DIVERSIFICATION, ORGANIZATIONAL ADJUSTMENT AND FIRM PERFORMANCE: EVIDENCE FROM MICRODATA

by

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Abstract

This paper proposes that diversification taxes firms' existing organizational systems by altering routines, formal contract structures and strategies. I test the proposition that organizational adjustment costs associated with diversification erode incumbent competitive advantage, using novel microdata on taxicab firms from the Economic Census. The tests exploit exogenous local characteristics of taxi markets to identify the impact of diversification on firm organization and performance. Supporting the contention that diversification leads to organizational adjustments, the results show that diversifying firms are less likely to adopt computerized dispatching systems for their taxicabs and make significant changes in their formal contract structures governing asset ownership. Consistent with the theory, diversification is associated with falling taxi productivity. Comparing the productivity of diversified and focused start-ups and incumbent firms reveals that the organizational change component of diversification accounts for an 18% decrease in paid ride-miles per taxi. The results support the core contention of the paper that diversification taxes firms' existing organizational capital.

Key words: Diversification, organizational adjustment, productivity, entry, liability of newness, competitive advantage

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Introduction

When firms expand by diversifying into new business segments, growth is accompanied by organizational change. Formal contractual structures are modified and informal routines evolve to enable the firm to carry out its new, larger purpose as efficiently as possible. But organizational change is not frictionless. Management systems, honed and developed over years to accomplish a narrower objective, are altered only at a cost. While organizational adjustment costs have intuitive appeal and have long been recognized in the theoretical literature on economic organization (Nelson and Winter, 1982; Hannan and Freeman, 1984; Leonard-Barton, 1992), there has been little empirical research connecting diversification, organizational change and firm performance.[1] Yet, the costs of organizational change seem particularly salient in the context of diversification.

This paper considers the relationship between entry, diversification, firm organization and performance. I propose that organizations are specialized, in the sense that firms make investments in unique organizational systems to accomplish a focused set of tasks. When organizational investments are sunk, the cost of reorganizing the firm constrains future diversification strategies because change destroys tacit knowledge embedded in the firm's organizational systems. Diversification can still be an optimal choice for the firm, but it may come at the cost of foregoing business unit competitive advantage.

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[1] Notable exceptions include Capron, Dussauge and Mitchell (1998); Capron (1999); and Karim and Mitchell (2000).

Using a unique data set, consisting of detailed firm-level observations on every major taxicab fleet in the United States from the Economic Census, I test the proposition that diversification imposes adjustment costs on organizations. By exploring diversification in a single industry, using rich microdata on organizational characteristics of firms, this paper goes inside the black box of diversification and organization to shed some light on the underlying mechanisms that influence the returns to scope.

The results are particularly convincing for two reasons. First, taxicabs offer an industrial context that is well-suited for close organizational analysis of diversification and organizational adjustment cost questions. The taxi segment of the ground passenger transportation industry is comprised of thousands of firms, producing roughly homogenous outputs in hundreds of heterogeneous geographically isolated markets. I exploit the exogenous variation in local markets to identify the impact of diversification on organizational change and productivity. The homogenous nature of production in the industry segment allows me to create an economically meaningful comparative measure of firm performance. Second, I study the impact of diversification on firm organization and performance, using data before and after exogenous regulatory changes that led to widespread diversification from taxicabs to limousines.

The central empirical objective of the paper is to show that diversification leads to costly organizational change, in the sense that organizational change erodes competitive advantage. I do so in two stages. First, I establish the existence of a causal relationship between diversification, organizational change and changes in business-unit productivity by showing that diversification leads to organizational change and reduced productivity in the firm's legacy (preexisting) business unit. Next, I show how organizational change costs erode the competitive advantages of incumbency.[2]

The results show: (1) diversifying firms are less likely to adopt computerized dispatching systems for their taxicabs and make significant changes in their formal contract structures governing asset ownership; (2) diversification reduces the productivity of firms' legacy taxicab operations; and (3) organizational change itself accounts for an 18% reduction in taxi productivity, eroding the productivity advantage that incumbents have over start-ups. The findings support the core contention of the paper: diversification erodes the inherent competitive advantage incumbents have over start-ups.

Theory and Related Literature

Conceptual basis

Firms diversify to seize new business opportunities.[3] Agency theory proposes that the separation of ownership and control within corporations can lead firms to pursue diversification even when it destroys market value in expectation (Jensen and Meckling, 1976), but, in general, one expects that on average diversification is undertaken in good faith with the goal of increasing firm value. The usual logic invoked by managers to justify a diversification strategy emphasizes synergies between two business units.

[2] The "competitive advantages of incumbency" is often referred to by its analogue, "the liability of newness" (Stinchcombe, 1965).
[3] As in Rumelt (1974), I distinguish between geographical *dispersion* and product *diversification*.

Synergies from diversification are, by definition, benefits that firms achieve through coordinating production across business units that cannot be achieved when production is optimized independently within business units. While synergy results from coordination, achieving synergy comes at the cost of implementing and maintaining coordinated production. Within-firm coordination costs across business units should always be non-zero unless optimizing each business unit independently also optimizes both jointly, in which case there is no need to integrate them (see Hoskisson and Hitt, 1988 p. 610 for a closely related argument).

But what are the coordination costs associated with diversification? This paper advances the theory that an important class of these costs may be characterized as organizational adjustment costs that are rooted in modifying firms' *ex ante* investments in specialized organizational capital.[4] Firms build their organizations around a nexus of formal contracts and routines to accomplish specialized tasks. When they experience a shock to their strategy set in the form of an unanticipated new potential diversification choice (e.g., due to a regulatory or technological change), they consider how reformulating the nexus will influence firm value.[5] In order to implement a diversification strategy, firms must realign their organization to integrate and coordinate with a new business unit. Realignment is costly in the sense that it destroys tacit knowledge embedded in the existing portfolio of routines and formal contractual structures and limits future strategies

[4] The idea that organizations are difficult to change is sometimes characterized in terms of "organizational rigidity" (Henderson and Kaplan, 2005; and Zbaracki, Bergen and Levy, 2006).

[5] What is unanticipated is having the *option* of entering a particular new business, perhaps because of regulatory change (as in the empirical context studied in this paper) or technological change. Unanticipated environmental shocks such as these alter the firm's choice set, allowing them to consider entering a new business that had, in the past, seemed outside the feasible option set. The *decision* to diversify on the other hand is, of course, endogenous (e.g., fully anticipated).

that the firm would have considered for a stand-alone business unit. Moreover, realignment is a cost of changing the organization. If a new firm were to pursue the same diversification strategy with full knowledge of the strategy set, it would organize their nexus of formal contracts, routines and strategies to reduce the cost of organizational change following realignment. Thus, we expect the costs of organizational change to be asymmetric in the sense that they are higher for incumbent firms than for start-ups.

Note that the theory does not require firms to destroy enterprise value, only organizational capital tied up in tacit knowledge, and it does not require incumbent firms to make mistakes for start-ups to "catch up" to them. The theory also does not predict specific organizational changes, only that organizations will make substantial change following diversification in ways that erode the organizational capital of the firm. The key assertion is that modifying the nexus of contracts, routines and strategies is costly because it was designed to accomplish a narrower set of tasks. Realignment costs will not always be large. Indeed, one expects realignment costs will vary based on how much organizational change is required to optimally coordinate production. Thus, unrelated conglomerate diversification may impose very small organizational change costs if only back office functions need be coordinated, while closely related diversification moves may impose large organizational adjustment costs if production related assets are shared. Similarly, a diversification move that was anticipated and planned for long in advance would be expected to have a smaller impact on the firm. The fundamental prediction of the theory is that diversification leads to adjustment costs. While the theory is simple, it generates some interesting predictions that have both positive and normative implications for organizational scholars and managers alike. I derive and test these implications, emphasizing related, horizontal product diversification; however, the theory applies to unrelated, geographical and vertical diversification as well, as long the gains from diversification are contingent on coordinating operations across business units and not derived solely from exploiting intangible assets or financial engineering.

This paper builds on the concept of organization as management system embedded in a nexus of contracts and routines (Alchian and Demsetz, 1972; Williamson, 1985; Nelson and Winter 1982; Williamson, 1999). I posit that when organizations are rigid, in the sense that altering the nexus of contracts and routines is difficult, diversification leads directly to organizational adjustment costs. Organizational adjustment costs arise because firms change their formal and informal organizational systems, following related product diversification in order to manage their product portfolio in an integrated manner. Therefore, when organizational systems are altered, diversification leads to lower business-unit productivity (though overall firm profits should increase); and the organizational costs of diversification should be greater for incumbents than for start-ups, since the latter are starting from scratch and therefore avoid adjustment costs (though there may be other liabilities associated with newness).

Hypotheses

I propose that optimal organizational design requires investments in systems that are costly to change and, hence, the costs of adjustment constrain future firm strategies.

Thus, the central testable proposition of this paper is that diversification triggers costly organizational adjustment. The logic for this claim is straightforward. When there is a shock that affects firms' potential strategy sets (e.g., a regulatory change), firms have a choice: embrace a new strategy that requires organizational adjustment or continue with the old strategy and organization. In this sense, firms choose between complementary combinations of management systems and strategy (Milgrom and Roberts, 1990). Moving between combinations is costly such that firms continue with an old strategy even when attractive new possibilities arise. Thus, firms diversify because of the promise of a new strategy even though they incur organizational adjustment costs to do so. I state this hypothesis generally below and rely on the institutional features of the industry to formulate more specific tests that explicitly connect the micro-organizational details of firms to the broader theory.

Diversification is a potential catalyst for organizational change when the aim of a firm's diversification strategy is to obtain operational synergies between business units because a shift toward coordinated operations necessarily requires organizational adjustments. The first hypothesis summarizes the expected relationship between diversification and adjustment, assuming the goal of a diversification move is to obtain operational synergies, positing that diversification leads to organizational changes and organizational adjustment costs.

> (H1a) Diversification leads to organizational change in the firm's legacy business unit(s) and/or the firm's new business unit.

(H1b) Diversification leads to falling productivity in the firm's legacy business unit(s) and/or the firm's new business unit.

(H1a) is deliberately broad since the theory only predicts organizational change, not particular organizational changes. The paper discusses the specific organizational changes in the context of the industry below. The theoretical lens allows for a sharper prediction about changes in productivity as in (H1b)

The second hypothesis makes a more precise statement about the size and competitive implications of adjustment costs. I have argued that diversification leads to organizational change costs. To the extent that diversification is costly for existing firms, because it forces them to alter their organizational practices *ex post*, I expect new firms to be relatively advantaged, since they can design organizational routines *ex ante* to better manage divergent tasks. Therefore, the diversification penalty should be higher for incumbent firms than for start-ups, since incumbent firms must adapt their organizations while start-ups can design theirs from scratch. This is the key issue in the paper. The second hypothesis is therefore:

(H2) The diversification penalty will be higher for incumbent firms than for start-ups because incumbent firms must adapt their organization *ex post*, while start-ups can design their organization *ex ante*.

Related literature

This paper examines the impact of diversification on firm organization and performance at an unusual level of detail. While most studies of diversification infer organizational effects of diversification from changes firm performance,[6] I observe both micro-organizational changes and changes in firm performance. Moreover, while most empirical papers only show evidence of the effect of diversifications on the corporate headquarters, this paper examines the effect of diversification at the business unit level.[7] The distinction is important because headquarters effects are primarily isolated administrative costs related to management oversight, while facility level effects tend to be operational in nature. Operational changes are more likely to create deeper organizational changes that ripple through the nexus of contracts and routines that define the firm (Alchian and Demsetz 1972; Williamson, 1985; Nelson and Winter 1982). I exploit this finer-grained view of the firm, to connect elements of the strategy literatures on entry and performance, with insights from the economics and corporate finance literature on diversification. In doing so, the paper contributes to both branches of the literature and offers a framework that connects them in the context of diversification, organizational change and firm performance.

There is a large literature in economics and corporate finance on the costs of diversification, often called the "diversification discount" literature because the central

[6] Lamont (1997) is a notable exception.
[7] As in this paper Schoar (2002) examines the effect of diversification on business unit performance, but she does not observe organizational changes, nor does she study the effect of diversification on competitive advantage.

stylized fact in the literature is that diversified firms seem to perform worse than focused firms (Lang and Stulz, 1994; Lamont, 1997; Scharfstein and Stein, 2000; Rajan, Servaes and Zingales, 2000; Schoar, 2002). However, in an influential study critiquing the diversification discount literature, Villalonga (2004), examining the effects of diversification on a large and diverse data set of firms, finds results that cast substantial doubt on the claim that related diversification reduces firms' market value.[8] A parallel literature in strategic management explores diversification with an emphasis on positive spillovers between business units (Rumelt, 1974; Chatterjee, 1986; Wernerfeldt and Montgomery, 1988; Hansen and Wernerfeldt, 1989; Chatterjee and Wernerfeldt, 1991; Farjoun, 1994; and Tanrivedi and Ventkatraman, 2004). As in the corporate finance literature, the strategy literature emphasizes the benefits of related diversification (versus unrelated diversification), which facilitates knowledge spillovers and synergies between business units.[9] This paper proposes an alternative to the related/unrelated diversification dichotomy that is rooted in the organizational details of diversification and is consistent with both "costly" diversification and profit maximization. The distinction is important because a theory of costly unrelated diversification relies on agency costs, inefficiencies and mistakes (Rajan, Servaes and Zingales, 2000); while the theory of costly related diversification, as advanced here, does not rely on managerial mistakes and is consistent

[8] Relatedness is defined in two ways in the literature. The finance literature tends to use an objective, but prosaic, measure based on SIC code. Diversification is said to be related when firms diversify within their two-digit SIC code and unrelated otherwise. The strategy literature tends to use intrinsically meaningful, but highly subjective, measures of relatedness, such as whether two business units have "related" activities, resources, skills, customer groups and physical bases. Consistent with the literature I emphasize horizontal diversification (diversification into new businesses) as opposed to vertical diversification (diversification into new phases of production within a business segment), although the theory proposed here applies to both horizontal and vertical diversification.

[9] The finding that related diversification is superior to unrelated diversification is not universal, particularly in the context of diversification by acquisition. See Chatterjee (1986) for evidence that unrelated diversification increases market value and Lubatkin (1987) for evidence that relatedness has no effect on the success of mergers.

with the growing evidence of organizational costs, associated with multidivisional firms operating within a single industry (Klein and Saidenberg, 2005; Sanzhar, 2006).

By considering how organizational change associated with diversification influences competition between start-ups (*de novo* entrants) and diversifying incumbents, the paper builds on and extends a nascent body of research, which may be called the *de novo* and *de alio* entry literature. Carroll, Bigelow, Sidel and Tsai (1996) and Khessina and Carroll (2001) present evidence that lateral entrants (or *de alio* entrants) – firms that enter a new business from within an industry – tend to survive longer than start-ups (or *de novo* entrants) in scale intensive industries (automobile and optical disk drive manufacturing). In related work, Klepper and Simons (2000) compare different types of lateral entrants into the television manufacturing industry and find that pre-entry experience facilitates different levels of knowledge spillovers in R&D. This paper builds on the *de novo* and *de alio* literature by explicitly considering how entry status influences the returns to diversification. While the early literature focuses on firm survival in the new business as the key outcome variable, this paper focuses on business unit productivity in the old (e.g., legacy) business as the key measure of firm performance. Diversified firms may outlast focused firms because they have deep pockets or less variable cash flows, reasons unrelated to productivity. Thus, the finding that diversification leads to falling productivity is complementary to the *de novo* and *de alio* literature, suggesting that economies of scope also play a role in determining competitive advantage in the competition between *de novo* and *de alio* entrants.

Although it has long been acknowledged that the success of diversification depends on how it is implemented (Chandler, 1962; Hoskisson and Hitt, 1990), there is very little research which has addressed how diversifying firms implement the fit between strategy and structure. Previous work by Capron, Dussauge, Mitchell (1998), Capron (1999) and Karim and Mitchell (2000), connects organizational change and diversification by examining resource transfers between acquirers and target firms. This paper complements this earlier research on diversification and organizational change by examining changes in the formal contract structures (e.g., asset ownership contracts) and strategies (e.g., technology adoption) that govern and guide the firm. In doing so, this paper sheds some light on the implementation challenges facing organizations that undertake diversification.

Institutional Background

The taxicab and limousine segments of the ground passenger transportation industry

The taxicab segment of the ground passenger transportation industry (hereafter the "taxicab industry") is particularly well suited for studying diversification, organizational adjustment and productivity questions. One of the most attractive features of the taxicab industry is that it is a local business with regulated prices. Since taxi markets are geographically segmented, the nationwide taxicab industry is actually a collection of hundreds of independent city-level markets, providing considerable variation to identify the effects of interest. I exploit the fact that firms face regulated prices in their local markets to develop a precise and economically meaningful measure of firm performance that can be interpreted as physical output per unit of input. Furthermore, the level of horizontal integration between taxis and limousines changed dramatically during the sample period due to widespread regulatory changes, creating a quasi-natural experiment in lateral diversification.[10]

Prior to the 1990s, limousine fleets operated in a legal gray area that effectively eliminated joint ownership between taxi and black car fleets (Boorstin, 1986). As the black car business expanded across the country, local regulators, charged with overseeing the taxicab industry, became increasingly concerned that limousines were simply "unlicensed cabs" that threatened to undermine the taxicab regulatory system. Conflicts between black car fleets on one side and taxicab operators and local regulators on the other led to a strict legal segregation between black car companies and taxicab companies. Following the high-profile Freedom Cab lawsuit in Colorado in 1993, which was not directly related to cross-ownership, state legislatures became increasingly involved in mitigating these conflicts by passing laws explicitly wresting regulatory authority over limousines from local regulators (Cox, 1993). As state law legitimized black car fleets, regulatory limitations on cross ownership were removed, and private-for-hire fleets began to operate both taxicabs and limousines.

The term limousine is used to describe private vehicles operated for hire, which perform a similar function to taxicabs, usually at a higher quality level, except they may only

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[10] Much of the industry background in this section comes from interviews with municipal regulatory officials. I am grateful to thirty-seven taxi regulators for providing me with an extensive review of the history of taxicab and black car regulation in the United States.

accept pre-arranged rides. (Limousines are commonly referred to as "black cars" or "executive limousines" in the industry argot to distinguish them from "prom limos" or stretch limos). Because taxis and limousines use the same dispatching technology and maintenance facilities, serve overlapping customer segments, often at the same locations (e.g., hotels, airports, businesses and private homes), they are considered to be part of the same "private for-hire-vehicle industry"[11] by industry experts and have the same two-digit SIC code (41), diversification easily satisfies the standard definitions of "related diversification" used in both finance and strategy. The interpretation of taxi to limousine diversification as related diversification is important because it helps distinguish between causes of the costs of diversification. While it is widely acknowledged that unrelated diversification is plagued by agency costs, comparatively little is known about the costs of related diversification. However, as I have noted above, organizational change costs are not unique to related diversification.

The causes and consequences of diversification

The decision to diversify depends on the associated costs and benefits, as well as the regulatory environment, which determines whether the choice is available. I will quantify some of the costs of integration, but I cannot observe all of the potential benefits – particularly the long-run benefits. Thus, it is not surprising that we observe a great deal of integration despite the organizational costs on which I focus.

[11] In the industry argot the "private for-hire-vehicle industry" is a non-public component (e.g., it excludes public transportation services) of the ground passenger transportation industry. The private for-hire-vehicle industry includes private busses, airport shuttles, children's ambulatory vehicles, paratransit vehicles, jitney services in addition to taxicabs and limousines. The paper focuses exclusively on the taxicab and limousine segments of the industry.

The logic behind expanding from taxicab into limousine services is straightforward. Limousine services represent a higher priced, differentiated service offering that is produced in a manner that is qualitatively similar to taxicab services. Fleets recruit drivers, acquire vehicles and permits, match drivers to cars, and schedule and deliver rides to passengers. Multidivisional (e.g., taxi and limousine) fleets attempt to spread their fixed costs in each of these functions across the boundaries of the taxi and limousine businesses. Taxi firms also report that they "up sell" taxi customers to limousines where possible, and use limousines to meet unmet taxi demand during peak times, a strategy that smoothes overall capacity utilization.

Taken together the advantages of integration can be substantial. However, taxi fleet operators also describe several costs of operating both taxicabs and limousines, in the same fleet. Managing two types of drivers, vehicles, incentive schemes and customers can divert managerial attention, particularly as task differentiation between the two businesses increases. For example, taxi managers observed that they spent more time on customer relationship management issues following diversification, a managerial challenge not faced by taxi fleet operators that focus on transactional spot-market exchange. Variation in incentive schemes[12] can lead to coordination failures, particularly "channel conflict" when taxi drivers refuse to cede lucrative rides to limousines, and decreased utilization of taxicabs ("cannibalization"), as fleets steer higher value rides

[12] Firms face an extreme moral hazard problem because they cannot monitor taxi driver effort, the firm. The near-ubiquitous solution is for taxi drivers to be compensated with very high-powered incentives (100% commission-based compensation). By contrast, monitoring is much easier in the black car business, since most rides are dispatched. Therefore, black car drivers often are compensated with lower-powered incentives.

toward limousines (in particular, airport rides tend to be shifted toward limousines). While cannibalization directly offsets the gross benefits of up-selling, steering can also lead to more pernicious outcomes as taxi drivers subvert the dispatching system by picking up fares intended for limousines, thereby creating chaos in the dispatching system. Firms may respond to internal conflicts by keeping their recruiting and dispatching processes separate, but keeping these processes separate also reduces the benefits of integration. The tension in taxicab and limousine firms between capturing synergies by closely integrating business units and avoiding the organizational costs of integration by keeping the businesses separate goes to the heart of the thesis of this paper. I presume that firms make this choice in an attempt to maximize profitability and observe the subsequent organizational choices firms make.

Unfortunately for the econometrician, organizational costs of diversification are difficult to observe directly. However, we do observe formal contract structures in the Economic Census, in terms of ownership of taxicabs, and should expect firms to shift toward driver ownership when taxi firms diversify into limousines for two major reasons. First, at times of peak demand (usually 7am-7pm), mixed taxi and limo fleets sometimes have to substitute taxicabs for limousines on the margin to meet all of their commitments. Because of moral hazard problems with respect to vehicle maintenance, driver-owned taxis tend to be cleaner and better maintained than fleet-owned taxis, and the driver-owners tend to operate the vehicle in a manner that is less risky than non-owners (Schneider, 2005). Conduct and vehicle maintenance issues make driver-owned taxis a natural complement to firms that operate limousines, since limousine customers expect a higher class of service than the standard “street hail” taxi service. Firms find that customers are willing to accept a clean, well-maintained taxicab with a courteous driver as a substitute for limousine service but are far more likely to be angered if a dirty, poorly maintained taxi driven by an erratic driver arrives in place of a limousine. (This point was a resounding theme echoed by a number of fleet owners across the country.) Second, during periods of lower demand, independent driver-owners act as consolidators across firms. Firms that operate both limousines and taxicabs experience lower demand for taxicab services off-peak (usually 7pm-7am) because limousine capacity absorbs a significant fraction of a firm’s hotel and airport volume. Thus, multi-product fleets rely more extensively on contracting with independent driver-owners to reduce underutilization of their own vehicles.

The second important observable organizational characteristic is whether firms adopt sophisticated computerized dispatching systems. These systems involve a mobile data terminal, installed in each vehicle, which can transmit data to a central computer that uses the information to improve coordination across vehicles. When a customer requests a ride, the central computer determines the caller location, using a built-in street directory, and sends a message to a human dispatcher. (More advanced systems communicate directly with vehicles). While computerized dispatching improves coordination, the benefits of the technology are reduced to the extent limousines cannibalize taxi rides. Furthermore, implementing a major new system at the same time the firm is diversifying, can overwhelm managers (Penrose, 1959). Since diversification requires managerial attention, and the benefits from computerized dispatching are reduced by cannibalization, diversifying firms should be less likely to adopt computerized dispatching systems than incumbents who do not diversify, a factor that contributes to falling relative taxi productivity in diversifiers. We might consider non-adoption of technology is an organizational cost of diversification because it is a cost of limiting a firm's strategy set within one business unit so as to improve joint profitability. While the Penrosian view does not necessarily imply that start-up would be more likely to adopt dispatching technology compared to incumbents, it makes a sharp prediction about adoption within the set of incumbent firms.

In order to focus on the relationship between diversification and competitive advantage, this paper does not propose a theory linking diversification to other specific organizational changes as in Rawley and Simcoe (2007). Nor do I do attempt to measure the effect of specific organizational changes other than diversification on firm performance directly. However, the institutional details of the industry do give us deeper insight into the nature of diversification, organizational change and firm performance in the taxicab and limousine industry, and I take advantage of these insights to develop sharper tests of the organizational predictions of the first hypothesis (H1a). Specifically, in the context of the taxi and limousine industry, the organizational changes predicted by H1a are that when taxicab fleets diversify into limousines, the firm will be less likely to adopt computerized dispatching systems and will shift toward less vertical integration in taxicabs.

Data and Measures

The Economic Census

The core dataset for this paper comes from the 1992 and 1997 Economic Census. The Economic Census includes every taxi and limousine firm in the United States with at least one employee (SIC code 412100 [taxicabs] and 411920 [limousines]). The comprehensiveness of the database is extremely useful as it allows us to track every incumbent firm (fleets that existed in 1992) with at least one employee longitudinally over time and to observe every new and lateral entrant into the taxi and limousine market in 1997. The database contains detailed plant-level data on firm revenue, line of business revenue at the six-digit industry level, number of vehicles by type (e.g., taxi vs. limousine) and geographic identifiers.[13]

The 1992 and 1997 Economic Census contain complete records on 1,020 and 1,106 observations, respectively; on taxi firms with at least two taxicabs; $10,000 of taxi revenue; and at least two taxi fleets in their market (county).[14] I use all of the complete observations for computing total factor productivity and for cross-sectional tests of the impact of diversification on competitive advantage.[15] The cross-sectional samples consist of approximately 30% of all taxi firms (with at least one employee) and between

[13] Less than 1% of plants were in firms that had multiple locations. Using an alternative sample that excluded multi-plant firms had no effect on the results.
[14] Approximately 2,000 observations in 1992 and 1997 are not used because they do not contain the number of taxicabs in their fleet. This set is primarily composed of administrative record (AR) observations – very small firms that the Economic Census does not actually survey but rather imputes values for. Using alternative samples with more or less stringent sample restrictions led to the same qualitative findings.
[15] Firms that existed in 1992 but were small or reported incomplete data are properly treated as incumbents (rather than start-ups) in 1997 cross sectional regressions.

50-65% of the $1 billion taxicab industry. For tests of the impact of diversification on within-firm changes, I use the subset of firms that existed and reported complete data in both 1992 and 1997 (n=560). The within-firm changes sample includes approximately half the firms and about 70% of revenue in the cross sectional regressions.

Table 1 shows the descriptive statistics for both the cross-sectional data sets and the within-firm changes set. Table 1 reveals that in 1992, 99% of taxi firms were single product firms. By 1997, 62% of taxi firms also operated limousines (40% are incumbents while are 22% start-ups). I define lateral diversifiers from taxicab to limousine operations as those firms that had SIC code 412100 and no limousines in their fleet in 1992, but had at least one limousine in their fleet by 1997.[16] Panel A reports a 27% drop in fleet ownership rates across firms (83% - 56%), while Panel B shows that within-firm decline in fleet owned taxis is 23% (86% - 63%), suggesting a link between changes in the scope of the firm and changes in asset ownership.

Not shown in Table 1 are the pooled cross-sectional data containing observations on both taxi and limousine fleets from the 1997 Economic Census, which are used to test the impact of diversification on overall firm productivity. The Economic Census includes data on 2,341 taxi and limousine fleets with at least two vehicles; $10,000 of total revenue; and at least two private-for-hire fleets in their market. This data is available from the author upon request

[16] Alternative measures of lateral entry, including measures that required taxi firms to have a certain fraction (e.g., 10%) of their vehicle capital in limousines or attain x% of their revenue in limousines were very highly correlated with the “single limousine” measure of lateral entry and yielded qualitatively identical results.

Survey data

I augment the Economic Census by merging in dispatching technology data from the Transit Cooperative Research Program (TCRP), conducted by the Institute for Transportation Research and Education at North Carolina State University in conjunction with the International Taxicab and Livery Association and Multisystems, Inc in 1998. A report, including summary statistics from the survey, was published in 2002 under the title "TCRP Report 75: The Role of the Private-for-Hire Vehicle Industry in Public Transit".[17] I conducted a follow-up to the TCRP survey in 2004 by mailing questionnaires to the largest 2,000 taxicab operators in the Dun and Bradstreet national database of firms with taxicab SIC codes (e.g., 412100). 391 surveys were returned undeliverable and 403 firms responded with complete questionnaires (25% response rate). 272 of the firms that responded to my survey began operations before 1997. I merged the 635 (363 TCRP observations and 272 author survey observations) technology observations with the Economic Census data by zip code or county, generating 409 complete observations.[18] Of these 409 observations, 166 were in both the 1992 and 1997 Economic Census.

[17] The TCRP survey questionnaire was mailed to 13,751 private-for-hire operators (taxi, limousine and other private transportation providers) identified from previous studies of which 1,691 were returned undeliverable. 677 operators responded to the survey, representing at least one fleet from each state. 363 taxi fleets completed all the fields of interest for the analyses in this paper including questions about dispatching technology, and number of vehicles by ownership type. I am grateful to Tom Cook and Gorman Gilbert for generously sharing the detailed responses to the TCRP survey with us.

[18] The 226 unmatched observations were primarily small firms that could not be matched precisely where there were multiple small fleets within a market.

In addition, I conducted 73 semi-structured interviews with city taxi regulators (37), fleet owners and mobile dispatching technology vendors (26) and taxi drivers (10), focusing on the relationship between regulatory change, lateral entry and driver ownership. These interviews provided a wealth of insights that connected observable organizational changes to their underlying causes and consequences.[19]

Measures

Empirical tests on taxicab productivity and profitability are facilitated by the relatively simple and homogenous production function in the taxicab industry, which minimizes measurement error in the key reduced-form establishment-level productivity measures I employ. I define the profit function in the usual way with two parameters that link profitability and productivity to the firm's entry and diversification status. Profit π for an input and output price-taking firm *i*, in business-unit *j* = {Taxi, Limousine}, and geographic market *m*, which can be represented by:

$$(1)\ \pi_i = (p_{Tm}-c_{Tm})Y_{iT}(\theta,\sigma) + (p_{Bm}-c_{Bm})Y_{iB}(\theta,\sigma) - F(K_i,\sigma)$$

$$Y_j = A_{ij}(\theta,\sigma)K_{ij}^{\alpha}L_{ij}^{\alpha-1}$$

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where Y is output in units (ride-mile equivalents or "rides" assuming miles per ride are approximately constant across vehicles within a market), subscripts T and B index taxicab and limousine operations; F>0 is the fixed cost of operations, where fixed costs are increasing in total capital (K) and scope (σ). The market price per ride p>0 and the cost of selling an additional ride c>0 convert physical output into gross profit, where physical output Y is generated by a production function that transforms inputs capital (K) and labor (L) using technology (A), which can be interpreted as total factor productivity in quantities (TFPQ). The two key parameters $\theta = \{0,1\}$ and $\sigma = \{0,1\}$ index whether the firm is an incumbent or start-up, and whether the firm is diversified or focused, respectively.

It is clear from equation (1) that potential fixed cost savings play an important role in determining firm strategy with respect to scope. Therefore, caution must be used when interpreting differences in productivity as differences in profitability. The key assumption required to connect productivity to profitability is that fixed costs are independent of entry status θ, as is evident in equation (1).

The standard approach for measuring plant (e.g., fleet) total factor productivity in quantities (TFPQ) for firm *i*, at time *t* is to compute TFPQ as the residual of a regression of logged capital and labor inputs *k* and *l* and a time-specific intercept *a* on the log of physical output *q* as in:

(2) $q_{it} = \alpha_t + \beta_{kt}k_{it} - \beta_{lt}l_{it} + TFPQ_{it}$

The key feature of (2) is that output is measured in physical units *q* rather than in dollars. In the appendix section A, I show that when market prices are fixed and labor is used proportionately to capital, as in the taxi market, TFPQ can be computed for firm *i* at time *t* by regressing the log of firm-specific capital *k*, market-level fixed effects *λ*, and a time-specific intercept *α* on the log of dollar denominated revenue *r* as in:

$$(3)\ r_{it} = \alpha_t + \lambda_{mt} + \beta_t k_{it} + TFPQ_{it},$$

where TFPQ is the residual. Thus, TFPQ in (3) is a measure of asset utilization relative to other fleets in the same market that is standardized to have mean zero within market (county), which is identical to TFPQ in (2). Table 3 Panel A below shows the TFPQ calculation, while Panel B shows the descriptive statistics for TFPQ. Taxi TFPQ measures are winsorized at the 1st and 99th percentiles, although doing so has no effect on the results.[20]

I also use (3) to calculate taxi-only and overall (taxi and limousine) firm productivity. In the pooled (taxi and limousine) regressions, *q* is log overall revenue and *k* is log overall capital. However, in the pooled calculation, I lose the interpretation of total factor productivity (TFP) as TFP in quantities (TFPQ), since limousine prices are not regulated at the local level. While TFPQ is ideal, TFP delivers a useful, if imperfect, measure of

[20] Taxi TFPQ measures are winsorized at the 1st and 99th percentiles. Winsorizing truncates values at x% of the distribution of total factor productivity (here 1% and 99%). Because changes in TFPQ are differenced at both firm and market levels the tails of the distribution are extremely small and winsorizing has no perceptible impact on the results.

multi-factor productivity. A major concern with price contamination in TFP calculations is the possibility that entrants charge lower prices than incumbents. The price contamination issue is mitigated somewhat in the multifactor productivity tests, as I only use multifactor productivity to compare taxi to limo diversifiers against diversified start-ups. As in the taxicab productivity calculations, I estimate multifactor productivity using the full sample of firms.

Specification

Changes in taxicab organization and productivity following diversification into limousines

The baseline tests measure the effect of diversification on changes in taxicab organization and productivity. To implement these tests, I take differences in asset ownership rates and productivity at the firm level from 1992 and 1997 to eliminate unobservable time-invariant firm characteristics that influence these variables and use (4):

$$(4)\ DEPVAR_i = \beta_0 + \bullet\beta_1 \Delta STATUS_i + \mathbf{X_{c,i}\beta_c} + \varepsilon_i$$

where *DEPVAR* is one of three dependent variables, according to the specific test: a dummy variable that is equal to one when firms use computerized dispatching technology and zero otherwise; within-firm change in the fraction of vehicles that are owned and operated by the fleets (*ΔFOWN*), as opposed to those taxis that are owned by independent drivers but operated by the firm; and change in taxicab productivity as defined above (*ΔTFPQ*).

ΔSTATUS is a categorical variable that captures whether the firm diversified during the sample period. $\boldsymbol{X_{c,i}}$ is a vector of controls that could plausibly shift the supply or demand structure of the local taxicab market including: organizational form, size, changes in local market population, changes in the number of taxis in the market and changes in the number of limousines in the market. Since taxicab capital under management is included as a continuous variable in the first stage of the total factor productivity calculation, size is included non-parametrically in the second stage, using the intuitive ranges, *SMALL*, *MEDIUM* and *LARGE*, which correspond to each 1/3 of the size distribution. The results are robust to alternative measures of size and to specifications that include firm-level fixed effects, rather than computing changes in firm characteristics directly and to the inclusion of market-level fixed effects.[21] I also include a dummy variable *RESPONDENT* in the regressions on dispatching technology adoption (first specification) that is equal to one when firms responded to my survey and is zero otherwise. *RESPONDENT* captures the effect of potential sampling bias in the technology surveys.

[21] I compute differences at the firm-level to eliminate the effect of time invariant unobserved firm specific characteristics rather than using firm fixed effects, although the coefficient estimates are identical in either case. Estimates are identical when the OLS regressions are run with no constant. Including the constant adds precision but has little effect on the results.

Identification strategy

The key exogenous factors that allow me to identify the first hypothesis are that firms face an unexpected change in their strategy set after they sink investments into their organization and that observed market-level characteristics interact with unobserved firm-level characteristics to exogenously influence the firm's decision to diversify. In the ideal experiment, we would randomly assign the "treatment" diversification, and factors of production, and observe how firm organization and productivity changed in the treatment group compared to a control group. Under the assumption that diversification increases the value of the firm, the OLS estimates of the effects of diversification on productivity and asset ownership that control for time-invariant firm characteristics and time varying market-level characteristics will be biased toward zero, unless firms are exposed to time-varying firm-specific shocks that are correlated with the diversification decision and the outcome variables of interest. Since firms will only choose to diversify and make subsequent organizational changes if the costs of diversification are sufficiently low relative to the new opportunity, we should observe smaller effects of diversification in equilibrium than we would observed if diversification was randomly assigned. Thus, measuring within-firm changes in asset ownership and productivity, assuming profit maximization, in the presence of a regulatory shock, greatly reduces the need for an alternative identification strategy. Indeed, the endogeneity of diversification biases the productivity results in the direction of finding no result. However, one cannot be certain that there are not time-varying firm-specific shocks that are correlated with diversification and the outcome variables of interest. In particular, we might be concerned that firms diversify after being exposed to negative productivity shock. Diversifying in response to unobserved negative productivity shocks is a threat to causal inference because an exogenous shock to firm strategy sets (e.g., the regulatory change) does not prevent endogenous firm choice from biasing OLS estimates.

I address endogeneity issues using lagged (e.g., 1992) concentration of limousines in the firm's market as an instrumental variable (IV) for the entry decision. Lagged concentration of limousines in the firm's market is a good instrument for entry, since incumbent firms will be more interested in entering the limousine market when it is not dominated by a major player (Caves, 1998). When a few major players dominate a market it is usually because they have developed deep relationships in the lucrative corporate market for limousine service (Taxi, Limousine and Paratransit Association Fact Book: Limousine and Sedan Division, 2004). Taxi firms could still enter the transactional, and less profitable, consumer market for limousines and hope to steal share from the corporate market in the long-run, but; in general, entering the low end of the market appears to be far less attractive in the short run. High limousine concentration also represents an entry barrier because concentrated competition increases the threat of retaliation.[22] Furthermore, lagged market concentration of limousines should not affect changes in any given firm's organizational characteristics or productivity levels (relative to other firms in the same market). Results are robust to alternative instruments that

[22] Retaliation could be economic or physical. A large number of sources have noted the connection between the ground passenger transportation industry and organized crime, making the threat of physical conflict a very real consideration in the industry (see Raab, 1987; also Lindberg, Petranko, Gladden and Johnson, 1998). Blasi, 2006 and especially Celona, 2004a and 2004b report explicit connections between organized crime and intimidation of limo drivers. Interviews with taxi managers confirmed that the role of organized crime can act as a substantial barrier to entry in the limo industry.

proxy for the degree of competition in the local limousine market, for example using limousines per capita by market as an instrument, and to selection correction using propensity score matching. Alternative specifications and results are available from the author upon request.

Diversification, organizational adjustment costs and profitability

Estimating the impact of diversification on organizational adjustment costs and on firm profitability requires some additional assumptions. The key assumption is that fixed costs are independent of entry status conditional on firm scope. In other words, fixed costs can only vary with scope, not with entry status. The fixed cost assumption seems reasonable given the nature of the industry as fixed costs are typically facilities, dispatching systems and back-office labor, which should not differ for start-ups versus incumbents conditional on the scope of the operation. I formulate the connection between total factor productivity and profitability more formally in the appendix section B.

To test the second hypothesis I use (5):

$$(5)\ TFP_{imt} = \beta_0 + \mathbf{STATUS_{it}} \bullet \boldsymbol{\beta}_S + \mathbf{X_{c,it}} \boldsymbol{\beta}_c + \varepsilon_{it}$$

where t=1997, *TFP* is multifactor productivity in the pooled (taxi and limo) regressions and total factor productivity in quantities (*TFPQ*) in the taxi-only regressions, ***STATUS*** is a vector of dummies that capture the interaction between entry status and firm scope (e.g., single product incumbent, lateral diversifier, taxi-only start-up, diversified entrant). $\boldsymbol{X_{c,it}}$ is a vector controls as above, except that the controls are in levels rather than in changes.

Taking differences in the performance of single product start-ups and single product incumbents establishes the net incumbency advantage.[23] I then use the difference in the levels of performance between two-product start-ups and lateral diversifiers to establish the gross effect of a change in scope and the advantages of incumbency. Differencing these two differences recovers the net cost of organizational change – the main test of the second hypothesis (H2).

Results and Discussion

Baseline within-firm changes

The first sets of results show within-firm changes in taxi business-unit organization and productivity for firms that expanded the scope of their operations to include limousines compared to those who did not. Tables 4 (dispatching technology adoption), Table 5 (changes in asset ownership) and Table 6 (changes in productivity) show the baseline within-firm results for incumbent-only taxi firms.

[23] This is an implicit assumption described explicitly in the appendix section B as assumption A1. The assumption is consistent with a simple learning by doing economy (Arrow, 1962) or an economy where firms learn about their true ability after entering a market (Jovanovic, 1982), and is generally presumed to hold true, in the absence or technological or organizational change, in the first-mover advantage literature (Lieberman and Montgomery, 1988).

Table 4 shows the effect of diversification on dispatching technology adoption. As expected, diversification leads to a lower rate of computerized dispatching technology adoption. The point estimate is -0.09 including only a respondent dummy, and is significant at the 5% level. The respondent dummy is large and significant by construction, since I treat all non-respondents as non-adopters. This assumption is conservative in the sense that it biases the coefficient estimates on diversification toward zero, if we expect response rates to be independent of the diversification decision and dispatching technology adopters to be more likely to respond to surveys about dispatching technology than non-adopters. The results are qualitatively unchanged when the respondent dummy is excluded and the tests are run only on the set of respondents (although the magnitude of the effect increases). Including a vector of controls in Table 4 reduces the point estimate to -0.06, but the coefficient on diversification continues to be significant at the 5% level. A coefficient of -0.06 can be interpreted as showing that diversifiers are 6% less likely to adopt computerized dispatching than non-diversified firms. Given a mean dispatching technology adoption rate of 34%, a 6% change in the adoption rate means diversification reduces the rate at which dispatching technology is adopted by 18%. The 2SLS results are noisier but are also negative and not statistically different from the OLS estimates. Taken together, the results provide some evidence that diversification leads to less investment in efficiency-enhancing dispatching technology, suggesting one connection between diversification, organizational change and business unit productivity.

Table 5 shows the unconditional within-firm mean change in fleet ownership rates (*ΔFOWN*) for lateral diversifiers compared to the excluded category (incumbents who did not expand laterally) is -0.29 (-25%) and significant at the 1% level (column 1). A 25% effect of diversification on fleet ownership rates accounts for almost half of the secular shift in driver owned taxis in taxicab firms from 1992-1997. The result changes little with the inclusion of a number of controls because the estimation approach is essentially a differences-in-differences specification that controls for time invariant firm characteristics (column 2a). The 2SLS estimates of the change in fleet ownership rates are even larger at -0.48 (-38%) and significant at the 1% level (column 2b). Compared to the OLS results, the 2SLS results suggest that lateral diversifiers changed less than they would have had lateral entry been randomly assigned. The larger coefficient estimate suggests that lateral diversifiers did not shift even further toward driver-ownership because changing asset ownership patters within firms is costly or because they faced some constraints on realigning their organization. Including a number of firm and market level controls has very little impact on the 2SLS estimates as well. The fact that diversifiers shifted their asset ownership structure dramatically following diversification strongly supports part (a) of the first hypothesis (H1a).

Table 5 does not provide evidence as to whether changes in asset ownership are creating organizational adjustment costs or whether they are a consequence of firms' efforts to adapt to their organizational structure efficiently. In other words, we may worry that if firms are making mistakes by shifting toward driver ownership of taxis, following diversification into limousines, the productivity regressions may be biased toward larger negative productivity effects by omitting the interaction between diversification and changes in asset ownership. Although one might expect that firms are not systematically making mistakes, the potential for bias is relevant. However, since the objective of this paper is to address whether diversification erodes competitive advantage by reorganizing the firm rather than assessing whether specific organizational changes are costly *per se*, and because properly addressing second order effects would require a lengthy digression I move forward without including interaction effects. The reader may take some comfort in this approach, based on Rawley and Simcoe's (2007) finding that changes in asset ownership following diversification are efficiency-improving adaptations conditional on choosing to diversify such that the bias from the omitted interaction effects is toward zero.

Figure 1 shows the kernel density distributions of changes in total factor productivity for diversifiers and non-diversifiers (Figures 3 and 4 in the appendix show distributions of levels of total factor productivity for 1992 and 1997, respectively). More formally, Table 6 gives an unusually precise estimate of the impact of diversification on firm performance. The dependent variable is measured in quantities and has been differenced at both the firm and market level. Column (1a) shows that lateral entry into the limousine business is correlated with a within-firm change in taxicab productivity of -0.45 (-36%) and is significant at the 1% level.

The inclusion of a number of exogenous firm and market level controls reduces the point estimate to -0.41 (-34%) without affecting the statistical significance of the result (column 2a). Changes in the competitive dimensions of the market, e.g., the number of taxicabs and limousines operated by other fleets, do not have much influence on the costs of lateral expansion because differencing total factor productivity, at the market level, leaves little variation to be explained by changes in these variables. Alternatively, this may imply that competition between taxi fleets tends to be muted by regulatory limitations on entry, oligopolistic behavior and/or within market geographic or customer segmentation. Under either interpretation, changes in taxi business-unit productivity do not appear to be driven by the threat that competitors would steal market share from the lateral diversifier once we control for market-level fixed effects, providing some evidence that diversification was not a preemption strategy aimed at preventing competitors from taking market share. The coefficient on changes in taxi ownership rates in other fleets is positive and significant because permit prices are correlated with expected positive future productivity shocks. When permit prices rise, drivers are more likely to face wealth constraints, limiting independent ownership of taxicabs. However, the economic magnitude of the effect is small at 5% (0.20 x 0.27) in the average market.

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****FIGURE 1 ABOUT HERE****

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Since the decision to diversify laterally is endogenous, the results shown in column (1a) and (2a) can only be interpreted as correlations. It is possible that other unobserved characteristics of the firm or market influenced both the lateral entry decision and the decline in taxi productivity. To control for the endogeneity of the lateral entry strategy with the change in productivity, I use the lagged level of concentration of limousines in the firm's market as an instrument for lateral entry. Column (1b) shows 2SLS estimates of the effect of diversification on changes in productivity. The first-stage results are strong (F-statistic of 32), indicating that the instrument is powerful (see 1SLS summary statistics at the bottom of column 1b). The point estimate on diversification in the univariate 2SLS specification is -0.53 (-41%) and is significant at the 1% level. Including a vector of controls in column (2b) reduces the point estimate to -0.46 (-37%) and continues to be significant at the 5% level. The interpretation is that there is a causal relationship between lateral entry and changes in core taxicab business-unit productivity. The results confirm that the cost of diversification is economically and statistically significant.

Table 6 provides strong evidence that diversification into limousines reduces taxi productivity, but it is incomplete with respect to overall firm performance because it does not take into account the impact of limousines on firms' profits. Furthermore, firms may rationally choose to grow total profits at the cost of generating lower average return on investment (Levinthal and Wu, 2006). It is precisely because productivity and profitability are not perfectly correlated that within-firm changes in productivity cannot address the impact of diversification on competitive advantage. To do so, I turn to cross-sectional results.

Diversification and profitability

Table 7 shows the impact of diversification on firm profitability for the taxi-only segment and for overall firm pooled (taxi and limo) performance (see also Figure 2 for the distributions of taxi-only total factor productivity). These tables test the second hypothesis, which predicts incumbents will pay a larger diversification penalty than start-ups. The key relationships in these tables are between four types of firms that have the pair of entry status and scope status attributes in the {Incumbent/start-up, focused/diversified} space. By comparing all four groups against one another, I recover the impact of diversification on profitability (see the appendix section B for the explicit formulation of the relationship between productivity and profitability). Overall pooled (taxi and limo) performance is examined to understand whether the taxi-only profitability impact of diversification in incumbents relative to start-ups can be explained by differences in productivity in limousines between start-ups and incumbents.

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****FIGURE 2 ABOUT HERE****

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As in the within-firm regressions, the results of the cross-sectional regressions show large economic and statistical effects of diversification on performance. The tables also show a pattern consistent with the assumption that start-ups are generally disadvantaged compared to incumbent firms. What is particularly interesting in these tables is that the incumbency advantage tends to be eroded by the decision to diversify. These results are clear in both taxi-only and pooled (taxi and limo) regressions.

To identify the impact of diversification on business unit profitability in cross-section requires the assumption that lateral diversifiers would have outperformed single product start-ups by the margin between single product incumbents and single product start-ups had the former not expanded into limousines. Given the "liability of newness" assumption, subtracting the performance of two-product start-ups from the performance of lateral diversifiers controls for the effect of operating a firm with broader scope. Comparing the productivity advantage focused incumbents have over focused start-ups against the productivity differential between diversified incumbents and diversified start-ups explains how much competitive advantage, in terms of productivity, lateral diversifiers lose by choosing to become lateral diversifiers instead of remaining focused incumbents (see the appendix section B for a mathematical derivation).

The key identifying assumption in the cross-sectional tests is that start-ups decide to diversify using the same selection process that incumbents follow. This assumption appears to be reasonable, given the findings in the within-firm regressions and the continued use of county-level fixed effects in the cross-sectional tests. Recall that 1992 productivity levels were almost identical for both future diversifiers and future on-diversifiers, while the 2SLS results in Table 6 showed that the selection effect biases the OLS productivity results toward zero. Therefore, for incumbents, we can be reasonably confident that variation in ability (e.g., 1992 productivity) does not drive the diversification decision and that, on average, firms that earn the highest marginal returns from diversification choose to do so. If start-ups also choose whether to diversify based only on how good they are at diversifying and not based on unobserved (to the econometrician) quality differences between firms, the assumption holds, and the cross-sectional results are well identified. Even if start-ups do not follow the incumbents' selection process exactly, the results are precisely identified, or biased toward zero, unless high-productivity start-ups diversify and higher levels of productivity are also correlated with higher marginal returns to diversification. The most plausible case for there to be a correlation between high productivity and diversification arises if high-productivity start-ups systematically select locations to enter where marginal returns to diversification are high. However, the empirical pattern of entry is at odds with a story of high-performing start-ups selecting markets based on marginal returns to diversification. Instead, we observe the opposite: start-ups were more likely to enter as diversified firms in non-urbanized areas where average revenue per unit of invested capital is lower for both focused and diversified firms. Thus, unless high-productivity firms systematically choose low-return markets, the selection bias from sorting on quality should bias the results toward zero.

The main cross-sectional productivity results are presented in Table 7 columns 1 and 2, using the taxi-only production characteristics and the taxi-only subset. Column 1 shows the results without controls, where the excluded category is incumbent firms who did not expand into limousines. The TFPQ of start-up taxi fleet is -0.23 below the mean of incumbent firms, while taxi to limo diversifiers and diversified start-ups fall 0.66 and

0.67 below TFPQ of incumbents who did not expand into limousines. The "cross-sectional difference in differences" in the taxi-only case is -0.21 (-19% of TFPQ). Figure 2 shows the effect graphically. Adding a number of controls in Table 7 for exogenous firm and market-level characteristics reduces the coefficient estimates slightly to -0.17 (16% of TFPQ) and the result continues to be significant at the 5% level (column 2, bottom). These results provide support for the second hypothesis, that diseconomies of scope have a disproportionate impact on the productivity of lateral diversifiers compared to start-ups, as lateral diversification erodes the advantages of incumbency relative to start-ups.

One potential problem with interpreting the declining taxi-only productivity gap between incumbents and start-ups when both are diversified compared to when both are focused as an adjustment cost is that incumbents may be more productive than start-ups in limousines. Indeed, if part of the measured adjustment cost simply reflects that incumbents are better at cross-selling limousine services, than start-ups taxi revenue may be falling slower than limousine revenue is increasing and we may mistake true synergies as adjustment costs. To address this issue, I examine whether measured adjustment costs change when accounting for pooled revenues and capital stock. Table 7 column 3 shows that taxi to limo diversifiers' and diversified start-ups' multifactor productivity is far below incumbents who do not diversify (the excluded group), while diversified start-ups and focused (taxi only) start-ups are -0.26 (23% of TFP) behind. In column (3), the "cross-sectional differences in differences" is -0.26 TFP points (23% of TFP) and significant at the 5% level. Adding a vector of controls in column 4 has a small effect on the estimate of organizational adjustment costs. Although the pooled results measure TFP and not TFPQ and are therefore not as precise as the taxi-only estimates, they provide some evidence that the diversification penalty in taxicabs has real economic implications for overall firm performance.

Conclusion

The decision to diversify is one of the central strategic choices firms make. A number of papers have found a positive relationship between relatedness of diversification and performance, suggesting that related diversification creates synergies while unrelated diversification destroys value. While characterizing the costs and benefits of related and unrelated diversification is useful, it is necessarily incomplete. Synergies are not achieved by fiat. Indeed, integrating new businesses into the nexus of contracts, routines and strategies that defines the firm comes at a cost. This paper proposes a conceptual framework emphasizing the organizational adjustment costs of diversification. *Ex ante* investments in specialized organizational capital constrains future business development strategy because organizations are rigid and cannot be costlessly modified. The organizational rigidity of incumbents represents an opportunity for start-ups to exploit their organizational flexibility to compete more effectively against incumbents. This paper demonstrates the importance of flexibility with respect to diversification, which suggests that organizational flexibility may represent a competitive advantage that helps start-ups overcome the liability of newness.

The paper exploits a quasi-natural experiment in diversification, using a rich and novel micro-data set on taxi firms to test the influence of diversification on firm organization and performance. Although I cannot observe all of the organizational changes that diversification creates, I find strong evidence that firms fundamentally alter the organization of their legacy taxicab business, when they diversify, investing less in efficiency-enhancing dispatching technology and realigning asset ownership relationships within their taxi business. Recognizing that some organizational costs are a fixed cost of coordinating multiple business units and others are adjustment costs that offset tacit knowledge and thereby influence competitive advantage, I distinguish between diversification costs in general and organizational adjustment costs using cross-sectional data, and find that the latter accounts for an 18% reduction in taxi productivity. The cost of organizational adjustment fully eliminates the productivity advantage incumbents have over start-ups, suggesting that start-ups can exploit organizational upheaval in incumbent firms.

The evidence assembled paints a picture of diversification as a process by which firms grow by making costly adjustments to their organizational systems, or forgo or defer efficiency enhancing changes in one business unit while integrating a new business unit into the firm's organizational systems. Although the particular forms organizational changes take are likely to vary across industries, the results of this work are broadly applicable to industrial contexts where synergies are gained by sublimating the organization of one business unit to the overall needs of the firm.

Building on this result, one potentially interesting avenue for future research would be to explore the relationship between diversification, organizational change and productivity to understand whether the observed organizational change magnified or dampened the organizational alignment costs associated with diversification. Throughout I have assumed that firm behavior could be explained by an equilibrium model of complementarities as in Milgrom and Roberts, (1990), Ichniowski, Shaw and Prennushi (1997) or Van Biesebroeck (2006), but the same results might be generated by agency costs, inefficiencies and mistakes as in diversification discount literature. While addressing the question of when adjustment costs are efficiency enhancing adaptations to an organizational shock versus value destroying managerial oversight costs goes beyond the scope of this paper, it has clear implications for our understanding of diversification and organizational change. I attempt to abstract from this question by comparing diversified start-up against diversified incumbents, but it would also be interesting to understand the persistence of the organizational alignment cost effect. Another limitation of this paper is that it examines only firms that are first time diversifiers. It is possible that firms gain experience from diversifying that allows them to manage subsequent diversification moves more effectively. A third limitation is that the paper does not trace out the persistence of the adjustment effect. Future research might extend this work by exploiting a longer time series and/or variation in firm scope to try to understand whether the magnitude and persistence of the adjustment cost effect is mediated by the number of business units the diversified entity operated.

The paper shows that diversification imposes both static and dynamic costs on firms and explicitly connects the latter to organizational change. The existence of adjustment costs in the context of diversification has implications for the study of firms as organizations more broadly. In particular, organizational adjustment costs impose a hurdle for strategies that require organizational change. Diversification, vertical integration, geographical dispersion, merger activity and reengineering can all impose large organizational adjustment costs. To create enterprise value, each of these activities must generate incremental value for the firm over and above the organizational adjustment costs they create. Thus, organizational adjustment costs help explain the limits to firm change and growth. Moreover, the finding that organizational adjustment costs are asymmetric in the context of diversification – start-ups are shown to be more flexible than incumbents – suggests that start-ups may be more flexible than incumbents in a more general sense. While others have argued start-ups respond more effectively than incumbents to technological change, this paper provides evidence that start-ups are also more nimble with respect to change more broadly.

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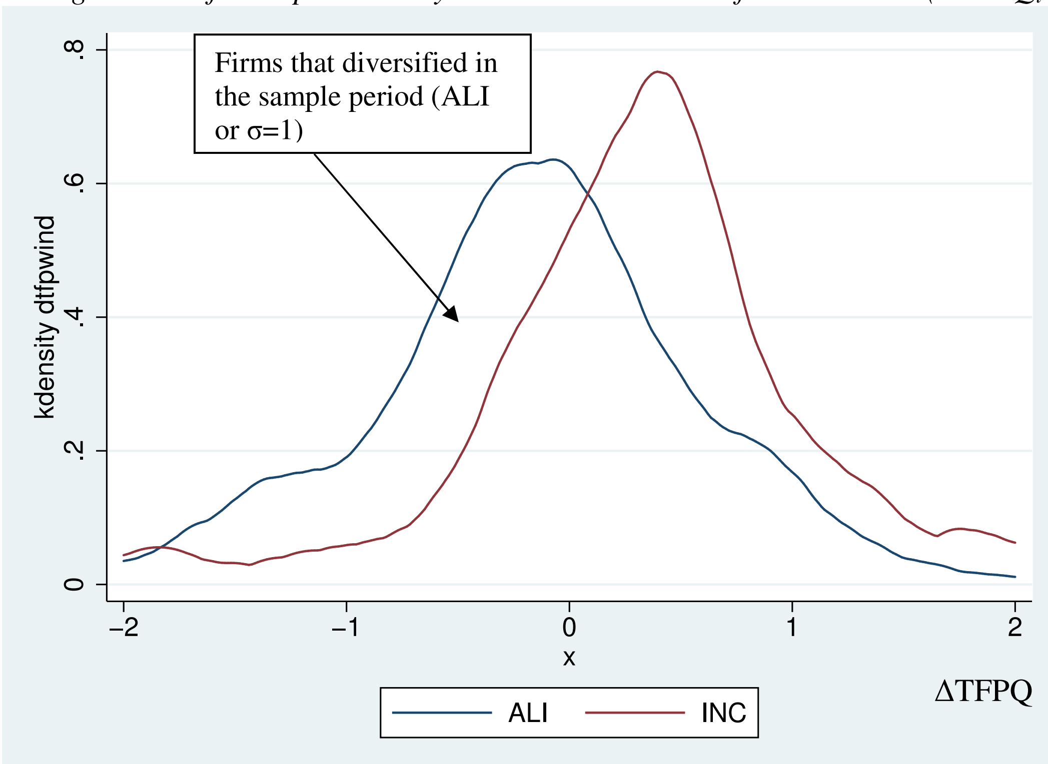
Figure 1 Distributions of the change total factor productivity (ΔTFPQ) **

Change in total factor productivity conditional on diversification status ($\Delta TFPQ_i \mid \sigma$)



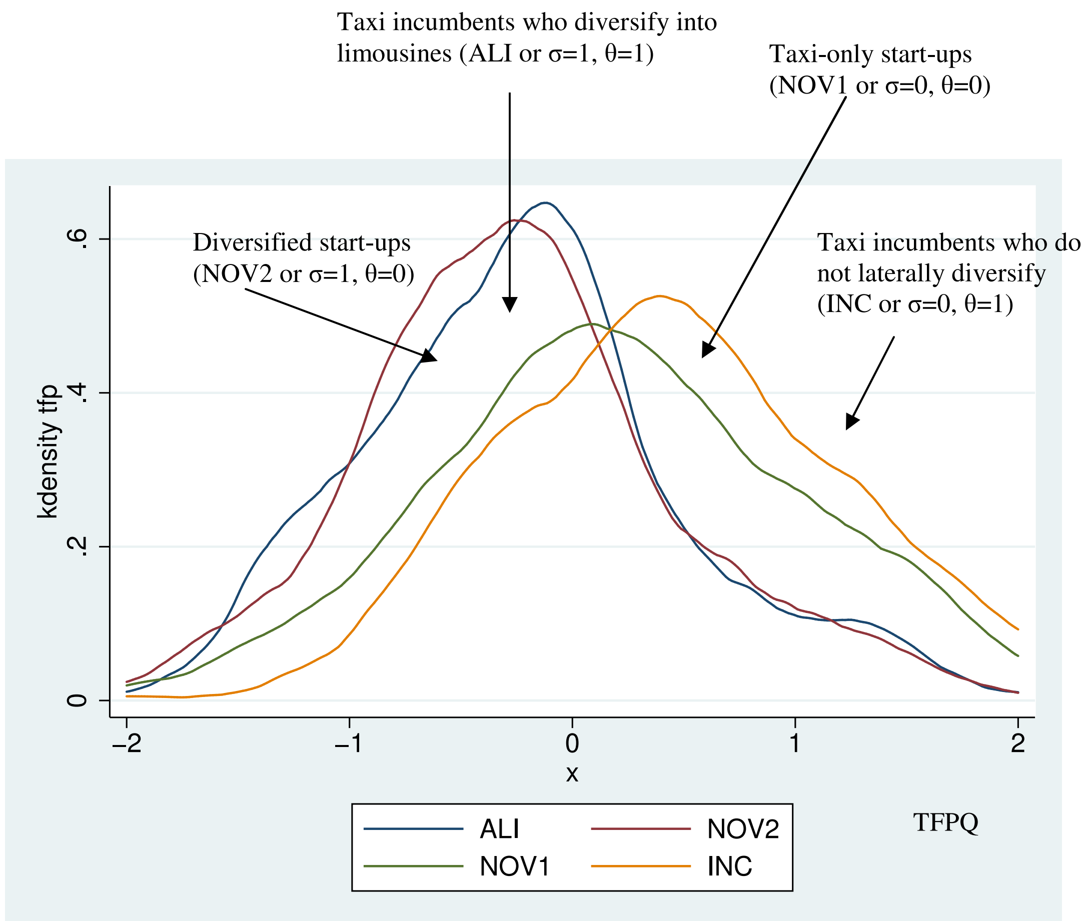
This figure shows a kernel density plot of the distribution of the change in total factor productivity (1992-1997) conditional on diversification status. n=560.

** See Table 6 column 1a for regression output comparing the means of these distributions

ALI = Future diversifier (σ=1); INC = Incumbent that does not diversify (σ=0)

Figure 2 Distributions of taxi-only total factor productivity (TFPQ) **

1997 total factor productivity conditional on diversification and entry status ($\Delta TFPQ_i \mid \sigma, \theta$)



This figure shows a kernel density plot of the distribution of the total factor productivity (TFPQ) in 1997 conditional on diversification (σ) and entry status (θ). n = 560

** See Table 7 for regression output that compares the four means of these distributions

ALI = Diversified firm (σ=1, θ=1); INC = Incumbent who did not diversify (σ=0, θ=1); NOV1 = Taxi-only start-up (σ=0, θ=0); NOV2 = Diversified start-up (σ=1, θ=0)

Table 1 Descriptive statistics

Panel A - Unbalanced panel		1992			1997	
	N	Mean	Std dev	N	Mean	Std dev
TFPQ	1020	0.00	0.70	1106	0.00	0.79
Taxi revenue ($000)	1020	511	1694	1106	595	2157
Taxi capital	1020	185	874	1106	227	1104
Total taxis	1020	18	61	1106	26	74
Fleet owned taxis (share)	1020	0.83	0.37	1106	0.56	0.34
Taxi-only incumbent	1020	0.99	0.38	1106	0.25	0.43
Taxi to limo diversifier	1020	n/a	n/a	1106	0.40	0.49
Taxi-only start-up	1020	n/a	n/a	1106	0.12	0.33
Taxi + Limo start-up	1020	n/a	n/a	1106	0.22	0.41
Taxi firm exits after 1992	1020	0.34	0.47	1106	n/a	n/a
Future taxi to limo diversfr.	1020	0.26	0.43	1106	n/a	n/a
Taxis in the county	1020	270	534	1106	626	772
Limos in the county	1020	145	276	1106	322	482
Limo mrkt. concen. (HHI)	1020	0.04	0.12	1106	0.23	0.27
County population (000)	1020	1238	1152	1106	1231	1236
County square miles	1020	723	1501	1106	778	1534
Sole proprietor	1020	0.10	0.30	1106	0.12	0.33
Partnership	1020	0.02	0.14	1106	0.02	0.15
Cooperative	1020	0.03	0.16	1106	0.02	0.13

Panel B - Balanced panel		1992			1997	
	N	Mean	Std dev	N	Mean	Std dev
TFPQ	560	0.05	0.68	560	0.11	0.80
Taxi revenue ($000)	560	675	1900	560	849	2739
Taxi capital ($000)	560	230	930	560	319	1294
Total taxis	560	21	63	560	33	79
Fleet owned taxis (share)	560	0.86	0.33	560	0.63	0.36
Taxi to limo diversifier	560	n/a	n/a	560	0.54	0.50
Taxis in the county	560	228	480	560	472	673
Limos in the county	560	103	228	560	221	414
Limo mrkt. concen. (HHI)	560	0.05	0.13	560	0.32	0.36
County population (000)	560	885	1036	560	985	1148
County square miles	560	861	1642	560	878	1714
Sole proprietor	560	0.14	0.35	560	0.14	0.35
Partnership	560	0.02	0.13	560	0.02	0.15
Cooperative	560	0.04	0.19	560	0.04	0.19

Panel A includes all firms with SIC codes 4121 (taxicabs) or 4119 (limousines), taxi revenue ≥ $10K, at least 2 taxicabs, and at least 2 taxi fleets in their market (county) in either 1992 or 1997. Panel B includes firms that meet the criterion for inclusion in Panel A for both 1992 and 1997. Note that Census Bureau restrictions prohibit publication of minimum and maximum variable values.

Table 2 Correlations between key variables (1997)
n=1106

	1	2	3	4	5	6	7	8	9	10
1	1.00									
2	0.35	1.00								
3	0.12	0.65	1.00							
4	0.15	0.63	0.94	1.00						
5	-0.05	0.15	0.16	0.05	1.00					
6	0.32	0.23	0.16	0.14	0.27	1.00				
7	-0.23	-0.11	-0.08	-0.06	-0.27	-0.31	1.00			
8	0.10	-0.04	-0.02	-0.04	0.29	-0.22	-0.48	1.00		
9	-0.16	-0.08	-0.01	-0.05	-0.20	-0.31	-0.43	-0.20	1.00	
10	-0.08	-0.02	0.19	0.03	0.08	-0.08	-0.09	0.08	0.12	1.00
11	0.02	0.10	-0.13	0.15	-0.09	0.08	0.08	-0.11	-0.09	-0.46

1 = TFPQ
2 = Taxi revenue
3 = Taxi capital
4 = Total taxis
5 = Fleet owned taxis
6 = Taxi-only incumbent
7 = Taxi to limo diversifier
8 = Taxi-only start-up
9 = Taxi and limo start-up
10 = Limo market concentration
11 = County population

Table 3 Total factor productivity calculations

$r_{it} = a_t + \lambda_{mt} + Bk_{it} + TFPQ_{it}$

Panel A – Total factor productivity calculations

Dependent variable = Log revenue

	(1) Taxi only TFPQ		(2) Taxi only TFPQ		(3) Taxi+ Limo TFP	
Year	1992		1997		1997	
Log capital	0.85	***	0.83	***	0.79	***
	(0.03)		(0.03)		(0.03)	
Constant	1.54	***	1.41	***	1.27	***
	(0.13)		(0.14)		(0.15)	
County fixed effects	218		223		656	
N	1020		1106		2341	
R^2	0.71		0.68		0.45	

Panel B – Summary statistics for TFPQ (Panel A residuals)

TFPQ	(1)	(2)	(3)
Mean	0.00	0.00	0.00
Std. deviation	0.74	0.81	1.04

Standard errors are robust.
Columns (1) and (2) are TFPQ calculations for taxicab operations (e.g., taxicab revenue and taxicab capital) only. The results include all firms with SIC codes 412100 (taxicabs) or 411920 (limousines), taxi revenue ≥ $10K, at least 2 taxicabs, and at least 2 taxi fleets in their market (county) in either 1992 or 1997.
Column (3) is multifactor productivity for taxi and limo combined operations (e.g., pooled revenue and capital). The results include all firms with SIC codes 412100 (taxicabs) or 411920 (limousines), taxi+limo revenue ≥ $10K, at least 2 vehicles, and at least 2 fleets in their market (county) in 1997.
*** significant at the 1% level, ** significant at the 5% level, * significant at the 10% level

Table 4 Diversification and adoption of computerized dispatching

$TECH_{i1997} - TECH_{i1992} = a + B_1\sigma_i + \boldsymbol{X_{ic}B_c} + e_i$

Dependent variable = Adopted computerized dispatching technology, *TECH* ={0,1}

	(1a) OLS		(1b) 2SLS		(2a) OLS		(2b) 2SLS	
Taxi to limo diversifier (σ)	-0.09	***	-0.22	**	-0.06	**	-0.20	
	(0.03)		(0.11)		(0.03)		(0.14)	
Middle 1/3 of the 1992 size ($Taxi K) distrib.					-0.03		-0.07	
					(0.05)		(0.05)	
Largest 1/3 of the 1992 size ($Taxi K) distrib.					0.15	***	-0.04	
					(0.04)		(0.06)	
Corporation					0.09	*	0.09	*
					(0.05)		(0.05)	
Δlog(taxis in the county$_{-i}$)					0.02	*	0.02	
					(0.01)		(0.01)	
Δlog (limos in the county$_{-i}$)					0.02		0.02	
					(0.02)		(0.02)	
Δlog (county pop.)					0.09		0.11	
					(0.07)		(0.08)	
Respondent dummy	0.24	***	0.28	**	0.23	***	0.29	**
	(0.06)		(0.11)		(0.06)		(0.11)	
Constant	0.12	**	0.10	*	0.11		0.06	
	(0.05)		(0.06)		(0.09)		(0.07)	
R^2	0.11		n/a		0.14		n/a	
N	560		560		560		560	
<u>1st stage summary statistics</u>								
F-statistic			32				10	
t-statistic on IV			-5.6				-5.3	
R^2			0.05				0.12	
N			560				560	

Standard errors are robust and clustered at the market (county) level

The results in this table include all firms with SIC codes 412100 (taxicabs) or 411920 (limousines), taxi revenue ≥ $10K, at least 2 taxicabs, and at least 2 taxi fleets in their market (county) in both ‘92 and ‘97.

The excluded status category is incumbents who did not laterally diversify. The excluded size category is the smallest 1/3 of the 1992 size distribution measured in terms of dollars of taxi capital.

The 2SLS estimates use IV = Herfindahl index of lagged (1992) market (county) concentration of limos.

The Durbin-Wu-Hausman test rejects the null hypothesis that the instrument is not necessary at the 1% level [χ^2= 22 in column 2(b)]

*** significant at the 1% level, ** significant at the 5% level, * significant at the 10% level

Table 5 Diversification and asset ownership

$FOWN_{i1997} - FOWN_{i1992} = a + B_1\sigma_i + \boldsymbol{X_{ic}B_c} + e_i$

Dep. variable = Change in the % of vehicles in the fleet owned by the firm (ΔFOWN)

	(1a) OLS		(1b) 2SLS		(2a) OLS		(2b) 2SLS	
Taxi to limo diversifier (σ)	-0.29	***	-0.46	***	-0.28	***	-0.48	***
	(0.09)		(0.09)		(0.09)		(0.09)	
Middle 1/3 of the 1992 size ($Taxi K) distrib.					-0.03		-0.07	
					(0.05)		(0.05)	
Largest 1/3 of the 1992 size ($Taxi K) distrib.					0.02		-0.04	
					(0.04)		(0.06)	
Corporation					0.07		0.19	**
					(0.05)		(0.05)	
ΔCounty taxi ownership rate$_{-i}$					0.09	*	0.09	*
					(0.05)		(0.05)	
Δlog(taxis in the county$_{-i}$)					0.02	*	0.02	*
					(0.01)		(0.01)	
Δlog (limos in the county$_{-i}$)					-0.01		-0.01	
					(0.02)		(0.02)	
Δlog (county pop.)					-0.15		-0.17	
					(0.15)		(0.15)	
Urban					-0.02		-0.01	
					(0.06)		(0.06)	
Constant	0.08	**	0.02		-0.04		0.07	
	(0.04)		(0.04)		(0.09)		(0.10)	
R^2	0.09		n/a		0.11		n/a	
N	560		560		560		560	
1st stage summary statistics								
F-statistic			32				9	
t-statistic on IV			-5.6				-5.3	
R^2			0.05				0.13	
N			560				560	

Standard errors are robust and clustered at the market (county) level

The results in this table include all firms with SIC codes 412100 (taxicabs) or 411920 (limousines), taxi revenue ≥ $10K, at least 2 taxicabs, and at least 2 taxi fleets in their market (county) in both '92 and '97.

The excluded status category is incumbents who did not laterally diversify. The excluded size category is the smallest 1/3 of the 1992 size distribution measured in terms of dollars of taxi capital.

The 2SLS estimates use IV = Herfindahl index of lagged (1992) market (county) concentration of limos.

The Durbin-Wu-Hausman test rejects the null hypothesis that the instrument is not necessary at the 1% level [χ^2= 20 in column 2(b)]

*** significant at the 1% level, ** significant at the 5% level, * significant at the 10% level

Table 6 Within-firm effect of diversification on productivity

$TFPQ_{i1997} - TFPQ_{i1992} = a + B_1\sigma_i + \boldsymbol{X_{ic}B_c} + e_i$

Dependent variable = Change in total factor productivity (ΔTFPQ)	(1a) OLS		(1b) 2SLS		(2a) OLS		(2b) 2SLS	
Taxi to limo diversifier (σ)	-0.45 (0.10)	***	-0.53 (0.17)	***	-0.41 (0.11)	***	-0.46 (0.19)	**
Middle 1/3 of 1992 size ($Taxi K) distrib.					-0.08 (0.09)		-0.09 (0.09)	
Largest 1/3 of 1992 size size ($Taxi K) distrib.					0.15 (0.07)	*	0.13 (0.10)	
Corporation					-0.06 (0.06)		-0.05 (0.07)	
ΔCounty taxi ownership rate$_{-i}$					0.20 (0.07)	***	0.20 (0.07)	***
Δlog(taxis in the county$_{-i}$)					0.02 (0.03)		0.02 (0.03)	
Δlog (limos in the county$_{-i}$)					-0.02 (0.03)		-0.02 (0.03)	
Δlog (county pop.)					-0.20 (0.29)		-0.21 (0.28)	
Constant	0.30 (0.07)	***	0.38 (0.09)	***	0.39 (0.11)	***	0.42 (0.15)	***
N	560		560		560		560	
R^2	0.08		n/a		0.12		n/a	
1st stage summary statistics								
F-statistic			32				10	
t-statistic on IV			-5.6				-5.3	
R^2			0.05				0.12	
N			560				560	

Standard errors are robust and clustered at the market (county) level
Results in this table include all firms with SIC codes 412100 (taxicabs) or 411920 (limousines), taxi revenue ≥ $10K, ≥2 taxicabs, and ≥2 taxi fleets in their market (county) in both 1992 and 1997.
The excluded status category is incumbents who did not laterally diversify. The excluded size category is the smallest 1/3 of the 1992 size distribution measured in terms of dollars of taxi capital.
The 2SLS estimates use IV = HHI index of lagged (1992) market (county) concentration of limos.
The Durbin-Wu-Hausman test rejects the null hypothesis that the instrument is not necessary at the 1% level [χ^2= 33 in column 2(b)]
*** significant at the 1% level, ** significant at the 5% level, * significant at the 10% level

Table 7 Diversification and organizational adjustment costs

$TFP_{i1997} = a + \boldsymbol{X_{\sigma\theta}(\sigma_i,\theta_i)B_{\sigma\theta}} + \boldsymbol{X_{ic}B_c} + e_i$

	Taxi-only Dep. var. = total factor productivity (TFPQ)				Pooled (Taxi and Limo) Dep. var. = multi-factor productivity (TFP)			
	(1)		(2)		(3)		(4)	
Taxi to limo diversifier	-0.66	***	-0.61	***	-0.84	***	-0.85	***
	(0.09)		(0.08)		(0.08)		(0.08)	
Taxi and limo start-up	-0.67	***	-0.62	***	-0.84	***	-0.79	***
	(0.08)		(0.07)		(0.05)		(0.04)	
Taxi only start-up	-0.23	**	-0.17	**	-0.26	***	-0.18	**
	(0.09)		(0.08)		(0.08)		(0.08)	
Middle 1/3 of the '97 sz. ($Taxi K) distrib.			0.02				-0.01	
			(0.10)				(0.05)	
Largest 1/3 of the '97 sz. ($Taxi K) distrib.			0.16	*			0.14	*
			(0.19)				(0.08)	
Corporation			0.16	*			0.21	***
			(0.08)				(0.04)	
Log (total county $taxis_{-i}$)			0.07				0.07	*
			(0.06)				(0.03)	
Log (total county $limos_{-i}$)			-0.06				-0.03	
			(0.05)				(0.03)	
Limousine SIC indicator					0.11	**	0.09	
					(0.06)		(0.06)	
Constant	0.43	***	0.12		0.33	***	-0.04	
	(0.06)		(0.16)		(0.05)		(0.06)	
N	1106		1106		2341		2341	
R^2	0.13		0.16		0.20		0.23	
ΔIncumbent TFPQ - ΔStart-up TFPQ	-0.21	**	-0.17	**	-0.26	**	-0.23	**
	(0.09)		(0.09)		(0.11)		(0.10)	

Standard errors are robust and clustered at the market (county) level

The results in the "Taxi-only" regressions include all firms with SIC codes 412100 (taxicabs) or 411920 (limousines), taxi revenue ≥$10K, ≥2 taxicabs, and ≥2 taxi fleets in their market (county) in either 1992 or 1997. The "Pooled" regressions include all firms with SIC codes 412100 (taxicabs) or 411920 (limousines), taxi + limo revenue ≥ $10K, ≥2 vehicles, ≥2 fleets in their market in 1997.

The excluded status category is incumbents who did not laterally diversify. The excluded size category is "smallest 1/3 of the 1997 size distribution measured in dollars of taxi capital." (or taxi+limo capital)

*** significant at the 1% level, ** significant at the 5% level, * significant at the 10% level

Appendix: Calculating Total Factor Productivity and Estimating Profitability

A. Calculating Total Factor Productivity in Quantities (TFPQ)

Prices are set by local regulation in every major market in the taxi industry. Regulated prices allow productivity regressions with market-level fixed effects to capture differences in physical output per unit of input across firms. This paper measures output in physical units rather than relying simply on revenue measures of output as most productivity studies do. A number of papers have demonstrated the perils of relying on deflated revenues to measure total factor productivity (TFP) including Klette and Griliches (1996), Katayama, Lu and Tybout (2003), and most recently, Foster, Halitwanger and Syverson (2005). Foster, Halitwanger and Syverson (2005) call physical output measures of technical efficiency TFPQ to differentiate it from traditional measures of TFP. This paper follows their notation by using TFPQ to represent the technical efficiency of the firm. The standard approach to measuring TFPQ for firm *i* at time *t* uses (i):

$$\text{(i) } q_{it} = \alpha_t + \beta_{kt} k_{it} - \beta_{lt} l_{it} + TFPQ_{it}$$

where *q* is physical quantities of output produced, and *k* and *l* are the logs of capital and labor. TFPQ is the residual from the production function. In this dataset we do not observe physical outputs or market prices, only revenues in dollars. However, we can easily recover TFPQ as a measure of physical output by including a market fixed effect in a standard Cobb-Douglas production function, because market prices are fixed for all firms in a market *m*. In other words, we observe:

$$\text{(ii) } p_m + q_{it} = a_t + \omega_{kt} k_{it} + \omega_{lt} l_{it} + TFP_{it}$$

To recover equation (i), if prices (*p*) were known, we would just subtract p_m from equation (ii). Since we do not observe p_m directly, we de-mean the data at the market level by including a market-level fixed effect, which eliminates p_m and transforms the standard TFPQ calculation in equation (i) into a market-adjusted measure of deviation from mean quantity produced conditional on deviation from mean input levels:

$$\text{(iii) } TFPQ_{imt} = \alpha_t + q_{it} - q_{mt} - \beta_{kt}(k_{it} - k_{mt}) - \beta_{lt}(l_{it} - l_{mt})$$

where equation (iii) is equivalent to equation (i) with the addition of market-level fixed effects.

The main difficulty in computing TFPQ in this context is in the construction of the dependent variables capital (*k*) and labor (*l*). The Economic Census does not report business-unit capital or labor values for taxi firms, rather these must be inferred from physical measures of business-unit capital and overall firm labor. Business-unit capital is fairly straight-forward to compute because firms report the number of taxicabs and limousines they own and operate. I convert the stock of capital to a flow measure using conversion factors from the Taxi Limousine and Paratransit (TLPA) annual Factbooks for

1992 and 1997 that describe the relative costs of operating fleet-owned versus driver-owned taxicabs using the methodology described in Foster, Haltiwanger and Krizan (1998).[24] However, because taxi drivers are almost ubiquitously independent contractors rather than employees,[25] while limousine drivers tend to be a mix of employees and independent contractors, it is difficult to apportion labor across business units in a meaningful way for multi-product firms. Since taxi drivers are almost never employees, the issue of allocating labor to business units is solved by using (iii) without a labor term to compute y=TFPQ as the residual of a regression of firm-specific capital k, market-level fixed effects λ and time-specific intercept α on log revenue in (iv).[26]

$$\text{(iv) } r_{it} = \alpha_t + \lambda_{mt} + \beta k_{it} + TFPQ_{imt}$$

I show kernel density plots of total factor productivity (TFPQ) conditional on future (contemporaneous) entry status for 1992 (1997) in figures 3 and 4 below.

[24] The TLPA estimates for the total cost of ownership versus total cost of operating a driver owned vehicle were approximately $12,000 versus $4,000 in 1992. Since there are only two components of k and equation (iii) contains market-level fixed effects the precise costs of fleet ownership and driver ownership are irrelevant – only the ratio (3:1) of these costs matter in computing TFPQ. I validated these estimates using OLS regressions of vehicle counts by ownership type against total revenue and found very similar results to the TLPA estimates. Alternative specifications of equation (iii), where the cost of the two types of vehicles was allowed to vary, yielded qualitatively identical results (available upon request).

[25] The only exception to the general rule that taxi drivers operate their vehicles as independent contractors that I am aware of is in Las Vegas where drivers are required by law to be hired as employees. Here, the fixed proportion of capital to labor and market-level fixed effects in (iii) eliminate the effect of *market level* variation in employment rates.

[26] Because the ratio of capital to labor is fixed at 1:1 at the level of the vehicle at any given point in time it is straightforward to normalize labor to unity across firms (e.g., the production function is Leontief).

B. Using total factor productivity to estimate profitability

Let firm i's productivity be completely characterized by a function f that transformations two parameters θ and σ into output plus a noise term ε that has mean zero, where θ captures whether the firm is a start-up or incumbent firm, and σ captures whether the firm is a one product firm or a two product firm.

$TFP_i = f(\theta,\sigma) + \varepsilon_i$

$\theta=1$ if it is an incumbent and zero otherwise

$\sigma=1$ if the firm is a two product firm and zero otherwise

No incumbent firms were two-product firms in the pre-period so that when TFP=f(1,1) we hypothesize that there is an interaction effect between θ and σ that captures the cost of organizational change. (Since ε is randomly distributed I drop the subscript i).

$C(\delta) = g(\theta^*\sigma) > 0$ when $\theta=1$ and $\sigma=1$ and is zero otherwise

Therefore,

$E[f(1,1)] = E[f(1,0)] + E[f(0,1)] - C(\delta)$

The first hypothesis predicts that more experienced firms are more productive so that $E[f(1,0)] - E[f(0,0)]>0$. I have confined the analysis to the case where increasing levels of firm scope leads to increased cannibalization so that by assumption E[f(0,1)] – E[f(0,0)]<0.[27] I therefore normalize E[f(0,0)]=0 without loss of generality.

I test the assumption (A1) that incumbents generally outperform start-ups by netting the average productivity of one-product incumbents against one-product start-ups.

$$\text{(iv) } E[f(1,0)] - E[f(0,0)] = V(\theta=1)$$

Where $V(\theta=1)$ is the average value of being an incumbent. A1 predicts that $V(\theta=1)>0$.

The gross effect of incumbency and change in firm scope can be computed by subtracting the average productivity of two-product start-ups from the average productivity of lateral diversifiers.

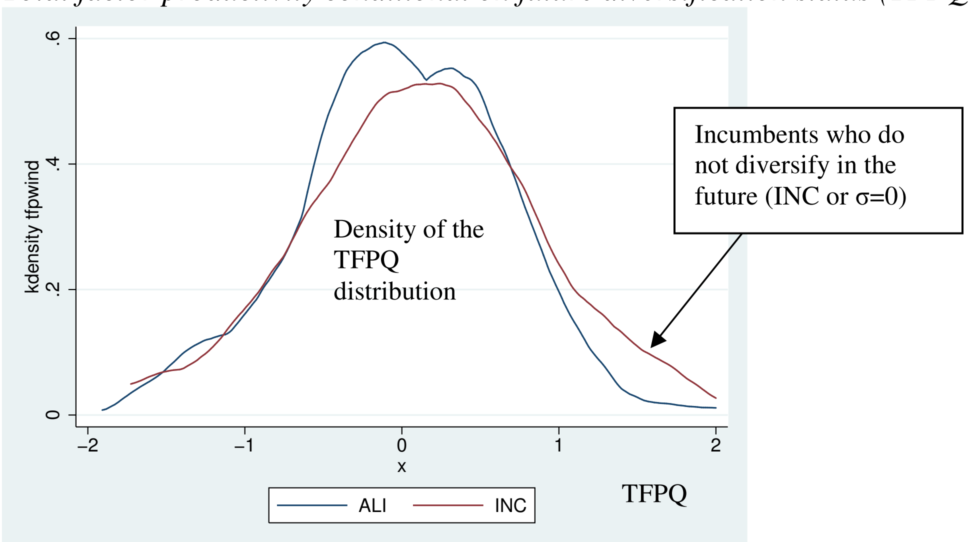
$$\text{(v) } E[f(1,1)] - E[f(0,1)]$$

$$= [E[f(1,0) + E[f(0,1)] - C(\delta)] - E[f(0,1)] = V(\theta=1) - C(\delta)$$

Netting equations (iv) and (v) recovers the cost of change in firm scope. H2 predicts that $C(\delta)>0$.

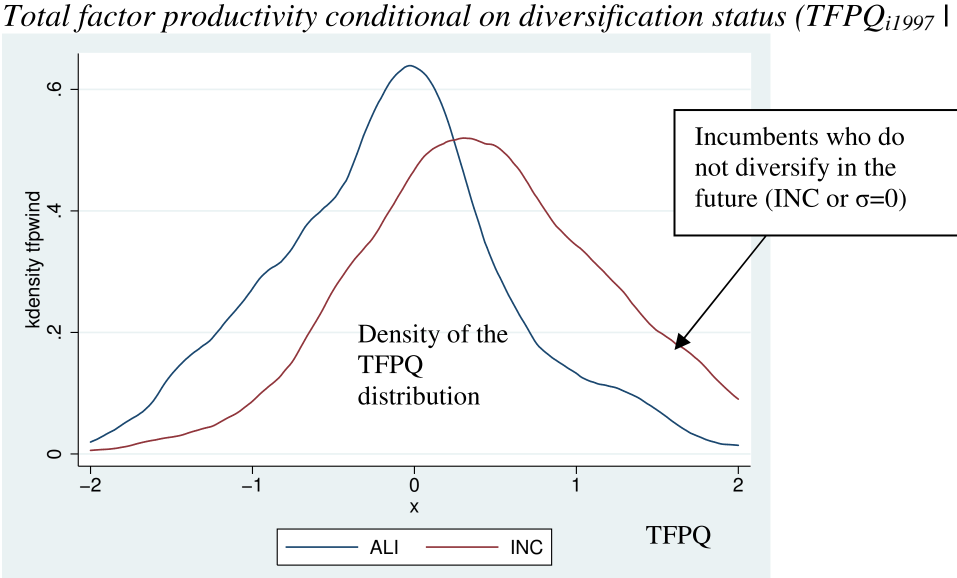
[27] Note that if taxicabs and limousines are complementary with respect to output the bias in the test is upward. In other words the bias would lead us to reject H3 when we should not.

Figure 3 Distribution of 1992 total factor productivity (TFPQ)
Total factor productivity conditional on future diversification status ($TFPQ_{i1992} \mid \sigma$)



n = 560
ALI = Future diversifier (σ=1)
INC = Incumbent that does not diversify (σ=0)

Figure 4 Distribution of 1997 total factor productivity (TFPQ)
Total factor productivity conditional on diversification status ($TFPQ_{i1997} \mid \sigma$)



n=560
ALI = Diversified firm (σ=1)
INC = Incumbent that did not diversify (σ=0)