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Post-merger restructuring and the boundaries of the firm ☆

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ABSTRACT

We examine how firms redraw their boundaries after acquisitions using plant-level data. We find that there is extensive restructuring in a short period following mergers and full-firm acquisitions. Acquirers of full firms sell 27% and close 19% of the plants of target firms within three years of the acquisition. Acquirers with skill in running their peripheral divisions tend to retain more acquired plants. Retained plants increase in productivity whereas sold plants do not. These results suggest that acquirers restructure targets in ways that exploit their comparative advantage.

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1. Introduction

Mergers and acquisitions are a fast way for a firm to grow and reconfigure its asset portfolio. Through mergers, firms frequently acquire portfolios of assets spanning several industries. After the merger, the acquiring firm faces decisions on how to redraw its boundaries. The acquirer can keep all or most of the acquired assets or shed some of the acquired assets through sales or closure. Although there is a vast literature on mergers and acquisitions,[1] there is little empirical evidence on the extent to which acquirers reconfigure their newly

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[1] See Andrade, Mitchell, and Stafford (2001) for a survey, and Betton, Eckbo, and Thorburn (2008) for a more recent perspective.

acquired assets or the direction of restructuring that follows a merger. Do acquirers keep most of the assets they acquire or do they shed or close some of the acquired assets? Our study provides the first evidence on the short-term restructuring after a merger by following acquirers longitudinally after an acquisition. We characterize the extent and direction of post-merger restructuring and examine the performance changes consequent to the restructuring.

Our first finding is that acquiring firms do not passively retain the assets acquired in a merger. Rather, the merger starts a vigorous restructuring that involves a significant number of selloffs and closures of the target firm's assets. Within three years, firms sell or close 46% of the plants they purchase via whole-firm acquisitions or mergers. The extent of restructuring far exceeds benchmarks based on industry/year matched firms or assets in partial-firm acquisitions. If we expand the horizon to five years following the mergers, sales increase by only 3% points and closures by only 6.6% points in years 4 and 5.

We next examine two related questions about the post-merger restructuring process. First, are acquirers more likely to keep certain assets than others? Second, does the post-merger performance of the acquired assets depend on whether the asset is kept or sold? To answer these questions we examine the cross-sectional variation of the plant retention, closure, and sales decisions of acquirers and characterize the changes in productive efficiency of kept and sold plants over three years after merger completion. This evidence complements and extends the knowledge of post-merger restructuring beyond the (very) long-term divestitures after merger that are examined by Kaplan and Weisbach (1992) and Porter (1987).

We show that the readjustment of firm boundaries after acquisitions varies cross-sectionally in ways that are consistent with the view that acquirers exploit their comparative advantage across industries to restructure target firms. We find that acquirers are more likely to retain plants of firms they purchase if they already operate a plant in the same industry and acquirers are particularly likely to retain purchased plants that add to their largest divisions. Plants in the target's peripheral divisions, which are less likely to be the object of the acquisition, are significantly more likely to be sold. These findings suggest that even when acquirers buy whole firms, they are ex-ante interested in a subset of the target firm's assets.

Among the acquirer's asset-side characteristics, we find that acquirers are more likely to retain acquired plants if the pre-merger productivity of plants in their own *peripheral* segments is high. Productivity in peripheral businesses reflects the ability and capacity of an acquirer to operate businesses that add to a firm's scope. Low productivity of existing peripheral segments/plants indicates that the firm is likely stretched while high peripheral plant productivity indicates that a firm can absorb and add to its existing businesses. We find that peripheral productivity is a significant predictor of the probability of retention after a merger. A one-standard-deviation increase in the productivity of the acquirer's own marginal plants increases the probability that the acquirer retains a newly acquired target plant by 17–19%. Additionally, theories of firm scope based on comparative advantage predict a stronger multiplicative effect of skill when there are positive industry shocks. Positive shocks amplify the comparative advantage of keeping an asset with a more efficient producer relative to its ownership by a less efficient producer. Thus, positive industry return shocks should make an acquirer with greater marginal productivity especially less likely to sell assets in the industry. We find support for this prediction. The retention probability is higher when the acquirer is skilled and when the plant belongs to an industry that experiences a positive shock.

We investigate the effects of the method of payment and financing on restructuring using Securities Data Company (SDC) data and other financing-side variables that proxy for firm financial constraints.[2] We find some evidence that the method of payment is related to the asset sales decision. Acquirers that pay with cash are somewhat less likely to sell target plants. Payment method has virtually no correlation with plant closures, which continue to be driven mainly by plant fundamentals. On the other hand, the financial conditions of the acquirer are more robust determinants of restructuring. Firms with high leverage, low cash, and non-dividend payers are more likely to sell plants. Thus, while the results discussed earlier suggest that asset-side fundamentals drive retention decisions, this evidence indicates a role for debt and financial constraints in setting firms' boundaries.

Besides the rates of selloffs and closures and their cross-sectional determinants, we also study the performance of plants transferred in acquisitions. We show that there are very distinct differences between kept and sold plants. Plants transferred in the acquisition and subsequently kept by the acquirer tend to improve in performance with significant increases in productivity and operating margins. There are similar large changes in performance for plants acquired and kept in targeted purchases of partial firms. In contrast, the performance of sold plants tends to be flat. This is true in whole-firm mergers where plants are transferred and resold as well as the more limited sales that follow partial-firm acquisitions. The improvement in performance of kept plants is related to how well an acquirer runs its existing businesses. The result is consistent with the brand-level evidence of Fee, Hadlock, and Pierce (2010) that acquirers realize marketing synergies when the target has complementary brands. Our evidence is about the operating performance of newly acquired plants. When considering the effect of the method of payment from SDC and the financing-side liquidity variables, we find that changes in productivity are significantly related to proxies for acquirer financial constraints, but are unrelated to how the acquirer pays for the acquisition, consistent with some post-merger sales taking place to improve the financial liquidity of the purchaser.

[2] For early work on the method of payment, see Hansen (1987) or Fishman (1989). See Section 5 of Eckbo (2008) for a recent review of the method in payment effects in acquisitions. For work on financing constraints, see Kaplan and Zingales (1997), Almeida, Campello, and Weisbach (2004), or more recently, Denis and Sibilkov (2010) and Hadlock and Pierce (2010).

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We conduct several additional tests. We examine acquirers' own plants after they complete an acquisition. Unconditionally, we find that acquirers close and sell their own plants at higher rates than their industry benchmarks. However, these rates are much lower than the disposal rates of target plants. We examine why there are differences in the rates of disposal of acquirer- and target-owned plants after the merger. We find that the differences in rates of sales are driven by differences in plant attributes. In other words, acquirers in our sample do not sell and close target plants at a higher rate just because they belonged to the target rather than the acquirer; rather, the nature of the plants and the industry conditions matter. We also find improvements in performance of acquirers' own plants after an acquisition is completed. The results represent additional evidence that firms redraw boundaries after an acquisition in a manner that exploits their comparative advantage.

To further examine empire-building motivations for mergers, we consider repeat acquirers, who may be particularly disposed towards empire building. If so, repeat acquirers may be less likely to sell after acquisitions and show less improvements in performance. Neither prediction is supported. We find no evidence of inefficient retention decisions or low performance of retained plants in this subsample. In fact, disposition rather than retention is more likely for repeated acquirers. Following Romano (1987), Bertrand and Mullainathan (2003), or Bebchuk and Cohen (2003), we also consider the effects of state-level anti-takeover laws. Business combination laws (BCLs) protect acquirers by decreasing the threat of a takeover in case they make poor quality acquisitions. We find little evidence that BCLs affect the direction or consequences of acquisitions.

In sum, our evidence suggests that on the real assets side of a merger, the deployment and disposal of assets by acquirers is broadly consistent with the analysis of organizational capability and resource complementarity in Maksimovic and Phillips (2002). As they emphasize, marginal returns and opportunity costs are important determinants of the boundaries of the firm. Firms retain assets in which they have a comparative advantage in operations, but sell assets that they do not have a comparative advantage in or assets that are peripheral to their operations, especially when the market price of such assets is high.

The results are less consistent with agency-related empire-building motivations for mergers. We do not preclude all kinds of agency problems. Rather, our results circumscribe and put boundary conditions on the manner in which mergers may reflect agency problems. For instance, the evidence is not consistent with the view that mergers reflect pure taste for size or larger empires. Nor do mergers seem to be a mechanism for resolving empire-building tendencies of targets. Were this the case, we should see greater improvement in performance for liberated assets sold off after acquisitions. However, this is not supported by the data. We do not preclude the possibility that agency problems are manifest in mergers elsewhere in the firms outside the operating side. For instance, acquirers may waste resources by dissipating proceeds of asset sales on perquisites. Alternatively, acquirers may overpay for target assets. However, we find little evidence that acquirers systematically mismanage the assets that they acquire. This result is consistent with the stock market evidence that combined acquirer-target gains are positive.[3] Little in the results suggests that agency problems pervade the operating side of the aggregate merged firm, but it is possible that they result in significant redistributive effects with wealth transfers from acquirers to targets.

Empirically, our work extends and adds to the literature on mergers and acquisitions on four distinct dimensions. First, we offer the first longitudinal analysis of the short-term restructuring after a merger, an issue that economists have long been interested in. Pinning down the extent and direction of post-merger restructuring has been challenging because it is difficult to separate and track the newly acquired assets once merged into the acquirer's businesses. In an initial attempt, Ravenscraft and Scherer (1987) use Line of Business data to examine the performance between 1975 and 1977 of segments acquired in 65 tender offers. Because the Line of Business data are only available in the narrow window of time between 1975 and 1977, Ravenscraft and Scherer cannot compare the performance of individual business lines of the merged firm with the pre-merger performance of the same units. Thus, they compare Line of Business data after the merger with the whole target-firm pre-merger, which in their sample may operate several such lines of business. Given these limitations, they argue that the data "compels an agnostic inference that takeovers neither degraded nor improved the basic operating performance of target firms (p. 153)." Our plant-level data set avoids this problem as assets bought and sold can be tracked separately post-acquisition from the acquirer's existing assets. We can thus follow both the disposition of assets post-merger and classify performance by whether the asset is retained or not.

Second, our work is related to previous studies of longer-term divestitures including Porter (1987) and Kaplan and Weisbach (1992). Porter argues that many mergers are eventually divested in the long-term. He interprets this finding as evidence that mergers are misconceived ventures. In a careful study, Kaplan and Weisbach (1992) refute Porter's view. Kaplan and Weisbach examine divestitures of targets over relatively long time periods of up to 17 years after a merger. They find that 44% of their sample of mergers occurring between 1971 and 1982 had been wholly divested by 1989. Using firm write-off accounting data, up to half of divested mergers were deemed successful.

We complement both Porter (1987) and Kaplan and Weisbach (1992) by focusing on the *short*-term restructuring that occurs in a time period of three years in the immediate aftermath of the merger. Additionally, we are not restricted to examining the timing of total divestitures because our data set is at the level of the individual plant. Thus, we can track individually all acquired plants, including plants absorbed by the acquirer's existing

[3] The literature finds that there is a slight increase in combined acquirer-target market values upon announcement (Andrade, Mitchell, and Stafford, 2001). Market values do not drop after conglomerate mergers (Graham, Lemmon, and Wolf, 2002).

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divisions and plants sold between acquisition dates and final divestitures of the acquired assets. The disaggregate view of targets at the level of plants also enables us to test predictions of theories of the firm about both the disposal and post-acquisition profitability of the acquired plants.

Third, we add to recent existing studies of divestitures. Our study focuses on a longitudinal analysis of closure and retention after whole-firm mergers. Maksimovic and Phillips (2001) and Schlingemann, Stulz, and Walkling (2002) study sales of industry segments using Census and Compustat segment data, respectively. They find that firms are more likely to sell assets in periods of high industry liquidity. Maksimovic and Phillips (2001) and Schoar (2002) look at the changes in plant productivity around acquisitions. None of the prior studies explores the extent of the plant retention/sales/closures after mergers or the cross-sectional determinants of these decisions, and none finds the asymmetry in the productivity changes depending on whether the (just-acquired) plant is retained or sold off (once again after the initial transfer). These questions are the main focus of our study.

Fourth, we introduce new variables from the financing side, specifically, acquirer financial conditions from Compustat and the method of payment from SDC, and test whether they are related to post-merger restructuring. A large literature, reviewed recently in Eckbo (2008), argues that the choice of method of payment depends on the firms' characteristics and deal properties, and predicts market reactions to deal announcements. We show that while the method of payment is important in explaining restructuring decisions, the effect comes from acquirer financial characteristics. Acquirers that have high measures of financial constraints are more likely to sell plants. We emphasize that while acquirer financial conditions do matter, the fundamental efficiency and demand variables from the asset side are still significant in ways that are consistent with economically sensible post-merger restructuring.

The remainder of this paper is organized as follows. In the next section, we present the underlying framework of our study coming from prior work on mergers and acquisitions. In Section 3, we describe our sample and the data and variables we use. Sections 4 and 5 estimate models of the decision to retain, sell, or close plants. Section 6 examines the changes in productive efficiency after mergers. Section 7 concludes.

2. Framework for our study

We exploit the fact that in mergers, the acquired target firm consists of a collection of assets. These assets have varying degrees of fit with the acquirer's core competence. The acquiring firm has to decide how to redraw its boundaries—which plants to keep and which to sell. We examine the magnitude and direction of the restructuring as well as its relation to ex-post performance. To motivate our tests, we discuss the testable hypotheses from alternative theories that could explain mergers. To focus on the key elements of the tests, consider two merger theories drawn from the opposite ends of a spectrum. At one end is an empire-building theory of mergers driven by pure taste for size. At the other end are organizational theories of firm growth in which firms expand in businesses to exploit their comparative advantage.

The hypothesis that firms' investment and acquisitions are driven by managerial desire to build empires and maximize firm size has received a great deal of attention in the finance literature, especially since Jensen (1986).[4] In the post-merger context, inefficient investment observationally similar to empire building might also occur if merger decisions are motivated by hubris, as in Roll (1986), when the acquirer's managers' incorrectly believe that they have the ability to operate the target's assets more productively than they can. If an acquirer's actions are driven by either a pure taste for large size or hubris, then after a merger we would expect the firms will be as equally likely to keep assets that do not fit with their particular skills. We also would not expect large sales rates nor increases in productivity of retained assets post-purchase.

While the above arguments identify empire building with acquirers, it is also possible that mergers are a mechanism for resolving empire-building related agency problems in targets. Under this view, some firms build empires and hold a suboptimally large portfolio of assets. They may find it hard to break up these assets on their own because managers develop loyalties to employees or certain projects. Mergers facilitate the break up of such firms and liberate trapped assets (e.g., Jensen, 1986; Boot, 1992). Under this view, the acquirer need not have comparative advantage in operating the acquired assets, so there is no particular asymmetry in performance between assets kept by acquirers and sold-off assets.

An alternative view of mergers and acquisitions is based on theories of organizational capability of firms, in particular Maksimovic and Phillips (2002). These theories emphasize the role of marginal returns and opportunity costs in determining the boundaries of the firm. Firms retain assets in which they have a comparative advantage in operating but sell assets that they do not have a comparative advantage in or assets that are peripheral to their operations. This prediction would especially hold when the market price of such assets is high. Firm boundaries are predicted to shift across industries in response to shocks that alter their and their competitors' comparative advantage. Under this view, a firm's organization and talent is likely to be better suited for some industries than for others.[5] The payoffs from using that talent depend on the demand level in each industry and the level of competition. Industry shocks change these payoffs. At the margin, the firm deploys its managerial assets in industries where it obtains the greatest marginal payoff. After the purchase, acquirers would sell off assets that are found not to be a good match for them in order to direct management time to its most productive use. Lastly, a firm's comparative advantage

[4] See also Morck, Shleifer, and Vishny (1990) or Jensen (1993). Earlier authors in economics who consider empire building include Baumol (1959) and Mueller (1969).

[5] See also Lucas (1978). Fluck and Lynch (1999) develop a theory related to financial synergies about why firms buy and sell firms across the business cycle. Under their theory, managers make optimal decisions in the face of financial frictions.

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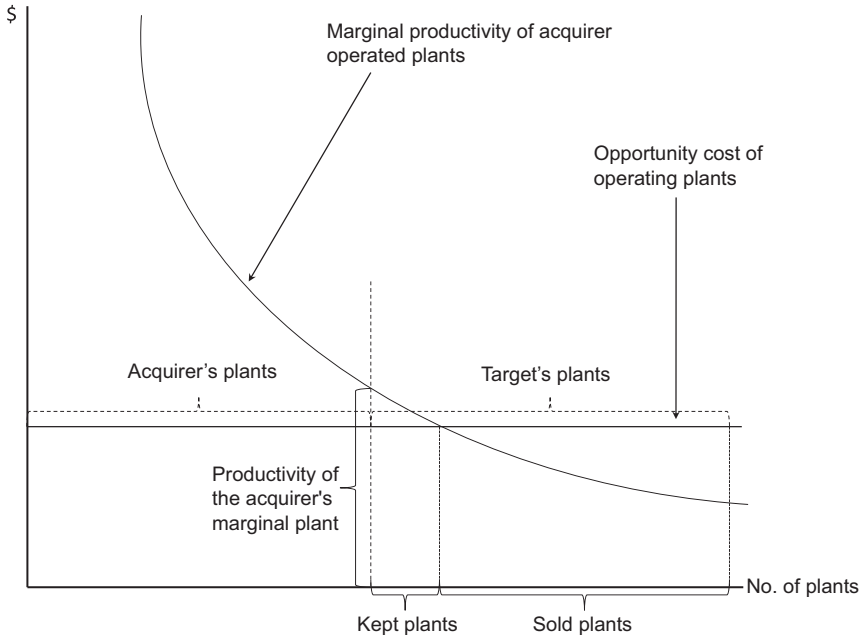

Fig. 1. The relation between the marginal capital product of plants operated by the acquirer, the opportunity cost of plants, and the number of the target's plants that are kept or sold off in post-merger restructuring by the acquirer. In the case depicted, the product of the acquirer's marginal plant initially exceeds the opportunity cost of operating the plant. The acquirer optimally keeps a sufficient number of the target's plants to equalize the marginal product of the plants and the opportunity cost of operating a plant. Excess plants are sold off.

may vary by industry, and may shift over time within an industry as shocks disproportionately benefit highly productive or less productive producers, leading to plant sales between firms.

Fig. 1 illustrates how these considerations affect the disposal of acquired assets. In order to focus on the essentials, we illustrate this effect assuming that the acquirer operates in only one industry and that the only post-acquisition decision is whether to keep or sell the targets' plants. The acquirer optimizes size at the point at which where the marginal product of operating the marginal plant is equal to the opportunity cost that can be realized by selling the plant to another firm. In Fig. 1, the acquirer's marginal plant's productivity exceeds its opportunity cost and the firm is initially below its optimum size. Following the merger, the acquirer size is greater than its optimal size and it sells plants until its optimal size is established. Acquirers with highly productive marginal plants are further away from optimal size and thus keep a larger proportion of acquired plants. Similarly, keeping the characteristics of the acquirer constant, more assets will be sold when the target is larger relative to the acquirer.

We also examine how efficient and inefficient acquirers in an industry react differently to a value-increasing shock that could, for example, be caused by an increase in demand.[6] As a result of a positive industry shock, acquirers who are less efficient in running marginal plants will have a higher opportunity cost of retaining their newly acquired plants because the plants can be redeployed elsewhere more profitably. The higher opportunity costs of retaining their newly acquired plants should make acquirers more likely to sell. By contrast, acquirers who are more efficient at the margin will face a relatively lower incentive to sell.

Figs. 2 and 3 illustrate these effects. A positive shock to the industry has two effects. First, it increases the productivity of each plant, depicted by a vertical movement in the plant marginal productivity curve. Second, it increases the value of the plant to other producers, depicted as an upward shift of the opportunity cost of operating a plant. The effect of the shock on the acquirer depends of the relative magnitudes of the two shifts. Fig. 2 shows the case in which the increase in the acquirer's productivity is high relative to the increase in the opportunity cost of operating plants. In this case, the acquirer retains more plants. Fig. 3 shows the case in which the acquirer's productivity is small in comparison to the increase in the opportunity cost. In this case, relatively few plants are retained. As argued in Maksimovic and Phillips (2002), a positive industry shock has a greater effect on plant productivity for acquirers who are initially more productive. As a result, we expect that a positive industry shock will increase the probability of retention of purchased plants by high productivity acquirers relative to the probability of retentions by low productivity acquirers.

Below, we use plant-level data to test the relation between the acquirer's marginal productivity and the decision to retain and sell assets when the industry

[6] See Appendix to Maksimovic and Phillips (2007) for a model demonstrating this effect, together with an explicit discussion of assumptions and empirical justification. See Yang (2008) for a dynamic model of reallocations.

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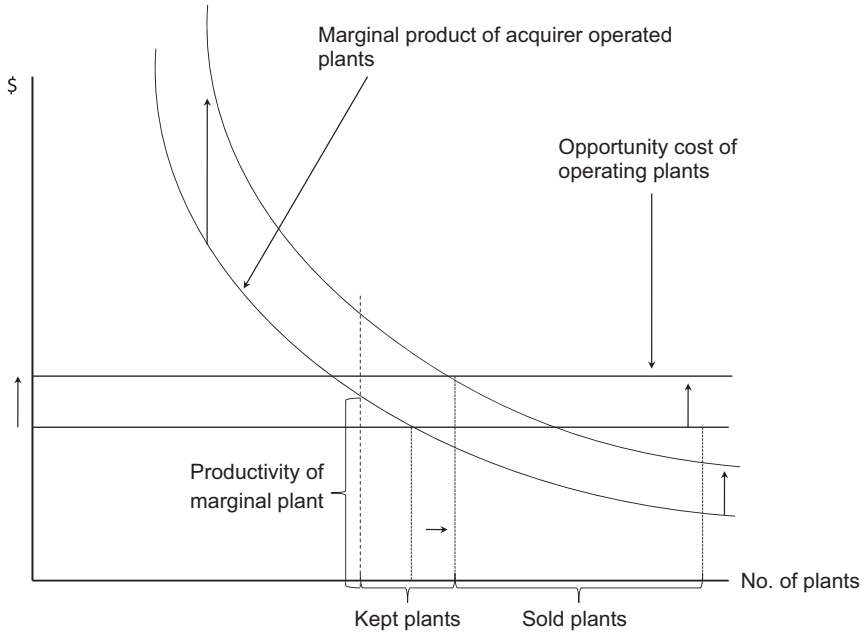

Fig. 2. The relation between the marginal capital product of plants operated by the acquirer, the opportunity cost of plants, and the number of the target's plants that are kept or sold off in post-merger restructuring by the acquirer when the industry is undergoing a positive valuation shock. The valuation shock causes the marginal product of a plant operated by the acquirer and the opportunity cost of operating plants to increase. In the case depicted, the marginal product curve increases by more than the opportunity cost of operating a plant. The acquirer optimally retains a larger number of plants than in the absence of the valuation shock. Excess plants are sold off.

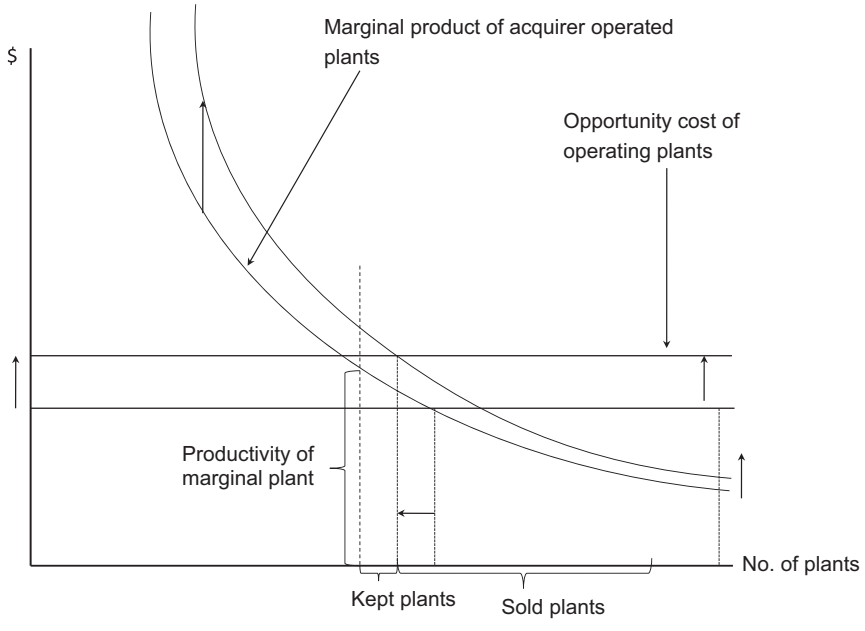

Fig. 3. The relation between the marginal capital product of plants operated by the acquirer, the opportunity cost of plants, and the number of the target's plants that are kept or sold off in post-merger restructuring by the acquirer when the industry is undergoing a positive valuation shock. The valuation shock causes the marginal product of a plant operated by the acquirer and the opportunity cost of operating plants to increase. In the case depicted, the marginal product curve increases by less than the opportunity cost of operating a plant. The acquirer optimally retains a smaller number of plants than in the absence of the valuation shock. Excess plants are sold off.

experiences a valuation shock. We also provide secondary evidence on whether operating gains in mergers are related to operating synergies or complementarities suggested by Rhodes-Kropf and Robinson (2008).

Lastly we examine whether the method of financing matters. The method of financing acquisitions has received a good deal of attention in the mergers literature. Empirically, Andrade, Mitchell, and Stafford (2001) show

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that acquirer announcement effects are lower for stock-financed acquisitions, perhaps because acquirers might be using overpriced equity (Shleifer and Vishny, 2003; Rhodes-Kropf and Viswanathan, 2004). These firms may be more likely to engage in acquisitions and operate plants in ways that do not create wealth. In particular, they may not sell newly acquired plants if doing so signals to the market that they do not have a comparative advantage in operating such plants. Alternatively, Eckbo, Giammarino, and Heinkel (1990) argue that cash transactions could signal superior bidder quality, in which case cash bidders may be less likely to dispose of plants.

We conduct other tests that shed light on agency motivations for mergers. One possibility is that only a subset of firms engage in empire building. Firms engaging in multiple acquisitions may have a particular taste for empire building. To allow for this possibility, in our empirical specifications we also test agency hypotheses related to firms that engage in multiple acquisitions, namely that repeat acquirers keep a greater proportion of the assets that they acquire and operate acquired assets less efficiently than other firms. In related tests, we consider the effect of passing state anti-takeover "business combination" laws (BCLs), which could shelter incumbent managers from the consequences of poor acquisitions. We test whether post-merger restructuring and performance are related to the passage of BCLs.

We emphasize that while our data allow us to test whether the acquirers' disposition of the target's assets is consistent with their comparative advantage, we cannot rule out all forms of agency problems. Our tests of post-merger restructuring do not imply that acquirers have no unresolved agency problems. Nor do we rule out inefficiencies in non-manufacturing expenditures, although the evidence on advertising expenditures in Fee, Hadlock, and Pierce (2010) suggests that these overheads may also undergo rationalization. Alternatively, acquirers' managers may divest efficiently, but divert a portion of the proceeds for their own benefit as higher overhead at the firm level. Finally, asset outcomes could be efficient but there could still be redistributive effects from acquirer to target shareholders because acquirers overpay for their acquisitions (Roll, 1986; Morck, Shleifer, and Vishny, 1990; Moeller, Schlingemann, and Stulz, 2005).

Our work is related to Matsusaka's (2001) model of inter-industry firm migration but there are some important differences. First, we focus on whether the firm's and the target's characteristics prior to the merger predict sales and keep decisions of acquired plants, and do not condition the acquirer's decision to stay in the industry on information on information about his performance that is generated after the merger. This differs from Matsusaka's model, which focuses on post-acquisition learning. Second, we look at both diversifying and non-diversifying mergers which do not involve pure migration across industries. Moreover, many of our diversifying segments (in particular of targets' peripheral segments), disposed of soon after the merger, are clearly not candidates for the type of industry migration that Matsusaka analyzes in his model. For similar reasons, our regressions do not directly test the predictions of Bernardo and Chowdhry (2002).

3. Data

3.1. Sample

Our initial sample comes from the Securities Data Company (SDC) mergers and acquisitions (M&A) database, where we identify all mergers announced between 1981 and 2000 that involved U.S. targets, had a completion code equal to 1, and as in Schwert (1996), were completed within 180 days of announcement. To be a potential candidate for our final sample, we require that at least one of the target's four-digit SIC codes as reported in SDC be in the manufacturing sector, i.e., have four-digit SIC codes between 2000 and 3999. We match the resulting sample with the Longitudinal Research Database (LRD) maintained at the Census Bureau. The LRD tracks approximately 50,000 manufacturing plants every year in the Annual Survey of Manufactures (ASM). The ASM contains plant-level information on output, employment, and expenditures of manufacturing plants. Larger plants that have at least 250 employees are in the data with certainty through 1999. In 1999 the certainty cutoff was raised to 500 employees and in 2004 it was raised to 1000 employees.[7] All smaller plants are surveyed every fifth year. In addition, a random sample of smaller plants is selected every fifth year to participate in a rotating five-year panel with weights depending on plant size. Once selected, plants are required by federal law to answer the survey questions. Many data items used also represent items that are also reported to the U.S. Internal Revenue Service (e.g., the number of employees, employee compensation, total value of shipments).

To track the acquired plants in the LRD, we require that the selected M&A deals have a match with the LRD. The sample period we study is based on data availability in the Census Bureau and SDC. The start date is based on availability of reliable data on M&A transactions in the SDC database. The end date of 2000 is dictated by the fact that we need three years after the completion date to track ownership changes. When we conducted the analysis, the Census Bureau data were available only until 2004.

For every target that is matched to the LRD database, we record the owner of the plant in the reporting year prior to the acquisition completion date. We track the plant ownership forward three years after the acquisition completion year. For ownership change we rely on this identification which was available for all years. If the plant is shut down within the three-year period, we record the year in which it was shut. If the plant remains open, we trace its ownership. In some cases, we cannot track the plant disposition decision reliably, because the output or the number of employees is below the Census reporting cutoff in the next five-year sample. We discard these cases. They account for about 5% of the total plants transferred in our sample. Given that we calculate productivity and cash flow changes as well as use lagged year data, we also lose the initial year a firm or firm segment

[7] Our results are robust to excluding these later years or making the certainty cutoff uniform through 2003 and excluding just 2004.

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enters the database. We also lose observations that are non-contiguous. Finally, we only include firms if their plants in an industry (at the three-digit SIC code) have total shipments of at least $1 million in real 1982 dollars.

Table 1 shows the composition of our sample over time and how many potential mergers we matched to the LRD manufacturing database. In our final sample of 2,030 acquisitions, the target had at least one reported SIC code between 2000 and 3999 according to the SDC database or the Compustat database and had matching target data in Compustat (both the SDC and Compustat database report multiple SIC codes, with the Compustat database reporting segment SIC codes beginning in 1984). We then match these deals to the Department of Commerce LRD database.Of these 2,030 transactions, we matched 1,303 transactions to the LRD database. By examining deals classified as outside manufacturing by SDC and Compustat, we also match an additional 180 transactions giving us a total match of 1,483 deals. The 1,483 M&A deals constitute our primary sample.

Failures to match Compustat to Department of Commerce data occur for several potential reasons. First, firms with smaller plants will not match up to the database as plants of firms are only covered probabilistically if the plants have more than 250 employees. In this case we would expect unmatched firms to be smaller than matched firms. Second, we are using Compustat data that were matched by Census Bureau staff by name and address in addition to Employer Identifier Number (EIN). In many cases, names in the Census Bureau data represent divisions and not ultimate parents and thus the firm may not be matched. However, as long as we can establish a match between a firm's Compustat record and any division or plant record in the LRD we can use internal Census Bureau data establish a match between the Compustat record and all the firm's plants covered by the LRD. Comparing the Compustat data median and mean sales data for matched and unmatched firms, we find that the matched firms are three to four times larger than unmatched firms, supporting the first explanation. Matched firms have median (mean) sales of $187 ($981) million, while unmatched firms have median (mean) sales of $44 ($343) million dollars.

The time period from 1981 to 2000 covers two cycles in M&A transactions. The number of transactions in our sample increases in the 1980s, peaks in the late 1980s, then declines in the early 1990s, before picking up again towards the end of our sample period. The dates of the peaks in M&A activity are related to the National Bureau of Economic Research (NBER) business cycle dates. They are also consistent with the literature on merger waves (Andrade, Mitchell, and Stafford, 2001; Maksimovic and Phillips, 2001; Harford, 2005; Yang, 2008).

Table 1
Number of deals.

The table describes the number of merger transactions in our study. The data comprise whole-firm acquisitions listed in the SDC M&A database in which the announcement date is between 1981 and 2000, the completion date is within 180 days of the announcement, and the acquisition target is a domestic U.S. firm with at least one reported four-digit SIC code from either SDC or Compustat between 2000 and 3999. Column 2 reports the number of transactions in the SDC Platinum that meet all criteria and match to Compustat. Column 3 reports the number of these transactions that were able to be matched to the Longitudinal Research Database maintained at the U.S. Department of Commerce. It includes 180 transactions that were coded as outside manufacturing by SDC and Compustat but were also found to have manufacturing assets.

Year	# Deals SDC/Compustat in manufacturing	Total # deals matched to LRD
1981	33	18
1982	59	46
1983	48	41
1984	70	58
1985	74	66
1986	125	104
1987	95	77
1988	154	115
1989	115	102
1990	62	59
1991	54	33
1992	44	28
1993	54	51
1994	79	48
1995	120	66
1996	115	93
1997	158	105
1998	186	113
1999	208	139
2000	177	121
Total	2,030	1,483

3.2. Characteristics of acquirers and targets

Table 2 describes the cross-sectional characteristics of the firms involved in the transaction. In columns 2 and 3, we report the mean and median market value (ME) and book-to-market (BE/ME) decile of targets for each sample year. The book-to-market ratio is computed from Compustat data following the algorithm of Fama and French.[8] The market value of each firm is also obtained as the market value in the December of the year prior to the transaction and is assigned deciles based on Ken French's Web site. Target firms tend to have below-median market capitalization. For 17 of the 20 years, the median target's market capitalization decile is under 3.0. In each year, the target firms' book-to-market deciles are higher than their corresponding market value deciles. The target's mean book-to-market decile is close to 5.0, and reaches a maximum of 5.84 in 1991.

Columns 4 and 5 of Table 2 report the industry-adjusted margins of plants owned by acquirers and targets in the year prior to the acquisition. We find that both acquirers and targets operate profitable plants that tend to earn above-industry margins for all but two years covered by our sample. The median industry-adjusted margins of acquirer-owned plants are positive. Target-owned plants display a similar pattern. Industry-adjusted margins of acquirers tend to exceed those of targets, suggesting that acquirers are more productive than targets.

The last two columns of Table 2 report data on the deflated shipments of acquirers and targets. For each year

[8] We obtain the cutoffs for the deciles of the distribution of BE/ME from Ken French's Web site http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html for the relevant year.

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Table 2
Target and acquirer characteristics: target data market value available.

The table reports the mean and median (in parentheses) of selected characteristics of acquirers and targets. The sample consists of mergers from the SDC Platinum database in which the announcement date is between 1981 and 2000, the completion date is within 180 days of the announcement, the acquisition target is a domestic U.S. firm with at least one reported four-digit SIC code between 2000 and 3999, and the target has matching input/output data in the Longitudinal Research Database maintained at the U.S. Department of Commerce. The sample comprises firms for which the market value of the target is available. BE/ME decile and ME decile denote the book-to-market and NYSE market capitalization deciles to which the target belongs based on year $t-1$ values. The adjusted margin is the actual operating margin of a target plant minus the median margin for all plants that have the same three-digit SIC code. The deflated shipments equals the value of shipments for a plant reported in the ASM adjusted for inflation using the SIC deflator from the Bartelsman and Gray (1994) database.

Year	*BE/ME decile*	*ME decile*	*Adjusted margin (%)*		*Deflated shipments*	
	Target	Target	Acquirer	Target	Acquirer	Target
1981	5.61 (5)	3.89 (2.5)	1.28	0.87	254,814	152,447
1982	5.07 (4)	3.60 (3)	2.46	1.02	178,348	76,465
1983	4.65 (4)	2.5 (1)	3.62	0.57	81,614	42,277
1984	4.98 (5)	2.72 (1)	0.22	2.57	326,670	114,538
1985	4.69 (4)	3.32 (2)	1.69	0.83	237,487	154,729
1986	4.58 (4)	3.18 (2)	2.38	2.22	170,048	95,584
1987	4.85(4)	2.73 (2)	3.21	0.98	293,416	85,519
1988	5.08 (5)	2.63 (2)	5.64	4.36	195,577	119,498
1989	4.38 (4)	3.05 (2)	2.93	−0.48	135,143	65,729
1990	5.18 (4)	3.02 (2)	0.69	7.80	418,129	163,169
1991	5.84 (6)	2.94 (1.5)	0.92	−2.38	422,266	155,766
1992	3.75 (3)	2.93 (2)	1.57	1.57	430,009	55,630
1993	5.09 (4)	2.50 (2)	7.65	0.29	511,955	91,724
1994	4.72 (3)	2.94 (2)	5.63	3.65	377,213	94,126
1995	4.42 (4)	3.02 (2)	4.64	1.40	160,551	64,866
1996	4.76 (4)	2.65 (1)	3.72	2.96	322,041	111,002
1997	4.88 (4)	2.90 (2)	5.17	3.72	524,207	152,392
1998	5.39 (5)	3.06 (2)	3.82	3.07	1,225,467	154,534
1999	5.12 (5)	3.58 (3)	4.65	4.04	2,718,597	146,281
2000	4.73 (4)	3.49 (3)	4.91	3.58	1,455,530	107,710

in our sample, the median deflated shipments of acquirer plants is greater than that of target plants. Thus, manufacturing plants of acquirers tend to be larger than plants operated by targets. The ratio of plant sizes is somewhat lower than the (unreported) ratio of market values of acquirers to targets, reflecting the fact that in our sample, acquirers not only own larger plants than targets but also operate more plants than targets.

We also investigate, but do not report in Table 2, the cross-sectional characteristics of the subset of mergers for which both acquirer and target characteristics are available on Compustat and LRD. Except for 1983, the median and mean BE/ME deciles for acquirers are below 5.0. The median and mean BE/ME deciles for acquirers are significantly lower in the 1990s, when they are close to 2.0, suggesting that acquirers are more likely to be glamor firms in the 1990s. Interestingly, targets also tend to have median and mean BE/ME below 5, as in the larger sample in Table 2. Thus, both the acquirers and the targets tend to be growth firms rather than distressed or value firms. The low BE/ME deciles and the higher BE/ME for acquirers relative to targets mirrors similar evidence on the high margins and productivity in Table 2. One interpretation of this pattern is that the opportunity cost of suboptimally used capacity is high when there are more growth opportunities, so mergers tend to concentrate in firms and time periods in which there are more growth opportunities. Alternatively, it is also possible that mergers tend to occur when market valuations are relatively high, perhaps because firms can use their stock as currency for acquiring other companies, as in Shleifer and Vishny (2003) and Rhodes-Kropf and Viswanathan (2004).

For this subsample, we also examined the size of acquirers as reflected in the Fama-French market capitalization deciles. Except for 1981, the median and mean market capitalization decile for acquirers exceed 5.0, while median and mean target market value deciles are consistently below 4.0. In terms of actual market capitalization, the median acquirer size by year ranges from $381 million to $1.9 billion, about ten times the median size of targets. Acquirers in the late 1990s tend to have especially high market values relative to the target size.

3.3. Variable construction

3.3.1. Organizational form and relatedness

To obtain a measure of organizational structure, we aggregate each firm's plants that operate in each industry into portfolios at the three-digit SIC code level. We call these firm-level industry portfolios of plants "segments." Segments, defined this way, capture all the plant-level operations of a firm in an industry.[9] We classify firms as single segment or multiple segment, based on the three-digit SIC code. We classify a firm as a multi-segment firm if it produces more than 10% of its sales in a second SIC code outside its principal three-digit SIC code. Using the 10% cutoff facilitates comparison with previous studies as 10% is the cutoff that public firms report. For multiple-segment firms, we also classify each segment as either a main segment or a peripheral segment. Main segments are segments whose value of shipments is at least 25% of the firm's total shipments. We classify a target firm's plants as being related to the acquiring firm if it has the same three-digit SIC code as a main division of the acquirer. Thus, within acquisitions, some plants can be classified as related and others as unrelated.

3.3.2. Plant-level measures of productive efficiency

We use two measures of productive efficiency: total factor productivity and operating margin. Both measures exclude indirect segment-level costs such as advertising or research and development. They focus on the operating or productive efficiency of plants.

One measure of productive efficiency is the total factor productivity (TFP) of a plant. We compute TFP not only to

[9] The segments we construct do not correspond to those reported by Compustat. Segment data reported by Compustat are subject to reporting biases. Firms have considerable flexibility in how they report segments, as shown by Pacter (1993). Firms may also have strategic reasons for the specific segments they choose or choose not to report, as Hayes and Lundholm (1996) shows. Hyland (1997) finds that only 72% of firms that report under the Financial Accounting Standards Board (FASB) standards that they go from one segment to more than one segment actually increase their number of segments. See also Villalonga (2004).

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examine post-merger performance but also to capture acquirer skill. We measure acquirer skill as the average TFP of a firm's peripheral divisions (segments with less than 10% of firm output). TFP takes the actual amount of output a plant produces with a given amount of inputs and compares it to a predicted amount of output. "Predicted output" is what the plant is expected to have produced, given the amount of inputs it used. A plant that produces more than the predicted amount of output has a greater-than-average productivity. This measure does not impose the restrictions of constant returns-to-scale and constant elasticity of scale that a "dollar in, dollar out" cash flow measure would require.

To calculate a plant's TFP and predicted output, we assume that the plants in each industry have a translog production function. This functional form is a second-degree approximation to any arbitrary production function, and therefore takes into account interactions between inputs. In estimating the production function we use the last five years of data for each plant. Thus, the first year of our data for which we have calculated productivity is 1979. For each industry, we estimate this production function, using an unbalanced panel with plant-level fixed effects. To estimate productivity, we take the translog production function and run a regression of log of the total value of shipments on the log of inputs, including cross-product and squared terms:

$$\ln Q_{it} = A + f_i + \sum_{j=1}^{N} c_j \ln L_{jit} + \sum_{j=1}^{N}\sum_{k=j}^{N} c_{jk} \ln L_{jit} \ln L_{kit}, \qquad (1)$$

where Q_{it} represents output of plant i in year t, and L_{jit} is the quantity of input j used in production for plant i for time period t. A is a technology shift parameter, assumed to be constant by industry, f_i is a plant-firm specific fixed effect (if a plant changes owners, a new fixed effect is estimated; we leave off the firm subscript for tractability) and $c_j = \sum_{i=1}^{N} c_{ji}$ indexes returns-to-scale. We deflate for industry price at the four-digit level.

We obtain our measure of plant-level TFP from Eq. (1). This measure has two components that we add together to get a measure of productivity. First, we have a plant-firm fixed effect, f_i. The fixed effect captures persistent productivity effects, such as those arising from managerial quality (Griliches, 1957; Mundlak, 1961, 1978). It also captures a segment's ability to price higher than the industry average. Second, we obtain a plant residual in each year. In each case, we standardize plant-level TFP by subtracting out industry average TFP in each year and dividing by the standard deviation of TFP for each industry. We standardize to control for differences in precision with which productivity is estimated within industries. This correction is analogous to a simple measurement error correction and is similar to the procedure used to produce standardized cumulative excess returns in event studies.[10]

We also calculate operating margins for each plant. The numerator of this margin is the value of shipments less the value of labor costs and all input costs, such as materials and energy. We divide this numerator by the value of shipments made by the plant. We industry-adjust a plant's operating margin in each year by subtracting out the industry median operating margin. All dollar values for this calculation are deflated to 1982 dollars using three-digit price with separate deflators from the Bureau of Economic Analysis for shipments, wage costs, materials, and energy. This operating margin differs from a typical accounting cash flow number because the plant-level data does not measure indirect and headquarter-level costs such as research and development (R&D).

We examine the change in industry-adjusted operating margins and TFP after mergers. In analyzing the changes over time, we control for predictable time-series variation in performance by subtracting the typical change that occurs for plants.[11] We estimate the typical change in TFP by regressing future changes in TFP (and operating margins) on initial TFP (operating margins) levels for all plants. Analogous to obtaining a coefficient of mean reversion, we obtain a coefficient for predicting the change in performance based on the initial level of productivity or operating margin for each year. We apply this coefficient to the initial levels of TFP (operating margins) for the plants of merging firms in our sample and compare actual performance to predicted performance. We also examine the mean and median changes in industry-adjusted performance without conditioning on the level of performance.

In estimating the operating margins and TFPs in our sample, we use data for over one million plant years, and for approximately 50,000 plants each year. In the productivity regression for each industry, we include three different types of inputs: capital, labor, and materials. All these data exist at the plant-level. Our productivity calculations do not capture any headquarters- or divisional-level costs that are not reported at the plant-level (i.e., overhead, research and development). The ASM also reports the value of shipments for each plant. We thus deflate the value of shipments by 1982 price deflators to get a real value of shipments. For all inputs and outputs measured in dollars, we adjust for inflation by using four-digit SIC deflator data from the Bartelsman and Gray (1994) database. Each input has to have a non-zero reported value. Kovenock and Phillips (1997) describe these inputs and the method for accounting for inflation and depreciation of capital stock in more detail.

3.3.3. Other firm and industry control variables

We also include other firm and industry variables in our regressions. We include the log of firm size and the number of plants operated by the firm at the beginning of the year. We also include the log of target size divided by acquirer size as a measure of relative size for the target to the acquirer. We define firm size as the total deflated value (using industry price deflators) of shipments in 1982 dollars. We also include four industry-level variables: INDRET—the two-year buy-and-hold return for the

[10] This standardization does not affect the results we report. The results have similar levels of significance when we do not standardize productivity in this manner.

[11] The literature on operating performance, e.g., Barber and Lyon (1996) and Lie (2001), emphasizes the importance of this correction. For instance, Lie writes that the failure to consider this introduces bias into ex-post performance statistics.

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Fama-French 48-industry group to which a target plant belongs; industry R&D ratio; INDMARG—the industry operating margin; and the standard deviation of the industry operating margin (SD—INDMARG). Industry R&D (IND R&D) is calculated as the sum of firm-level R&D from Compustat at the three-digit SIC code level, divided by the sum of firm-level sales in each year. INDMARG is the sum of firm-level operating income before depreciation from Compustat at the three-digit SIC code level, divided by the sum of firm-level sales in each year. SD—INDMARG is the standard deviation of the industry operating margin using the last ten years of data.

We include the target's book-to-market value of equity ratio in all regressions. This variable is constructed using the book value of equity from Compustat divided by the market value of equity in each year. An analogous variable is calculated for the acquiring firm. We also construct a variable to capture potential operating synergies between merging firms which we call "SYNERGY," which is the product of the industry-adjusted acquirer and target margins. The rationale for this variable is based on Rhodes-Kropf and Robinson (2008) who suggest that asset complementarities may arise when acquirers are matched with similar quality targets.

4. The decision to sell, keep, or close target plants

4.1. Overall disposition rates

Table 3 describes the status of target-owned plants acquired in a merger at the end of three years after the merger. We benchmark the selloff and closure rates against industry rates for firms not involved in mergers. These asset sales and closure rates are based on firms not involved in mergers that are in industries that experience a merger transaction in the same three-digit SIC code and year. Even in the relatively narrow window of three years, there is a high degree of turnover of just-acquired plants in our sample. In the aggregate sample, 12,893 plants change hands in acquisitions. Of these, only 54.42% continue to be operated by the acquirer three years after the acquisition. Of the remaining, 18.58% are closed, while 27.00% of the plants are sold off. We discuss basic patterns in these selloff rates and then turn to the cross-sectional tests.

One question is whether this vigorous rate of restructuring continues after three years. In unreported results, we extend out the period of time to five years and find that the percentage sold increase by 2.98% and the percentage closed increase by 6.62% compared to the original rates of 27% sold and 19% closed. Thus, the vast majority of restructuring occurs *within* three years. It does not seem likely that much learning about the acquirer's ability to operate assets takes place over this short period.

We also examine how the restructuring in our sample compares to the restructuring that follows targeted purchases of assets in partial-firm acquisitions. We construct the sample by analyzing targeted acquisitions of plants where the selling firm remains in existence after sales to the acquirer, and to avoid double-counting, we exclude sales that form part of the post-merger restructuring in Table 3. We find that in asset sales, the acquiring firm sells and closes a much lower amount of the plants purchased. Subsequent to the purchase, over the next three years the acquirer sells 6.8% of the assets purchased and closes 8.8% of the targeted purchases. It is clear from

Table 3
Disposition of target and acquirer plants.
The table reports the year +3 ownership status of plants, where the merger is completed in year 0. The sample consists of mergers from the SDC Platinum database in which the announcement date is between 1981 and 2000, the completion date is within 180 days of the announcement, the acquisition target is a domestic U.S. firm with at least one reported four-digit SIC code between 2000 and 3999, and the target has matching input/output data in the Longitudinal Research Database maintained at the U.S. Department of Commerce. Kept plants are still owned by the acquirer, sold plants are owned by a firm other than the acquirer, and closed plants are plants that shut down as of year +3. In each period, we classify the deals by the number of target plants acquired for target disposition and by the number of acquirer plants for acquirer disposition. 1980s transactions have a completion date between 1981 and 1989 and 1990s transactions form the complementary set. Industry benchmarks for asset sales and closures are from industries that experience a merger transaction in the same three-digit SIC code and year. A target plant is related if it belongs to the same three-digit SIC code as a main division of the acquirer.

(1) # Plants in deal	(2) # Total bought	(3) % Kept target	(4) % Closed target	(5) % Closed matched industry	(6) % Sold target (partial)	(7) % Sold target (total)	(8) % Sold matched industry	(9) % Sold acquirer (total)	(10) % Closed acquirer
Panel A: Full sample									
1–5	1,954	56.59%	16.15%	2.40%	9.29%	27.20%	7.19%	14.17%	3.13%
6–10	1,193	53.76%	21.38%	4.23%	13.67%	24.86%	10.8%	12.51%	3.88%
11–25	2,316	54.69%	19.96%	4.57%	17.79%	25.35%	12.62%	14.12%	5.25%
26–50	3,337	56.57%	16.98%	5.19%	22.07%	26.45%	14.01%	18.49%	5.02%
≥51	4,093	51.76%	19.44%	5.18%	26.07%	28.80%	10.96%	16.08%	5.08%
Total	12,893	54.42%	18.58%	3.29%	19.99%	27.00%	8.98%	14.69%	4.02%
Panel B: By time period									
1980s	6,710	50.33%	19.42%	3.71%	23.40%	30.25%	10.81%	15.57%	3.88%
1990s	6,183	59.15%	17.61%	2.89%	16.04%	23.24%	7.33%	13.95%	4.14%
Panel C: By relatedness									
Related	4,080	54.78%	17.72%		14.12%	22.53%			
Unrelated	8,813	51.02%	17.87%		21.51%	27.46%			

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these results that targeted asset purchases are quite different from whole-firm acquisitions, which are followed by much higher levels of selloffs.

4.2. Disposition by number of plants acquired

We also classify targets based on the number of target plants transferred in the M&A transaction. We sort the sample into five bins: 1–5 plants acquired, 6–10 plants acquired, 11–25 plants acquired, 26–50 plants acquired, and more than 51 plants acquired. We examine whether the tendency to dispose of acquired plants is more pronounced when a large number of target plants are acquired. This outcome is likely, for instance, if the acquirer has a comparative advantage in operating only some of a multi-division target's lines of business or if it buys multi-plant targets with a view of creating value by breaking up the plants, as in the bustup mergers analyzed by Berger and Ofek (1996).

Table 3 suggests that the tendency to dispose of acquired plants is not necessarily concentrated in multi-plant target acquisitions. To the first order, the fraction of the target plants kept at the end of year 3 by the acquirer remains flat at about 55%, when up to 50 plants are transferred in acquisitions. The kept proportion declines to about 52% when more than 50 plants are acquired. About one-quarter of all plants acquired are sold off by year 3 and this proportion does not vary much with the number of plants transferred in the acquisition.

The industry-size-year benchmarks for firms not involved in mergers are much lower than the rates shown for firms involved in mergers. The benchmark probability of plant sale is 7.2% if the firm has 1–5 plants, rising to 14% if firms have 26–50 plants, with an overall sale rate of 8.98%. These rates are only about one-third of the proportion sold off for target firms involved in acquisitions. The probability of plant closure after mergers is 16% if only 1–5 plants are transferred in the acquisition and is relatively flat at about 20% when at least five plants are transferred in the merger transaction against industry-size-year benchmarks for non-merging firms of 2.4% for matched industry firms with 1–5 plants and about 5% for matched firms with more than five plants. The last two columns of Table 3 report selloff and closure rates for plants owned by the acquirer prior to merger. These rates tend to be higher than benchmarks but lower than target plant disposal rates. As we discuss below, this difference can be explained by differences in observed plant characteristics of the acquirer-owned plants.

Overall, the summary statistics suggest that there is significant post-merger restructuring of plants in a short period of three years after merger completion. Acquirers do not passively absorb the newly acquired plants. This finding provides little support for a pure empire-building motivation for acquisitions that would predict that acquirers retain the bulk of assets acquired through a merger.

4.3. Disposition in the 1980s versus the 1990s

The merger wave in the 1980s is often characterized as the unwinding of the conglomerate expansion wave of the 1960s and 1970s. If so, the probability of retaining a plant should be higher in the 1990s compared to the 1980s. Table 3 shows that the overall percentage of kept plants is higher at 59% in the 1990s deals compared to 50% in the 1980s. In unreported results, we also find that the total number of plants in large acquisitions involving at least 51 plants, in which the undoing of inefficiently large firms is more likely to be a prime objective, is 2,497 plants in the 1980s, almost 55% more than the 1,596 plants transferred in large acquisitions in the 1990s.

4.4. Relatedness

We next classify the post-merger disposition decision by the type of acquisition. If expansion of managerial scope motivates related acquisitions, as in Maksimovic and Phillips (2002), related acquisitions should result in greater retention of target plants. However, if acquisitions are carried out with the view of shutting down extra capacity, perhaps for reasons of maximizing profits in an oligopolistic setting, there could be more closures in related acquisitions. Antitrust concerns would also predict lower likelihood of retention in acquisitions that are related. We measure relatedness at the plant level, based on whether target plants have the same three-digit SIC code as an acquirer's main division. In our sample, 4,080 related plants are acquired while 8,813 plants are not related. We find that 55% of related plants are kept, while 51% of unrelated plants are kept. There are similar differences in the selloff decision. For related plants, 22.5% are sold off, while 27.5% of unrelated plants are sold off.

5. Disposal of plants: multinomial logit

The high proportion of target plants that are sold suggests that a pure taste for big empires cannot be the only driver of acquisitions. In this section, we analyze the cross-sectional variation in disposition decisions of acquirers to test whether the patterns are consistent with neoclassical theories of firm scope. To test these hypotheses, we examine how the proportion of plants acquired depends on the marginal skill of the acquirer and the opportunity cost of retaining the acquired plants. We also include other control variables, including the size of the acquisition, acquirer characteristics, industry conditions, the characteristics of the acquired plants, and their position in the organizational structure of the target.

We estimate the decision to keep, sell, or close a target plant acquired after a merger using a multinomial logit model.[12] The dependent variable in this model is 0, 1, or 2 depending on whether the plant is sold, kept, or closed, respectively. Thus, the baseline decision is to keep a plant, and Table 4 reports estimates for the decision to sell off an acquired target plant (Panel A) or the decision to close the plant (Panel B) relative to the baseline decision to keep.

[12] A Hausman test confirms the validity of the independence of irrelevant alternatives assumption in the multinomial logit.

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Table 4
Multinomial logit for plant disposal.

The table reports logit estimates of the decision to sell or close acquired plants by year +3 after acquisition completion for the sample used in Table 3. RELATED is 1 if the target's main business overlaps with an acquirer main division and zero otherwise. TMAIN is 1 if the plant's output is at least 25% of the total target output and zero otherwise. TBEME is the target's book-to-market ratio decile. AMARG (TMARG) denote the acquirer (target) operating margin at the firm (plant) level less the three-digit SIC median. ASKILL is the average three-digit SIC industry-adjusted margin of acquirer plants outside the main divisions. IND R&D (INDMARG) denotes the aggregate R & D expenditure (operating margin) of all firms in the plant's three-digit SIC code. INDRET is the (t, $t+2$) buy-and-hold return for the plant's Fama-French 48-industry group. SYNERGY is the product of acquirer and target industry-adjusted margins. SD(INDMARG) is the standard deviation of operating margins of all plants in the same three-digit SIC code. TRELSIZE is the ratio of the aggregate deflated output of the target to that of the acquirer. ANUMPLANT and LN(AOUTPUT) denote the number of plants owned by and log deflated output of the acquirer. 1980s is 1 for mergers completed between 1981 and 1989 and zero otherwise. z-statistics based on robust standard errors, clustered at the industry level with correlation within firm panel units, are reported in parentheses.

Independent variable	*Specification #*				
	(1)	(2)	(3)	(4)	(5)
Panel A:Dependent variable: decision to sell plant					
RELATED	−0.80 (−8.73)[a]	−0.81 (−8.67)[a]	−0.75 (−7.93)[a]	−0.73 (−7.63)[a]	−0.72 (−7.59)[a]
TMAIN	−0.91 (−13.59)[a]	−0.91 (−13.69)[a]	−0.95 (−14.02)[a]	−0.95 (−13.94)[a]	−0.96 (−13.88)
TBEME	0.09 (1.77)[c]	0.08 (1.62)	0.10 (2.03)[b]	0.09 (1.81)[c]	0.09 (1.70)[c]
TMARG	−0.76 (−6.42)[a]	−0.75 (−6.22)[a]	−0.78 (−6.36)[a]	−0.78 (−6.4)[a]	−0.73 (−5.29)[a]
AMARG		−0.07 (−0.24)	−0.31 (−0.98)	−0.31 (−1.00)	−0.35 (−1.11)
INDRET			0.19 (2.37)[b]	0.20 (2.54)[b]	0.22 (2.84)[a]
ASKILL		−0.94 (−2.47)[b]	−1.00 (−2.59)[b]	−0.093 (−0.19)	−0.033 (−0.08)
ASKILL* INDRET				−3.22 (−3.05)[a]	−3.36 (−3.28)[a]
SYNERGY					−4.11 (−3.87)[a]
IND R&D			3.69 (2.83)[a]	3.53 (2.7)[a]	3.56 (2.70)
SD (INDMARG)			−0.55 (−0.56)	−0.563 (−0.57)	−0.34 (−0.35)
INDMARG			1.01 (3.23)[a]	0.99 (3.18)[a]	1.01 (3.24)[a]
TRELSIZE	0.08 (1.54)	0.08 (1.52)	0.06 (1.24)	0.06 (1.26)	0.06 (1.17)
LN (AOUTPUT)	0.06 (2.45)[b]	0.05 (2.37)[b]	0.05 (2.16)[b]	0.05 (2.18)[b]	0.04 (1.88)[c]
ANUMPLANT	0.00 (0.66)	0.00 (0.67)	0.00 (0.80)	0.00 (0.73)	0.00 (0.75)
1980s	0.28 (4.54)[a]	0.27 (4.45)[a]	0.32 (5.07)[a]	0.32 (4.98)[a]	0.31 (4.76)[a]
Constant	−0.86 (−2.79)[a]	−0.82 (−2.63)[a]	−1.06 (−2.91)[a]	−1.07 (−2.93)[a]	−1.01 (−2.73)[a]
Panel B: Dependent variable: decision to close plant					
RELATED	−0.43 (−4.24)[a]	−0.43 (−4.18)[a]	−0.35 (−3.33)[a]	−0.35 (−3.36)[a]	−0.35 (−3.33)
TMAIN	−0.46 (−6.72)[a]	−0.46 (−6.77)[a]	−0.49 (−7.01)[a]	−0.49 (−7.02)[a]	−0.48 (−6.68)
TBEME	−0.01 (−0.22)	−0.01 (−0.22)	0.05 (0.86)	0.04 (0.85)	0.05 (0.93)
TMARG	−0.77 (−6.27)[a]	−0.79 (−6.17)[a]	−0.75 (−5.87)[a]	−0.75 (−5.86)[a]	−0.64 (−4.07)
AMARG		0.12 (0.39)	−0.14 (−0.46)	−0.15 (−0.49)	−0.15 (−0.46)
INDRET			0.06 (0.67)	0.06 (0.70)	0.08 (0.96)
ASKILL		−0.45 (−1.17)	−0.54 (−1.40)	−0.64 (−1.42)	−0.67 (−1.57)
ASKILL* INDRET				0.19 (0.19)	−0.07 (−0.08)
SYNERGY					−3.06 (−2.61)[a]
IND R&D			4.86 (3.72)[a]	4.88 (3.73)[a]	4.94 (3.73)[a]
SD (INDMARG)			2.55 (2.40)[b]	2.55 (2.4)[b]	2.80 (2.40)[b]
INDMARG			1.10 (3.37)[a]	1.09 (3.33)[a]	1.13 (3.26)[a]
TRELSIZE	−0.12 (−2.36)[b]	−0.12 (−2.38)[b]	−0.12 (−2.33)[b]	−0.12 (−2.3)[b]	−0.11 (−2.04)[b]
LN (AOUTPUT)	−0.14 (−5.69)[a]	−0.14 (−5.76)[a]	−0.13 (−5.42)a	−0.13 (−5.4)[a]	−0.13 (−5.22)[a]
ANUMPLANT	0.00 (0.66)	0.00 (0.72)	0.00 (1.23)	0.00 (1.22)	0.00 (1.14)
1980s	0.35 (5.39)[a]	0.34 (5.36)[a]	0.43 (6.44)[a]	0.43 (6.45)[a]	0.44 (6.45)[a]
Constant	1.21 (3.82)[a]	1.23 (3.88)[a]	0.16 (0.42)	0.17 (0.45)	0.12 (0.30)
N	8,164	8,164	8,026	8,026	7,859
Pseudo-R^2	0.04	0.04	0.045	0.046	0.048

[a] = *significant at 1%*, [b] = *significant at 5%*, [c] = *significant at 10%*.

Standard errors are robust and control for industry and firm clustering. Table 4 presents the logit coefficients and Table 5 presents marginal effects including the implied marginal effects for the decision to keep a plant.

We report estimates of five specifications that vary according to the explanatory variables included in the model. We divide the explanatory variables into several groups. One group includes characteristics of the transacting firms and the plants' position in their organizational structure. The second group pertains to the target plants' industry. The final group of explanatory variables includes additional acquirer characteristics and interactions with industry variables, which allow us to further test predictions about efficient disposal decisions. Specification (1) reports the effect of the target plant characteristics. Acquirer characteristics are added in specification (2). Here, we also introduce a dummy variable for the 1980s time period to control for the potential changes in the disposal decision between the 1980s and the 1990s. Specification 3 includes the key acquirer operating margins and skill variables to test the key predictions of the comparative advantage theory. Finally, specifications (4) and (5) add several industry-level variables, industry return and its interaction with peripheral

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Table 5
Logit marginal effects.

The table reports marginal effects for the logit estimates in Table 4. RELATED is 1 if the target's main business overlaps with an acquirer main division and zero otherwise. TMAIN is 1 if the plant's output is at least 25% of the total target output and zero otherwise. TBEME is the target's book-to-market ratio decile. AMARG (TMARG) denote the acquirer (target) operating margin at the firm (plant) level less the three-digit SIC median. ASKILL is the average three-digit SIC industry-adjusted margin of acquirer plants outside the main divisions. IND R&D (INDMARG) denotes the aggregate R & D expenditure (operating margin) of all firms in the plant's three-digit SIC code. INDRET is the $(t, t+2)$ buy-and-hold return for the plant's Fama-French 48-industry group. SYNERGY is the product of acquirer and target industry-adjusted margins. SD(INDMARG) is the standard deviation of operating margins of all plants in the same three-digit SIC code. TRELSIZE is the ratio of the aggregate deflated output of the target to that of the acquirer. ANUMPLANT and LN(AOUTPUT) denote the number of plants owned by and log deflated output of the acquirer. 1980s is 1 for mergers completed between 1981 and 1989 and zero otherwise. *z*-statistics based on robust standard errors, clustered at the industry level with correlation within firm panel units, are reported in parentheses.

	Specification #				
Independent variable	(1)	(2)	(3)	(4)	(5)
Marginal effect on keep decision					
RELATED	0.16 (8.02)[a]	0.16 (7.96)[a]	0.14 (7.00)[a]	0.14 (6.81)[a]	0.14 (6.73)[a]
TMAIN	0.16 (13.48)[a]	0.17 (13.58)[a]	0.17 (13.99)[a]	0.17 (13.94)[a]	0.17 (13.67)[a]
TBEME	−0.01 (−1.00)	−0.01 (−0.90)	−0.18 (−1.83)[a]	−0.02 (−1.67)[c]	−0.02 (−1.71)[c]
TMARG	0.18 (7.87)[a]	0.18 (7.66)[a]	0.18 (7.56)[a]	0.18 (7.57)[a]	0.17 (5.88)[a]
AMARG		0.00 (−0.07)	0.05 (0.93)	0.06 (0.95)	0.06 (0.99)
ASKILL		0.17 (2.3)[b]	0.19 (2.52)[b]	0.08 (0.92)	0.08 (0.94)
INDRET			−0.03 (−1.94)[c]	−0.03 (−2.07)[b]	−0.04 (−2.42)[b]
ASKILL* INDRET				0.39 (2.02)[b]	0.44 (2.26)[b]
SYNERGY					0.87 (4.01)[a]
IND R&D			−1.02 (−3.98)[a]	−1.00 (−3.91)[a]	−1.00 (−3.95)[a]
SD (INDMARG)			−0.21 (−1.07)	−0.21 (−1.07)	−0.27 (−1.32)
INDMARG			−0.25 (−4.09)[a]	−0.25 (−4.03)[a]	−0.25 (−4.05)[a]
TRELSIZE	0.00 (0.34)	0.00 (0.37)	0.00 (0.49)	0.00 (0.49)	0.00 (0.44)
LN (AOUTPUT)	0.01 (1.82)[c]	0.01 (1.92)[c]	0.01 (1.80)[c]	0.01 (1.80)[c]	0.01 (1.91)[c]
ANUMPLANT	0.00 (−0.82)	0.00 (−0.86)	0.00 (−1.25)	0.00 (−1.28)	0.00 (−1.19)
1980s	−0.07 (−6.28)[a]	−0.07 (−6.2)[a]	−0.09 (−7.26)[a]	−0.09 (−7.24)[a]	−0.09 (−7.03)[a]
Marginal effect on sell decision					
RELATED	−0.13 (−7.22)[a]	−0.13 (−7.17)[a]	−0.13 (−6.74)[a]	−0.12 (−6.46)[a]	−0.12 (−6.42)[a]
TMAIN	−0.13 (−13.03)[a]	−0.13 (−13.13)[a]	−0.14 (−13.46)[a]	−0.14 (−13.37)[a]	−0.14 (−13.45)
TBEME	0.01 (1.91)[c]	0.01 (1.75)[c]	0.02 (1.90)[c]	0.01 (1.67)[c]	0.01 (1.55)
TMARG	−0.10 (−5.08)[a]	−0.09 (−4.89)[a]	−0.10 (−5.17)[a]	−0.10 (−5.21)[a]	−0.10 (−4.48)[a]
AMARG		−0.02 (−0.34)	−0.05 (−0.91)	−0.05 (−0.93)	−0.05 (−1.04)
ASKILL		−0.14 (−2.3)[b]	−0.15 (−2.36)[b]	0.01 (0.12)	0.02 (0.31)
INDRET			0.03 (2.3)[b]	0.03 (2.47)[b]	0.03 (2.74)[a]
ASKILL* INDRET				−0.55 (−3.21)[a]	−0.56 (−3.48)[a]
SYNERGY					−0.57 (−3.37)[a]
IND R&D			0.43 (2.05)[b]	0.40 (1.92)[c]	0.40 (1.91)[b]
SD (INDMARG)			−0.19 (−1.21)	−0.20 (−1.22)	−0.17 (−1.05)
INDMARG			0.13 (2.51)[b]	0.12 (2.46)[b]	0.12 (2.50)[b]
TRELSIZE	0.02 (2.19)[b]	0.02 (2.17)[b]	0.02 (1.85)[c]	0.02 (1.88)[c]	0.01 (1.75)[c]
LN (AOUTPUT)	0.01 (4)[a]	0.01 (3.93)[a]	0.01 (3.61)[a]	0.01 (3.63)[a]	0.01 (3.30)[a]
ANUMPLANT	0.00 (0.50)	0.00 (0.50)	0.00 (0.50)	0.00 (0.44)	0.00 (0.47)
1980s	0.03 (3.34)[a]	0.03 (3.25)[a]	0.04 (3.65)[a]	0.04 (3.55)[a]	0.03 (3.36)[a]
Marginal effect on close decision					
RELATED	−0.03 (−1.68)[c]	−0.03 (−1.62)	−0.02 (−1.04)	−0.02 (−1.17)	−0.02 (−1.20)
TMAIN	−0.03 (−3.46)[a]	−0.03 (−3.48)[a]	−0.04 (−3.69)[a]	−0.04 (−3.73)[a]	−0.04 (−3.49)[a]
TBEME	−0.01 (−0.67)	0.00 (−0.64)	0.00 (0.38)	0.00 (0.42)	0.00 (0.47)
TMARG	−0.09 (−4.88)[a]	−0.09 (−4.85)[a]	−0.08 (−4.50)[a]	−0.08 (−4.48)[a]	−0.07 (−2.99)[a]
AMARG		0.02 (0.47)	−0.01 (−0.20)	−0.01 (−0.22)	−0.01 (−0.19)
ASKILL		−0.03 (−0.54)	−0.04 (−0.76)	−0.09 (−1.40)	−0.10 (−1.64)[c]
INDRET			0.00 (0.08)	0.00 (0.07)	0.00 (0.24)
ASKILL* INDRET				0.16 (1.11)	0.12 (0.97)
SYNERGY					−0.30 (−1.78)[c]
IND R&D			0.59 (3.14)[a]	0.60 (3.18)[a]	0.60 (6.17)[a]
SD (INDMARG)			0.41 (2.65)[a]	0.41 (2.65)[a]	0.43 (2.57)[a]
INDMARG			0.13 (2.68)[a]	0.13 (2.66)[a]	0.13 (2.62)[a]
TRELSIZE	−0.02 (−2.89)[a]	−0.02 (−2.91)[a]	−0.20 (−2.78)[a]	−0.02 (−2.80)[a]	−0.02 (−2.44)[b]
LN (AOUTPUT)	−0.02 (−6.57)[a]	−0.02 (−6.61)[a]	−0.02 (−6.21)[a]	−0.02 (−6.23)[a]	−0.02 (−5.92)[a]
ANUMPLANT	0.00 (0.52)	0.00 (0.58)	0.00 (1.08)	0.00 (1.09)	0.00 (1.00)
1980s	0.04 (4.47)[a]	0.04 (4.45)[a]	0.05 (5.45)[a]	0.05 (5.48)[a]	0.05 (5.58)[a]

[a] = *significant at 1%*, [b] = *significant at 5%*, [c] = *significant at 10%.*

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skill, and the SYNERGY variable. We discuss the results from these sets of variables in the next sections.

5.1. Target characteristics

Panels A and B of Tables 4 and 5 show that relatedness of target plants (i.e., whether they produce in a similar three-digit SIC code to the acquirer's existing divisions) and central plants (TMAIN) in the target's organization are less likely to be sold than similar plants belonging to the target's peripheral divisions. Both variables are statistically significant and economically material and their effects persist across specifications. At the median of the sample data, the marginal effects of belonging to the target's main division and being in an industry related to the acquirer are of similar magnitude and each reduce the probability of the plant being sold by approximately 13% in most specifications.

The significance of the RELATED variable is consistent with the acquirer exploiting its core ability and expanding in divisions that are more productive. Its sign is not consistent with antitrust motivations for divestment, since antitrust concerns would predict less retention of related assets while we find greater retention of assets that are related.[13] The significance of TMAIN, and more broadly the fact that acquirers tend to keep only some parts of the target, suggests that acquirers buy whole firms when they are only interested in some parts of the target firm.

A question that naturally arises is whether acquirers should buy the parts of the target they are interested in or acquire the whole firm and divest its unwanted parts. We leave this theoretical and empirical issue for future work. From conversations with investment bankers, it appears that taxes are partially responsible for this choice. Asset purchases above their book values from C corporations would result in taxes paid by the selling firm and also additional taxes when proceeds are distributed to shareholders. Full-firm purchases structured as stock purchases, followed by sale of unwanted peripheral divisions, can reduce taxes paid at the time of transaction.

The next variable in the logit model is the industry-adjusted profitability of a target plant, TMARG. We expect that profitable plants are a priori less likely to be closed. Since a merger increases firm size and thereby the opportunity cost of managing a plant for the acquirer, the neoclassical model also predicts that less productive plants are likely to be sold to other firms which are below their target size, and therefore have a lower opportunity cost of running the plant. Thus, we would expect a negative relation between TMARG and the decision to sell a plant. We find evidence for this view.

The TMARG profitability variable is a statistically significant predictor of the decision to sell and it has a negative coefficient. The marginal effect of the target plant's operating margin (TMARG) is between 9% and 10% (Table 5, Panel B). Target plant profitability matters even after including other controls for the decision to sell. The marginal effect of a plant's operating margin on the retention probability is an economically significant 18% (Table 5, Panel A). Profitability is also significant in explaining the closure decision, as shown in Panels B and C of Tables 4 and 5.

The variable TMARG controls for profitability at the plant level. We supplement this with the target book-to-market ratio as a potential predictor of the disposition decision. The associated variable, TBEME, is the BE/ME decile to which a target belongs. TBEME should capture the future profitability or the growth prospects of targets, at the level of the enterprise being acquired. The target firm's book-to-market ratio is positively related to the probability of sale at significance levels of between 1% and 10% depending on specification.[14] An alternative interpretation is that high TBEME indicates targets with low valuations. Thus, a positive coefficient for TBEME indicates that low-valued targets are more likely to result in a post-merger asset sale, perhaps because the target's portfolio of assets was suboptimal. Table 5 indicates that the marginal effect of book-to-market is more modest than that of TMARG, and ranges from 1% to 2% in the selloff decision at significance levels ranging from 1% to 10%. TBEME has relatively little effect on the closure decision, where it tends to be economically and statistically insignificant.

5.2. Acquirer characteristics

Specification (2) of Tables 4 and 5 introduces controls for acquirer size. Following our discussion of the effect of the productivity of marginal plants on the decision to retain in Section 2, we include the size of the target relative to acquirer size (TRELSIZE). Relatively larger acquisitions move the firm further from its optimal boundary and are predicted to result in larger divestitures.[15] In addition, we include the logarithm of the deflated output and following Table 3, the number of plants transferred in the acquisition as additional controls. The coefficient for the aggregate acquirer output is positive, suggesting that large acquirers are more likely to divest target plants. The marginal effect of this variable on the retention probability is about 1%. Marginal effects for TRELSIZE reported in Table 5 are positive and significant.These results are consistent with the predictions of Maksimovic and Phillips (2002) model in which there are decreasing returns-to-scale with larger acquisitions moving the firm farther away from its optimal boundary. As a result, a large acquisition increases the probability that an acquired plant will be sold.

Specification (3) of Tables 4 and 5 introduces other acquirer characteristics. The overall acquirer margin, AMARG, is insignificant. Thus, the probability that a plant is sold does not depend on the acquirer's overall operating margin, so more profitable acquirers do not sell plants with a higher probability than less profitable

[13] We also discuss later how including industry concentration measures from the Census does not change these results.

[14] Note that high values of book-to-market are associated with higher target plant sales even after controlling for industry margins, stock price run-ups and R&D levels in specifications (4) and (5) (Table 5, Panels A and B).

[15] See also Healy, Palepu, and Ruback (1991) for a discussion of the effect of relative acquirer and target size of merger outcomes.

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acquirers. On the other hand, the acquirer's productivity in its marginal businesses matters. Consistent with the neoclassical model of firm scope, we find that in specifications (3) and (4), as predicted, the profitability of acquirer's peripheral plants (ASKILL) reduces the probability that the acquirer will sell an acquired plant. Thus, a firm whose marginal divisions have low profitability is less likely to retain a newly acquired plant by an economically significant marginal effect of 17% as shown in Table 5, Panel C.

The significance of ASKILL is consistent with the prediction that as a firm's scope increases, its ability to operate plants efficiently at the margin decreases. A firm whose marginal divisions are relatively inefficient is less likely to increase its size by retaining plants acquired in a merger, holding all other things equal. The significance of ASKILL is particularly striking in light of the insignificance of the *overall* acquirer margin, AMARG. The decision to retain a plant is better viewed as a function of the acquirer's ability at the margin rather than its average ability, precisely as predicted by neoclassical theories in which mergers are driven by changes in optimal firm scope. We also include SYNERGY in specification (5). The results show that there is greater retention and less closure in higher synergy acquisitions. We also split SYNERGY into separate variables to see if SYNERGY is significant for cases when both acquirer and target industry-adjusted margins are positive (SYNERGY positive) and when both are negative (SYNERGY negative). We find no differences in selloffs when high margin firms buy high margin firms and low margin firms buy low margin firms.

5.3. Industry characteristics

Specifications (4) and (5) in Tables 4 and 5 introduce several industry variables. These variables capture the industry conditions because the decision to retain or sell a plant is likely to depend on the value of assets to other industry participants and based on industry shocks, as in studies by Mitchell and Mulherin (1996). We capture the opportunity cost and the value in the industry after industry shocks using the industry return in the two years subsequent. Furthermore, the changing opportunities within an industry, which is captured by industry variability, could also affect the decision to sell a plant.

Specification (4) shows that plants in industries that experience a run-up in market valuation have a significantly higher probability of being sold, as shown by the significant coefficient of INDRET. Table 5 shows that the marginal effect of INDRET on the probability of an asset sale is 3%. Following Maksimovic and Phillips (2002), the opportunity cost of retaining a plant following a positive shock in the industry is likely to be higher when the plant owner is *less* efficient. Such producers are better off selling their capacity after a positive industry shock because the capacity they own is more productively used outside the firm. We test for this explanation in specification (6) in Tables 4 and 5 by interacting the industry return run-up (INDRET) with the efficiency of the acquirer's peripheral divisions (ASKILL). Consistent with this opportunity cost prediction, newly acquired plants are more likely to be sold following positive industry returns but these sales are less likely when the acquirer is not efficient in running peripheral divisions. Efficient acquirers are significantly less likely to sell plants after a positive industry shock than at other times.

Table 4 also reports coefficients for other variables. Plant sales following mergers are more likely in high R&D industries. Greater variability in industry margins is not related to the probability of sale. However, the level of industry margin matters. Sales are more likely when industries have high operating margins. From Table 5, the marginal effect of operating margin on the probability of sales is 12%. We also find evidence that the time period matters. The 1980s dummy variable is positive and significant.

The estimates for the probability of plant closure are presented in Panel B of Table 4. Acquired plants in the target's main division, plants with high operating margins, and plants in industries related to the acquirer are less likely to be closed. Plants in mergers where the target is large relative to the acquirer, and where the acquirer itself is large, are also less likely to be closed. We also find other significant industry effects. The probability of a closure of an acquired plant is higher in high R&D industries, industries with high operating margins and industries in which the dispersion of plant productivities is high. Closures were significantly higher in the 1980s, running at a 4–5% higher rate as shown in Panel B of Table 5. The lower probability of plant retention in the 1980s transactions supports a widely held view that the 1980s mergers reversed the conglomerate wave of the 1960s and 1970s.

In contrast to the sales decision, we do not find that the decision to close a plant is related to the productivity of the acquirer's peripheral divisions, the run-up in stock prices, or the interaction of the two. Thus, closure does not depend on changes in the opportunity cost of operating the plant by the acquirer. Similarly, the acquirer's operating margin does not predict plant closures. The requirement that the NPV be non-negative for the plant to remain open is less likely to be sensitive to the marginal changes in the comparative advantage of the owner, especially since the opportunity cost of closing the plant is selling it to the highest bidder, whose bid may change in different ways from that of the owner in response to an industry shock. This contrasts with the sale decision, which is sensitive to shifts in the relative opportunity costs of ownership, which themselves change as the efficiencies of different producers in the industry shift in response to industry shocks.

We also examine the role of industry concentration and industry fixed effects. Industry concentration could matter because antitrust officials may require acquirers to sell off target plants in highly concentrated industries. Industry concentration is not significant in explaining post-merger restructuring decisions. In fact, the coefficient for concentration is opposite to the antitrust explanation. As industry concentration increases, acquiring firms are less likely to sell off plants and more likely to close plants. The sign of industry concentration is more consistent with the conjecture that acquirers in concentrated industries are eliminating productive capacity belonging to rivals. The coefficients are never significant,

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as the p-value for the coefficient on the concentration ratio in the selloff specification is 0.133 and for the closure specification is 0.142. We also reestimate Table 4 after replacing all the industry variables by three-digit industry fixed effects. With one exception, the coefficient estimates for acquirer and target variables were within 5% of values reported here, and at the same level of significance. The exception is the coefficient of ASKILL, which increased from a 5% to a 1% level of significance with the three-digit industry dummies.

The logit estimates provide compelling evidence that acquiring firms, on average, make economically rational asset disposal decisions. Assets in the target's main divisions and assets that are in industries related to acquirer are more likely to be retained. Assets whose opportunity costs have increased are more likely to be sold. Acquirers who are efficient in operating marginal plants are more likely to retain purchased plants. In particular, acquirers who are efficient at operating marginal plants are more likely to retain them following positive shocks to the industry. There are the states in which the neoclassical model predicts that the acquirer has a higher comparative advantage in retaining the plant. Importantly, the decision to dispose of or retain the asset depends on the acquirer efficiency at the margin, in line with theories of firm scope.

5.4. Method of payment and acquirer financial constraints

Thus far, our results indicate that there is substantial post-merger restructuring of targets that is explained by several characteristics of the acquired assets and the assets of the acquiring firm. We next examine the role of the financing side in explaining post-merger restructuring.

Eckbo (2008) reviews the extensive literature on the method of payment in mergers and acquisitions and highlights the fact that stock payments are becoming more prevalent in the U.S. As Eckbo points out, the method of payment literature is mainly concerned about the relation between method of payment, bidding, and announcement effects. Post-merger restructuring is not considered or explicitly modeled in these theories. Implications for restructuring come from theories such as Hansen (1987) or Fishman (1989) in which stock payment manifests uncertainty and asymmetric information about the target's value for the acquirer. If mergers that require extensive restructuring of targets involve more uncertainty about outcome and more information asymmetry, stock financing should be associated with more post-merger restructuring while cash should involve more "buy-and-hold" type of mergers. We test this prediction.[16]

We use the SDC mergers and acquisitions database to identify the method of payment. As Eckbo (2008) points out (see his Fig. 4), many purchases involve stock and cash payments in varying proportions. We handle the varying percentages in two different ways. First we just use the actual percentage of cash paid. Second, we also classify deals into cash and stock deals based on whether the cash payment is greater than or equal to 50% of the total consideration paid for the target. The results are similar under either approach so we report the ones based on the method of payment dummy.

We present these results in Table 6. Each specification reported in the table includes both the financial variables of interest and, as controls, the full set of variables drawn from Table 4. The coefficient for cash is negative and at best, weakly significant ($p=0.10$) so a target plant is less likely to be sold if the acquisition is cash financed than if it is stock financed. Column 1 of Table 6 shows that the method of payment is unrelated to the plant closure decision. Including the payment method does not materially affect the sign or significance of the control variables included in our regression.

We also consider the possibility that financial constraints matter. For instance, firms that are financially constrained may be more likely to sell off assets to generate scarce resources for their main businesses. Financial constraints may be correlated with stock-financed mergers because constrained firms may also be less willing to use cash to pay for acquisitions. While constraints may be related to selloffs, they are less likely to affect closures to the same degree if selling viable plants generates more resources than closure of loss-making plants. Accordingly, we test whether financial constraints affect post-merger restructuring, with more pronounced effects on selloffs relative to closures.

Prior research suggests two lines of attack to develop proxies for financial constraints. One approach is to use an index of financial constraints. An early contribution is the KZ index derived by Kaplan and Zingales (1997) and developed by Lamont, Polk, and Saa-Requejo (2001). However, recent work (Almeida, Campello, and Weisbach, 2004; Faulkender and Wang, 2006; Hadlock and Pierce, 2010; Denis and Sibilkov, 2010) suggests that the index is less useful than individual firm attributes that might proxy for constraints.[17] Both approaches give similar results. Proxies for financial constraints include leverage, a dividend-paying status indicator variable, whether or not the firm has a long-term debt rating, and the cash balances held by a firm divided by assets.[18] Table 6 presents the logit results for selloffs and closures, respectively. More highly levered firms, non-dividend

[16] Eckbo discusses other explanations for payment method but they find little empirical support or make no specific predictions about restructuring. For instance, Eckbo argues tax motivations for payment method are not supported by empirical evidence (Franks, Harris, and Mayer, 1988; Eckbo and Langohr, 1989). Behavioral theories based on overvaluation (e.g., Shleifer and Vishny, 2003; Rhodes-Kropf and Viswanathan, 2004) argue that acquisitions monetize overvalued stock but make no predictions either about the specific types of assets acquired or the (extensive) magnitude and direction of the follow-on restructuring.

[17] See, e.g., Hadlock and Pierce (2010) who discuss Kaplan-Zingales and Whited and Wu (2006). They argue that not all components of KZ, which is derived from 49 firms and 719 firm-years, have the predicted signs in their larger sample of 356 firms and 1,848 firm-years.

[18] The restructuring logits already include firm size and profitability. We remain wary of interpreting size as a primary proxy for financing constraints because of its theory of the firm implications. Finally, as Hadlock and Pierce (2010) note, cash has a dual interpretation. High cash balances may indicate unconstrained firms or very constrained firms that optimally hold cash towards a precautionary motive.

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Table 6
Multinomial logit—method of payment, leverage, and financing.

The table reports estimates of a multinomial logit that models an acquirer's decision to sell or close a target plant relative to the baseline of keeping the plant. PCASH is 1 if cash is used to pay for at least 51% of the acquisition cost. PCASH INTERNAL is 1 if the acquirer uses its own cash resources to pay for the deal and zero otherwise. PCASH DEBT is 1 if debt is used to finance part of the cash payment and zero otherwise. KZ is the Kaplan-Zingales (1997) financial constraints index. LEVERAGE is the acquirer's debt-to-assets ratio DIV is 1 if the acquirer pays dividends and is zero otherwise. CASH denotes the acquirer's cash balance to its book value of assets. LT RATING is 1 if the acquirer has a credit rating and is zero otherwise. The models include controls used in the full specification #5 of Table 4. Robust *z*-statistics that allow for industry clustering and correlation within firm panels are in parentheses.

Independent variable	*Specification #*					
	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable: sell plant						
PCASH	−0.167 (−1.65)[c]	−0.155 (−1.52)	−0.157 (−1.51)			
PCASH INTERNAL				−0.274 (−2.28)[b]	−0.272 (−2.26)[b]	−0.253 (−1.97)[c]
PCASH DEBT				−0.077 (−0.66)	−0.054 (−0.46)	−0.083 (−0.72)
KZ		0.012 (3.88)[a]			0.013 (3.94)[a]	
LEVERAGE			1.389 (4.04)[a]			1.414 (4.09)[a]
DIV			−0.398 (−3.15)[a]			−0.406 (−3.20)[a]
CASH			−4.173 (−4.30)[a]			−4.041 (−4.12)[a]
LT RATING			−0.088 (−0.69)			−0.102 (−0.80)
CONTROLS FROM Table 4	Yes	Yes	Yes	Yes	Yes	Yes
Dependent variable: close plant						
PCASH	0.001 (0.01)	0.017 (0.16)	0.028 (0.26)			
PCASH INTERNAL				−0.038 (−0.30)	−0.032 (−0.25)	−0.006 (−0.04)
PCASH DEBT				0.035 (0.29)	0.061 (0.50)	0.056 (0.46)
KZ		0.009 (2.29)[b]			0.009 (2.33)[b]	
LEVERAGE			0.695 (2.40)[b]			0.698 (2.41)[b]
DIV			−0.314 (−2.13)[b]			−0.318 (−2.15)[b]
CASH			−0.937 (−1.31)			−0.898 (−1.25)
LT RATING			0.037 (0.31)			0.031 (0.26)
CONTROLS FROM Table 4	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo-R^2	0.091	0.093	0.101	0.091	0.094	0.101
N	3,757	3,757	3,757	3,757	3,757	3,757

[a] = *significant at 1%*, [b] = *significant at 5%*, [c] = *significant at 10%*.

payers, and firms with lower cash balances are more likely to sell off assets, while rating is not significant. Leverage is significant in the closure logits. Interestingly, none of the asset-side variables are significantly impacted by cash or the financing-side variables, suggesting that the financial variables bring additional orthogonal information to the logits.[19]

6. Post-merger performance

In this section, we analyze the changes in performance of the kept and sold plants still in operation at the end of year 3 after the acquisition is completed. Not surprisingly, closed plants tend to shrink and have poor profitability prior to their closure; we do not report the performance data for these plants. We partition our sample into kept plants and sold-off plants and analyze the changes for each subsample separately. We also analyze the cross-sectional determinants of the performance changes within each sample.

6.1. Unconditional changes in performance

We examine changes in the performance of acquired plants over a four-year window, from $t-1$ to $t+3$, where t denotes the merger year. We measure performance by the post-merger changes in the operating margins and productivity of the acquired plants.

Table 7 reports the data on post-acquisition performance of acquired plants. The upper panel reports data for kept plants while the lower panel deals with sold plants. We consider two measures of performance: the total factor productivity (TFP), which is reported in the first row of each panel, and the adjusted operating margin, which is reported in the second row of each panel. Table 7 reports the TFP or margin level as of year -1 and the changes in these measures between year -1 and years $+1$, $+2$, and $+3$.[20]

[19] In unreported results, we also instrument for method of payment. Firms are more likely to use cash when industry profitability is high and industry R&D is low. However, the strong predictors of the use of cash in the first stage include the 1980s indicator variable and the financial constraints variables. Because these variables themselves are predictors of the post-merger restructuring, including them with instrumented cash makes the instrumented cash variable entirely insignificant.

[20] Consistent with prior work, in this sample we find that combined (value-weighted) target-acquirer three-day announcement returns are slightly greater than zero (1.69% median return, 3.05% mean return), target returns are highly positive (13.5% median return, 18.0% mean return), while acquirer returns are insignificant but slightly negative.

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Table 7
Post-acquisition changes in performance.

The table reports the average total factor productivity (TFP) and excess operating margin in year −1 and the changes in TFP and excess operating margin between year −1 and years +1, +2, and +3 where a full-firm merger is completed in year 0. Acquired plants are classified as Kept if the acquirer retains ownership of plants as of year +3 and as Sold if he plant was operating but not owned by the acquirer as of year +3. We report statistics for two efficiency measures π: (1) Operating margin, which is ratio of the operating income before depreciation to the total plant shipments minus the industry median margin; (2) TFP, which is a plant's log output minus the predicted output based on a log-linear production function with squared and cross-product terms estimated for all plants in the industry. The sample consists of mergers from the SDC M&A database announced between 1981 and 2000 and completed within 180 days of announcement, in which the target is a domestic U.S. firm with at least one reported Four-digit SIC code between 2000 and 3999 and has matching input/output data in the Longitudinal Research Database maintained at the U.S. Department of Commerce. We report two sets of estimates, one for all target plants and one for all target plants for which the acquirer's book-to-market is available in Compustat. Standard errors are in parentheses and the number of plants are below each performance statistic.

Statistic	*Full sample*				*Sample with acquirer BE/ME*			
	π_{-1}	$\Delta\pi_{-1,+1}$	$\Delta\pi_{-1,+2}$	$\Delta\pi_{-1,+3}$	π_{-1}	$\Delta\pi_{-1,+1}$	$\Delta\pi_{-1,+2}$	$\Delta\pi_{-1,+3}$
Kept plants								
$\pi = TFP$	0.201 (19.70)[a]	0.063 (7.56)[a]	0.081 (8.91)[a]	0.063 (6.61)[a]	0.21 (17.64)[a]	0.057 (5.76)[a]	0.094 (8.87)[a]	0.064 (5.31)[a]
N	6,348	6,346	6,346	6,346	4,452	4,452	4,452	4,452
$\pi = Margin$	0.032 (12.22)[a]	0.011 (5.34)[a]	0.011 (5.10)[a]	0.021 (9.24)[a]	0.036 (11.42)[a]	0.017 (6.75)[a]	0.012 (4.55)[a]	0.022 (7.94)[a]
N	6,409	6,409	6,409	6,409	4,452	4,452	4,452	4,452
Sold Plants								
$\pi = TFP$	0.047 (3.28)[a]	0.013 (1.05)	0.022 (1.60)	0.027 (1.87)[c]	0.055 (2.85)[a]	0.006 (0.34)	0.016 (0.87)	0.027 (1.45)
N	2,871	2,871	2,871	2,871	1,530	1,530	1,530	1,530
$\pi = Margin$	0.002 (0.63)	−0.001 (−0.37)	0.003 (0.75)	0.007 (1.95)[c]	−0.007 (−1.38)	0.002 (0.49)	−0.003 (−0.57)	−0.003 (−0.54)
N	2,905	2,905	2,905	2,905	1,530	1,530	1,530	1,530

t-statistics from test of significance of the average from zero in parentheses.
[a]=*significant at 1%*, [b]=*significant at 5%*, [c]=*significant at 10%.*

When we separate the acquired plants into those sold by the acquirer and those kept, we find striking differences in performance between kept and sold plants.[21] We find that on an unconditional basis, kept plants tend to be strong-performing prior to acquisition and these plants continue their strong performance after the merger. For instance, the average change in TFP for kept plants over the three-year window is 6.3%, while the average change in margin is about 2.1%, and both are significant at the 1% level. Sold plants also have positive performance changes although these changes are less pronounced than changes for kept plants. The average TFP change for sold plants is about 2.7%, while the improvement in operating margin is 0.7%, both marginally significant at about the 10% level.

The performance changes for sold plants are between one-half and one-third the corresponding changes for plants kept by the acquirer. The evidence seems in line with the view that acquirers keep the portions of the target that they can improve operationally but tend to shed the assets in which they have no comparative advantage in running. The asymmetry between the performance changes for kept and sold plants also seems inconsistent with the view that mergers resolve agency problems by liberating and reallocating less productive assets trapped in targets unwilling to shed these assets. If this were the case, we would expect particularly pronounced improvements in sold-off assets, but the more significant improvements are concentrated in the kept assets.

[21] We also separately analyze plants that are closed between t and $t+3$. As expected, plants that were closed tend to shrink and have poor profitability prior to their closure. We exclude closed plants from all subsequent analysis.

6.2. Changes in performance and acquirer and target characteristics

The summary statistics in Table 7 reflect unconditional changes in performance. We next present a cross-sectional analysis of the performance changes. We consider two approaches. Both give similar results. First, we regress performance changes on ex-ante acquirer and target characteristics. In addition, we control for self-selection by adding an extra variable, the inverse Mills ratio derived from probit estimates of the sell-keep decision. This is equivalent to estimating a switching regression (Maddala, 1983; Li and Prabhala, 2007). The instruments that are used in our first-stage regression are the left-out industry variables that do not enter the change in performance regressions.These changes in performance are industry-adjusted measures. Table 8 reports these estimates for our base specifications and for specifications that add the method of payment and acquirer financial conditions, respectively.[22]

Table 8 reports regressions for changes in performance for kept and sold target plants. The change in performance is

[22] The sell-keep probit estimates are qualitatively similar to the multinomial logit estimates in Tables 5 and 6. For brevity, we do not discuss these results again. We also examined merger announcement effects. These are not significantly related to disposition decision or ex-ante characteristics with two exceptions: a positive relation of target returns to target B/M, and a negative relation to industry operating margins. The general absence of significance for acquirer and combined returns is perhaps not surprising given that announcement effects also reflect (in varying degrees) information revealed about acquirers' own existing businesses, information about the level and type of payment, and synergies (Hietala, Kaplan, and Robinson, 2003) plus any changes in administrative overheads.

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Table 8
Post-acquisition changes in performance: regressions.

The table reports regression estimates. The dependent variable is either the change in the total factor productivity (TFP) or the change in the excess operating margin between years −1 and +3 where the acquisition is completed in year 0. The sample comprises all acquired plants that were either kept (the first two columns of results) or sold (the last two columns of results). TMARG (AMARG) is the industry-adjusted target (acquirer) operating margin while ASKILL is the average of this margin over acquirer plants outside its main division. SYNERGY denotes the product of the acquirer and target operating margins. TRELSIZE is the acquirer-to-target ratio of aggregate deflated output. TBEME is the decile to which a target's book-to-market ratio belongs. 1980s is 1 if the merger is completed between 1981 and 1989 and zero otherwise. ABEME is the decile to which the acquirer's book-to-market ratio belongs. λ is the inverse Mills ratio from a probit model (estimates not reported to conserve space) in which the dependent variable is 1 if a plant is sold and zero if a plant is kept and the independent variables are as in Table 4. *Z*-statistics reported in parentheses are based on robust standard errors allowing for clustering at the industry level and correlation within firm panel units.

	Kept plants		Sold plants	
Panel A: Dependent variable = Δ TFP				
TMARG	−0.145 (−2.41)[a]	−0.280 (−3.48)[a]	−0.35 (−3.29)[a]	−0.304 (−1.73)[c]
AMARG	0.541 (4.81)[a]	0.611 (3.68)[a]	0.011 (0.05)	0.128 (0.41)
SYNERGY	3.101 (7.00)[a]	3.517 (5.64)[a]	0.483 (0.53)	1.335 (1.01)
ASKILL	−0.257 (−0.92)	−0.179 (−1.16)	−0.110 (−0.39)	−0.214 (−0.68)
TRELSIZE	−0.024 (−2.66)[a]	−0.056 (−4.45)[a]	−0.034 (−2.02)	−0.068 (−2.37)
TBEME	−0.044 (−2.19)[b]	−0.012 (−0.34)	0.004 (0.14)	0.076 (1.24)
1980s	−0.023 (−0.96)	−0.077 (−2.19)	−0.000 (−0.01)	−0.087 (−1.11)
ABEME		−0.046 (−0.93)		0.168 (1.43)
λ	−0.104 (−1.44)	−0.148 (−1.56)	0.020 (0.25)	−0.059 (−0.50)
CONSTANT	−0.069 (−1.62)	−0.168 (−2.67)[b]	−0.126 (−1.01)	−0.273 (−1.36)
N	4,238	2,356	1,452	671
Adjusted R^2	0.023	0.033	0.006	0.011
Panel B: Dependent variable = Δ excess operating margin				
TMARG	−0.026 (−1.50)	−0.053 (−2.24)[b]	−0.139 (−4.72)[a]	−0.159 (−3.48)[a]
AMARG	0.541 (4.81)[a]	0.611 (3.68)[a]	0.011 (0.05)	0.128 (0.41)
SYNERGY	0.363 (3.26)[a]	0.396 (2.20)[b]	0.028 (0.11)	0.322 (1.09)
ASKILL	−0.029 (−0.90)	−0.020 (−0.53)	−0.046 (−0.55)	−0.082 (−0.93)
TRELSIZE	−0.002 (−0.74)	−0.005 (−1.66)	−0.011 (−2.39)[b]	−0.013 (−1.55)
TBEME	0.004 (0.89)	0.015 (1.75)[c]	−0.002 (−0.27)	0.015 (0.94)
1980s	−0.014 (−0.93)	−0.017 (−1.87)[c]	0.012 (1.06)	0.025 (1.28)
ABEME		−0.038 (−2.94)[a]		−0.022 (−0.78)
λ	−0.043 (−2.43)[b]	−0.032 (−1.36)	0.006 (0.26)	0.001 (0.03)
CONSTANT	−0.021 (−1.94)	−0.016 (−0.98)	−0.058 (−1.64)	−0.074 (−1.26)
N	4,452	2,475	1,530	707
Adjusted R^2	0.017	0.033	0.022	0.028

[a] = *significant at 1%*, [b] = *significant at 5%*, [c] = *significant at 10%*.

measured from the year prior to the merger to three years after. Specifications (1) and (2) in Table 8, the left columns, report the results for kept plants while specifications (3) and (4) report the results for sold plants.Panel A reports change in performance when performance is measured using TFP. Panel B presents results for changes in operating margins as the measure of efficiency. As in Section 2, our dependent variable is the change in performance adjusted for the predictable portion of performance changes.

From Table 8, the variable TMARG, the ex-ante profitability of the target plant, has a negative coefficient. It is significant in all four specifications in Panel A and three of the four specifications in Panel B, consistent with the view that underperforming plants that are kept tend to improve more after mergers. The second variable, AMARG, denotes the current (industry-adjusted) profitability of acquirers. If above-industry margin reflects acquirer skill, more profitable acquirers should be more likely to improve future profitability of plants that they elect to keep. The evidence is supportive of this view. AMARG is significant and has a positive sign in Table 8. This is in contrast to the insignificance of the AMARG in the decision to keep or sell a plant in Table 4. This difference in coefficients across the equations suggests that while an acquirer whose plants are more profitable does not have an advantage in operating an average acquired plant, for those plants for which there is a match between the acquirer's skill and the target plant, higher acquirer productivity leads to improved performance. Consistent with this idea, we find that SYNERGY has a positive coefficient, suggesting complementarity between acquirers and targets with high margins (Robinson and Rhodes-Kropf, 2008). When we split the SYNERGY variable into cases when both acquirer and target industry-adjusted margins are positive (SYNERGY positive) and negative (SYNERGY negative), we find that the gains are larger for the SYNERGY-positive cases but both variables are positive.[23] We also find that acquirer skill has a positive coefficient.

Other variables in our specification include TRELSIZE, the size of the target relative to acquirer size, to examine whether there are neoclassical decreasing returns-to-scale.Examining our regression results in Table 8 for the subsequent changes

[23] The result is consistent with the brand-level evidence of Fee, Hadlock, and Pierce (2010) that acquirers realize marketing synergies, and with Hoberg and Phillips (2010) who show results consistent with synergies and new product creation using text-based analysis.

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in TFP, we see that the coefficients for TRELSIZE are negative and significant in Table 8 for kept plants for the change in TFP. These results are consistent with decreasing returns-to-scale and that larger acquisitions move the firm farther away from its optimal boundary, thus decreasing the gains for kept plants.

We include the acquired target's book-to-market ratio, TBEME, as a control variable. Plants may have unobserved future efficiency gains not reflected in current productivity levels. TBEME should capture this effect, to the extent it is capitalized in target firms' share prices. There is no consistent pattern in the data. For instance, in Panel A, TBEME has a negative coefficient and it is statistically significant in one specification (column 1, TFP) but not in the others. The method of payment has little effect on the productivity changes or changes in operating margins.

We consider the 1980s dummy variable next. This variable controls for the hypothesis that target plant efficiency gains may be a pure 1980s effect. Perhaps the deconglomeration wave of the 1980s corrected inefficient resource allocation in conglomerates formed in the 1960s and 1970s, while the 1990s mergers are pure financial transactions caused by firms exploiting overvalued stock. We find no support for this view. There is mixed evidence on the significance of the 1980s dummy: it is significant in one specification but not in the others. However, all coefficients, including the significant one, are negative. If the efficiency gains are time-period effects, they are *more* concentrated in the 1990s rather than the 1980s. Thus, even if the 1990s merger wave is a stock market-driven wave caused by firms exploiting their overvalued stock as acquisition currency, it is still the case that the acquisitions resulted in more productive efficiency gains for the kept plants.

For both the TFP specification and the operating margin specification, we report two specifications that incorporate acquirer-related stock market information. As before, the requirement that we have acquirer data shrinks our sample. For instance, we have a sample of 4,238 plants in the TFP specifications that do not require acquirer data, but the sample is 2,356 plants when we impose the requirement that acquirer stock market data are available. Interestingly, the acquirer BE/ME has a negative coefficient. It is not significant in the TFP specification but is significant at 1% in the operating margin specification. These results show that low BE/ME acquirers, i.e., glamor acquirers, are able to achieve greater efficiency gains in the targets' plants they keep. If acquisitions merely reflect bidders using overvalued stock to pay for targets, we would not necessarily see greater real efficiency gains concentrated among glamor bidders. Our view is that using overvalued stock as currency is probably not the whole story for why acquisitions occur. While firms do probably use their stock as currency for acquisitions, the systematically higher profitability changes of the plants they keep must also be explained in such a theory.

The third and fourth columns of Table 8 report the results for sold plants. Scope-of-firm theories make no particular predictions about efficiency changes for the sold plants. Thus, it may not be surprising that sold plants show few of the patterns for kept plants. A common element in both kept plants and sold plants is the negative sign for TMARG, the prior performance of plants, which indicates that ex-post performance improvements are greater for plants that have less strong performance ex-ante. Interestingly, the relative size of the target plant is *negatively* related to changes in efficiency, while target size is insignificant in the kept equation. Thus, increases in efficiency in sold plants are concentrated in the subset of small plants sold off by acquirers.

Interestingly, the 1980s dummy variable is insignificant in the sold specification. If the 1980s mergers were intended to undo agency-related inefficiencies of large conglomerates, one might expect that the post-merger selloffs in the 1980s should result in greater productive efficiency gains for sold plants. However, the coefficient for 1980s is insignificant, and in any case, the point estimate is *negative* in all specifications in Panel A. Thus, we find no support for the view that the plants sold off during the 1980s deconglomeration wave became more efficient in the hands of the new owners.

In Table 9, we consider the effect of the method of payment from SDC and financing-side liquidity variables, adding these variables to our base specification from Table 8.We find evidence that changes in productivity are significantly related to the liquidity of purchaser but not the method of payment, consistent with some sales taking place to improve the liquidity of the purchaser and consistent with the acquirer using its liquidity to improve the productivity of the assets purchased.

The bottom line of this section is that even after adjustment for selection and reversion to the mean in performance, our evidence suggests that the post-merger asset retention/sale decisions lead to efficient outcomes, on average. Sold plants do not demonstrably improve or deteriorate in performance. Plants that are retained by acquirers, which are efficient to begin with as shown in Table 6, become even more efficient, on average.[24]

6.3. Repeat acquirers and anti-takeover laws

This section considers additional within-sample cross-sectional tests to shed light on the empire-building motive for acquisitions. One set of tests examines repeated acquisitions, which could be associated with firms with particularly strong tastes for empire building. From an agency theory perspective, repeated acquisitions could be associated with firms or managers with particularly strong tastes for empire building. An alternative view is that repeated acquisitions might lead to organizational learning and therefore superior outcomes in later acquisitions as firms become more skilled at post-merger restructuring, thereby making better decisions about what target assets to keep or divest and how to improve the assets they keep. We test these hypotheses by examining the disposal decisions and performance

[24] As additional analysis, we also examined the changes in the output and the input factors in the TFP regressions (1). Relative to other plants in the industry, output decreased less and capital expenditures were cut more in kept plants but the differences in materials or labor inputs were not significant.

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Table 9
Post-acquisition change in performance: financing-side variables.

The table reports regression estimates. The dependent variable is either the change in the total factor productivity (TFP) or the change in the excess operating margin between years −1 and +3 where the acquisition is completed in year 0. The sample comprises all acquired plants that were either kept (the first two columns of results) or sold (the last two columns of results). The explanatory variables include as controls all variables in Table 8 and additional financing-side variables. PCASH is 1 if cash is used to pay for at least 51% of the acquisition cost. LEVERAGE is the acquirer's debt-to-assets ratio. DIV is 1 if the acquirer pays dividends and is zero otherwise. CASH denotes the acquirer's cash balance to its book value of assets. LT RATING is 1 if the acquirer has a credit rating and is zero otherwise. All models control for the variables used in Table 8. Robust *Z*-statistics that allow for industry clustering and correlation within firm panels are in parentheses.

Panel A: Dependent variable = Δ TFP

Independent variables	Kept plants		Sold plants	
PCASH	0.017 (0.29)	0.041 (0.69)	−0.054 (−0.99)	−0.051 (−0.83)
LEVERAGE		−0.128 (−0.94)		−0.089 (−0.35)
DIV		0.111 (1.81)[c]		0.019 (0.25)
CASH		0.099 (0.25)		1.066 (1.37)
LT RATING		0.090 (1.44)		0.036 (0.40)
TABLE 8 CONTROLS	Yes	Yes	Yes	Yes
Adjusted R^2	0.038	0.041	0.051	0.058
N	2,049	2,049	623	623

Panel B: Dependent variable = Δ excess operating margin

Independent variables	Kept plants		Sold plants	
PCASH	−0.015 (−0.91)	−0.014 (−0.80)	0.015 (0.93)	0.023 (1.62)
LEVERAGE		−0.080 (−3.14)[a]		−0.049 (−0.93)
DIV		0.041 (3.77)[a]		0.002 (0.15)
CASH		1.066 (1.37)		0.369 (1.79)
LT RATING		0.023 (2.07)[b]		0.022 (0.92)
TABLE 8 CONTROLS	Yes	Yes	Yes	Yes
Adjusted R^2	0.026	0.023	0.047	0.049
N	2,049	2,049	623	623

[a] = *significant at 1%*, [b] = *significant at 5%*, [c] = *significant at 10%*.

changes.[25] In addition, we also consider the effect of state-level anti-takeover laws on post-merger restructuring. The passage of such laws makes it easier for acquirers in the state to engage in empire-building motivated takeovers by lowering the threat that they themselves will be taken over in the event the merger is value-destroying.

6.3.1. Repeat acquirers

Table 10 examines the asset disposal decisions and the performance changes associated with acquisitions by firms that have already acquired other firms previously. We include indicator variables for the subsequent acquisitions by a firm. DEALNUM2 indicates plants are part of a second acquisition by a firm. DEALNUM3 indicates plants are part of a third acquisition by a firm and DEALNUM4+ indicates plants are part of a fourth or higher acquisition by a firm.

Panel A of Table 10 provides the multinomial logit estimates for the plant keep, sale, or closure decision for repeat acquirers. The logit specification is a full model that includes the explanatory variables of Tables 4 and 5 as controls (and obtain similar results) but to conserve space, we report only the coefficients related to repeat acquirers. These include DEALNUM2, DEALNUM3, and DEALNUM4+, which indicate plants that are transferred in the second, third, or fourth or higher acquisitions by a firm. Panel A shows that the marginal effects for the repeated deal variables for the closure decision are not significant. On average, repeated acquirers do not retain more of the target's assets. Table 10 shows that the target assets acquired in third or later deals are *more* likely to be sold off.

The performance results are reported in Panel B. Once again, to conserve space, we just report the coefficient estimates related to repeat acquirers and suppress the other results, which are similar to the results in Tables 8 and 9. Columns 1 and 3 of Panel B correspond to the same columns of Table 8 and do not include the Acquirer Book-to-Market (ABEME) ratio in the controls. The specifications reported in columns 2 and 4 do include ABEME in the controls. The results indicate that when repeat acquirers buy target plants, the target plant performance for kept plants is relatively flat in the second deal, worse in two out of the four specifications for the third deal with significance of between 5% and 10%, but improves significantly in the fourth deal and beyond in all specifications at significance levels of between 5% and 1%. Sold plants in later deals tend to show positive performance improvements in most specifications as indicated by positive significant coefficients for DEALNUM3 and DEALNUM4+. From an economic standpoint, there is little evidence that serial acquisitions result in destructive allocation of real resources.

6.3.2. Anti-takeover laws

As discussed in Romano (1987), Bertrand and Mullainathan (2003), and Bebchuk and Cohen (2003),

[25] A separate and now extensive literature studies announcement effects associated with repeat acquirers. Early papers include Schipper and Thompson (1983) and Asquith, Bruner, and Mullins (1983), while more recent work includes Fuller, Netter, and Stegemoller (2002) and Ahern (2007). See Ahern (2007) for an excellent overview of this literature.

Table 10
Repeat acquirers: disposition and performance changes.

Panel A reports estimates of a multinomial logit specification that models an acquirer's decision to sell or close a target plant relative to the baseline of keeping the plant. DEALNUM2, DEALNUM3, and DEALNUM4+ are dummy variables that equal 1 if the acquisition is the second, third, or at least the fourth acquisition completed by an acquirer in our sample, and zero otherwise. The models include controls used in the full specifications in Tables 4. Panel B reports estimates in which the dependent variable is either the change in the total factor productivity (TFP) or the change in operating margin between year −1 and year +3, for a plant owned by the acquirer prior to the merger. Robust *Z*-statistics that allow for industry clustering and correlation within firm panels are in parentheses. *a*, *b*, and *c* denote significance at the 1%, 5%, and 10% levels.

Panel A: Logit estimates: target plant disposition

	Decision to	
Independent variable	*Sell plant*	*Close plant*
	Logit coefficients	
DEALNUM2	0.07 (0.71)	0.01 (0.83)
DEALNUM3	0.55 (4.64)[a]	0.10 (4.26)[a]
DEALNUM4+	0.55 (4.45)[a]	0.11 (4.26)[a]
Table 4 controls	Yes	Yes
N	8,026	8,026

Panel B: Target plant performance

Independent variable	π = TFP		π = Operating margin	
	Performance of kept plants			
DEALNUM2	0.01 (0.23)	0.07 (1.56)	0.01 (1.34)	0.03 (3.02)
DEALNUM3	−0.12 (−2.17)[b]	−0.10 (−1.61)[c]	−0.02 (−1.35)	−0.02 (−1.56)
DEALNUM4+	0.15 (3.14)[a]	0.26 (3.74)[a]	0.03 (2.37)[b]	0.04 (2.61)[b]
Table 8 controls	Yes	Yes	Yes	Yes
F-statistic	6.83 (0.00)	7.50 (0.00)	112.62 (0.00)	59.74 (0.00)
N	4,239	2,356	4,452	2,475
	Performance of sold plants			
DEALNUM2	0.048 (0.77)	−0.05 (−0.53)	−0.003 (−0.23)	−0.01 (−0.45)
DEALNUM3	0.12 (1.63)[c]	0.10 (0.99)	0.04 (2.11)	0.05 (1.93)[c]
DEALNUM4+	0.19 (2.21)[b]	0.27 (1.90)[c]	0.03 (1.40)	0.06 (1.93)[c]
Table 8 controls	Yes	Yes	Yes	Yes
F-statistic	2.18 (0.02)	1.95 (0.03)	59.37 (0.00)	21.86 (0.00)
N	1,451	670	1,530	707

different states enacted these laws at different points of time in an effort to deter hostile takeovers.[26] As the literature points out, the most stringent among these laws are business combination laws (BCLs). The passage of a BCL in a state provides more protection for acquirers by decreasing the threat that they themselves will be taken over if they make poor quality acquisitions. Thus, comparing post-merger restructuring in BCL-protected takeovers with that in non-BCL-protected takeovers can potentially uncover traces of empire-building motivated takeovers.

In unreported results, we analyze whether the introduction of a BCL is related to the nature of the post-merger restructuring carried out by acquirers. We estimate the specifications of Tables 5 and 7 for pre- and post-BCL law passage including state fixed effects. We find little trace of a BCL effect on post-merger restructuring. There is no overall tendency for firms headquartered in states that passed BCLs to sell or close plants at a different rate post-merger, nor is there an effect on the rates when targets are headquartered in BCL states. The coefficient for the interaction between the marginal productivity and industry returns is lower for these firms, suggesting that redeployment of assets in response to industry shocks is somewhat slower in states which enact a BCL. However, this difference entirely vanishes once we include industry effects. This result suggests that BCLs take place in states in which a significant fraction of industries experiences negative return shocks. We also find no significant differences in changes in industry-adjusted productivity for plants sold or retained post-BCL law passage. Thus, while BCLs might have the effect of deterring some mergers, conditional on a merger taking place, we find no evidence that the existence of a BCL affects the redeployment of assets once we control for industry effects.

6.4. Acquirer's existing assets

While the previous tests deal with the disposition of *target* plants after an acquisition, a related question is how acquirers dispose of their own assets in the short period after a merger. We present some evidence on this issue. We test whether acquirers treat their existing plants symmetrically with their newly acquired plants or whether they have different propensities to dispose of their own plants. Our tests control for the other characteristics that drive plant disposal decisions.

[26] Given the exact dates for final passage differ slightly between these papers, we use the dates from Sapra, Subramanian, and Subramanian (2009) who reconcile some discrepancies in the dates using Lexis-Nexis.

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Table 11
Changes in performance of *acquirer's* own plants after acquisition.

The table reports the average total factor productivity (TFP) and operating margin in year −1 and the changes in TFP between year −1 and years +1, +2, and +3 for plants owned by firms that make an acquisition between 1980 and 2000 and have matching book-to-market data in Compustat. Acquirer data is identified from the SDC M&A database. Year 0 denotes the merger completion year. A plant is classified as Kept if it remains in the acquirer's possession as of year +3 and Sold if it is operating but not under the acquirer's ownership in year +3. We report statistics for two efficiency measures π: (1) Operating margin, which is ratio of the operating income before depreciation to the total plant shipments minus the industry median margin; (2) TFP, which is a plant's log output minus the predicted output based on a log-linear production function with squared and cross-product terms estimated for all plants in the industry. The operating margins and TFP statistics in this table are regression-adjusted for predictable time-series changes. Standard errors are in parentheses and the number of plants are below each performance statistic.

	Full sample				*Sample with acquirer BE/ME*			
Panel A: Kept plants								
Statistic	π_{-1}	$\Delta\pi_{-1,+1}$	$\Delta\pi_{-1,+2}$	$\Delta\pi_{-1,+3}$	π_{-1}	$\Delta\pi_{-1,+1}$	$\Delta\pi_{-1,+2}$	$\Delta\pi_{-1,+3}$
$\pi = TFP$	0.17 (21.13)[a]	0.07 (8.25)[a]	0.078(15.60)[a]	0.069 (11.50)[a]	0.17 (21.13)[a]	0.07 (10.29)[a]	0.08 (9.75)[a]	0.069 (8.63)[a]
N	15,290	15,290	15,290	15,290	9,362	9,362	9,362	9,362
$\pi = Margin$	0.036 (22.44)[a]	0.005 (3.13)[a]	0.008 (6.15)[a]	0.01 (6.67)[a]	0.035 (17.50)[a]	0.007 (4.12)[a]	0.011 (5.79)[a]	0.017 (8.63)[a]
N	15.426	15.426	15.426	15.426	9,398	9,398	9,398	9,398
Panel B: Sold plants								
$\pi = TFP$	0.059 (4.47)[a]	0.006 (0.46)	0.02 (1.48)	0.036 (2.73)[a]	0.07 (3.89)[a]	−0.024 (−1.50)	−0.01 (−0.56)	0.035 (1.80)
N	2,893	2,893	2,893	2,893	1,601	1,601	1,601	1,601
$\pi = Margin$	0.007 (2.00)[b]	−0.008 (−2.85)[a]	−0.005 (−1.52)	−0.001 (−0.29)	0.01 (2.85)[a]	−0.02 (−4.50)[a]	−0.02 (−3.40)[a]	−0.008 (−1.70)[c]
N	3,066	3,066	3,066	3,066	1,676	1,676	1,676	1,676

t-statistics from test of significance of the average from zero in parentheses.
[a]=*significant at 1%*, [b]=*significant at 5%*, [c]=*significant at 10%.*

We combine all the target and acquirer plants in one specification. We then estimate one specification with all common variables for acquirers and target and add an acquirer-plant indicator variable that we interact with all common independent variables. Specifically, we estimate a specification similar to the one we estimate for targets in Table 5 for all plants incorporating acquirer interaction variables. In the interest of space, we just discuss these results here and do not report them.

In the (unreported) multinomial logit model for plant disposal, we find that the acquirer-plant indicator variable is insignificant as are most of its interactions with the right-hand-side explanatory variables. Thus, most of the differences between the selloff and closure decisions of acquirer and target plants can be explained by differences in plant and firm characteristics. The notable exceptions include negative signs on the acquirer skill variable and the industry operating margin both interacted with the acquirer-plant indicator variable. The negative signs indicate that skilled acquirers and acquirers in industries with high margins are less likely to sell off their plants than they are to sell those of the target. Acquirer skill continues to matter in asset retention decisions.

We also examine the post-merger change in performances of acquirer's existing plants. Theory does not make strong predictions about the productivity of such plants. The increase in the scope of the firm might decrease the productivity of existing plants. On the other hand, the restructuring (sales and closures of inefficient plants) following the merger might improve the match between the remaining plants and the firm's core ability, leading to increases in productivity.

Table 11 presents the results for the post-acquisition performance for plants owned by the acquirer prior to the acquisition. As in Table 7 for target plants transferred in the acquisition, the upper panel reports results for kept plants and the lower panel reports data for sold plants. In each panel, we report results for the full sample and for the subsample of acquirers for which the book-to-market ratio is available. As before, we employ two measures of performance: the total factor productivity (TFP), which is reported in the first row of each panel, and the adjusted operating margin, which is reported in the second row of each panel. These tables report the TFP or margin level as of year −1 and the changes in these measures between year −1 and years +1, +2, and +3.

The unconditional averages show that kept plants exhibit strong performance prior to acquisition and these plants continue their strong performance after the merger. For instance, the average change in TFP for kept plants over the three year window is 6.9% while the average change in margin is about 1% and both are significant at the 1% level. The evidence on the performance of sold plants shows a mixed pattern, with some evidence of positive and negative changes depending on the horizon and measure of productive efficiency. The subsample of sold plants where acquirer BE/ME is available shows a notable decline in operating margins across all horizons. The more significant and robust finding from the table is, however, the asymmetry between kept and sold plants. Kept plants tend to improve far more than sold plants, regardless of whether the plant was owned by the acquirer before acquisition or whether the plant was obtained in the acquisition.

The results in this section are related to Schoar (2002). Schoar (2002) analyzes the post-acquisition changes in TFP for incumbent plants owned by an acquirer. She finds that the overall TFP changes are flat for the acquirers' owned plants. We find that acquirers' retained plants increase in productivity. Our analysis differs from Schoar's study on several dimensions. First, we differ from Schoar in that we focus on the differences between acquirer's

kept and sold plants in whole-firm acquisitions. Schoar looks at TFP changes after purchases of new plants through either partial-firm or full-firm acquisitions or through the opening of new plants. Second, our sample of firms also differs. The algorithm used in Schoar (2002) to match firms in the Census data to Compustat differs from ours as well. She matches Compustat to firms in the LRD using a 1987 Census bridge file. We use a year-by-year match from the SDC and Compustat samples to the Census Bureau data, enabling us to match many more full-firm mergers that occur in a larger population of firms. Third, our methods are different. We adjust for time-series predictability in TFP changes in the spirit of the Barber and Lyon (1996) and Lie (2001) recommendations, controlling for the initial level of productivity. Indeed, while we obtain qualitatively similar findings in specifications that do not control for the ex-ante level of TFP in plants, ex-ante productivity levels are influential predictors of future productivity changes. Lastly, Schoar only finds decreases in the productivity for diversifying acquisitions. This is consistent with our finding that acquirer plants in related acquisitions increase in productivity.[27]

7. Conclusions

We analyze the disposition and efficiency changes of firm plants involved in takeovers of manufacturing firms in the U.S. between 1981 and 2000. We find that extensive post-merger restructuring takes place. Only just over one-half of the acquired plants are retained by the acquirer for at least three years. Slightly more than one-quarter of the acquired plants are sold within this interval, and the remainder are closed down. Increasing the time window to five years does not change these results much. Thus, most of the restructuring occurs within a three-year period. In addition, we find that the rates of sales and closures are much lower for targeted acquisitions where the target is just selling part of its assets. In these partial-firm acquisitions, acquirers sell less than 10% and close less than10% of the assets they buy over the next three years.

Examining the cross-sectional patterns following mergers we show that plants in related transactions and plants that are in the target's main division, and deals that involve cash as a method of payment are less likely to be sold, whereas plants that are in the target's peripheral divisions or are unrelated to the acquirer's main division are significantly more likely to be sold. The probability of a plant sale is also higher if market values have increased in the plant's industry. Examining the existing plants of the acquirer, we find that they close and sell fewer of their own plants than those of the target's plants. However, these differences are driven by fundamental acquirer- and plant-level characteristics. Controlling for these characteristics, acquiring firms overall sell and close similar amounts of their own plants as they do of plants they purchase.

Overall, the plants that are retained by the acquirers (both their own plants and the plants they purchase) increase in productivity when benchmarked against industry plants, whereas the plants that are sold do not. While most of the evidence is consistent with fundamental factors driving retention decisions, acquirers that finance acquisitions with cash are more likely to retain assets. However, the method of payment does not impact subsequent productivity changes. We do find some evidence that variables proxying for financial constraints may drive disposition decisions. Firms that have more leverage and less cash are more likely to sell off plants. These results, however, do not affect the importance of productivity and firm-structure variables, suggesting that even firms with possible financial constraints make optimal retention and selloff decisions. Thus, while much of our evidence suggests that asset-side fundamentals drive retention decisions, this evidence is consistent with a role for debt and financial constraints in setting firms' boundaries, specifically that firms with high debt are undergoing restructuring and committing to sell off assets. Lastly, there is little evidence that repeat acquirers' disposition decisions are less efficient. If anything, repeat acquirers sell a larger proportion of acquired plants. Moreover, the gain in retained target plants' productivity is particularly high for acquirers who do the largest number of deals.

These outcomes are not consistent with the notion that pure empire building by managers explains the disposition of assets and the operating decisions following mergers. The outcomes are more consistent with the neoclassical comparative advantage view of firm growth. In particular, the skill of the acquirer at the margin is an important predictor of post-merger restructuring. Acquirers with low skill in marginal businesses are more likely to sell. The average productivity of the acquirer's plants does not predict disposal decisions. In addition, acquirers are more likely to retain a plant if they are efficient in the industry and the industry has experienced a positive shock. These effects are economically significant. A further implication of the managerial scope-based theory of the firm is that skill in operating peripheral divisions should matter more for the selloff decision than the closure decision. We find support for this hypothesis. The acquirer's peripheral skill variable is not significant in explaining the closure decision, which is largely driven by the profitability of the unit being considered for closure.

Our findings have broader implications. Given the magnitude of post-merger restructuring reported here, mergers should not be viewed as a stopping point in defining a firm's boundaries. Rather, each merger should be viewed as an initial step that sets in motion a vigorous restructuring process that resets the boundaries of the acquiring firm. Moreover, the resetting of boundaries appears to follow economically sensible principles. Firms tend to retain plants in which they have a comparative advantage and improve their productivity but they tend to sell or close other plants. Thus, even if the initial

[27] We also analyze regressions of these performance changes on explanatory variables as in Tables 8 and 9. The results are similar. Profitably run acquirers tend to improve the performance of their kept plants and acquirer variables do not explain performance changes in sold-off plants. To conserve space, we do not report these results; they are available upon request from the authors.

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decision to acquire a target involves overpayment, empire building, or simple hubris, our results indicate that economic rationality asserts itself soon afterwards. Acquirers find it advantageous to enter into post-merger restructuring and deals with other firms that result, on average, in an improved allocation of resources following mergers.

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