year data, all independent variables were measured using the beginning-of-fiscal year data.

matically different from those not in the sample, which may lead to the so-called endogenous treatment of sampled firms. Thus, estimating the empirical model using the OLS estimator is likely to yield biased results (Greene, 2018). Thus, I utilize the Heckman selection model (Heckman, 1976; 1979) to estimate my regression equation. The Heckman selection model assumes that there is a regression relationship between a dependent variable and a set of independent variables; however, the dependent variable is not always observed. It is observed only when certain conditions are met. These conditions are specified using an auxiliary selection equation.

In this paper, I assume that the dependent variable is likely to be unobserved when a firm has a high number of divisions because as the number of divisions increases, the likelihood of obtaining benchmarks for all divisions goes down. Therefore, I include the number of divisions in the selection equation. Also, firms that operate in related industries may be more likely to be included in the sample. To account for this effect, I calculate the entropy measure of diversity in operations at the 5-digit NAICS and then, obtain the natural log of the related component of the total entropy index as a measure of relatedness to be included in the selection equation. I also include the natural log of the imputed average Tobin's q in the selection equation because the dependent variable is more likely to be observed when the imputed Tobin's q can be calculated. Finally, I include in the selection equation the natural logarithm of total sales because firms in the sample are significantly larger than censored firms. Thus, I specify a selection model, which suggests that the dependent variable is observed if:

$$\beta_0 + \beta_1 divisions_{i,t-1} + \beta_2 \ln relatedness_{i,t-1} + \beta_3 \ln \bar{Q}_{i,t-1} + \beta_4 \ln sales_{i,t-1} + u_{it} > 0$$

where u is normally distributed with mean 0 and a standard deviation 1. If there is a significant correlation between u and e, the errors in the main regression equation, then the OLS estimation of the main regression equation yields biased results. On the other hand, the Heckman selection model provides a procedure that produces consistent and asymptotically unbiased estimates even when the model omits some relevant variables (Greene, 2018).

Empirical Findings

Table 1 reports the descriptive statistics and correlations. The average level of allocation efficiency (hereafter, efficiency) appears to be approximately −0.009, suggesting that the average multidivisional firm (i.e., a firm with total assets of $10 billion) in my dataset has destroyed on average $90 million through its resource allocation policies.[5] However, the standard deviation of efficiency is more than ten times its mean level, suggesting that firms in my sample vary in terms of their efficiency. Also note that, in my sample, efficiency is not observed for more than half of the firms in the full sample. In my analysis below, I obtain and

5 The mean of total assets in the sample is approximately $10 billion.

report the unconditional mean level of efficiency after accounting for the potential bias due to the sample selection.

Table 1

Descriptive Statistics

Variable	Mean	SD	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) Efficiency	−0.009	0.089								
(2) K−diversity *(square root)*	5.074	2.128	−0.11							
(3) Q−diversity *(ln)*	−0.586	1.090	−0.10	0.14						
(4) O−diversity *(ln)*	0.249	0.236	−0.04	0.38	0.17					
(5) Excess capital	0.270	0.444	−0.06	0.01	0.06	0.00				
(6) Divisions	4.067	1.498	−0.03	0.16	0.05	0.18	−0.08			
(7) Relatedness *(ln)*	0.202	0.242	−0.02	−0.07	−0.04	−0.49	0.01	0.29		
(8) Average q *(ln)*	0.200	0.871	−0.22	−0.06	−0.10	−0.03	0.04	0.02	0.07	
(9) Sales *(ln)*	6.033	2.619	0.05	0.00	−0.08	−0.01	0.12	0.40	0.27	0.00

Note: Correlations above 0.068 or below −0.068 are significant at $p < 0.05$.

Table 1 also reports the Pearson's pairwise correlation coefficients. This table indicates that efficiency is significantly and negatively correlated with both K-diversity and Q-diversity. However, although the correlation between efficiency and O-diversity is negative, it is insignificant. Also, relatively low correlations among the three types of diversity suggest that each measure of diversity corresponds to a different (diversity) construct. Overall, these correlations provide some reassuring evidence on the validity of the measures in this study.

Table 2 presents the regression estimates based on the Heckman selection model. Thus, each regression model in this table includes the estimates of coefficients of the main and the selection equations. Estimates of models 1−3 are based on the full information maximum likelihood procedure, whereas the estimate of Model 4 is based on the two-step estimation procedure. The standard errors of the estimates presented by Models 1−3 have been corrected for (and therefore are robust to) the presence of heteroskedasticity in the errors. The Wald χ^2 tests reported at the bottom of each column reject the null hypotheses that the coefficients in each model are jointly not different from zero. Table 3 also reports the estimates of ρ, the estimated correlations between the error terms of the main and the selection equations, and the significance levels of the Wald tests of $\rho = 0$. In all models, estimates of ρ are significantly different from 0, justifying the use of the Heckman selection model.

Model 1 of Table 3 presents the estimate of a model containing a constant only. The coefficient of the constant term in this model ($\beta = -0.014$) gives the unconditional mean of efficiency after accounting for the effect of sample selection. The estimated unconditional mean given by this model is much lower than the unconditional mean reported in Table 1. This difference is statistically significant at the 3.5% level.

Table 2
Heckman Selection Model Regression Estimates

	(1)	(2)	(3)	(4)	(5)
Main Equation					
K−diversity		−0.007**	−0.014*	−0.006*	−0.013*
		(0.002)	(0.006)	(0.003)	(0.005)
Q−diversity		−0.012*	0.017*	−0.017**	0.010
		(0.006)	(0.007)	(0.006)	(0.014)
O−diversity		0.020	0.011	0.009	0.002
		(0.017)	(0.038)	(0.026)	(0.070)
K−diversity × Q−diversity			−0.007*		−0.006*
			(0.003)		(0.003)
K−diversity × O−diversity			0.002		0.002
			(0.008)		(0.013)
Excess capital		−0.014	−0.013	−0.014	−0.013
		(0.013)	(0.013)	(0.010)	(0.010)
Divisions		−0.006♠	−0.005♠	−0.012*	−0.010*
		(0.003)	(0.003)	(0.005)	(0.005)
Constant	−0.014*	0.019♠	0.046*	0.011	0.037
	(0.006)	(0.011)	(0.022)	(0.021)	(0.028)
Selection Equation					
Relatedness	0.679**	1.266***	1.262***	1.284***	1.284***
	(0.228)	(0.256)	(0.257)	(0.255)	(0.255)
Average q	0.829***	0.912***	0.911***	0.889***	0.889***
	(0.062)	(0.067)	(0.067)	(0.072)	(0.072)
Divisions	−0.282***	−0.351***	−0.351***	−0.352***	−0.352***
	(0.038)	(0.045)	(0.045)	(0.041)	(0.041)
Q−diversity	−0.637***	−0.658***	−0.659***	−0.658***	−0.658***
	(0.055)	(0.058)	(0.058)	(0.050)	(0.050)
O−diversity	−0.003	0.429♠	0.424	0.440♠	0.440♠
	(0.227)	(0.258)	(0.258)	(0.259)	(0.259)
Constant	0.317*	0.073	0.073	0.082	0.082
	(0.133)	(0.159)	(0.159)	(0.159)	(0.159)
N	1250	1061	1061	1061	1061
Uncensored N	597	408	408	408	408
ρ	0.115	0.216	0.214	0.546	0.539
Wald χ^2 test of $\rho = 0$	0.000	0.000	0.000		
Wald χ^2 test of all coefficients = 0		0.036	0.052	0.001	0.001

♠$p < 0.1$, *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.
Note: Heteroskedasticity-robust standard errors are given in parentheses. Models 1−3 are based on the full information maximum likelihood estimator, whereas models 4 and 5 are based on the two−step estimator of the Heckman selection model. Due to missing data on some variables, N and Uncensored N may differ across models.

Model 2 of Table 3 reports the estimate of the regression equation when the coefficients on the interaction terms are constrained to be zero. While the sign and the significance of the coefficients on both K-diversity and Q-diversity in this model are consistent with hypotheses 1 and 2, it is not appropriate to attach any substantive meaning to these results since the conceptual framework includes interactions between K-diversity and both Q- and O-diversity.

Essentially, the estimate of Model 2 is most likely biased because it omits the interaction terms (see, Brambor, Clark, & Golder, 2006; Li, Sharp, Bergh, & Vandenberg, 2019). Hence, I evaluate my hypotheses using the estimate of the full specification, presented by Model 3.

Hypothesis 1 postulates a negative relationship between K-diversity and efficiency. Estimate of Model 3 provides support for this hypothesis ($\beta = -0.014$, $p < 0.02$). However, since K-diversity interacts with Q- and O-diversity, these estimates (i.e., both the coefficient and its significance) are correct only when both Q- and O-diversity are simultaneously set to zero. When these variables are held constant at their means, however, the estimated marginal effect of K-diversity on efficiency goes down to -0.007 while its precision increases ($p < 0.005$). This estimate indicates that, everything else equal, one standard deviation increase in K-diversity is associated with 0.012 percentage points decrease in the mean level of efficiency. This number is roughly equal to the unconditional mean reported by Model 1, suggesting that K-diversity also has an economically significant effect on efficiency. However, these effects are correct only for particular values of the explanatory variables. As such, the reported coefficients on the main variables are not much informative and thus, I evaluate my hypotheses by obtaining the marginal effects conditional on various values of the conditioning (moderating) variables.

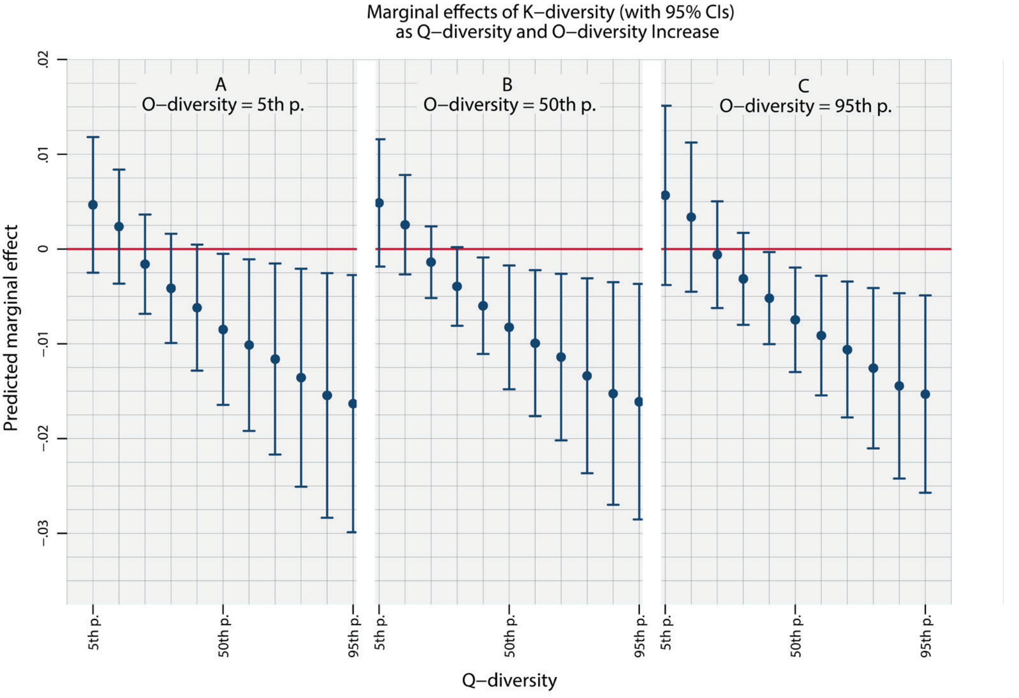

Figure 1. The Contingent Effect of K-diversity on Resource Allocation Efficiency

Figure 1 illustrates how the predicted marginal effect of K-diversity changes for different percentile values of both Q- and O-diversity. Panels A, B, and C of this figure show the predicted marginal effects of K-diversity while varying Q-diversity, but holding O-diversity constant at the 5th, 50th, and 95th percentile values, respectively. The figure indicates that for values of Q-diversity above its 20th percentile, the marginal effects of K-diversity are negative. However, these effects are significant—at the 5% level—only when Q-diversity takes values equal to or above its median. Moreover, as panels A, B, and C of Figure 1 indicate, the predicted marginal effects do not appear to vary significantly over the distribution of O-diversity.[6] Thus, while results of Model 3 support Hypothesis 1, there is evidence indicating that some effect of K-diversity may be contingent on the level of Q-diversity.

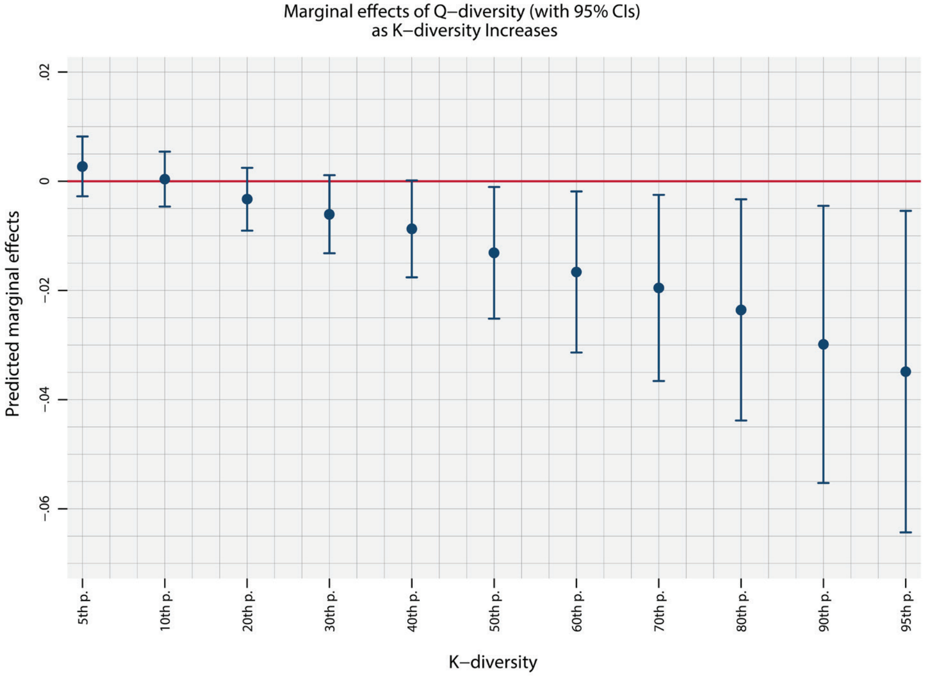

Figure 2. The Contingent Effect of Q-diversity on Resource Allocation Efficiency

Hypothesis 2 postulates a negative relationship between Q-diversity and efficiency. However, Hypothesis 4 argues that the negative relationship between Q-diversity and efficiency is contingent on the levels of K-diversity. Thus, using Model 3 results, I estimate the marginal effects of Q-diversity on efficiency over the distribution of K-diversity. Figure 2 presents the

6 While unreported further analysis indicates that the negative marginal effect of K-diversity becomes significant for values of Q-diversity above -1.7 (the 25th percentile) when O-diversity is held constant at its mean level, the overall results suggest that O-diversity does not have a significant effect on the nature of the interaction between K- and Q-diversity.

estimated marginal effects of Q-diversity with 95% confidence intervals. According to Figure 2, there is a negative relationship between Q-diversity and efficiency. Moreover, consistent with Hypothesis 4, it appears that the negative marginal effect of Q-diversity depends on the level of K-diversity. As K-diversity goes down, the marginal effect of Q-diversity becomes weaker. For sufficiently low levels of K-diversity, i.e., for values of K-diversity below its 40th percentile, the marginal effects of Q-diversity are indistinguishable from zero.[7]

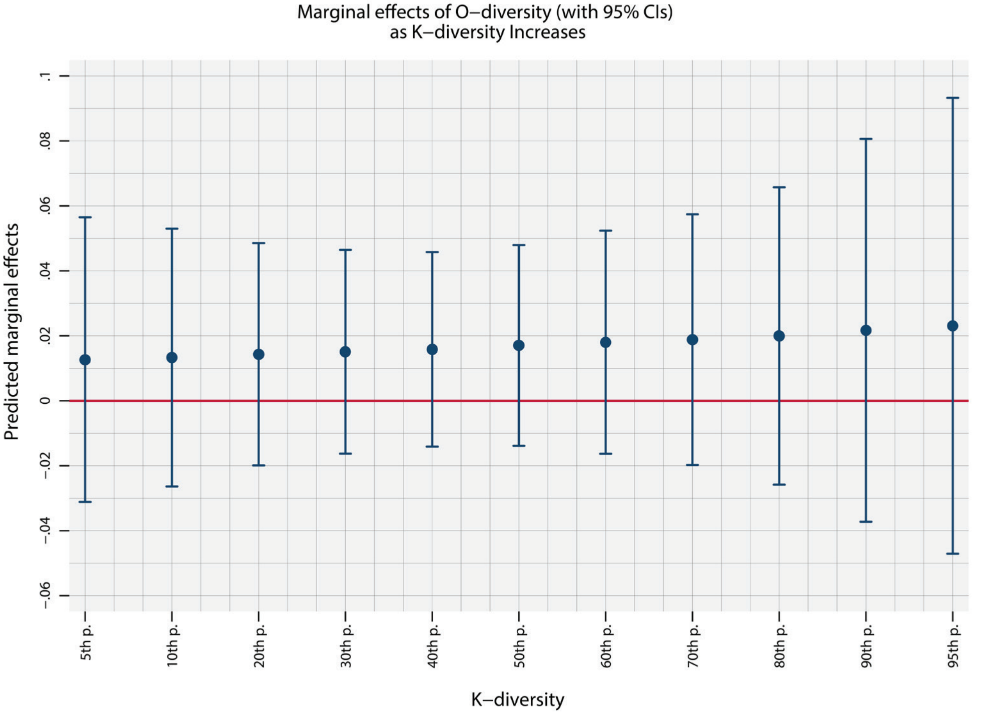

Figure 3. The Contingent Effect of O-diversity on Resource Allocation Efficiency

Hypothesis 3 posits a negative relationship between O-diversity and efficiency. However, Hypothesis 5 states that the negative relationship between O-diversity and efficiency becomes weaker as K-diversity goes down. The results of Model 3 are not consistent with these hypotheses. Figure 3 presents the estimated marginal effects of O-diversity based on Model 3 results. According to Figure 3, there is a positive, nonetheless insignificant, relationship between O-diversity and efficiency. Moreover, this relationship does not appear to vary over different values of K-diversity. Finally, I examine the robustness of Model 3 results

7 Model 3 results suggest that when the value of K-diversity is set to zero, the relationship between Q-diversity and efficiency becomes positive and significant at the 2.5% level. However, this conclusion is not realistic given that K-diversity is always positive and well above 1 for most of the multidivisional firms in my sample. When K-diversity is held constant at its lowest sample value, the marginal effect of Q-diversity on efficiency becomes indistinguishable from zero.

using Heckman's two-step estimation procedure. Model 4 of Table 3 presents this estimate. In terms of coefficient sign and significance, this estimate is quite similar to that of Model 3, providing further evidence that the findings presented so far do not depend on the estimator used to deal with the potential effect of sample selection.

Discussion and Conclusion

In an internal document leaked to the Wall Street Journal in 2006, Brad Garlinghouse, then a senior vice president at Yahoo!, compared their corporate strategy to "spreading peanut butter across the myriad opportunities that continue[d] to evolve in the online world. The result: a thin layer of investment spread across everything [they did] and thus [they] focus[d] on nothing in particular" ("Yahoo memo," 2006). Apparently, Yahoo! had a scheme of allocating its resources evenly across divisions, and perhaps, irrespective of the investment opportunities the divisions then faced. Whether such a resource allocation policy is a widespread phenomenon is a fundamental question for both researchers and practitioners because resource allocation is the most central managerial task with wide-ranging implications (Bower, 2017; Levinthal, 2017; Maritan & Lee, 2017).

According to the M-form hypothesis (Williamson, 1975; 1996), the headquarters in a multidivisional firm is well-positioned to allocate resources efficiently owing to its superior access to information regarding investment opportunities. Several researchers have criticized this hypothesis on the ground that a headquarters might not have either the proper incentives or the information needed to manage the resource allocation process efficiently (e.g., Arrfelt et al., 2013; Bower, 1970; Hill, 1994; Ozbas & Scharfstein, 2010; Rajan et al., 2000; Scharfstein & Stein, 2000). Moreover, descriptive studies of the resource allocation process have shown that the allocation of capital is a political process that entails crucial interactions, including the exchange of critical information among executives, who often hold diverse specializations and interests (Bower & Gilbert, 2005). Thus, the information used in decisions of resource allocation is generally distorted and incomplete. On this basis, this paper contributes to the literature by postulating that diversity in industry-specific knowledge, diversity in industry-specific investment opportunities, and diversity in operations lead to inefficient resource allocation. The empirical results corroborate the purported negative effects of diversities in both industry-specific knowledge and investment opportunities on allocation efficiency. Moreover, I find that the negative relationship between the diversity in industry-specific investment opportunities and allocation efficiency is less pronounced when the diversity in industry-specific knowledge is low. These results appear robust to the potential bias due to sample selection.

These results provide several contributions to the literature on resource allocation within multidivisional firms. It is generally held that in large multidivisional firms, divisional managers develop industry-specific cognitive frames (i.e., industry-specific knowledge and specializations) that aid in identifying industry-specific profitable investment opportunities. Such benefits notwithstanding, one implication of the findings of this study is that diversity in industry-specific knowledge may create a limit on the headquarters' ownership advantage (i.e., the headquarters' easier access to information) in the resource allocation process. Accordingly, it appears that managerial specializations may be a double-edged sword. Which effect dominates may be contingent on the structural and strategic context of the resource allocation process (Bower, 2017; Gilbert & Christensen, 2005). The results of this paper suggest that diversity in cognitive frames may lead to inefficient resource allocation when the external strategic context exhibits diversity (i.e., when Q-diversity increases). Future research may explore how multidivisional firms design and manage their resource allocation processes (i.e., their structural context) to align the interest and actions of top management team members, and thereby bring their different specializations to bear on decision making in an efficient manner.

Previous studies have also suggested that resource allocation efficiency decreases when there is greater diversity in industry-specific investment opportunities across divisions (Lamont & Polk, 2002; Rajan et al., 2000; Scharfstein & Stein, 2000). The findings of this paper extend this proposition by providing a boundary condition on the impact of diversity in industry-specific investment opportunities. Note that a negative effect may appear counterintuitive because the potential for value creation through resource allocation is greater when there are differences in terms of investment opportunities across divisions. For example, in a two-segment firm, a transfer between divisions is not expected to create value if each of the divisions has the same potential for value creation. The finding of negative effect becomes plausible under a model of influence cost in the resource allocation process. As diversity in investment opportunities, and thus, the prospect of cross-subsidization across divisions increases, divisional managers' tendency to protect or enlarge their turfs becomes stronger, leading to inefficient allocation decisions. The significant interaction effect between diversities in both industry-specific knowledge and investment opportunities gives credence to the preceding interpretation. When the diversity in industry-specific knowledge is sufficiently low, the relationship between the diversity in industry-specific investment opportunities and resource allocation efficiency becomes positive (albeit insignificant), suggesting that when influence activity is not likely to pay off, the bright side of diversity in industry-specific investment opportunities may dominate. However, this effect is not strong, and thus requires further investigation.

Numerous studies have attributed the so-called diversification discount to the non-synergistic asset combinations in diversified firms (for instance, see Coff, 2002; Markides & Williamson, 1994; Miller, 2006; Palich, Cardinal, & Miller, 2000; Robins & Wiersema, 1995; Sakhartov & Folta, 2014; Seth, Song, & Pettit, 2002). While I cannot reject this conjecture, the results of this paper indicate that unrelated diversity in operations does not have an impact on resource allocation efficiency. One possible explanation for this result is that what causes resource allocation inefficiencies in multidivisional firms may not be operational diversity, *per se*. Rather, the diversities in industry-specific knowledge and investment opportunities may be among the primary causes of allocation inefficiencies. Note that while the overall conceptual framework of this paper hinges on the bounded rationality assumption, the first and second hypotheses depend crucially on the existence of a conflict of interest among divisional and top managers whereas the third hypothesis is based on potential inefficiencies resulting from operational complexity. In light of these assumptions, the findings imply that resource allocation inefficiency does not arise as much from operational complexity as from incentive incompatibilities and conflicts of interest among executives. However, this conjecture requires further investigations through different or more refined measures and methodologies.

There are a few limitations to this study. First, the conceptual framework ignores the direct and indirect impacts of firm-specific capabilities and organizational structures on allocation efficiency. A firm's governance structure, reward systems, and management capabilities affect resource deployment at both the business and functional level (for instance, see Arrfelt, Wiseman, McNamara, & Hult, 2015; Lovallo et al., 2020; Kor & Mahoney, 2005; Tağ, 2008; 2021). Moreover, firms may face different levels of environmental complexity which might affect their allocation strategies and the level of allocative efficiency they achieve. Thus, the results would be biased to the extent unobserved firm or industry-level heterogeneity is related to the included variables and my selection equation does not account for the influence of the omitted variables. Second, I conceptualize and measure investment opportunities at the industry level rather than at the division level. In practice, however, firms may be allocating their resources based on their evaluation of division-specific investment opportunities, which are functions of both firm-specific capabilities and industry-specific conditions. Thus, our understanding of the relationship between resource allocation efficiency and diversity in investment opportunities could be improved by developing improved measures of divisional investment opportunities. Finally, resource allocation by a headquarters is potentially more valuable when some divisions face constraints on capital while other divisions are capital rich. Therefore, it might be useful to control for this influence by examining resource allocation decisions at the divisional level.

Peer-review: Externally peer-reviewed.

Conflict of Interest: The author has no conflict of interest to declare.

Grant Support: The author declared that this study has received no financial support.

Acknowledgement: The first version of this paper was presented at the 67th Annual Meeting of the Academy of Management, held in Philadelphia, USA. I am grateful for the insightful feedback from anonymous reviewers, conference participants, and the paper discussant Constantinos C. Markides. The current version of the paper develops and tests two additional hypotheses and utilizes a more refined dataset.

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