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The Market for Corporate Assets: Who Engages in Mergers and Asset Sales and Are There Efficiency Gains?

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ABSTRACT

We analyze the market for corporate assets. There is an active market for corporate assets, with close to seven percent of plants changing ownership annually through mergers, acquisitions, and asset sales in peak expansion years. The probability of asset sales and whole-firm transactions is related to firm organization and ex ante efficiency of buyers and sellers. The timing of sales and the pattern of efficiency gains suggests that the transactions that occur, especially through asset sales of plants and divisions, tend to improve the allocation of resources and are consistent with a simple neoclassical model of profit maximizing by firms.

In the United States there is a large and active market for corporate assets, from individual plants and divisions up to sales of entire corporations. Each year over the period 1974 to 1992, an average 3.89 percent of the large manufacturing plants in the country changed ownership.[1] This average masks substantial procyclical time variation, so that in expansion years, an average of 6.19 percent of manufacturing plants are involved in mergers and acquisitions and asset sales in each year. While the literature has succeeded in providing many insights about the gains and losses in mergers, mergers comprise only about one half of the total number of assets traded.[2] Much less is known about partial-firm asset sales.[3]

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[1] These statistics are described in detail below.

[2] For a comprehensive survey see Jensen and Ruback (1983) and also Ravenscraft and Scherer (1987).

[3] Early studies are Alexander, Benson, and Kampmeyer (1984), and Hite, Owers, and Rogers (1987). The number of transactions in these studies has been fairly small because the data is difficult to obtain. Schlingemann, Stulz, and Walkling (2002) also analyze segment sales.

In this study, we treat mergers, acquisitions, and asset sales as components of the overall market for firm assets in manufacturing industries. Using detailed plant-level data from the Longitudinal Research Database (LRD) compiled at the Census Bureau, we track sales of individual plants and benchmark their efficiency against that of other plants in the industry. We ask several questions: Does the market facilitate the reallocation of assets to more efficient uses? How big is the market for plants, and each of the segments (individual plants, divisions, and entire firms)? What are the factors that drive mergers and asset sales? We also ask whether firm organization affects how firms participate in the market for assets. Does the subsequent productivity of the transacted plants vary by the buying and selling firms' organizational characteristics?

An influential view in the literature is that major investment and takeover decisions of firms are influenced by conflicts of interest between managers and the owners of the firm.[4] This view suggests that many acquisitions are undertaken for empire building and managerial entrenchment by managers, and that they serve little economic purpose. Morck, Shleifer, and Vishny (1990) provide evidence that the stock market reacts negatively to diversifying acquisitions and to acquisitions where the bidder's managers perform poorly prior to the acquisitions. For asset sales, Jain (1985) finds that selloff announcements are greeted positively by the market and that they proceed a period of negative returns for the sellers. Lang, Poulsen, and Stulz (1995) find asset sales follow poor firm-level performance. John and Ofek (1995) find that the remaining assets of the firm improve in performance after asset sales that subsequently leave the firm more focused. These studies suggest that transactions either follow inefficient investments by firms or act to unwind such investments.

An alternative view, modeled in Maksimovic and Phillips (2002), posits that firms grow and purchase assets efficiently across the industries in which they operate.[5] This model is also consistent with existing evidence.[6] The model makes specific testable predictions about the timing and the direction of sales. In our model, firms become focused when their prospects in their main industry significantly improve. They may optimally choose to remain unfocused if their prospects in their main industry are not as good as other firms that choose to become focused. Firms sell assets in their less productive divisions following positive demand shocks for these divisions.

[4] See Jensen (1986) and Hart and Moore (1995).

[5] The model is based on Lucas (1978). Lucas (1978) and Williamson (1985) stress the costs of managing a larger organization.

[6] We do not have transaction prices or stock price data. Thus, we cannot test whether one party gains or loses in the stock market as a result of the transaction. The advantage of our study is that we look at actual productivity changes while stock market data includes a response to the price paid and prior expectations, in addition to the value of any productivity changes.

The intuition for the Maksimovic and Phillips (2002) model is simple. Some firms are more productive and can produce more than other firms from a given number of plants. Firms adjust in size until the marginal benefit is equal to the marginal cost of production. As output prices increase, the more productive firms have a larger gain in value from the assets they control. As a result, they find it optimal to acquire plants from less productive firms in the industry, even when that entails some increase in the costs of management. By the same token, a positive shock in an industry increases the opportunity cost of operating as an inefficient producer in that industry. Thus, industry shocks alter the value of the assets and create incentives for transfers to more productive uses. Given the generally positive upward trend in GDP in the U.S. economy during the mid- and late 1980s, the model can explain the trend towards increased focus over this period.

Empirically we find that the pattern of transactions (procyclical sales and subsequent increases in productivity) is consistent with this model. Our empirical results show that assets are more likely to be sold (1) when the economy is undergoing positive demand shocks, (2) when the assets are less productive than their industry benchmarks, (3) when the selling division is less productive, and (4) when the selling firm has more productive divisions in other industries. For mergers and acquisitions, we find evidence that the less productive firms tend to sell at times of industry expansion. Firms are more likely to be buyers when they are efficient and are more likely to purchase additional assets in industries that experience an increase in demand.

Sellers *and* buyers of individual plants and divisions tend to be large conglomerates. A firm's internal organization has a significant effect on the probability that an asset is sold. Assets are significantly more likely to be sold by peripheral divisions than by main divisions of conglomerates. The sales of main divisions are much rarer events, perhaps because only divisions in which the firm has a core competency become main divisions. For conglomerates, we find that the probability of the whole firm being sold off is negatively correlated with firm size and with firm focus.

Our results show that most transactions in the market for assets result in productivity gains. The average productivity of the buyer's and seller's existing assets is an important determinant of the gain to trade, suggesting that firms have differing levels of ability to exploit assets, and that their comparative advantage is in their main industries. The subsequent observed increase in productivity of the transferred assets is consistent with these gains offsetting the increased costs to the purchasing firm of managing a larger organization.[7] Thus, the market for corporate assets facilitates the redeployment of assets from firms with a lower ability to exploit them to firms with a higher ability. There is less support for the hypothesis that

[7] Thus, the existence of measurable productivity gains following a transfer does not imply that the transfer's timing is not optimal. A full dynamic model would be necessary to address the question of the optimal timing of transfers.

empire building predominantly drives asset purchases. However, because measured gains are negative for a minority of transactions, we cannot reject the possibility that some transactions may be motivated by agency considerations.

Our evidence primarily relates to two literatures: the literature on asset sales and the literature on mergers. Our paper views and considers these two types of transactions as part of a larger market for assets. The literature on sales of plants and divisions is relatively small. Alexander et al. (1984), Jain (1985), and Hite et al. (1987) have found a positive stock market response to asset sales. Lang et al. (1995) have shown these asset sales follow poor firm-level performance and that the stock-market gains are positive for firms that pay out the proceeds instead of reinvesting within the firm.[8] John and Ofek (1995) show that the remaining assets of the firm improve in performance after asset sales that subsequently leave the firm more focused. Maksimovic and Phillips (1998) show that firms in Chapter 11 tend to sell their most efficient plants, whereas firms in a control sample tend to sell their least efficient plants.

Schlingemann, Stulz, and Walkling (2002) (SSW) examine sales of divisions. They compare firms that report the sale of one or more whole segments with a control sample of firms which do not divest. Working with accounting data, they predict how firms choose which segments to divest. SSW's principal finding is that the liquidity of the market for assets plays an important role in determining which asset is divested. The probability that a segment is divested is higher if the asset is in an industry with a liquid market for assets and if it performs poorly. The divested segments are on average smaller than segments that are retained.

There is a large literature on the gains from mergers that has examined the gains to the bidders and targets in the stock market. Lang, Stulz, and Walkling (1991) show that the total stock market gains in tender offers are highest when the bidder has a high Tobin's q and the target has a low q. This is consistent with the notion that gains are highest when well-managed firms take over badly managed firms. Less is known about the gains in partial firm sales. Several studies have examined the cash flow performance of firms before and after mergers. Matsusaka (1993) examines the ex ante financial performance of firms before they merge and Ravenscraft and Scherer (1987) examine the ex post financial performance of mergers using FTC line-of-business data. Other studies that have documented performance changes following mergers using the LRD include Lichtenberg and Siegel (1992) and McGuckin and Nguyen (1995, 1999). McGuckin and Nguyen (1999) show

[8] The advantage over using stock market data and event studies is that a stock market response reflects the price paid relative to anticipated gains. Gains in productivity can still occur if the excess stock market return equals zero if the seller captures the gains. Similarly a combined positive stock market response (for buyers and sellers) may reflect information being revealed about the assets' value in the future and may not represent any real productivity gains.

that whether a firm is multiplant or single plant affects observed productivity gains. Kaplan and Weisbach (1992) track firms after they merge and find that divestiture rates by purchasers of unrelated firms are higher than purchasers of related firms. Even the firms that were broken up, however, show positive combined stock market responses (buyer and seller) at the time of the acquisition and do not show declines in operating performance before they are broken up. Our theory predicts that firms will buy assets outside of their main areas of expertise during recessions and sell unrelated assets to firms expanding their core business units during booms. Fluck and Lynch (1999) also predict that conglomerate firms maximizing shareholder value will buy firms outside of their primary area of expertise during recessions.

Following Jensen (1986), several authors argue that firm investment and growth can be explained by managers' tendency to overinvest in projects that yield private gains. Using data on bidding firms, Lang et al. (1991) show that the shareholders do not benefit if acquisitions are made using free cash flows. Scharfstein (1997) and Rajan, Servaes, and Zingales (2000) argue that investment distortions are endemic within conglomerates. A similar logic might suggest that firms acquire plants and divisions that they cannot run efficiently. By contrast, our view of acquisitions is based on Maksimovic and Phillips (2002), who show that the growth by conglomerates' divisions is consistent with a simple profit-maximizing model with scarce managerial or organizational ability. Graham, Lemmon, and Wolf (2002) show that conglomerate firms purchase firms that have lower Tobin's q than the firms that remain single-segment firms. Chevalier (1999) also shows that conglomerate firms purchase firms that have a different sensitivity of cash flow to investment than firms that conglomerates choose not to purchase. These results are consistent with our model and evidence that conglomerate firms, given productivity differences, make selective acquisitions of certain types of firms.[9]

Two recent studies by Mitchell and Mulherin (1996) and Andrade and Stafford (1999) show that industry characteristics such as technological changes and capacity utilization are strongly associated with the incidence of mergers, takeovers, and investment. We are able to exploit plant-level data to obtain a more detailed picture of intraindustry firm-level determinants of asset transactions. Our evidence suggests that firm organization and efficiency drives most of the intraindustry trades.

The remainder of this paper is organized as follows. We discuss our analytical framework of analysis in Section I. The data is discussed in Section II. Section III presents the descriptive statistics of the market for assets. The firm's decisions to buy and sell and the gains from the transaction are analyzed in Sections IV and V, respectively. Section VI concludes.

[9] The evidence in Maksimovic and Phillips (2002) shows that conglomerates grow their more productive segments faster.

I. Framework for Analyzing Trades in Assets

The hypotheses that we examine are motivated by a neo-classical model of firm organization across multiple markets, advanced by Maksimovic and Phillips (2002). Firms sell some or all their assets when there is an expected gain in productivity if the assets are operated by another firm. These trades occur because firms differ in organizational ability and these differences determine their productivity in different industries. The model shows how a profit-maximizing firm chooses the quantity of capacity to employ in each industry and how demand shocks in one industry affect capacity decisions in other industries. It provides predictions on how firm organization affects who trades assets, and the magnitude of the gains from such activity. These predictions differ from the predictions of models that assume that firms acquire assets outside their main industry because managers engage in empire building behavior. Thus, the predictions of the model can be used to test the hypothesis that the trade in assets by multiindustry firms allocates assets to more productive uses. This section describes the model and sets out the hypotheses motivated by the model.

Consider first the market for assets when firms maximize profits and financial market imperfections are not material. Following Lucas (1978), Maksimovic and Phillips (2002) argue that management teams of firms or firm organizations differ in their ability to operate plants efficiently.[10] Management teams of all abilities find it more difficult to manage a large firm than a small firm. Thus, a high quality management team may operate a marginal plant in a large firm only as efficiently as a low quality management team operates a marginal plant in a small firm. Firm size and the scope of a firm's operations adjust until the profit from operating the marginal plant is equalized across all firms in the industry. As industry conditions change, a firm's comparative advantage in operating plants also changes. As a result, there are gains to trading assets, and trade occurs until the profit from operating the marginal plant is again equalized. In the equilibrium, firms with more skilled managers or organizations still have a higher average productivity than firms managed by less skilled managers.

The model focuses on how changes in industry demand affect the marginal value of plant production in single-segment and in multisegment firms, and thus the direction and the gains to trade in plants. As demand increases, output prices also increase, and the ability to produce more output per unit input becomes relatively more valuable. The increased value of output is now greater than the increased cost of operating the firm at a larger size. More productive firms can sell the output at a price that is high enough to compensate for the diseconomies of operating at a larger size. This raises the

[10] More generally, their model can be reinterpreted as positing the existence of a fixed firm-specific factor of production that induces diminishing returns to scale. Following Lucas (1978), they identify this factor with managerial, or more generally, organizational ability.

price of capacity in the market for physical assets and less productive managers will find it more advantageous to sell their plants to more productive managers instead of producing output themselves.

Thus the model predicts that assets flow from more productive to less productive firms when demand increases.[11] The divisions with more skilled management teams thus gain in size relative to divisions managed by less skilled managers in the same industry. The volume of sales is higher when the technology in the industry is such that productivity does not decrease steeply as a firm acquires more capacity in the industry. The magnitude of transactions in response to such demand shocks depends, in part, on whether or not there are significant diseconomies of scale.

When demand falls, the costs of managing a large firm outweigh the benefits of high productivity and at the margin firms may shed assets. However, if the overall trend in the economy exhibits positive growth, we would expect the magnitude of this flow to be lower empirically. Firms would expect such transactions to be reversed subsequently when economic growth resumes. In addition, the existence of transaction costs would reduce the incentive to engage in such transactions, as the opportunity cost of an asset being operated outside its best use is lower in a recession. Under these conditions, the incentives to engage in transactions will be larger after positive industry shocks, giving rise to more transactions when demand increases.

To summarize, the profit-maximizing model suggests tests of the following predictions.

HYPOTHESIS 1: *Sales of assets are more likely to occur when the industry receives a positive demand shock. The higher (lower) the productivity of a division (or a single-segment firm) the higher the probability that it buys (sells).*

Trade-offs between managerial ability and size also hold within multisegment firms. A firm grows its segments until the value of a marginal investment is equalized across industries in which it operates. Thus, the growth and efficiency of a segment may affect a firm's decision to buy or sell plants in another segment. The model predicts that a firm reduces its capacity in an industry by selling assets when the value of these assets to another firm is higher. The opportunity cost may be high either because other firms in the industry can better use the assets, or because the selling firm has better prospects in other industries. Thus, a multisegment firm sells plants in a segment when its other segments are growing fast and it is an efficient producer in these other segments. It may also sell a segment when the segment is not an efficient producer, but the industry is doing well and the plant is relatively more valuable to other, more efficient, producers. These predictions are summarized in the following hypothesis.

[11] The model allows buying of new capacity from an external market with an upward sloping supply curve. An upward sloping supply curve can be justified given adjustment costs for new capacity, or through time-to-build, or given increasing costs of needed inputs to build new capacity. Firms may also scrap assets if the demand in the industry is sufficiently low.

HYPOTHESIS 2: *Asset trades in multisegment firms follow a specific pattern: There is an increased probability that a segment is sold (purchased), when (1) the firm has lower (higher) productivity in an industry and this industry receives a positive demand shock, and (2) the firm's other segments have higher (lower) relative productivity and these other industries receive positive demand shocks.*

The asset purchase decision works similarly to the sale decision. Multisegment firms may purchase plants in an industry if their other segments are less productive producers in industries that receive a positive demand shock. In that case, these less productive segments optimally sell out to more productive producers in their respective industries, and the firm expands faster in its remaining segments. Firms may also purchase plants in an industry when their prospects elsewhere diminish. This occurs if they are more productive producers in other industries and these industries suffer negative demand shocks.

This prediction may also be used to distinguish the neoclassical model from several hypotheses about the acquisition decisions of multisegment firms when managers act opportunistically or when there are material financial market imperfections. Lamont (1997), for example, suggests that firms would be more likely to invest outside their main divisions when their main division receives a positive demand shock. Thus, if the main division of firms is more efficient than peripherals, this prediction on the effect of demand shocks on the purchase and sale decisions in other industries is opposite to that of our model.

Jensen's (1986) free cash flow theory suggests that when firms have excess cash flow, they tend to use it to acquire additional assets that they cannot operate efficiently. More recently Rajan et al. (2000) and Scharfstein and Stein (2000) have also argued that the organizational structure of conglomerates makes them likely to waste assets. Although we cannot identify the dissipation of shareholder wealth from managers overpaying for acquisitions or the appropriation of cash flows from assets, our empirical tests will detect the extent to which the dissipation of free cash flows in multisegment firms leads to acquisition patterns that differ from those predicted by efficient allocation across industries.

These predictions regarding the flow of assets between firms have implications for the analysis of firm organization and restructuring. Profit-maximizing firms grow more in industries in which they have a comparative advantage. Thus, on average, the larger divisions of multisegment firms are predicted to have a higher mean productivity than smaller, peripheral divisions.[12] As a result, in the long run, main divisions are more likely to be buyers and peripheral divisions are more likely to be sellers. For the same

[12] Maksimovic and Phillips (2002) examine this prediction and show it to be consistent with segment-level data constructed from underlying plant-level census data.

reason the expected gain in productivity is higher when the plant is sold by a peripheral division and purchased by a buyer's main division than if the purchase is of a plant in a buyer's peripheral division.

The differences in productivity between main and peripheral units of the same firm are also likely to create an association between organizational structure and trades following a demand shock. When the main division of a multisegment firm receives a positive demand shock, the firm will sell capacity in the peripheral divisions. When the main unit receives a negative demand shock, the firm will acquire assets in peripheral units.[13] We summarize these predictions in the following hypothesis.

HYPOTHESIS 3: *Multisegment firms increase their focus through acquisitions when demand is high in their main industries, and decrease their focus when demand is low. The probability that an asset is sold and the expected gain from the sale are higher for assets operated by peripheral divisions of firms.*

Our model does not make a distinct prediction for transactions involving the whole firm—such as mergers—and transactions involving only some plants or divisions. In fact, we expect the model to predict mergers less well than partial firm transactions: Mergers or acquisitions of multidivisional firms may involve the transfer of some divisions that do not fit under new ownership and that would not have occurred in isolation.[14]

II. Data

We use data from the Longitudinal Research Database (LRD), maintained by the Center for Economic Studies at the Bureau of the Census.[15] The LRD database contains detailed plant-level data for manufacturing plants (SIC codes 2000–3999) on the value of shipments produced by each plant, investments broken down by equipment and buildings, and the number of employees. The LRD tracks approximately 50,000 manufacturing plants every year in the Annual Survey of Manufactures (ASM). This database is only a survey for smaller plants. The ASM covers all plants with more than 250 employees. In addition, it also includes smaller plants that are randomly selected every fifth year to complete a rotating five-year panel. Once selected, plants

[13] We would also expect to see similar effects on other divisions when peripheral units receive demand shocks. However, because peripheral units are smaller than main units, these effects are less likely to be detectable.

[14] Another model that has implications for the timing of asset sales is Shleifer and Vishny (1992). Shleifer and Vishny stress the importance of asset sales that occur by firms with high debt when industries become temporarily distressed. We do not examine the predictions of this model in this paper given that this database does not have financial structure variables.

[15] For a more detailed description of the Longitudinal Research Database (LRD) see McGuckin and Pascoe (1988).

are required by U.S. law to answer the questions. Many data items used (e.g., the number of employees, employee compensation, total value of shipments) also represent items that are also reported to the IRS, increasing the accuracy of the data.

There are several advantages to this database. First, it covers both public and private firms in manufacturing industries. Second, coverage is at the plant level, and output is assigned by plants at the four-digit SIC code level. Thus, firms that produce under multiple SIC codes are not assigned to just one industry. Third, plant-level coverage means that we can track plants even as they change owners. In addition to a plant-level identifier, the database contains a code that identifies which assets change ownership. These two features are key to our study, as they allow us to identify assets that have changed hands from year to year. Thus, plants have to be part of an ASM panel for the plants to remain in our study.

We confine our analysis to the period 1974 through 1992. We use 1974 as the starting year of our analysis because it is the first year of a five-year panel; 1992 is the last year of data available to us. We aggregate plants into firm-level business segments at the three-digit SIC code level and exclude segments that are less than $1 million in real value of shipments in 1982 dollars. Our regressions contain observations beginning in 1979 given we use five years of lagged data in order to calculate productivity for each plant in each year.

III. The Basic Facts

Before preceding to test the hypotheses from the prior section, we first describe the data and present some basic facts about the market for assets.

A. The Number and Types of Transactions

We classify firms as single segment or multiple segment based on three-digit SIC codes. If a firm produces 97.5 percent of its sales or higher in one three-digit SIC code, we classify that firm as a single-segment firm and exclude the small peripheral segment. We classify all other firms as multiple-segment firms. For these firms, we also classify each segment as either a main segment or a peripheral segment. Main segments are segments whose real value of shipments (in 1982 dollars) is at least 25 percent of the firm's total shipments.

We classify transactions into three types: single-plant transactions by single-plant firms, multiplant transactions broken into full divisions and partial divisions (at the three-digit SIC code level), and full-firm transactions. We break transactions into these three categories as it seems plausible that transactions in which a single plant changes hands between multiplant firms in the same industry are marginal investment transactions that have the least implications for both future investment policy and corporate control.

Transactions in which a division is sold have greater implications for managerial control. Finally whole-firm transactions (mergers and acquisitions) include the purchase of a whole multisegment firm, and thus buyers may obtain extra assets outside of their area of expertise that they would not otherwise acquire. Gains may thus differ across transaction types.

Table I presents summary statistics for asset reallocations in our data set between 1974 and 1992. We break out the transactions into whole-firm dispositions (mergers and takeovers) and sales of assets by firms that remain in existence.[16]

Table I shows that from 1974 to 1992, the total number of plants reallocated in mergers and takeovers was approximately equal to the total number of plants reallocated in sales by ongoing firms. On average, 1.95 percent of plants are reallocated annually through takeovers and mergers, whereas 0.95 percent and 0.99 percent are reallocated through sales of entire and partial divisions, respectively. In each case, the plants reallocated tend to be below average in size (real value of shipments) for their industry. More plants than not are sold to buyers whose major focus is producing in the same industry, defined at the three-digit SIC code level.[17] The proportion of same industry buyers is lowest for whole-firm dispositions, and highest for partial-division sales. Table I also shows that more transactions occur in industries that are in expansion than in recession.

Table I also shows the two-digit SIC code industries with the highest and lowest rates of reallocations in our sample. The highest annual rate is 4.72 percent, for Rubber and Plastics, followed by Electronics, Primary Metal products, Optical Equipment, and Processed Food Products. The lowest annual reallocation rate is 2.77 percent, for Leather and Leather Products, followed by Clothes and Apparel, Printing and Publishing, Lumber and Wood products, and Oil Refining. Comparing the types of transactions across industries, it is evident that the rates of partial- and full-division sales in particular differ considerably within these industries. Thus, for example, the full-division sales rates for Rubber and Plastics and Leather and Leather Products are 1.33 percent and 0.68 percent, respectively. The corresponding rates for partial-division sales are 1.36 percent and 0.46 percent, respectively.

B. Who Are the Buyers and Sellers?

Table II shows the characteristics of the firms that sell and acquire assets, by transaction category. In the table, we also break out mergers and acquisitions into those that involve sellers with just one plant, sellers in just one industry, and sellers who operate in more than one industry. In all cases, the characteristics are measured in the year prior to the transaction. The acquiring firm in the case of partial and full divisional sales is the buying

[16] Thus, a firm that sells its only division is classified as a merger.

[17] More precisely, buyers for whom that industry is one of the top two industries in which they operate, and who produce at least 25 percent of their output in that industry.

Table I

Asset Reallocations: Summary Statistics

Sample characteristics for asset reallocations for the years 1974 to 1992. Reallocations include partial firm asset sales and sales through mergers and acquisitions in which the selling firm disposes of all its assets. Plant-level data is obtained from the Annual Survey of Manufactures from the Bureau of the Census, U.S. Department of Commerce. The average annual percentage of plants reallocated is the number of plants reallocated in a given year divided by the total plants, averaged over all years. The percentage sold to buyer inside industry excludes plant sales to buyers with no existing plants in manufacturing prior to the purchase. Average plant sizes are the total value of shipments in thousands of dollars for each plant deflated by three-digit SIC code deflators from the Bureau of Economic Analysis.

	Sample of Firms			
			Asset Sales	
	Total	Mergers and Acquisitions	Full Segment	Partial Segment
Panel A: Reallocation rates across and within industries				
Full period: 1974 to 1992				
Number of plants reallocated	35,291	17,720	8,556	9,015
Average annual % of plants reallocated	3.89%	1.95%[a,c]	0.95%	0.99%
% Plants sold to buyer inside industry				
Same three-digit SIC code	56.8%	54.1%[b,c]	55.5%	63.1%
Same four-digit SIC code	47.7%	44.9%[a,c]	47.9%	53.0%
Average plant size (Real $ in thousands, value of shipments)	$30,332	$28,435	$30,916	$33,506
Average industry plant size (Real $ in thousands, value of shipments)	$35,790	$34,569	$36,440	$37,574

	Sample of Firms			
			Asset Sales	
	Total	Mergers and Acquisitions	Full Segment	Partial Segment
Panel B: Reallocation rates by 2-digit SIC code				
Industry reallocations: Highest quartile				
SIC Code: 30, Rubber and plastic products Yearly percentage plant sales (number of sales)	4.72% (2167)	2.03% (974)	1.33% (577)	1.36% (616)
SIC Code: 36, Electronics/communications Yearly percentage plant sales (number of sales)	4.61% (3037)	2.12% (1397)	1.28% (840)	1.21% (800)
SIC Code: 33, Primary metal products Yearly percentage plant sales (number of sales)	4.49% (1663)	1.95% (732)	1.33% (487)	1.20% (444)
SIC Code: 38, Scientific/optical equipment Yearly percentage plant sales (number of sales)	4.38% (1113)	2.22% (570)	1.32% (332)	0.83% (211)
SIC Code: 20, Processed food products Yearly percentage plant sales (number of sales)	4.24% (2358)	2.23% (2358)	0.58% (603)	1.40% (1491)
Industry reallocations: Lowest quartile				
SIC Code: 29, Oil refining Yearly percentage plant sales (number of sales)	3.21% (307)	2.13% (307)	0.51% (71)	0.58% (82)
SIC Code: 24, Lumber and wood products Yearly percentage plant sales (number of sales)	3.04% (1436)	1.54% (743)	0.59% (273)	0.90% (420)
SIC Code: 27, Printing and publishing Yearly percentage plant sales (number of sales)	2.99% (1104)	1.84% (1104)	0.57% (331)	0.57% (344)
SIC Code: 23, Clothes and apparel Yearly percentage plant sales (number of sales)	2.95% (1495)	1.78% (893)	0.55% (275)	0.62% (327)
SIC Code: 31, Leather and leather products Yearly percentage plant sales (number of sales)	2.77% (253)	1.63% (143)	0.68% (63)	0.46% (47)

[a, b] Test of whether the proportion of mergers is significantly different from the proportion of full-segment sales at the 1 percent and 5 percent levels, respectively, using a two-tailed test.

[c] Test of whether the proportion of mergers is significantly different from the proportion of combined full- and partial-segment sales at the 1 percent level using a two-tailed test.

Table II

Asset reallocations: Summary Statistics

Sample characteristics for asset reallocations for the years 1974 to 1992. Reallocations include partial firm asset sales and sales through takeovers and mergers in which the selling firm disposes of all its assets. Plant-level data is obtained from the Annual Survey of Manufactures from the Bureau of the Census, U.S. Department of Commerce. Recession (expansion) years are the three years classified as having the largest decline (expansion) in the aggregate real value of industrial production. Industry capacity utilization quartiles are yearly quartiles based on the rates reported by the Department of the Census. Long-run industry growth/decline quartiles are calculated using growth rates for aggregate industry shipments over a 15-year period, with beginning and ending periods representing three-year averages for 1974 to 1976 and 1990 to 1992.

	Sample of Firms			
			Asset Sales	
	Total	Mergers and Takeovers	Full Division	Partial Division
Transactions by aggregate economy conditions				
Recession years (1981, 1982, 1991)				
Average % reallocated (total number)	3.57% (5,148)	2.16% (3,112)	0.70% (1,003)	0.72% (1,033)
Expansion years (1986, 1987, 1988)				
Average % reallocated (total number)	6.19% (8,989)	2.69% (3,904)	1.73% (2,509)	1.77% (2,576)
Indeterminate Years	3.21%	1.73%	0.70%	0.78%
Transactions by industry capacity utilization				
Low industry capacity utilization (bottom quartile)				
Average % reallocated (total number)	3.86% (8,618)	1.90% (4,244)	0.99% (2,210)	0.97% (2,164)
High industry capacity utilization (top quartile)				
Average % reallocated (total number)	3.69% (8,413)	1.92% (4,375)	0.87% (1,977)	0.90% (2,061)
Transactions by long-run industry growth/decline				
Quartile 1: Declining industry growth				
Average % reallocated (total number)	4.01% (6,290)	1.95% (3,058)	1.09% (1,707)	0.97% (1,525)
Quartile 2				
Average % reallocated (total number)	3.86% (5,250)	1.96% (2,666)	1.05% (1,425)	0.85% (1,160)
Quartile 3				
Average % reallocated (total number)	3.52% (10,008)	1.80% (5,131)	0.88% (2,505)	0.83% (2,372)
Quartile 4: High industry growth				
Average % reallocated (total number)	4.03% (15,746)	2.01% (7,870)	0.87% (3,405)	1.14% (4,471)

firm. In the case of mergers and acquisitions, these are the surviving firms. For mergers we also report the characteristics of buyers who operate in multiple three-digit SIC code industries.

Firms that sell full and partial divisions tend to be quite large (average revenues of $1.328 and $1.849 billion) and operate in an average of approximately eight three-digit industries. Sellers of partial divisions tend to operate a greater number of plants (an average of 31.48 in contrast to an average of 23.72 plants operated by sellers of entire divisions). Only approximately a quarter of the plants sold in the sales of entire divisions belong to one of the seller's main divisions, whereas approximately half of plants sold in partial division sales belong to one of the seller's main divisions.

Buyers of entire divisions are of similar size and operate a similar number of plants as the sellers, whereas the buyers of partial divisions are on average about two thirds as large as the sellers. Buyers in both categories tend to be slightly more focused than the sellers, operating in an average of approximately six three-digit SIC code industries. The buyers' main divisions acquired 53.8 percent and 63.1 percent of the plants purchased in entire and partial-division transactions, respectively. Thus, the market for asset sales is one in which both the buyers and sellers are conglomerate firms. The sellers sell peripheral divisions and marginal plants to the main divisions of the buyers. Although the buyers are somewhat smaller and more focused than the sellers, the differences between them are not large.

In contrast, the average seller in a merger operates 1.78 plants and has sales of $51 million. Approximately 80 percent of all full-firm sales (mergers and purchases) involve the sale of small, one-plant firms. About 10 percent of all mergers involve multiplant single-industry firms (average number of plants, 5.15) and approximately 10 percent involve multiple-industry firms. Even in this last category, the sellers have an average of only 7 plants, have sales of $239 million, and operate in an average of approximately three three-digit SIC code industries. Buyers of whole firms are larger than the sellers. On average, they operate 16.64 plants, produce in 4.66 three-digit SIC code industries, and have annual sales of $856 million. About a half of the acquired plants are operated by the buying firms' main divisions.

To summarize, we find several differences between the buyers in partial firm dispositions and mergers. On average, buyers of full or partial divisions tend to be larger than buyers in mergers, they operate more plants, and tend to operate in a larger number of industries. These differences arise because a larger proportion of buyers in mergers are single-industry firms. The subset of buyers in mergers who operate in multiple industries are slightly bigger in size and in the number of industries in which they operate.

C. Aggregate and Industry Demand and Asset Reallocations

We compare asset reallocations during economic expansions and recessions. We classify years as recession or expansion years by using aggregate and aggregate-detrended industrial production. Detrended industrial production is defined as the actual less predicted industrial production, where we calculate predicted industrial production from a regression of industrial production on a yearly time trend. Recession years are years in which both real and detrended industrial production decline relative to the previous year. We classify years as expansion years when both real and detrended industrial production increase relative to the previous year.

This procedure gives us results similar to the NBER recession dating procedure, which the NBER does quarterly. This procedure also allows us to classify a year such as 1980, which, according to the NBER, had a recession of less than six months. Using this procedure, we classify 1981, 1982, and 1991 as recession years. For comparability, we also take the top three expansion years—1986 through 1988. (Other expansion years were 1976 through 1978 and 1984 through 1985.) Given that actual and detrended industrial production did not move in the same direction, 1979, 1980, 1983, 1989, and 1992 are indeterminate years.

Table III shows that more assets are reallocated in expansions. The rates of reallocations during expansion years (the three years with the highest increases in the aggregate real value of industries production) and recession years (the three years with the largest decline in the aggregate real value of industries production) are 6.20 percent and 3.57 percent, respectively. The rates of full- and partial-division sales, in particular, are much higher in expansions (1.73 percent and 1.78 percent, respectively), than in recession years (0.70 percent and 0.72 percent, respectively). The reallocations rate due to mergers is somewhat higher in expansions than in recessions (2.69 percent compared to 2.16 percent). By contrast, the total reallocation rate in the remaining indeterminate years is 3.21 percent, the reallocation rate due to mergers is a low 1.73 percent, whereas the partial- and full-division sales rates are 0.78 percent and 0.70 percent, respectively. Thus, the partial- and full-division sales are sharply higher in expansion years.

We find that the number of transactions is sharply higher in expansions. The fact that transactions are lower in recessions is consistent with the overall positive growth trend in the economy causing firms to expect to need more capacity in the future, when growth resumes. In addition, transactions in recessions may result in gains that are less likely to offset transactions costs because the opportunity cost of an asset being operated outside its best use is lower in a recession.

We next explore differences in capacity utilization on the rate of transactions. We use industry-level capacity utilization data from the Bureau of the Census. For each year we use capacity utilization to classify into quartiles all the three-digit SIC industries. We report the average rate of transactions over the sample period for the top and bottom quartile. As Table II shows, the rates of reallocation do not differ materially across capacity utilization quartiles.

We also report the rates of reallocations by long-run industry growth. As Table III shows, more reallocations take place in the fastest growing industries—15,746 in the fastest growing quartile compared to 6,290 in the

Table III

Buyer and Seller Characteristics

Sample characteristics of purchasing firms prior to asset purchases for the years 1974 to 1992. Data is aggregated to firm-level from individual manufacturing plants. Plant-level data is from the Annual Survey of Manufactures from the Bureau of the Census, U.S. Department of Commerce. Buyers without any prior manufacturing plants (foreign buyers, outside manufacturing buyers) are excluded as prepurchase characteristics can not be calculated. Average buyer and seller size is the average value of total shipments deflated by industry price deflators from the Bureau of Economic Analysis. 1992 was the last year available at the time the study was conducted.

	Sample of Firms				
	Asset Sales		Mergers and Takovers		
	Full Division	Partial Division	Firms with Plants = 1	Firms with Plants > 1	Multiple Industry Firms (Three-digit SIC Code)
Seller characteristics prior to sale					
Full period: 1974 to 1992					
Number of selling firms	3,774	4,205	9,480	2,204	1,224
Average number of plants	23.72	31.48	1.00	5.15	7.0
Average seller size (millions $)	1,328	1,849	22	176	239
Average number of three-digit industries	7.56	7.77	1.00	2.21	3.17
Average number of four-digit industries	9.58	10.56	1.00	2.53	3.61
% of plants sold by seller in its primary line of business					
Seller's primary three-digit line(s)*	28.2%	50.8%	100.0%	70.6%	62.2%
Seller's primary four-digit line(s)*	25.6%	36.3%	100.0%	61.6%	54.9%
Buyer characteristics prior to purchase					
Full period: 1974 to 1992					
Number of buyers	2,267	2,755	1,648	4,530	3,627
Average number of plants	23.50	23.38	1.00	22.33	26.80
Average buyer size (millions $)	1,307	1,357	27.9	1,157	1,410
Average number of three-digit industries	6.24	5.75	1.00	6.00	7.24
Average number of four-digit industries	8.21	7.58	1.00	7.87	9.51
% of plants bought that are in buyer's home industry					
At the three-digit SIC code	53.8%	63.1%	59.1%	30.8%	26.3%
At the four-digit SIC code	47.9%	55.2%	49.9%	21.0%	17.4%

* If the seller (buyer) produces in multiple industries, the seller's (buyer's) home industries are those industries that have at least 20 percent of the firm's sales.

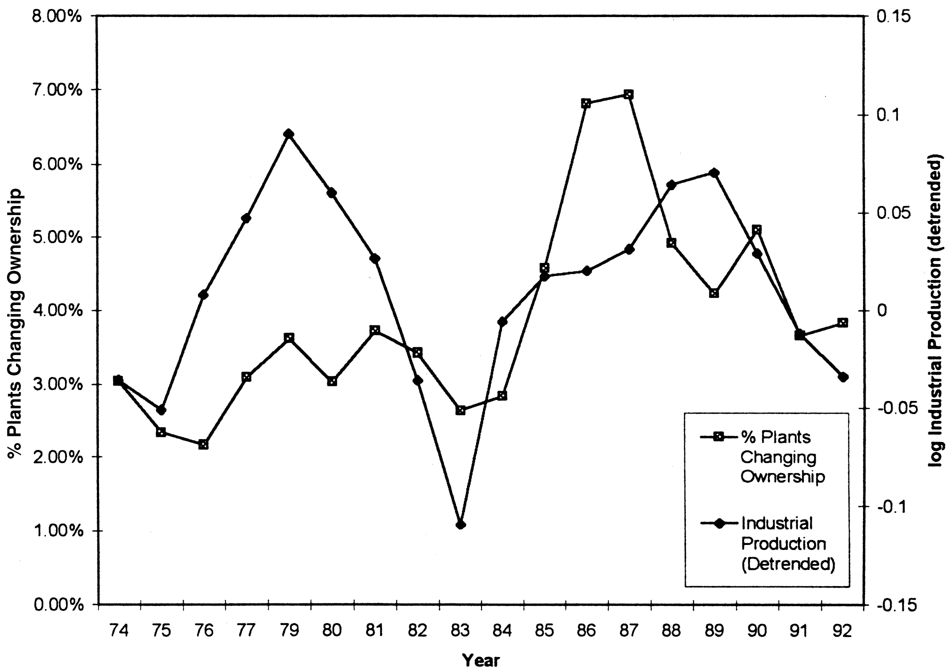

Figure 1. Left-hand scale is the total percentage of plants changing ownership by year. Right-hand scale is aggregate real industrial production detrended.

slowest growing quartile of industries. However, the overall rate of transactions is similar at approximately four percent. There is some limited evidence that industries which have more moderate growth rates have a somewhat lower rate of transactions, but the effect, if it exists, is relatively small.

We also subclassify the reallocations into those that occurred in years in which the industry (at the three-digit SIC level) was in expansion, and those that occurred in years in which the industry was in recession. For an industry to be classified as being in expansion, its real production in that year has to increase and its real level of output has to exceed its long-term trend level. For an industry to be classified as being in recession, the industry's real output has to decline in that year and the real level of output has to be below the long-term trend level.

Table III suggests that the average rate of reallocations, and in particular the rate of partial firm sales, is higher in periods of macroeconomic expansion. There is less evidence that differences in industry conditions have a material effect.

A similar pattern emerges when the time series of sales is plotted. Figure 1 shows both the annual rate of reallocations and detrended aggregate industrial production. Detrended industrial production is calculated as described earlier.

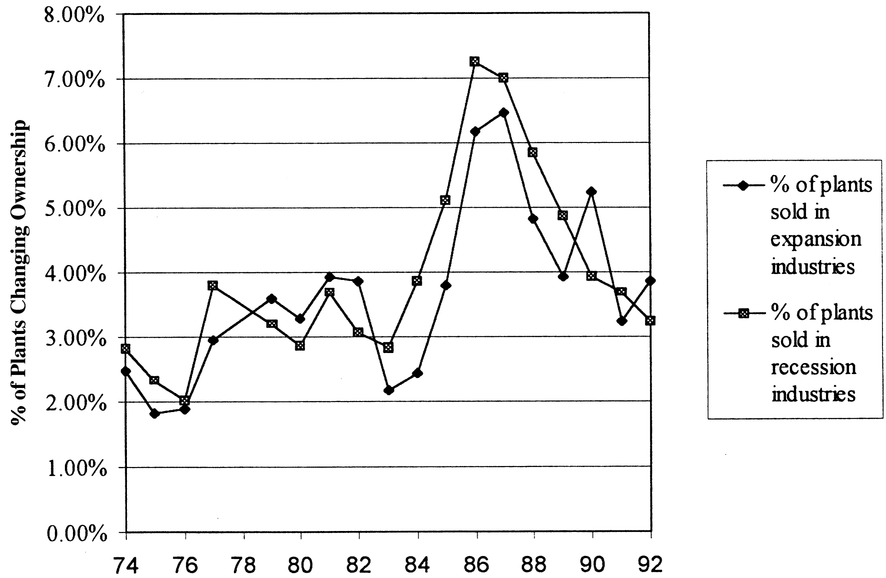

Figure 2. Change of ownership by type of industry. Expansion (recession) industries are the industries in which real and detrended value of shipments at the industry level increase (decline).

Figure 1 shows that, consistent with Table II, the annual percentage of plants that transferred ownership is high in expansions. It is highest in 1986 and in 1987, when nearly seven percent of the plants change ownership (adding up mergers and full- and partial-firm asset sales). The proportion of transactions that occur in industries that are in expansion also varies considerably, and is procyclical. In 1987 and 1988, when few industries are in recession, the number of plants transacted in these industries clearly declines.

However, when we plot the time series of the proportion of plants transacted in industries that were in recession and expansion in Figure 2, we find that the proportions are very similar. The reason for this result is that few industries are in recession when the overall economy is in expansion. Those that are in recession have a similar proportion of plants transacted. Thus, time series variation in the overall rate of asset reallocations is driven by economy-wide factors.

We next examine the time series variation in the percentage of plants broken down by mergers and acquisitions, division sales and partial-division sales. Figure 3 breaks the transactions into these categories. In particular, mergers are strongly procyclical, rising in the years before the 1982 recession to over three percent of plants, before falling to one percent of plants in 1984. The rate of mergers and acquisitions increased again to almost four percent of plants by 1987. Partial-firm asset sales vary less year by year; however they still hit a peak of over four percent (combining full and partial segment sales) in 1987.

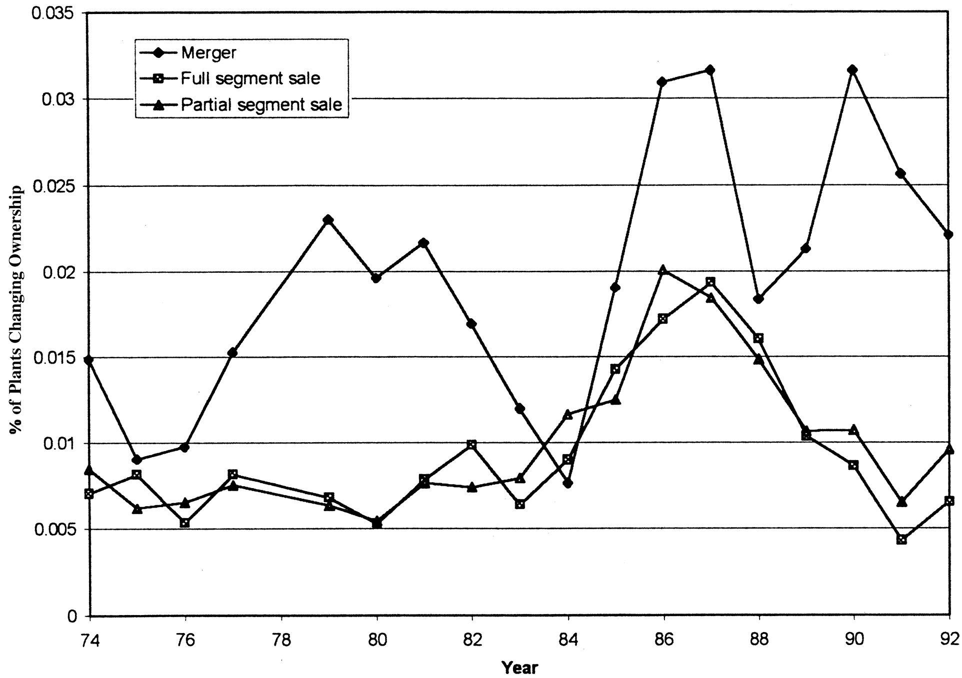

Figure 3. Percentage of plants reallocated through mergers, full-segment sales, and partial-segment sales by year.

The summary statistics suggest that the rate of asset sales, and in particular of full- and partial-divisions sales, is affected by economy-wide factors. There is less evidence that the average rate of transactions is affected by industry factors, such as capacity utilization and long-term growth. We next explore how within-industry and within-firm characteristics affect which firms sell plants and what plants firms choose to sell.

IV. The Probability of an Asset Sale

A. How Sales Vary with Firm Organization

In Figure 4, we show how the proportion of assets sold by division rank, where rank equals one for the largest segment by real value of shipments.

For firms with a given number of segments, as the segment rank of a particular segment increases, the proportion of its assets sold also increases sharply. The plants in the largest segment of a firm are the least likely to be sold. For example, the proportion of largest segment plants sold is less than one percent for firms with seven or more segments, whereas the proportion of plants that these firms sell in their smallest segments rises to three and four percent. Schlingemann et al. (2002) find using accounting data on whole

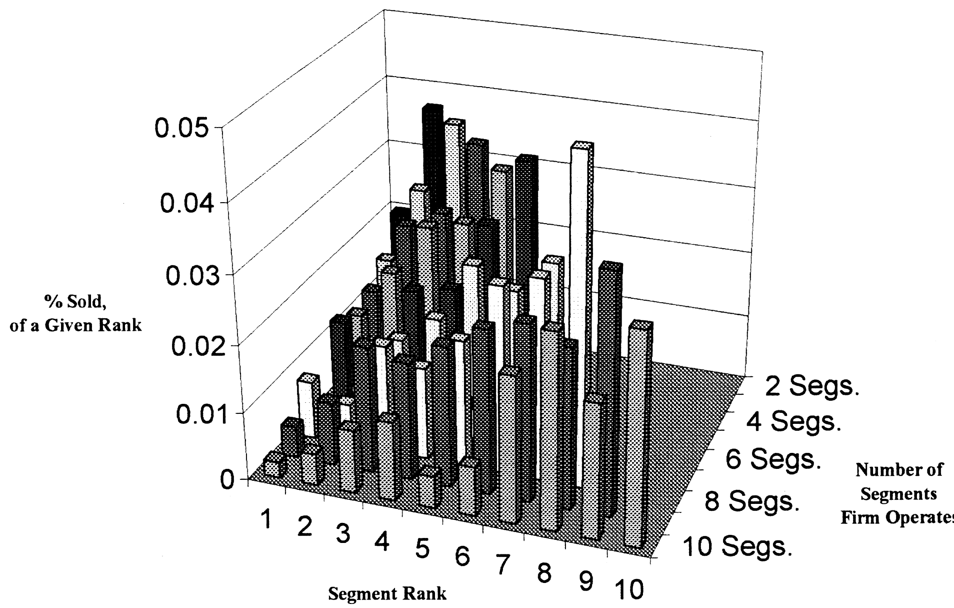

Figure 4. Percentage of plants sold via asset sale by segment rank as the number of segments the firm operates increases. Segment rank equals one for the largest segment a firm operates.

segments that a firm is more likely to sell small rather than large segments. Maksimovic and Phillips (2002) find that there is an inverse relation between the rank of a segment and its efficiency, and that the equally ranked segments of larger firms tend to be more efficient than those of smaller firms. Thus, Figure 4 accords well with the hypothesis that firms are more likely to sell their least efficient plants and also that, holding segment ranks constant across firms, the rate of plant sales is lower for more efficient segments.

There also exists an inverse relation between the number of segments a firm possesses and the probability that it will be acquired. Three percent of single-segment firms are bought out or merged, whereas only 1.5 percent of firms with six and seven segments are merged.

B. Measurement of Productivity and Demand in Business Segments

To analyze the relation between demand and firms' productivity on asset sales, we need measures of both these variables. We discuss our measures next.

B.1. Productivity of Business Segments

We calculate productivity for all firm segments at the plant level. Our primary measure of performance is total factor productivity (TFP). TFP takes the actual amount of output produced for a given amount of inputs and compares it to a predicted amount of output. "Predicted output" is what the plant should have produced, given the amount of inputs it used and the mean industry production technology in place. A plant that produces more than the predicted amount of output has a greater-than-average productivity. This measure is more flexible than a cash-flow measure of performance, and does not impose the restrictions of constant returns to scale and constant elasticity of scale that a "dollar in, dollar out" cash-flow measure requires.

In calculating the predicted output of each plant, we assume that for each industry there exists a production function that defines the relation between a plant's inputs and outputs. Then, for each industry, we estimate this production function using an unbalanced panel with plant-level fixed effects, using all plants in the industry within our 1974 to 1992 time frame. If a plant changes owners, we effectively treat the years under each owner as separate plants, allowing plant-level fixed effects to differ by each owner. For each industry, we calculate productivity using up to five years of lagged data. Thus we can calculate productivity for the 1979 to 1992 period. In addition, each plant has to have at least two years of productivity to be included. Finally, each input has to have a nonzero reported value.

In calculating productivity, we assume that the plants in each industry have a translog production function.[18] This functional form is a second-degree approximation to any arbitrary production function, and therefore takes into account interactions between inputs. To estimate predicted outputs, 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:

$$\ln Q_{it} = a_i + A + \sum_{j=1}^{N} a_j \ln L_{jit} + \sum_{j=1}^{N} \sum_{k=j}^{N} a_{jk} \ln L_{jit} \ln L_{kit}, \tag{1}$$

where Q_{it} represents output of plant i in year t, a_i is a plant-level fixed effect, and L_{jit} is the quantity of input j used in production for plant i for time period t. The parameter A is a technology shift parameter, assumed to be constant by industry, and $a_j = \sum_{i=1}^{N} a_{ji}$ indexes returns to scale. Plants that change ownership have a different fixed effect for each owner, allowing the plant-level fixed effect to differ by owner.

Our measure of TFP is the residual from equation (1) plus the plant-level fixed effect. We standardize plant-level TFP by dividing by the standard deviation of TFP for each industry. Thus, our comparisons of plants' TFP are not driven by differences in the dispersion of productivity within each industry. We discuss the details of the variables used and present some summary statistics from our estimation of TFP in the Appendix.

To check robustness of our regression results, we also use two alternative measures of productivity. First we use value added per worker. Value added per worker is defined as total sales less materials cost of goods sold, divided

[18] See Caves and Barton (1990) and especially Jorgenson (1986) for more details and extensive references on estimating firm production functions.

by the number of workers. This measure has been used in McGuckin and Nguyen (1995). Second, we use cash flow per dollar of sales. Cash flow is defined as sales less the sum of the materials cost of goods sold and the capital expenditures, all divided by the value of sales. Neither of these measures has the desirable theoretical properties of TFP. However, they have the advantage of being familiar, and since they are not computed from a regression, may have desirable statistical properties.

B.2. Demand in Business Segments

To examine the effect of demand on asset sales, we include measures of both aggregate and industry demand. For aggregate demand we use detrended aggregate industrial production, as described earlier.[19] We capture changes in demand for an industry's output using an indicator of economic activity in downstream industries. By using a downstream demand indicator we avoid potential endogeneity problems that may arise if we were to use changes in the value of an industry's own shipments to proxy for demand shocks. Our measure of downstream industry demand is based on a four-digit industry measure of downstream economic activity from Baily, Bartelsman, and Haltiwanger (1998). This measure is constructed by using the 1977 input–output matrix to construct a weighted average index of downstream economic activity, with weights equal to the share of total shipments from the industry in question.[20]

C. Probability of Asset Sales

We next analyze how seller characteristics and firm organization influence partial firm sales. We separately examine sellers who are single-segment firms, and those that are multiple-segment firms. To be included in the subsample of firms that might have a partial-firm sale, the single-segment firms must have at least two plants. The regressions in this table (and all subsequent tables) cover the years from 1978 to 1992.[21]

Hypothesis 2 above suggests that a multiple-segment firm's decision to sell plants or an entire segment is influenced by its performance in other segments. We test for this effect, and for the effect of industry- and economy-

[19] Results are similar using actual industrial production. We use detrended industrial production to capture the idea that reallocations take place in response to a shock to the marginal value of production.

[20] The measure was first used in Bartelsman, Caballero, and Lyons (1994) (BCL). The BCL measure is still subject to simultaneity bias if a demand shock to the upstream industry affects activity in the downstream industry. To avoid this problem, in constructing each upstream industry's index of downstream demand, we exclude all downstream industries from the index if they purchase a large share of their inputs from that upstream industry (see Shea (1993)). Our results are similar using either this series or the original one constructed by BCL. We would like to thank John Haltiwanger for kindly providing both of these data series to us.

[21] The beginning year for these regressions is 1978 as that is the first year the change in downstream industry demand is available. A previous version of the paper used the change in own industry shipments (beginning in 1975) and found similar results. We also included industry profitability in the regressions. This variable is insignificant when added to the existing variables.

wide conditions.[22] In each case, we run an unbalanced panel probit regression allowing for correlated residuals within panel units, and we report heteroskedasticity-consistent standard errors. We control for firm size, number of plants, and relative segment rank. Relative segment rank is defined as the segment rank, with the largest segment having rank equal to one, divided by the total number of segments.

The results in Table IV show that demand at the aggregate level affects the probability of a partial sale of plants. Plants and segments are more likely to be sold when aggregate industrial production is high. This effect is stronger for multiple-segment firms.

Productivity strongly affects the probability a plant is sold for multisegment firms. The probability of a sale declines as the plant productivity increases and as the plant's segment productivity increases. This is consistent with the firm selling its worst plants in its worst divisions.[23] Thus, the behavior of sellers is consistent with the hypothesis that they are selling plants for which they do not have superior expertise.

For multisegment firms, a firm's other segments' productivity affects the probability of a plant sale. The probability of sale is positively and significantly related to the segment's rank within the firm: The probability that a plant in a smaller segment is sold is higher, holding industry shocks and productivity constant. The probability of a plant sale is also higher if the firm's other segments are more productive. This effect is strongly significant. In addition, the probability that a plant is sold is higher when the firm's other segments are productive *and* the firm's other industries have a positive increase to demand. The estimated magnitude of this effect can be shown by varying the magnitude of the other segments' weighted TFP while holding all the remaining variables at their median values. The predicted probability that the segment is sold is 3.35 percent when the other segments' weighted TFP is relatively low (at the 10th percentile) and the other segment's relative demand is high. This probability increases to 4.16 percent when the other segments' weighted TFP is relatively high (at the 90th percentile), and relative demand is also high.

In Table V, we present robustness tests of our results using two alternative measures of efficiency: value added per worker and plant cash flow. The alternative measures of productivity yield similar results as those in Table IV.

In sum, the results in Tables IV and V confirm the importance of aggregate demand on the rate of transactions. They are also consistent with profit maximizing behavior by sellers. Plants are more likely to be sold when they

[22] In unreported regressions, we also analyze partial-segment and full-segment sales separately. We have also estimated the equation for main and peripheral divisions of multiple-segment firms separately. In all material respects, the results are qualitatively similar. In addition we analyzed alternative specifications in which the firm multiple segment variables were weighed by the size of each segment. The results do not differ in any material respect.

[23] In unreported regressions, we also examine the choice of which plant to sell within a segment. The probability that a plant is sold is negatively related to the difference between its productivity and that of the other plants in the segment.

Table IV

Partial Firm Sales

Regressions test the effects of plant-level productivity and industry-level demand on the decision to sell plants for single-segment and multiple-segment firms. The dependent variable is a binary variable that indicates that the firm sells a plant, while still remaining in operation the next year. Observations are at the plant level for all firms. Detrended aggregate industrial production is actual minus predicted U.S. aggregate industrial production where predicted industrial prediction is obtained by regressing industrial production on a yearly time trend. Productivity variables are industry and year adjusted. Segment variables are aggregated into three-digit SIC codes for industry segments from underlying plant-level data. We estimate the regressions using unbalanced panel probit regressions allowing for correlated residuals within panel units. Significance tests are conducted using heteroskedasticity consistent standard errors. Data are yearly from 1979 to 1992. (p-values are in parentheses.)

Variable	Dependent Variable: Plant Sale — Single segment firms (with >1 Plant)	Dependent Variable: Plant Sale — Multiple segment firms	Test for Significant Diff.: Single vs. Conglomerate Firms (p-Value)[a]
Constant	−6.162	−1.774	
	(0.000)*	(0.000)*	(0.000)*
Aggregate industrial production	0.831	1.104	
(detrended)	(0.000)*	(0.000)*	(0.000)*
Industry sensitivity to aggregate	0.009	−0.006	
industrial production	(0.277)	(0.003)*	(0.056)***
Lagged productivity (TFP) of plant[b]	−0.021	−0.075	
	(0.797)	(0.001)*	(0.042)**
Lagged segment TFP	0.026	−0.338	
	(0.705)	(0.000)*	(0.000)*
Segment TFP * change in	−0.055	0.000	
downstream industry demand	(0.317)	(0.987)	(0.812)
Lagged firm size (coefficient * 10,000,000)	0.642	−0.038	
	(0.000)*	(0.000)*	(0.000)*
Average number of plants per	−0.002	−0.022	
industry segment	(0.378)	(0.000)*	(0.000)*
Firm multiple segment variables			
Segment rank/number of segments		0.080	
		(0.000)*	
Other segment's weighted TFP[c]		0.240	
		(0.000)*	
Relative demand * other segments		0.073	
weighted TFP[d]		(0.003)*	
Total plant years	45,959	259,065	
Chi-squared statistic	108.44	1940.91	
Significance level (p-value)	<1%	<1%	

*, **, *** Significantly different from zero at the 1 percent, 5 percent, and 10 percent levels, respectively, using a two-tailed test.

[a] Significance test for a multiple-segment dummy variable interacted with each independent variable in a regression with all firms with greater than one plant.

[b] Total Factor Productivity (TFP) is calculated using a translog production function.

[c] Other segments' productivity is weighted average of the firm's other segment(s) weighted by the segment(s) sales.

[d] Relative industry demand equals one (zero, minus one) when the segment's change in downstream industry demand is greater (equal, less) than the change in downstream demand of the firm's median segment. Relative industry demand is interacted with the firm's other segments' weighted TFP.

Table V

Robustness Tests: Alternative Measures of Efficiency

Regressions test the effects of plant-level efficiency measures and industry-level demand on the decision to buy out another firm for single-segment and multiple-segment firms. The dependent variable is a binary variable which indicates that the firm sells a plant, while still remaining in operation the next year. Observations are at the plant level for all firms. Efficiency variables are industry and year adjusted. Segment variables are aggregated into three-digit SIC codes. Detrended aggregate industrial production is actual minus predicted U.S. aggregate industrial production where predicted industrial prediction is obtained by regressing industrial production on a yearly time trend. Columns one and two use value added per worker as the measure of efficiency. Value added is sales less materials divided by the number of workers. Columns three and four use plant cash flow as the measure of efficiency. Cash flow is sales less materials cost of goods sold less capital expenditures divided by sales. We estimate the regressions using unbalanced panel probit regressions allowing for correlated residuals within panel units. Significance tests are conducted using heteroskedasticity consistent standard errors. Coefficients for the value added measure of efficiency are multiplied by one hundred. (*p*-values are in parentheses.)

	Dependent Variable: Plant Sale			
	Efficiency measure: Value added per worker		Efficiency measure: Plant cash flow	
Variable	Single-segment Firms (with >1 Plant)	Multiple-segment Firms	Single-segment Firms (with >1 Plant)	Multiple-segment Firms
Constant	−6.364	−6.236	−6.004	−1.799
	(0.000)*	(0.000)*	(0.000)*	(0.000)*
Aggregate industrial production (detrended)	0.880	0.980	0.802	1.100
	(0.000)*	(0.000)*	(0.000)*	(0.000)*
Lagged plant efficiency measure	−0.166	−0.184	−0.404	−0.363
	(0.000)*	(0.000)*	(0.003)*	(0.000)*
Lagged segment efficiency measure	−0.004	−0.001	0.345	−0.162
	(0.597)	(0.670)*	(0.040)**	(0.015)**
Lagged segment efficiency ∗ change in downstream industry demand	0.061	0.046	−0.449	0.325
	(0.661)	(0.633)	(0.147)	(0.748)
Lagged firm size (coefficient ∗ 10,000,000)	0.710	0.066	0.671	−0.037
	(0.000)*	(0.000)*	(0.000)*	(0.000)*
Average number of plants per industry segment	−0.003	−0.024	−0.003	−0.022
	(0.184)	(0.000)*	(0.224)	(0.000)*
Firm multiple segment variables				
Segment rank/number of segments		0.489		0.124
		(0.000)*		(0.000)*
Other segment's weighted efficiency[a]		0.006		0.109
		(0.792)		(0.097)***
Relative demand ∗ other segments weighted efficiency[b]		0.129		−0.040
		(0.005)*		(0.450)
Total plant years	45,959	259,065	45,959	259,065
Chi-squared statistic	115.66	1561.24	95.39	623.74
Significance level (*p*-value)	<1%	<1%	<1%	<1%

*, **, *** Significantly different from zero at the 1 percent, 5 percent, and 10 percent levels, respectively, using a two-tailed test.

[a] Other segments' efficiency is weighted average of the firm's other segment(s) weighted by the segment(s) sales.

[b] Relative industry demand equals one (zero, minus one) when the segment's change in downstream industry demand is greater (equal, less) than the change in downstream demand of the firm's median segment. Relative industry demand is interacted with the firm's other segments' weighted TFP.

are not productive, when their segment is less productive, and when the firm has better performing assets elsewhere. This finding supports our Hypotheses 2 and 3.

In Table VI we analyze the economic significance of our regression results. Specifically, we analyze how the probability of a sale by a single-segment firm or a division of a conglomerate varies as the level of industrial production and the productivity of the asset vary, holding all other variables at their sample medians. The probability of a sale is derived using regression coefficients computed in Tables IV and V.

Panel A of Table VI shows how the probability that an asset is sold depends on the initial owner's corporate structure and the asset's productivity. In general, the probability that an asset is sold by a conglomerate firm rather than by a single-segment firm is higher by a factor of approximately four. Using our standard productivity measure, TFP, the probability that a median level asset is sold by a conglomerate firm in any year is 3.71 percent, whereas the corresponding probability for a single-segment firm is 0.85 percent. Assets operated by peripheral divisions of conglomerates are sold at a somewhat higher rate.[24] We also find that more efficient assets at the 90th percentile have a lower probability of being sold than less efficient assets (10th percentile). The results are not sensitive to the choice of productivity measure used. The table also shows that smaller peripheral divisions are more likely to be sold. The probability a division with segment rank equal to the 90th percentile is sold is 4.13 percent at the median productivity.

Panel B shows how variation in the real level of aggregate industrial production affects the probability of sale. We present results for the median level of detrended industrial production and for levels that correspond to the 90th and 10th percentiles, respectively. The rate of asset sales is very responsive to the variation in aggregate industrial production. Thus, for example, when the aggregate production is at the 90th percentile (the second highest year), the probability that an asset of a conglomerate firm is sold is 4.03 percent, whereas it is only 3.20 percent when the level of industrial production is at the 10th percentile (the second lowest year). The corresponding statistics for single-segment firms are 1.26 percent and 0.57 percent, again illustrating their lower participation in the market for partial-firm asset sales.

Panel C shows the combined effect of the variation in productivity and aggregate industrial production. A low productivity plant owned by a peripheral division of a conglomerate has a 4.82 percent probability of being sold when industrial production is high, whereas a high productivity plant at a time of low aggregate production has a probability of being sold of only 2.50 percent. The corresponding probabilities for single-segment firms are 1.46 percent and 0.48 percent, respectively.

[24] The difference between single-segment and conglomerate rates may arise in part because the exit from an industry is classified as a partial-firm sale for a multisegment firm, but a whole-firm sale in the case of a single-segment firm. We return to this point in our discussion of Table IX.

Table VI

Probability of an Asset Sale

Predicted probability of an asset sale varying performance measures and industrial production using the regression coefficients from Tables IV and V. Panel A presents results varying performance measures from the 10th to 90th percentiles. Panel B presents results varying detrended industrial production from its median value using yearly data from 1979 to 1992. Panel C varies both productivity and aggregate industrial production at their median values. We hold all other variables at their sample medians.

Panel A: Varying Initial Productivity/Performance

	10th Percentile	Median Level	90th Percentile
Single-segment firms			
Varying productivity (Table IV, column 1)	1.08%	0.85%	0.66%
Varying value added per worker (Table V, column 1)	1.02%	0.88%	0.72%
Varying cash flow (Table V, column 3)	0.99%	0.87%	0.77%
Conglomerate firms			
Varying productivity (Table IV, column 2)	4.32%	3.71%	2.86%
Also decreasing segment rank to 10% (main divisions)	4.11%	3.52%	2.71%
Also increasing segment rank to 90% (peripheral divisions)	4.80%	4.13%	3.20%
Varying value added per worker (Table V, column 2)	4.06%	3.66%	3.08%
Varying cash flow (Table V, column 4)	4.19%	3.59%	3.04%

Panel B: Varying Industrial Production

	10th Percentile	Median Level	90th Percentile
Single-segment firms			
(Table IV, column 1)	0.57%	0.85%	1.26%
Conglomerate firms			
All divisions (Table IV, column 2)	3.20%	3.71%	4.03%
Also decreasing segment rank to 10% (main divisions)	3.02%	3.52%	3.81%
Also increasing segment rank to 90% (peripheral divisions)	3.64%	4.13%	4.56%
All divisions (Table V, column 2)	3.21%	3.66%	4.09%
All divisions (Table V, column 4)	3.15%	3.59%	4.02%

Panel C: Varying Industrial Production and Productivity

	Productivity 10th and Industrial Production 90th percentile	Mean Level	Productivity 90th and Industrial Production 10th percentile
Single-segment firms			
Varying productivity (Table IV, column 1)	1.46%	0.85%	0.48%
Varying value added per worker (Table V, column 1)	1.39%	0.88%	0.51%
Varying cash flow (Table V, column 3)	1.32%	0.87%	0.56%
Conglomerate firms			
All divisions (Table IV, column 2)	4.82%	3.71%	2.50%
Also decreasing segment rank to 10% (main divisions)	4.59%	3.52%	2.36%
Also increasing segment rank to 90% (peripheral divisions)	5.34%	4.13%	2.80%
All divisions (Table V, column 2)	5.53%	3.66%	2.70%
All divisions (Table V, column 4)	4.67%	3.59%	2.66%

Taken together, the estimates in Table VI suggest that the probability that a plant is transferred is considerably higher if the plant belongs to a multisegment firm, particularly a small division of a multisegment firm. Inefficient plants are more likely to be sold than efficient plants, and there are considerably more sales in times of high production. These observations are consistent with the view that the market for plants facilitates the transfer of assets to productive uses, and that transfers occur at times when the marginal value of capital is high. There is no evidence that managers of conglomerate firms are less willing to sell assets than managers of single-segment firms.

D. Probability of Mergers and Acquisitions

In Table VII we analyze mergers and whole firm sell-offs. As before, we split the sample of selling firms into single-segment and multiple-segment firms. Because the majority of selling firms are small single-plant firms, we also analyze these separately.

The results in Table VII show that industry demand strongly influences mergers and acquisitions. The rate of mergers and firm sell-offs is higher when aggregate demand is high and in industries whose demand is sensitive to aggregate output shocks. In contrast to the case of partial firm sales, the role of productivity in predicting mergers is less clear-cut. The probability that a single-plant firm is sold decreases with its productivity. We find do not find similar significant effects with the sales of other firms. However, we do find that the probability that a multiple-segment firm is sold falls if the firm's productivity is high and when the industries in which it operates experience higher demand. This finding is consistent with the first hypothesis in this paper, that firms are more likely to sell in good times when they are less productive.

The significance of the relation between firm size and the probability of sale also differs across the categories in Table VII. There is a significant positive relation between firm size and the probability of sale for single-plant firms, no relation for multiple-plant single-segment firms, and a significant negative relation for multiple-segment firms. Controlling for size, focused firms are less likely to be sold then diversified firms.

E. Buyer Characteristics and the Probability of a Purchase

In Table VIII we examine the buyers of whole firms. We consider single-segment and multisegment firms separately. To investigate whether the motives for focus-increasing and diversifying purchases are the same, we classify multisegment buyers into those for whom the purchase increases firm focus and those for whom it decreases focus, as measured by the firm's herfindahl index across the segments it operates.

With only the exception of single-plant firms, we find that the probability that a firm is a buyer in a particular industry increases with the buying

Table VII

Mergers and Firm Selloffs: Selling Firm Characteristics

Regressions test the effects of plant-level productivity and industry-level demand on the decision to sell out or merge with another firm for single-segment and multiple-segment firms. The dependent variable is a binary variable that indicates that the firm sells to another firm. Productivity variables are industry and year adjusted. Firm-level variables are aggregated from plant-level data by weighting each plant by its real value of plant shipments. Industry-level variables are constructed for each firm using as weights the real value of that firm's industry production. We estimate the regressions using unbalanced panel probit regressions allowing for correlated residuals within panel units. Significance tests are conducted using heteroskedasticity-consistent standard errors following Huber–White. (p-values are in parentheses.)

	Dependent Variable: Firm Selloff			Test for Significant Diff.:
Variable	Single-segment Firms with 1 Plant	Single-segment Firms with >1 Plant	Multiple-segment Firms	Multiple-segment Interaction Variable (p-value)[a]
Constant	−1.833	−1.987	−1.808	
	(0.000)	(0.000)*	(0.000)*	(0.644)
Aggregate industrial production (detrended)	0.723	0.716	0.743	
	(0.000)*	(0.035)**	(0.006)*	(0.952)
Industry sensitivity to aggregate industrial production	0.012	0.013	0.018	
	(0.000)*	(0.054)***	(0.002)*	(0.519)
Lagged productivity of firm (TFP)[b]	−0.023	−0.018	−0.014	
	(0.041)**	(0.526)	(0.549)	(0.600)
Firm TFP ∗ downstream industry shipments	0.181	0.070	−0.568	
	(0.191)	(0.864)	(0.028)**	(0.615)
Lagged firm size (coefficient ∗ 10,000,000)	2.500	0.299	−0.145	
	(0.000)*	(0.186)	(0.042)**	(0.166)
Dispersion (herfandahl) across industries			−0.223	
			(0.000)*	
Total firm years	96,961	24,772	42,524	
Chi-squared statistic	56.12	11.62	39.36	
Significance level (p-value)	<1%	0.040	<1%	

*, **, *** Significantly different from zero at the 1 percent, 5 percent, and 10 percent levels, respectively, using a two-tailed test.

[a] Significance test for a multiple-segment dummy variable interacted with each independent variable in a regression with all firms with >1 plant.

[b] Total Factor Productivity (TFP) is calculated using a translog production function.

Table VIII

Mergers and Firm Selloffs: Buying Firm Characteristics

Regressions test the effects of plant-level productivity and industry-level demand on the decision to buy out another firm for single-segment and multiple-segment firms. The dependent variable is a binary variable that indicates that the firm buys another firm. Observations are at the firm level for all firms. Productivity variables are industry and year adjusted. Segment-level variables are aggregated from plant-level data by weighting each plant by its real value of plant shipments. Industry-level variables are constructed for each firm using as weights the real value of a firm's industry production. We estimate the regressions using unbalanced panel probit regressions allowing for correlated residuals within panel units. Focus-increasing (decreasing) purchases are transactions that result in the buying firm's sum of squared industry market shares (herfandahl) increasing (decreasing). Significance tests are conducted using heteroskedasticity-consistent standard errors following Huber–White. (p-values are in parentheses.)

	Dependent Variable: Firm Purchase			
	Single-segment Firms		Multiple-segment Firms	
Variable	With 1 Plant	With >1 Plant	Focus-increasing Purchase	Focus-decreasing Purchase
Constant	−2.381	−2.094	−2.122	−1.987
	(0.000)*	(0.000)*	(0.000)*	(0.000)*
Aggregate industrial production	0.551	0.450	0.914	0.817
(detrended)	(0.044)**	(0.206)	(0.001)*	(0.001)*
Industry sensitivity to aggregate	0.007	−0.008	−0.006	−0.004
industrial production	(0.216)	(0.318)	(0.371)	(0.512)
Lagged productivity of industry	−0.048	0.271	0.249	0.290
segment (TFP)[a]	(0.413)	(0.004)*	(0.100)***	(0.000)*
Firm TFP * downstream	0.618	0.884	0.062	−0.047
industry shipments	(0.580)	(0.643)	(0.549)	(0.412)
Lagged firm size	4.330	0.650	0.196	0.166
(coefficient * 10,000,000)	(0.000)*	(0.105)	(0.091)***	(0.051)**
Average number of plants per		0.027	0.090	0.075
industry segment		(0.000)*	(0.000)*	(0.000)*
Total plant years	77,713	24,774	40,152	40,498
Chi-squared statistic	21.33	99.85	141.37	144.31
Significance level (p-value)	<1%	<1%	<1%	<1%

*, **, *** Significantly different from zero at the 1 percent, 5 percent, and 10 percent levels, respectively, using a two-tailed test.
[a] Total Factor Productivity (TFP) is calculated using a translog production function.

firm's segment TFP, size, and with the number of plants the firm already owns. Acquisitions are more likely when aggregate industrial production is high. These results indicate that buying firms are growing in industries in which they are productive when demand is high.

Table IX calculates economic significance of the previous regressions in Tables VII and VIII. The table shows how the predicted probabilities of mergers or full firm purchases are affected by variation in firm productivity and

Table IX

Probability of Mergers

Predicted probability of a merger or full-firm purchase varying performance measures and industrial production using the regression coefficients from Tables VII and VIII. Panel A presents results varying performance measures from the 10th to 90th percentiles. Panel B presents results varying detrended industrial production from its median value over 1979 to 1992. Panel C varies both productivity and aggregate industrial production at their median values. We hold all other variables at their sample medians.

Panel A: Selling Firms			
Varying productivity	10th Percentile	Median	90th Percentile
Single-segment selling firms	2.63%	2.55%	2.45%
Conglomerate selling firms	3.21%	3.01%	2.77%
Varying industrial production	10th Percentile	Median	90th Percentile
Single-segment selling firms	2.33%	2.55%	2.75%
Conglomerate selling firms	2.74%	3.01%	3.25%
Varying productivity & industrial production	Productivity 10th, Industrial Production 90th Percentile	Median Level	Productivity 90th, Industrial Production 10th Percentile
Single-segment selling firms	2.83%	2.55%	2.26%
Conglomerate selling firms	3.46%	3.01%	2.53%

Panel B: Buying Firms			
Varying productivity	10th Percentile	Median	90th Percentile
Single-segment buying firms	1.85%	2.13%	2.56%
Conglomerate buying firms: Focus increasing	2.30%	2.47%	2.94%
Conglomerate buying firms: Focus decreasing	2.92%	3.27%	3.95%
Varying industrial production	10th Percentile	Median	90th Percentile
Single-segment buying firms	1.93%	2.13%	2.17%
Conglomerate buying firms: Focus increasing	2.03%	2.47%	2.56%
Conglomerate buying firms: Focus decreasing	2.76%	3.27%	3.37%
Varying productivity & industrial production	Productivity 10th, Industrial Production 90th Percentile	Median Level	Productivity 90th, Industrial Production 10th Percentile
Single-segment buying firms	1.78%	2.13%	2.60%
Conglomerate buying firms: Focus increasing	2.22%	2.47%	3.04%
Conglomerate buying firms: Focus decreasing	2.87%	3.27%	4.01%

demand conditions. For the case of buying firms, the explanatory variables and their variation parallel those discussed in the case of partial firm sales in Table VI.

Panel A shows the predicted probabilities of whole firms sales. As in the case of partial firm sales, whole single-segment firms are less likely to be sold than multisegment firms, at 2.55 percent and 3.01 percent, respectively. The difference between the two types of firms is less than the difference for asset sales. Taken together with the results on partial-firm sales in Table VII, our estimates predict that assets owned by conglomerate firms appear to be "in play" to a greater extent than assets owned by single-segment firms. Overall, predicted sales of multisegment firms are very sensitive to variations in both productivity and aggregate industrial demand.

Panel B shows predicted variation in the probability of purchase. Again, the predicted purchases by multisegment firms are higher than by single-segment firms. The predicted probability that a firm is a buyer varies with the firm's productivity. However, the predicted probability that a multisegment firm engages in a focus-decreasing purchase depends somewhat more on the buying firm's productivity. Both the probability of a purchase by a single-segment firm and of a focus-decreasing purchase by a multisegment firm are also higher when aggregate industrial output is high. Focus-increasing mergers by multisegment firms are not as sensitive to changes in aggregate industrial production.

V. Are There Productivity Gains and What Determines the Gains?

In this section, we examine the productivity change (industry adjusted in each year) surrounding the asset sales—both for full-firm mergers and sales and for partial-firm sales. To begin the analysis, we first present simple summary statistics on the change in productivity for the manufacturing plants involved in purchases subsequent to the transactions.

In Table X, we analyze the changes in productivity using a three-by-three matrix to capture the internal organization characteristics of the buyer and the seller. We classify both the buyer and the seller as a single-segment firm, or as a main or peripheral division of a multisegment firm. Because the results in Table VII suggest that single-plant firms may behave differently than the rest of the firm population, in the case of mergers we further subclassify single-segment sellers into firms with one plant and firms with more than one plant.

In this table, and in our subsequent tables analyzing productivity changes, we require that both buyer and seller ex ante data exist for each transaction. Transactions for which we have no ex ante data for buying firms include foreign firms purchasing assets for the first time in the United States, nonmanufacturing firms purchasing manufacturing assets, new firms formed to purchase existing assets, assets spun off or carved out from existing firms,

Table X

Summary Statistics for Change in Productivity for Assets Sold or Merged

The change in productivity, industry and year adjusted, for three years surrounding asset sales, mergers, or full-firm sales (year −1 to year +2). Values represent sample means for transactions between buyers and sellers. (Standard error of the mean in parentheses.) Third row is the number of plants transacted.

Panel A: Partial-Firm Sales

	Selling Firm Characteristics		
	Multidivision Firm		
	Main Division	Peripheral Division	Single-segment Firm
Buying firm characteristics			
Multidivision buyer adds to			
Main division	0.062	0.103*	0.127
	(0.039)	(0.036)	(0.092)
	444	580	87
Peripheral division	−0.008	0.047**	0.033
	(0.027)	(0.021)	(0.076)
	857	1,544	122
Single-segment buyer	0.019	0.107**	−0.038
	(0.052)	(0.042)	(0.069)
	275	382	126

Panel B: Full-Firm Mergers and Acquisitions

	Selling Firm Characteristics			
	Multidivision Firm		Single-segment Firm	
	Main Division	Peripheral Division	with 1 Plant	with >1 Plant
Buying firm characteristics				
Multidivision buyer adds to				
Main division	0.087**	0.143***	−0.020	−0.039
	(0.041)	(0.083)	(0.039)	(0.043)
	396	89	420	234
Peripheral division	−0.017	−0.020	−0.051***	0.058
	(0.020)	(0.025)	(0.028)	(0.039)
	1,278	914	723	401
Single-segment buyer	−0.044	0.037	0.053	−0.011
	(0.049)	(0.067)	(0.029)	(0.050)
	237	108	677	219

*, **, *** Significantly different from zero at the 1 percent, 5 percent, and 10 percent levels, respectively, using a two-tailed test.

and small firms outside of the ASM sample that purchase larger plants. Given that our subsequent regressions analyze the effect of differences between ex ante buyer and seller productivity, we also only analyze transactions for which we have ex ante productivity data for both buying and selling firms.[25] After these requirements are taken into account, we are able to analyze productivity changes for 10,109 transactions.

We calculate the industry adjusted change in productivity from the year before the transaction to two years after the transaction, year −1 to year +2, where year 0 is the year of the transaction. For our sample, the mean industry adjusted change in productivity is 0.02, and is significantly different from zero at the one percent significance level. The median change in productivity is also positive. Thus, the majority of the transactions in our sample have led to increases in productivity. Productivity changes for the transaction types are given in Table X.

Panel A of Table X presents the change in productivity for partial-firm asset sales. We find that all sales from peripheral divisions have significant positive ex post changes in productivity, regardless of the buyer's organizational characteristics. For single-segment sellers, no transactions resulted in a significant increase in productivity. There is no evidence that any category of transactions leads to significant declines in productivity of the assets sold.

Panel B presents the change in productivity for full-firm sales and mergers. Several facts emerge: We find significant productivity gains only when buyers add capacity to their main divisions—increasing the focus of their firm. Purchases by single-segment firms, although very frequent, do not result in increased productivity of the purchased assets. Thus, there is evidence that restructuring that involves sales from multisegment firms to single-segment firms does not result in gains. Productivity significantly decreases in only one class of transactions: purchases of single-plant firms by the peripheral divisions of multisegment firms.

The differences in the observed gains in Table X may exist because some types of buyers are more efficient in improving assets. The differences may also occur if, in some types of transactions, there is a higher incidence of inefficient sellers and efficient buyers, who have the expertise or resources to improve the assets. To examine the latter possibility, we classify transactions into those where the productivity of the buyer's assets in the industry exceeds that of the acquired plants, and into those where it does not.

For partial-firm asset sales, the buyer's existing plants are more productive than the acquired plants in 59.6 percent of the transactions. For mergers and acquisitions, 57.2 percent of the total transactions have buyers that are more productive than the plants they purchase. These proportions are significantly different from each other at the 1.5 percent level. Looking at differences based on firm organization, we also find significant differences. For example, for asset sales, we find that when firms add assets to their main divisions, their existing plants are more productive in 62.9 percent of the transactions. By contrast, for peripheral divisions 59.6 percent of buyers are more productive than purchased plants and for single segment firms

[25] This also eliminates transactions occurring prior to 1979, given that we calculate productivity in each industry using five years of lagged data.

54.9 percent are more productive than the purchased plants. In all cases the proportion of transactions is significantly greater than 50 percent at the 1 percent level.

We next examine if these differences between the buyer's and seller's productivity significantly affect productivity gains of the purchased plants in a multivariate regression. To test whether the transaction type affects productivity gains after controlling for productivity differences, we also allow for a differential effect for the difference in seller and buyer productivity based on the type of transaction. We regress the change in productivity of the purchased plants on the difference between the initial productivity of the buyer and the productivity of the plants purchased, buyer's and the seller's respective firm sizes, and the selling firm's initial productivity.

We expect the productivity of acquired plants to increase when they are acquired by a buyer who has higher productivity. However, the productivity of acquired plants may not increase when the buyer's productivity is lower. To examine whether this occurs, we interact the difference between buyer and seller productivity with an indicator variable that equals one when the purchased plant is more productive than the buyer. This variable allows the slope coefficient on the difference in buyer and seller productivity to change when buyers are less productive than the plants they purchase.

Lastly, to test whether there is a differential affect by type of transaction, we interact the difference in productivity between the buyer and seller with indicator variables identifying the different transaction categories from Table X. The interaction variables measure how the effect of the difference between the buyer's and seller's initial productivity on the asset's change in productivity depends on whether the transaction is a partial sale or a merger, and on the organizational structure of the buyer and the seller. The interaction variables thus allow different types of transactions to have larger or smaller sensitivities to the difference between initial buyer and seller productivity.

Table XI shows that the productivity gain following a transaction depends on the productivities of the selling and buying firms. Assets increase in productivity when the productivity of the buying firm is higher than the productivity of the assets purchased. This finding suggests that the earlier stock market evidence of Lang, Stulz, and Walkling (1989), which shows total stock market gains of tender offers when high q firms acquire low q targets, is not caused just by tax differences or by purely financial gains. However, when assets are purchased by a buyer with a lower productivity, the purchased assets' productivity falls. Gains in productivity are positively related to the seller's size and inversely related to the initial seller productivity.

None of the 17 estimated transaction interaction variables is statistically significant. Thus, there is little evidence that the type of transaction affects productivity gains, after controlling for the initial buyer's and seller's productivity.

The fact that some buyers acquire assets that are more productive than their existing assets, and that the acquired assets' productivity declines subsequently, may initially appear puzzling. One possible explanation is that

Table XI

Change in Productivity Based on Buying & Selling Firm Characteristics

This table presents a single regression that tests the joint effects of buyer and selling firm organization characteristics on the change in plant productivity over a three-year horizon from the year prior to the asset sale or merger (year −1) to the end of the second year (year +2) after the transaction. Total Factor Productivity (TFP) variables are calculated using a translog production function. Lagged firm productivity variables are aggregated up from individual plants. All productivity variables are industry and year adjusted. Transaction type variables are indicator variables that show whether the transaction was from a seller's main or peripheral division or from a single-segment firm to a buyer's main, peripheral, or to a single-segment buyer. Transaction type dummy variables are then interacted with the difference in productivity between the buying firm and the assets purchased. We estimate the regressions using ordinary least squares. Significance tests are conducted using heteroskedasticity-consistent standard errors. (*p*-values in parentheses.)

	Dependent Variable: Change in Productivity Year −1 to +2	
	Transaction Type	
Variable	Partial Firm Sale	Merger/Acquisition
Productivity and transaction size		
Lagged productivity (year −1)	−0.453	
of selling firm's plants	(0.000)*	
Difference in productivity (year −1)	0.399	
buying firm—productivity of plants purchased	(0.000)*	
Difference in productivity (year −1) ∗ Indicator	−0.084	
variable for negative difference in productivity	(0.004)*	
Buyer size (coefficient ∗ 10,000,000)	−0.003	
	(0.834)	
Seller size (coefficient ∗ 10,000,000)	0.123	
	(0.000)*	
Difference in productivity interacted with transaction characteristics		
Sale from seller's main division	−0.009	0.000
to buyer's main division	(0.931)	(0.907)
Sale from seller's main division	−0.014	−0.043
to buyer's peripheral division	(0.894)	(0.676)
Sale from seller's main division	−0.032	−0.119
to a single segment buyer	(0.776)	(0.282)
Sale from seller's peripheral division	0.119	omitted
to buyer's main division	(0.268)	
Sale from seller's peripheral division	−0.002	−0.058
to buyer's peripheral division	(0.987)	(0.572)
Sale from seller's peripheral division	−0.090	−0.165
to a single segment buyer	(0.400)	(0.179)
Sale from single segment firm	0.021	−0.034
to buyer's main division	(0.883)	(0.750)
Sale from single segment firm	0.065	−0.045
to buyer's peripheral division	(0.620)	(0.662)
Sale from single segment firm	−0.034	−0.155
to a single segment buyer	(0.786)	(0.131)
Constant		−0.066
		(0.000)*
Total transactions:		
Partial firm sales and merger and acquisitions	10,109	
R^2	0.21	
F-test all coefficients = 0 (p-value)	<1%	

* Significantly different from zero at the 1 percent levels using a two-tailed test.

Table XII

Change in Buyer Productivity

Buyer's change in productivity, industry and year adjusted, for three years surrounding asset purchases, mergers, or acquisitions (year −1 to year +2). Values represent sample means for transactions. We construct a firm-level weighted average of buyer's plants, with weights equal to an individual plant's value of shipments. For the existing assets' change in productivity, we present the weighted average change in productivity for plants in the same industry as the purchased assets. (Standard error of the mean is in parentheses.)

		Cases where	
	Overall Change in Productivity	Initial Buyer Productivity > Productivity of Assets Purchased	Initial Buyer Productivity < Productivity of Assets Purchased
Panel A: Change in Productivity of Buyer's Existing Assets (Excluding Purchased Assets)			
All transactions	0.004	−0.027**	0.053*
	(0.009)	(0.011)	(0.015)
Asset purchases	0.008	−0.028***	0.065*
	(0.014)	(0.016)	(0.023)
Mergers & acquisitions	0.000	−0.027***	0.044**
	(0.012)	(0.016)	(0.019)
Panel B: Change in Productivity of All Assets of Buyer (Including Purchased Assets)			
All transactions	0.020*	0.028*	−0.010
	(0.006)	(0.008)	(0.011)
Asset purchases	0.048*	0.056*	0.002
	(0.009)	(0.010)	(0.014)
Mergers & acquisitions	−0.003	0.004	−0.028**
	(0.007)	(0.009)	(0.013)
Number of buying firms	6905	5366	1539

*, **, *** Significantly different from zero at the 1 percent, 5 percent, and 10 percent levels, respectively, using a two-tailed test.

managers of these buying firms are destroying value by making inefficient acquisitions. However, such a conclusion would be unwarranted if the acquired assets provide synergies that increase the value of the buyers' existing assets.

To check whether this is the case, we calculate the industry- and year-adjusted changes in productivity of the buyer's assets for three years surrounding asset purchases (year −1 to year + 2). In Panel A of Table XII we present the changes in the productivity of buyers' existing plants in the same industry in which plants are acquired. The data is broken down into three categories: all transactions, partial-firm purchases, and whole-firm purchases. We further present productivity changes for transactions for the case in which the buyer's initial productivity exceeds that of the assets purchased, and for the case in which it does not.

Panel A shows that for all transactions, and for partial- and whole-firm transactions taken separately, there is no overall change in the productivity of the buyers' existing assets in the same industry. However, the buyers' assets exhibit a significant decline in productivity in those cases where the initial buyers' productivity exceeds that of the purchased assets. By contrast, buyers' existing assets in a segment show a significant increase in productivity when more productive plants are acquired in that segment.

The pattern of gains is consistent with the notion that the addition of a less productive plant to a segment increases control costs and lowers the productivity of existing assets. A majority of transactions are of this type. The fact that the acquisition of a more productive plant results in gains to the existing assets and a decline in productivity of the acquired plants is consistent with buyer purchasing expertise or productive ability that can be transferred to existing assets.

To determine whether the total gains in productivity outweigh the losses, we compute the total changes in the productivity of the buying firm around the period of the transaction. This calculation, which includes the purchased assets, shows the full effect of the purchase on all of the buyer's manufacturing operations. To get a firm-level measure of the productivity gain, we construct a weighted average of all plants of the buyer. We weight each plant's productivity by its initial value of shipments.

Panel B shows the buyers' total productivity gains at the firm level. The results show that there is a significant firm-level productivity gain in partial-firm sales when the buyer's productivity exceeds the productivity of the acquired plants. Thus, the productivity gain of the acquired plant(s) outweighs the productivity loss on the firm's existing assets. Panel B also shows that a significant firm-level productivity loss only occurs in the case when less productive firms acquire more productive firms. In this case, the productivity gain that the buying firm experiences is outweighed by the loss in productivity of the assets purchased. There are no significant firm-level productivity effects in whole-firm sales when the buyer is more efficient than the seller, or in partial-firm sales when the buyer acquires more efficient plants.

These results, combined with the summary statistics that show significant increases in productivity, are consistent with the hypothesis that the market for assets works well for asset sales and for the majority of mergers. Assets that are transacted result in significant gains, consistent with Hypothesis 1 presented earlier. Contrary to the hypothesis that these divisions get subsidized by their parent firms, multidivisional firms are more likely to sell less productive divisions and these sales to other firms result in subsequent productivity increases. Our results support the conclusion that assets change hands as the prospects in the overall economy and in their other industries improve and their owners discover that they do not have a comparative advantage in running these assets. There is significant firm-level fall in productivity surrounding a transaction in cases where more efficient firms are acquired by less efficient firms—a minority of transactions.[26]

Overall these results show that, as suggested by our first hypothesis, there are significant gains for assets being redeployed from less productive sellers to productive buyers. The results on the timing of transactions are consistent with our second hypothesis, which predicts that more productive firms will expand their operations in good times and when their prospects in a given industry look better than the other industries in which they operate.

VI. Conclusions

In this paper, we analyze the market for corporate assets (plants, divisions, and whole firms) in manufacturing industries. We analyze both the buyers and sellers. We show that the market for both full and partial firms is extensive. On average, 3.89 percent of plants change ownership in each year in our study. The total number of transactions varies with the economy and is strongly procyclical. In expansion years, close to 7 percent of plants annually change ownership. Approximately the same number of plants are sold through partial-firm asset sales as in mergers and acquisitions. The buyers and sellers in the partial-firm asset sale market are typically large multisegment firms, in contrast to the merger and acquisition market where the buyers are much bigger than the sellers.

We analyze the factors that are associated with the probability that assets transfer ownership. We have three main results on the probability assets are sold:

1. For multiple-division firms, the probability of a firm selling assets decreases with both the asset's and the segment's productivity. The probability that assets are sold is higher for peripheral divisions. The probability of mergers and firm sell-offs is higher when the selling firm is less productive and the industry experiences a positive demand shock.
2. The selling firm's productivity in other divisions impacts the probability of a sale. A division is more likely to be sold the better the prospects of the other divisions.
3. We find that the probability that a firm is a buyer of additional assets increases with its efficiency and size.

[26] In unreported results, we have also calculated the total effect of acquisitions at the segment level. These calculations measure the changes of productivity of the new and existing assets of the segment that acquires the new assets. The qualitative results at the segment level are the same as the results at the firm level.

In addition, we show that ex post productivity changes occur for assets transacted and these productivity changes are associated with buyer and seller initial productivity and firm organization. We also examine the overall changes in buyer productivity for purchasing firms. Our primary findings for changes in productivity for assets transacted are:

1. The gain in productivity of assets under new ownership is higher when the selling firm's productivity is low and is higher the more productive the buyer.
2. A firm's internal organization is also associated with observed changes in productivity of the asset sold. Asset sales from peripheral divisions of sellers to both main and peripheral divisions of buyers show significant productivity gains. For mergers and acquisitions, assets that are acquired by the buyer's main divisions from other multiple-segment firms show significant gains. These gains are primarily explained by the differences in the initial productivity of buying and selling divisions.
3. When we take into account both the purchased and existing assets, the change in productivity is positive for partial-firm asset purchases and is insignificantly different from zero for mergers and acquisitions.
4. When firms purchase assets of lower productivity, existing assets increase in productivity but the acquired assets decline in productivity. At the firm level, these losses on the acquired assets are offset by the productivity increases of the purchased assets. Overall firm productivity increases for partial-firm purchases and is insignificant for mergers and acquisitions.
5. When firms purchase assets of higher productivity, the acquired assets decline and the existing assets increase in productivity. At the firm level, the change in productivity is not significantly different from zero for partial-firm purchases by less efficient producers. Firm-level productivity declines for one category of transactions: mergers and acquisitions by less efficient firms.

These findings suggest that firms have differing levels of ability to exploit assets, and that their comparative advantage is in their main industries. The low productivity of firms' peripheral divisions prior to the sale, however, does not necessarily imply inefficient ownership. They may optimally operate these divisions until demand is high, at which point more efficient buyers acquire these assets.

The productivity gains we document are consistent with buying firms being able to offer a premium in part because of the gains in real productivity that occur. The results are also consistent with more skilled buying firms being able to transfer skill and improve the assets they purchase. There is no evidence that managers of conglomerate firms are less willing to sell assets than managers of single-segment firms.

The timing of sales and the pattern of productivity gains suggests that most transactions that occur in the market for plants and divisions tend to improve the allocation of resources and are consistent with profit maximizing by firms across the divisions they operate. Thus, the pattern is consistent with profit-maximizing behavior. However, our results do not disprove the existence of agency conflicts within firms. We identify one category of transactions, full-firm acquisitions by buyers with lower productivity than that of the assets they purchase, for which overall firm productivity declines. Moreover, if managers are able to appropriate the gains of productivity from any acquisitions, there might not be a gain to shareholders.

Our results would indicate that efficient firms refocusing in booms may produce the highest gains to transactions. Boards of directors should be more willing to accept productivity explanations for these types of transactions, particularly for partial firm acquisitions.

Despite our finding that most transactions result in gains in productivity, this does not refute the proposition that sometimes managers undertake transactions that, even given rational expectations, reduce value at the time the transaction is undertaken. For example, our research would also suggest that mergers and acquisitions by inefficient firms, presumably with lower stock market valuations relative to industry peers, should receive closer scrutiny by boards of directors. Further research should examine the link between acquirer and seller stock market valuations and subsequent productivity gains.

Overall, our results suggest that most transactions in the market for assets result in an increase in productive efficiency. We conclude that the market for corporate assets facilitates the redeployment of assets from firms with a lower ability to exploit them to firms with higher ability.

Appendix

In estimating the TFPs in our sample, we use data for approximately 50,000 plants each year. We are able to calculate lagged productivity for plants from 1979 to 1992 as we use five years of lagged data to calculate productivity. In the productivity regression for each industry, we include three different types of inputs: capital, labor, and materials, as explanatory variables for each plant. All these data exist at the plant level. We include plants if plants have at least two years of data. In addition, all observations must have nonzero values for all inputs and outputs. After productivity is calculated, we report and use these numbers in regressions after excluding the top and bottom one percent of the calculated productivities. We also only include plants if the total value of firm shipments is at least 10 million real 1982 dollars.[27] After imposing these restrictions, we end up with over 400,000 plant-level productivity measures.[28] In calculating productivity, the capital variable used

[27] We also find similar results changing this requirement to one million real 1982 dollars.

[28] The regressions in Table IV use 305,024 observations. Single-plant firms, representing 95,916 observations, are not included in Table IV. In addition, 15,874 observations are excluded as we also exclude outliers based on alternative measures of efficiency presented in Table V. The tables for mergers use firm-level observations obtained by aggregating these plant-level observations up to the firm level.

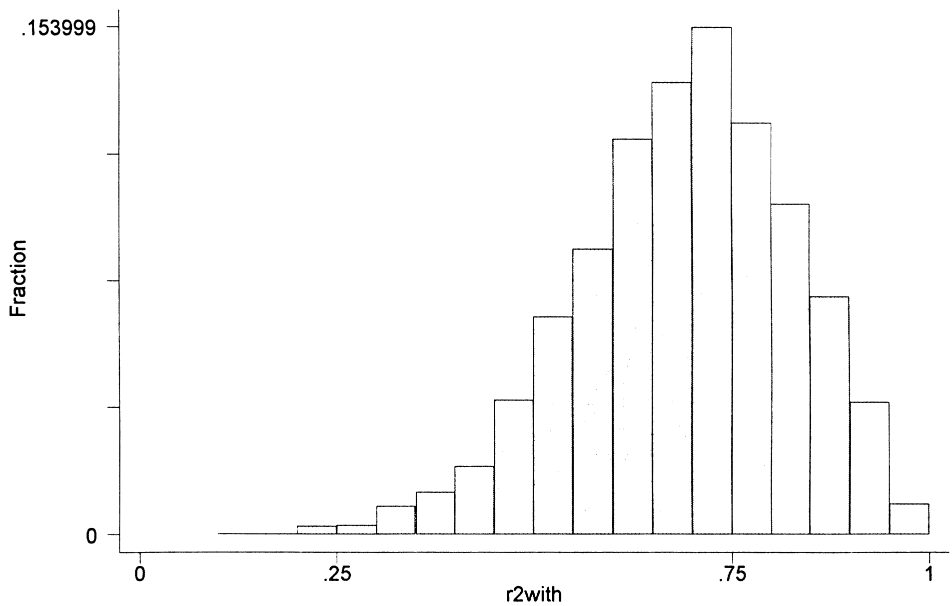

Figure A1. Histogram of *R*-squares from TFP within regressions run each year using five years of lagged data.

is plant's capital stock that is available to be used in production. To account for depreciation of beginning of period capital stock, we use data from the Bureau of Economic Analysis to make depreciation adjustments for beginning period capital stock at the two-digit level. To the beginning of period capital stock, we add the real dollars (in real 1982 dollars) spent on capital expenditures for additions to the capital stock. In addition, to capture vintage effects of capital, we include plant age in our productivity calculations. Plant age is either the first year in which the plant appeared in the database, or 1972 (the first year of the database), if the plant existed in 1972. For the dependent variable, output, the ASM does not state the actual quantity shipped by each plant, but shows only the value (in current period dollars) of shipments. We adjust all nominal dollar variables for inflation by using four-digit SIC code price deflators for output, materials, and capital from the Bartelsman and Gray (1994) database. Kovenock and Phillips (1997) describe these inputs and the method for accounting for inflation and depreciation of capital stock in more detail.

To measure the productivity for a firm's entire business segment, we construct a weighted average of individual plant productivity, in which the weights are the predicted plant-level real value of shipments. The variable for the productivity of the firm's other segments is the weighted average of all of the firm's other plants outside of the segment in question. Again, the weights are the predicted plant-level real value of shipments.

Table AI

Total Factor Productivity

Table reports mean coefficients from yearly regressions by industry. Each regression is repeated in each year for each industry using the last five years of data. Coefficients in column one represent the average coefficients from regressions estimated in each year for each industry (1,726 total regressions). Columns two and three represent illustrative industries for 1978. In each year, productivity is the residual plus the firm-specific fixed effect obtained from regressing the real value (deflated) of output on a plant's age, the value of materials and inputs, the real value of a plant's capital stock and the hours of labor utilized. Adjustments for depreciation for capital stock are made each year using depreciation deflators from the Bureau of Economic Analysis. All dollar amounts are deflated to 1982 dollars using deflators for the National Bureau of Economic Research. (p-values in parentheses).

Independent Variable: Real Value of Output			
Variable	Mean Coefficient	Meat Packing SIC 2011	Oil Refining SIC 2911
Age	0.013	0.019	0.169
	(0.061)***	(0.587)	(0.009)*
Inputs	0.108	0.003	1.661
	(0.000)*	(0.972)	(0.000)*
Capital stock	0.044	0.084	0.306
	(0.000)*	(0.124)	(0.001)*
Labor	0.674	0.773	−0.072
	(0.000)*	(0.000)*	(0.600)
(Inputs)^2	0.074	−0.001	0.009
	(0.000)*	(0.825)	(0.043)**
(Capital stock)^2	0.000	0.075	0.007
	(0.631)	(0.000)*	(0.411)
(Labor)^2	0.020	0.085	−0.024
	(0.000)*	(0.000)*	(0.039)**
Inputs * capital stock	−0.029	−0.005	0.003
	(0.000)*	(0.640)	(0.856)
Inputs * labor	−0.110	−0.005	−0.040
	(0.000)*	(0.503)	(0.003)*
Capital stock * labor	0.044	−0.144	−0.000
	(0.000)*	(0.000)*	(0.999)
Constant	3.352	2.819	−3.765
	(0.000)*	(0.000)*	(0.000)*
R^2		0.92	0.74

*, **, *** For column one mean value of the coefficient is significantly different from zero at the 1, 5, 10 percent levels, respectively, using a two-tailed t-test. For columns two and three, significance test is whether coefficient is significantly different from zero using a two tailed t-test.

We also include other firm and segment-level variables in our regressions to provide additional controls for unmeasured productivity differences and other factors, such as size, that can influence firm growth. We include the lagged firm size and the number of plants operated by a firm at the beginning of the year. We define firm size as the total value of shipments in real 1982 dollars. We exclude all industry segments with real value of shipments smaller than one million dollars from our regressions.

To allow for technical change, each regression is repeated for each industry for each year using data for the current year and the preceding four years, giving us a rolling panel of data for each year. Thus we can calculate productivity for the 1978 to 1992 period. We use the earlier years of data, 1974 to 1977, only for calculating the first year of productivity.[29] Thus, there are 1,726 separate regressions. Figure A1 shows the distribution of adjusted R^2 for the regressions.

In Table AI we present the means of the coefficients for the 1,726 separate regressions covering the whole sample and also the coefficients for two sample industries.

The coefficients for the sample industries are for 1979, the first year for which a five-year panel is available. The first industry, SIC 2011 Meat Packing, was selected because it is the first industry in our sample when industries are ranked by SIC codes. Because meat packing is labor intensive, the second industry, SIC 2911 Oil Refining was selected to illustrate a capital intensive industry. The means of the coefficients in the whole sample are significantly different from zero. The coefficients of the two sample industries reflect their technologies. As expected, labor inputs have a more significant role in the meat packing equation and capital stock inputs are more important in oil refining.

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[29] In an earlier version of this paper, we calculated TFPs using the entire sample period for each industry. The two methodologies yielded very similar qualitative results.

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