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Asset Efficiency and Reallocation Decisions of Bankrupt Firms

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ABSTRACT

This paper investigates whether Chapter 11 bankruptcy provides a mechanism by which insolvent firms are efficiently reorganized and the assets of unproductive firms are effectively redeployed. We argue that incentives to reorganize depend on the level of demand and industry conditions. Using plant-level data, we find that Chapter 11 status is much less important than industry conditions in explaining the productivity, asset sales, and closure conditions of Chapter 11 bankrupt firms. This suggests that firms that elect to enter into Chapter 11 incur few real economic costs.

A KEY QUESTION IN CORPORATE FINANCE LITERATURE is whether Chapter 11 bankruptcy provides a mechanism by which insolvent firms can be efficiently reorganized and the assets of unproductive firms effectively redeployed. Several studies have identified possible costs and benefits associated with Chapter 11 bankruptcy reorganizations. Of these costs, indirect or real costs represent a deadweight loss and are therefore considered most significant.[1]

In this paper, we examine the importance of these costs and the effect of plant-level efficiency, firm characteristics, and industry demand on the decisions to redeploy assets or close manufacturing plants in bankruptcy. Our approach differs in two ways from previous studies. First, our empirical de-

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[1] Bankruptcy costs can be both direct and indirect. Legal and administrative costs are commonly called direct costs of bankruptcy. For a review of the literature on bankruptcy costs see Altman (1993) or Senbet and Seward (1995). Warner (1977) and Weiss (1990) examine the direct costs (lawyers, accountants) of bankruptcy.

sign explicitly recognizes that if an important function of bankruptcy is to facilitate the redeployment of assets to more productive uses, then both its incidence and its effectiveness should differ systematically with industry conditions. Second, we use detailed plant-level operating data from a sample of 1195 plants of 302 firms that declared Chapter 11 and over 50,000 plants of nonbankrupt firms – representing both public and private firms in the U.S. manufacturing sector. These plant-level data enable us to track changes in composition of firms as they sell or close plants. Thus, our evaluation of reorganizations is not subject to sample selection bias inherent in the use of firm-level data from survivor firms.

There has been a major debate in the literature about the likely significance of the costs of bankruptcy reorganizations. Haugen and Senbet (1978) argue that bankruptcy costs per se are unlikely to be significant, since many of these costs would be associated with reorganizations outside of bankruptcy in which assets are reallocated to new users. Several recent papers, among them Harris and Raviv (1990), Diamond (1993), Jensen (1993), and Hart and Moore (1995), argue that bankruptcy can even be beneficial, triggering a change in control of the firm and the termination of unprofitable projects. By contrast, Bulow and Shoven (1978), Giammarino (1989), Bergman and Callen (1991), and Gertner and Scharfstein (1991) identify potential conflicts that, if unresolved, may cause the firm not to maintain, sell, or close assets optimally in bankruptcy.

The tests and evidence in this paper help resolve some of these debates. Central to our tests is the idea that industry conditions affect the marginal product of capital, and thus the incentives to disinvest and redeploy assets.[2] Therefore, if an important function of bankruptcy is to facilitate the redeployment of assets into more productive uses, both its incidence and its effectiveness in promoting value-enhancing transfers should also differ systematically with industry conditions.[3]

Our empirical results show that industry effects are important determinants of the frequency of bankruptcy and of economic decisions in bankruptcy. We find that in declining industries the proportion of plants in Chapter 11 is as much as three times higher than in high-growth industries. However, in declining industries the productivity of plants in Chapter 11 bankruptcy and subsequent to emerging does not significantly differ from that of their industry counterparts, nor does it decline during Chapter 11. This find-

[2] Related literature has considered asset sales by firms. Rajan (1992), Diamond (1993), and Brown, James, and Mooridian (1993) study how the presence of financial intermediaries (who have a comparative advantage in monitoring) among debtors in bankruptcy can affect the resolution of claims and the disposal of the bankrupt firm's assets.

[3] We do not examine costs that can arise outside bankruptcy in times of cash flow shortages or financial distress. Opler and Titman (1994) examine whether firms with high leverage lose market share relative to industry counterparts in industry downturns. Pulvino (1998) examines asset sales by financially distressed airlines. Andrade and Kaplan (1998) examine firms from a sample of highly leveraged transactions that become distressed. Gilson, John, and Lang (1990) examine private reorganizations of firms in default.

ing remains when we control for the changing composition of bankrupt firms as they make decisions to retain, sell, or close plants. Thus, Haugen and Senbet's (1978) contention that there are no indirect bankruptcy costs is supported in declining industries where most Chapter 11 bankruptcies occur. In high-growth industries, when we control for asset sales and closures, we find significant declines in productivity only for plants that immediately exit Chapter 11, or that remain in Chapter 11 for four or more years.

Analysis of plant sales and closures provides little evidence that Chapter 11 facilitates asset sales by less efficient firms. Bankrupt firms sell plants at a higher rate than nonbankrupt firms. However, for the most part, this difference is accounted for by sample selection and industry conditions, not by bankruptcy status. Although the probability of an asset sale is not strongly affected by bankruptcy status, we find that in high-growth industries, the plants that are sold by bankrupt firms experience a subsequent increase in productivity.

In declining industries, Chapter 11 status is associated with a higher probability of closing a plant. However, this higher probability is not caused by an increased tendency to weed out inefficient plants. Instead, it is caused by a higher rate of plant closures by Chapter 11 firms in response to declines in industry shipments.

Our analysis suggests that in declining demand industries, in which the marginal product of capital is low, firms can go bankrupt as a result of industry-wide excess capacity. The gains in redeploying assets in such industries are relatively small.

In high-growth industries, bankruptcy is more likely to be triggered by firm-specific inefficiency, and here the gains from redeploying assets of inefficient firms are greater. However, the effectiveness of bankruptcy in facilitating redeployment in high-growth industries might be limited because inefficient firms could have sufficient cash flows to continue to operate despite gains from asset transfers. Thus, Chapter 11 bankruptcy has a greater role in promoting the exit of capacity from declining industries than in changing firms' incentives to sell plants to more efficient producers.[4] More generally, our results suggest that we cannot evaluate other endogenous changes in corporate governance (boards of directors and managers) of bankrupt firms without explicitly considering the industry environment.

Our paper is part of a group of studies that considers the industry environment and the interaction of firms' asset sale and exit decisions with their environment.[5] The effect of demand conditions on the reorganization of insolvent firms has been recognized by Shleifer and Vishny (1992). They focus on asset sales and on how liquidation value depends on the cash reserves of firms in

[4] A related finding by Morck, Shleifer, and Vishny (1989) is that hostile takeovers are used to discipline managers in poorly performing industries, but alternative mechanisms are used in healthy industries.

[5] Papers in this group include Maksimovic and Zechner (1991), Chevalier (1995), and Kovenock and Phillips (1997).

the same industry. In their model, bankruptcies occur during industry downturns. As a result, the most efficient potential purchasers may also be in financial distress.[6] Thus, inefficient transfers by bankrupt firms are likely to be severe in times of low demand. Our approach differs because the optimal distribution of assets changes with demand. Higher potential costs of bankruptcy occur when firms fail to transfer assets at higher levels of demand.

The empirical analysis in our paper is related to the study of bankruptcy outcomes by Hotchkiss (1995), and the study of prebankruptcy asset sales by Khanna and Poulsen (1995). We differ from these papers in several key respects: First, we take into account the effect of industry conditions on the frequency and resolution of bankruptcy. Second, our data enable us to examine the performance and track the closures and sales of individual plants, rather than of the firm as a whole. Third, our sample also includes firms that do not emerge from Chapter 11 bankruptcy protection.

The paper is organized as follows. Our framework is discussed in Section I. We discuss data and our methodology in Section II. Section III contains results on firm productivity and the bankruptcy process. Section IV concludes the paper.

I. Bankruptcy and Reallocation in an Industry Equilibrium

Chapter 11 bankruptcy allows a reorganization of an insolvent firm's assets. How do industry conditions affect which firms enter bankruptcy and their bankruptcy costs?

Most studies of reorganization in finance analyze how a firm's capital structures induces it to liquidate unproductive capacity.[7] In single-firm analysis, the opportunity cost of capacity is taken as exogenous. The firm optimally scraps a plant when the plant's productivity falls below the firm's marginal gain from operating it. Hence, these studies suggest that there is a critical value of the asset's marginal product below which the asset should be liquidated, and above which it should be retained.

In multifirm industry settings, the firm's liquidation decision is more complex because the productivity of an individual plant may depend on the firm to which the plant belongs. Some firms are better than others at managing plants. Those firms that we term more productive get more output per unit of input from each of their plants. However, all firms face costs of internal control. These costs induce diminishing returns to scale at the firm level.[8]

[6] Shleifer and Vishny (1992) argue that firms trade off the benefits of a reduction of agency costs due to high debt against the expected loss from asset sales to inefficient firms which occur when highly leveraged firms become bankrupt during industry downturns.

[7] Important papers that take this approach include Harris and Raviv (1990), Diamond (1993), and Hart and Moore (1995).

[8] See Coase (1937) and Lucas (1978), for example, for analyses of optimal firm size that explore decreasing returns to scale that occur because of control costs. For empirical support of decreasing returns to scale, see Brock and Evans (1986). For a formal treatment of the trade in capacity in response to changes in industry conditions, see Maksimovic and Phillips (1996).

Firms trade plants until an equilibrium is reached in which marginal plants have the same total productivity in each firm.

When demand and output prices are high, the ability to get more output from inputs at the plant level is very valuable. Hence, firms that are better at managing plants can afford to pay larger costs of control. They increase in size by buying capacity from less productive firms. When demand is low, the ability to manage plants efficiently is less valuable relative to control costs. The gains from transferring plants from less productive but smaller firms to more productive firms will be smaller. Thus, a firm's decision to liquidate capacity depends both on its productivity and on industry conditions.

As the existing literature implies, highly productive firms liquidate capacity by selling it for scrap when demand falls below a critical level. However, less productive firms may have two optimal liquidation regions. Like the more productive firms, they can scrap plants when demand is low. They can also liquidate by selling out to more productive firms when demand is at higher levels. When demand is high, such sales are advantageous because the higher value of additional output that more efficient firms produce compensates for the additional control costs of operating the newly acquired assets.

The relation between the firm's cash flows and the optimal amount of capacity can also be different for high and low productivity firms. With high productivity firms, the cash flows and the optimal amount of capacity increases monotonically with demand. By contrast, for low productivity firms, value is maximized by selling off capacity when capacity is most valuable. This occurs when both demand and cash flows are high. Thus, if the compensation of a firm's managers depends on the amount of capacity they control, the interests of the managers and owners will be directly opposed when demand is high and the firm is of low productivity.

We examine how industry conditions affect both the incidence of bankruptcy and the productivity of firms entering bankruptcy. Because cash flows vary with output prices, we would expect that for a given debt level the productivity of the firms that go bankrupt is inversely related to industry demand. Bankrupt firms in high-demand industries are likely to be less productive than other industry firms, but the productivity of bankrupt firms in declining industries is likely to be closer to the industry average.

The relation between the productivity of bankrupt firms and demand also has implications for the view that bankruptcy triggers firms to optimally liquidate their assets. Liquidation policy must address two different outcomes, closures when demand is low and asset transfers when demand is high. If debt levels are set to bankrupt low-productivity firms when demand is high, then they will also bankrupt high-productivity firms when demand is low. Thus, if there are costs to bankruptcy, then bankruptcy is likely to be an ineffective method of enforcing optimal liquidation of low-productivity firms in high-demand industries. Bankruptcy can be effective in forcing firms to scrap assets when demand is low. However, when demand is low, both the value of the assets and the difference in value between efficient and inefficient firms is also likely to be lower. As a result, the value of high leverage in weeding out inefficient firms might not be high.

In the empirical tests that follow, we use plant-level manufacturing data to test for the existence of indirect bankruptcy costs. We distinguish between two types of potential indirect bankruptcy costs. The first type we consider is the effect of bankruptcy on the efficiency of a firm's plants. In both high- and low-demand industries, once a firm is in bankruptcy, it might have no incentive to maintain the value of its assets.[9] These assets include the value of a firm's reputation, which affects its ability to contract optimally with customers (Titman (1984) and Maksimovic and Titman (1991)). If these costs are significant, a bankrupt firm's productivity might decline relative to competitors. At each level of productivity, in high-demand industries, bankrupt firms are likely to have higher cash flows and thus may be able to maintain assets. However, opportunities for cost-saving investments are also likely to be greater when demand is high. Thus, the effect of the level of demand on the relative productivity of bankrupt firms is an empirical question that we investigate below.

The second type of indirect bankruptcy cost is an increased reorganization cost associated with a firm's bankruptcy status. We consider whether firms' asset sales and closure decisions are different from those of industry competitors. In high-demand industries managers could fail to sell assets when it is best to do so. This cost is potentially significant because assets in high-demand industries have high opportunity costs. Moreover, even unproductive firms in such industries have high cash flows, giving to the debtor in possession the resources to operate the firm. The bankrupt firm could also fail to liquidate assets by closing plants as soon as it is efficient to do so. This is especially apt to happen in low-demand industries.

In addition, we use our data to test aspects of a related model proposed by Shleifer and Vishny (1992). They argue that an important cost of bankruptcy is the cost of being forced to sell assets to less efficient producers in order to raise capital. In our context, there are three predictions based on their model. First, highly leveraged firms, which become bankrupt in industry downturns, have lower agency costs prior to bankruptcy, and therefore are at least as efficient as nonbankrupt firms. Second, bankrupt firms sell more assets than nonbankrupt firms. Third, all other factors being equal, bankrupt firms' assets sold may decrease in productivity under new owners.

II. Empirical Analysis: How Important Are Industry Conditions?

We explore the previous predictions on how industry demand and supply conditions, along with firm factors, influence the productivity and the reallocation decisions of firms in Chapter 11. Our null hypothesis is that value-

[9] In our empirical tests we follow firms for four years after they declare bankruptcy. Thus, we capture forgone opportunities to the extent that the bankrupt firms' failure to exploit opportunities is reflected in the cash flows of their existing plants during this period. We do not observe if bankrupt firms forgo entirely new projects as a result of bankruptcy status. If they exist, such costs are more likely to be significant in growing than in declining industries.

maximizing transfers occur and are related to demand and productivity conditions, and that there are no indirect bankruptcy costs. To examine whether industry demand and supply conditions influence indirect costs of bankruptcy, we investigate both long-run changes in industry shipments and short-run changes in aggregate industry investment. The detailed microlevel plant data we use allow us to control for this changing asset composition and compare the productivity of assets before, during, and after firms emerge from Chapter 11.

A. Data

We examine a sample of 302 firms that filed for Chapter 11. For inclusion in our sample, firms must satisfy two basic criteria. First, the firm must be a manufacturing firm producing products in SIC codes 2000 to 3999. Second, the bankruptcy had to occur in the years 1978 to 1989. We require that firms meet these criteria because of the unique nature of the microlevel data that we use to analyze plant-level productivity.

Our sample and tests include firms that declare Chapter 11 reorganization and subsequently change status to Chapter 7. We include all firms in Chapter 11, regardless of whether or not they emerge, thus avoiding survivorship bias.[10] The Chapter 11 bankrupt firms were identified from several sources. We use a comprehensive list compiled by the Securities and Exchange Commission.[11] Our sample also includes firms contained in Betker (1995) and Altman (1984). We also examined the *Wall Street Journal* Index for additional firms. We found 393 firms that satisfied our criteria for sample inclusion. We then verified the outcome of the bankruptcy process using LEXIS-NEXIS and the *Wall Street Journal* Index. We classify the outcome of the bankruptcy process as one of the following: plan confirmed and emerged, firm still in Chapter 11, or status changed to Chapter 7 liquidation.[12] For firms for which we were unable to find a bankruptcy resolution date, we located phone numbers from *Wards Business Directory* and called the firms. We were able to verify the resolution of the bankruptcy process for an additional 20 of these firms.

We use data from the Longitudinal Research Database (LRD), maintained by the Center for Economic Studies at the Bureau of the Census.[13] The LRD database contains detailed plant-level data on the value of shipments pro-

[10] We do not study firms that begin bankruptcy in Chapter 7. Conversations with Michael Berman, Bankruptcy Counsel, Office of General Counsel, at the Securities and Exchange Commission confirmed that the normal procedure for public firms in manufacturing that are liquidated is to first declare Chapter 11 and later convert to Chapter 7. In a subsample of Chapter 7 firms, we confirmed that all firms we examined that begin bankruptcy in Chapter 7 were either outside manufacturing or too small to be in our database.

[11] The list was kindly provided to us by Michael Berman.

[12] When a firm transfers to Chapter 7, we exclude it from that point onward in our analysis of the Chapter 11 period, because the incentives and decision rights of management and investors change in Chapter 7. We examine the Chapter 7 period for these firms in a separate table.

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

duced by each plant, investments broken down by equipment and buildings, and the number of employees. There are several advantages to this database. First, it covers both public and private firms in manufacturing industries. This mix is especially helpful for examining firms in bankruptcy. We can examine public firms that either did not emerge from Chapter 11, or emerged as private firms. Second, coverage is at the plant level and output is assigned by plants at the four-digit industry 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. Fourth, the database identifies when plants actually closed and not merely changed ownership.[14]

The LRD covers approximately 50,000 manufacturing plants every year in the Annual Survey of Manufacturers (ASM). The ASM covers all plants with more than 250 employees. Smaller plants are randomly selected every fifth year to complete a rotating five-year panel.

We confine our analysis to 1977 through 1990. We use 1977 as the starting year of our analysis because it is a complete census year. Earlier name records for the firms in this panel are incomplete, which makes it difficult to identify bankrupt firms in the early 1970s. 1990 is the most recent year of data available to us.

We match our sample of bankrupt firms to name records from the LRD. We are unable to match the names of several firms, either because they are not manufacturing firms or because we cannot find records for them in the LRD. Name records can be hard to match for several reasons: The bankrupt firm might be part of a larger corporation, and since the name records in the LRD are frequently at the division level, name changes at the firm level might not be updated in the LRD; or because abbreviations in firm names preclude unique identification. Because the remaining firms for which we were unable to find a resolution date were generally small firms that changed names, we use the LRD to locate subsequent name changes for them. Of the original 393 firms, we are able to verify for 302 firms that there was either a resolution of bankruptcy or that the firm remained in bankruptcy, and therefore keep these for our final sample of matched firms.

B. Variable Selection

We use both plant-level efficiency and industry-level variables to test our hypotheses that there are no bankruptcy costs, and that value-maximizing transfers occur for bankrupt firms. We examine whether plant-level efficiency, and asset sale and closure decisions are different from the decisions of industry competitors.

[14] One disadvantage of this database is that it does not have capital structure data. However, we identify bankruptcy status, and thus can test our null hypotheses of no bankruptcy costs, and that transfers and closures are unaffected by bankruptcy status.

B.1. Productivity and Cash Flow Variables

We calculate productivity and a measure of plant cash flow for both the bankrupt and nonbankrupt industry firms. Our primary measure of performance is Total Factor Productivity (TFP), which 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. A plant that produces more than the predicted amount of output, given its actual inputs, has a greater-than-average productivity. This measure is much more flexible than the cash flow measure, 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 a functional form of the firm's production function that defines the relation between the plant's inputs and outputs. Then, using all plants in the industry from 1977 to 1990, we obtain TFP as the residual from the estimation of a production function.[15]

We assume that the plants in our sample have a translog production function. This functional form is a second-degree approximation to any arbitrary production function, and therefore takes into account interactions between inputs.[16] To estimate predicted outputs, we take the translog production function and run a regression of log of total value of shipments on log of inputs, including cross-product and squared terms:

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

where Q_{it} represents output of plant i in year t, L_{jit} denotes the quantity of input j used in production for plant i for time period t. A is a technology shift parameter, assumed to be constant by industry, and $a_j = \sum_{i=1}^{N} a_{ji}$ indexes returns to scale. We standardize plant-level TFP by dividing by the standard deviation of TFP for each industry. Thus, our results are not driven by differences across industries in the dispersion of productivity in each industry.

In estimating the TFPs in our sample, we use data for more than 500,000 plant years, and approximately 50,000 plants each year. More than 90 percent of the plants in the ASM during this period are in an industry in which

[15] Our approach follows that of Kovenock and Phillips (1997). Alternatively, we could predict outputs for each plant by using averages of all the inputs in the industry and the plant's own inputs. In our regression approach, the calculated average TFP is also zero for each industry. Thus, the TFP numbers we present describe the plant's productivity relative to others in the industry. Another additional advantage is that our approach does not impose constant returns to scale or constant elasticity of substitution. Including fixed effects in the TFP regressions does not qualitatively alter the reported changes in productivity.

[16] The translog production function is used by Kim and Maksimovic (1990) in their study of agency costs and airline productivity and by Caves and Barton (1991).

a firm has filed for Chapter 11. We include three types of inputs—capital, labor, and materials—as explanatory variables in the productivity regression for each industry. All of these data exist at the plant level. However, the ASM does not state the actual quantity shipped by each plant, but shows only the value of shipments. As a result, we take the difference between actual and predicted shipments as our measure of TFP. We adjust for inflation by using four-digit SIC code data from the Bartelsman and Gray (1994) database. We make depreciation adjustments at the two-digit level using data from the Bureau of Economic Analysis. Kovenock and Phillips (1997) describe these inputs and the method for accounting for inflation and depreciation of capital stock in more detail.

We also calculate operating cash flow at the plant level as an alternative measure of performance. Operating cash flow is calculated as the value of shipments less labor, materials, and energy costs, divided by the value of shipments. We calculate this measure at both plant and firm level, noting that at neither level do we have corporate overhead or selling, or general and administrative expense. The cash flow measure is thus an operating margin.

In our logistic regressions, we also include other firm and plant-level variables to provide additional control for unmeasured productivity differences and other factors, such as size, that can influence the asset sale and closure decision. We include the log of firm size, relative plant scale, plant age, and the number of plants a firm operates. We define firm size as the total value of shipments. The number of plants and size can influence the closure decision, because firms can reallocate production to other plants if there is underutilized capacity. Plant scale is the plant's asset size divided by the average asset size for plants in each industry. Plant age is calculated as the current year less the first year the plant appeared in the database.

B.2. Industry Variables: Shipments and Capacity Utilization

We focus on industry conditions and shipment or output growth for two reasons. First, the value of capital and the value of transferring assets in an industry depend on industry growth. Second, firms' cash constraints may depend on industry conditions. If bankrupt firms in high-growth industries are less cash constrained than those in declining industries, then managers might not sell or close assets at the optimal time.

We calculate several different measures of industry demand and supply conditions. Our central variables are the yearly and long-run changes in industry shipments, industry-level research and development (R&D), and capacity utilization. For industry shipments, we use the Bartelsman and Gray (1994) database at the National Bureau of Economic Research (NBER) at the three-digit SIC code level. We use industry shipments and investment data to investigate if long-run changes in an industry affect the number of firms entering and leaving bankruptcy, and the relative performance of these firms.

We include industry research and development to capture variation in the difficulty of valuing businesses that produce unique products or rely on proprietary technology or brand names. We calculate industry research and development expenditures from COMPUSTAT firm-level data. Our calculations represent R&D and advertising, weighted by the firm's percentage of industry sales, aggregated up to the three-digit SIC code level.

We obtain data on capacity utilization from the Bureau of the Census publication, *The Annual Survey of Capacity Utilization*. Our capacity utilization measure is output as a percentage of normal full production at the three-digit SIC code level. We include capacity utilization to capture changes in the supply relative to demand conditions, and to examine whether excess capacity might exist in industries and perhaps cause firms to optimally close down plants.

To examine whether the level of industry demand alters the relation between the explanatory variables and actions (closures, asset sales), we divide our sample of industries into quartiles according to level of demand. Where appropriate, we report results for both the entire sample and the quartiles.

We classify industries into "demand" or change-in-shipment quartiles by constructing an index of long-run changes in real industry shipments over a ten-year period. We include *all* industries in constructing these quartiles, not just those that have firms entering bankruptcy. We measure the change by using the log of a three-year average of total shipments during the years 1986 to 1988, divided by the three-year average from 1977 to 1979. We use the total value of shipments, a production-based number, for U.S. producers. Thus, this measure captures both cost shifts from increased foreign imports or shocks to production costs, and demand changes in the industry. We use three-year averages as the endpoints to avoid short-term changes in demand. We classify all the three-digit SIC industries in our database into quartiles based on our index of long-run changes in industry shipments. We use three-digit SIC industries to prevent smaller, four-digit, industries from being overrepresented in any quartile. Then, we examine the productivity of the bankrupt firms' plants in these quartiles.

Note that, by design, we do *not* have a similar number of firms in each quartile. If certain industries have more firms and also more bankruptcies, then the quartile containing these industries has more firms represented. Thus, we can examine whether declining industries have a higher frequency of bankruptcies, and whether productivity of these firms is both significantly different from other firms in their quartile and from firms in other quartiles.

In addition to shipment growth quartiles, we also classify industries into quartiles by annual changes in aggregate investment. We examine investments expressed in real 1982 dollars divided by total industry assets, again in real 1982 dollars. We use the Bartelsman and Gray (1994) data for investment and assets, and also their constructed price deflators. Classifying industries this way provides an aggregate industry-level measure of investment in an industry. These investment changes are proxies for the marginal productivity of capital and the expectation of future returns in the industry.

We then examine the relative number and productivity of plants for the bankrupt firms in each quartile. Again, we do *not* have a similar number of firms in each quartile. Using this procedure, we examine whether bankrupt firms with high investment have lower productivity than nonbankrupt firms in the same industry and whether investment rates are lower than for industry nonbankrupt firms. For firms in each investment quartile, we also examine whether productivity decreases while the firms are under Chapter 11 bankruptcy protection. The results are similar using this classification and are available from the authors.

III. Results

A. Summary Statistics

Table I presents summary statistics for our total sample. Panel A shows that in our sample, the plants of bankrupt firms are, on average, bigger than those of nonbankrupt firms (average value of plant-level shipments of $61.95 million and $29.76 million, respectively) and somewhat older (11.5 and 8.2 years, respectively). In the whole sample, the average standardized TFP of plants of firms that filed for bankruptcy, calculated the year prior to filing of Chapter 11, is −0.048. Thus, these plants show a lower productivity than their industry averages. The difference across all industries and all shipment growth quartiles is statistically significant at the 10 percent level.

Panel B shows the median growth in real industry shipments for each industry quartile, and the summary statistics of the frequency of Chapter 11 bankruptcies across quartiles. There is a considerable difference in the real growth of industry shipments between quartiles 1 and 4. In quartile 4, shipments increase by 23.14 percent over the ten-year period, but in quartile 1 they decrease by 33.93 percent. In addition to the full sample, we present results for quartiles 1 to 4 separately. Quartile 1 we label the declining industry quartile, and quartile 4 the high-growth industry quartile.

There is also a substantial difference in the frequency of Chapter 11 across quartiles. This difference in frequency is consistent with a paper by Berkovitch and Israel (1997) in which they model the decision to declare Chapter 11 as a strategic choice variable. In their model, the proportion of firms entering Chapter 11 is higher in mature industries, because underinvestment problems are less important. We find that the proportion of plants in Chapter 11 falls monotonically from 3.23 percent to 0.98 percent as we move from declining industries to high-growth industries, suggesting that the incidence of bankruptcy depends on industry demand.

B. Industry Conditions and Bankruptcy

Table II tests whether the population of bankrupt firms differs across high- and low-growth industries. It provides evidence on the relative productivity of Chapter 11 plants before, during, and after emergence from bankruptcy.

Table I

Chapter 11 Bankruptcy Sample Characteristics

Sample characteristics of plants of bankrupt firms that declared Chapter 11 in the years 1978 to 1989. We obtain plant-level data from the Annual Survey of Manufacturers (ASM), Bureau of the Census, U.S. Department of Commerce. Total factor productivity (TFP) statistics are given for the year prior to the declaration of Chapter 11 for each of the bankrupt firms. TFP is a relative measure of productivity calculated such that average TFP over time equals 0. TFPs are standardized by dividing each TFP by the standard deviation of the industry's TFP at the four-digit level. Shipment or output change is determined by using aggregate industry data from the NBER for manufacturing industries. We determine quartiles by computing the change in the real value of shipments over 10 years at the three-digit SIC code level. We use the year of the first bankruptcy in an industry when there are multiple bankruptcies in an industry for the number of nonbankrupt industry firms and industry plants. Average plant age is calculated as the year before Chapter 11 less the time the plant first appeared in the database, beginning with 1972. (Standard errors of the means are in parentheses.)

	Sample of Firms	
	Bankrupt Firms	Nonbankrupt Industry Firms
Panel A: Characteristics of Plants of Bankrupt and Nonbankrupt Firms		
Number of plants (302 bankrupt firms)	1,075	56,256
Average plant size (Value of shipments in $ millions)	61.954	29.764
Average plant age (years)	11.5	8.24
	(0.154)	(0.025)
Total factor productivity: Year before Chapter 11		
Avg. standardized TFP (bankrupt - industry avg.)	−0.048*	
	(0.028)	
Panel B: Industry Characteristics: Growth in Industry Shipments Quartiles		
Quartile 1: Number of plants	259	8,021
% of industry plants in bankruptcy	3.23%	
Median growth in real industry shipments	−33.93%	
Quartile 2: Number of plants	457	18,089
% of industry plants in bankruptcy	2.53%	
Median growth in real industry shipments	−4.12%	
Quartile 3: Number of plants	199	12,978
% of industry plants in bankruptcy	1.53%	
Median growth in real industry shipments	8.11%	
Quartile 4: Number of plants	160	16,295
% of industry plants in bankruptcy	0.98%	
Median growth in real industry shipments	23.14%	

* Significantly different from zero at the 10 percent level using a two-tailed test for the difference of the mean from zero.

This table includes plants of firms that do not emerge from Chapter 11 as well as those plants that eventually emerge, are sold off, closed, or transferred to Chapter 7, for the years in which they are in Chapter 11. Thus, these initial data do not control for changes over time in the composition of firms as they make asset sale and closure decisions.

Table II

Industry-Adjusted Productivity of Plants of Chapter 11 Firms

This table presents summary statistics that examine whether the productivity and number of plants of bankrupt firms varies over aggregate industry quartiles. Quartiles are defined by change in industry demand over the 10-year period, using the change in three-year averages for 1977–1979 to 1986–1988. Numbers are average relative total factor productivity (TFP) less the industry average TFP for firms that declared Chapter 11 in the years 1978 to 1989. We standardize TFPs by dividing each TFP by the standard deviation of the industry TFPs at the four-digit code level. We determine quartiles by using aggregate industry shipment data from the NBER for manufacturing industries. The industry shipment data is the real value of shipments at the three-digit SIC code level. Q1 is productivity for quartile 1, Q4 is productivity for quartile 4. (t-statistics for significant differences from zero are in parentheses.)

	Average Productivity		Average Productivity by Industry Growth Quartile				t-statistics for Significant Difference for Q4 − Q1
	All Firms	n	Q1 (lowest quartile)	n	Q4	n	
Panel A: Years Before Chapter 11							
Year −2	−0.044	1188	−0.052	308	−0.009	196	(0.47)
	(−1.53)		(−1.04)		(−0.12)		
Year −1	−0.048[c]	1075	−0.032	259	−0.151[c]	160	(−1.14)
	(−1.70)		(−0.53)		(−1.70)		
Panel B: In Chapter 11							
Year 0	−0.092[a]	873	−0.118[c]	207	−0.188	154	(−0.56)
t-stat for average	(−2.51)		(−1.73)		(−1.46)		
t-stat for −1 to 0	(−0.89)		(−0.98)		(−0.24)		
Year +1	0.036	639	0.086	156	0.015	102	(−1.26)
t-stat for average	(0.86)		(1.06)		(0.13)		
t-stat for −1 to +1	(1.67)		(1.20)		(1.14)		
Year +2	−0.024	345	0.072	99	−0.237[b]	61	(−1.98)[b]
t-stat for average	(−0.51)		(0.72)		(−1.74)		
t-stat for −1 to +2	(0.42)		(1.04)		(−0.53)		
Year +3	−0.071	200	0.027	72	−0.369[a]	29	(−2.62)[a]
t-stat for average	(−1.14)		(0.31)		(−2.47)		
t-stat for −1 to +3	(−0.33)		(0.57)		(−1.26)		
Year +4	−0.023	143	0.093	56	−0.335[a]	24	(−2.40)[a]
t-stat for average	(−0.31)		(0.87)		(−2.66)		
t-stat for −1 to +4	(0.33)		(1.03)		(−1.19)		
Panel C: After Emerging from Chapter 11							
Year +1	−0.123[c]	372	−0.055[c]	75	0.022	49	(0.44)
t-stat for average	(−1.89)		(−0.48)		(0.17)		
t-stat for −1 to +1	(−0.83)		(−0.18)		(1.13)		
Year +2	−0.093	213	−0.040	56	−0.003	34	(0.65)
t-stat for average	(−1.48)		(−0.31)		(0.02)		
t-stat for −1 to +2	(−0.65)		(−0.06)		(0.90)		
Year +3	−0.165[c]	124	−0.003	28	−0.288	30	(−0.63)
t-stat for average	(−1.63)		(−0.01)		(−1.47)		
t-stat for −1 to +3	(−1.11)		(0.10)		(−0.64)		

[a,b,c] Significantly different from zero at the 1 percent, 5 percent, and 10 percent levels, respectively, using a two-tailed t-test.

Table II presents industry-adjusted productivity per-year statistics relative to the year the firm filed for Chapter 11, which we call year 0. In the interest of space, we present data only for the total sample and quartiles 1 and 4.[17] The last column of the table tests whether there is a significant difference between the productivity of plants in quartiles 1 and 4.

Panel A reports average total factor productivity of bankrupt firms' plants relative to their industry counterparts for the two years prior to filing for Chapter 11 protection. In Panel B, we present average industry-adjusted productivity for years while the firm is in Chapter 11, and in Panel C for the years after emerging from Chapter 11. These panels also report *t*-statistics for this average and for the unreported change in productivity relative to the year prior to Chapter 11. The unreported changes can be calculated by subtracting the average productivity in the year prior to Chapter 11 from the productivity for the year in question.

Column 1 in Panel A reveals that for the sample as a whole, in the year before bankruptcy the average productivity of Chapter 11 plants is significantly lower than that of their industry counterparts. Columns 2 and 3, however, show that this significant negative productivity is concentrated in quartile 4. The average productivity of quartile 1 plants in the year prior to Chapter 11 is not significantly different from their industry counterparts. Although quartile 1 firms have a lower average productivity than their industry counterparts, this difference is smaller than the difference for those plants in quartile 4.

In Panel B, we test whether the average productivity is significantly different from zero. For the full sample, the average industry-adjusted productivity in year 0 is negative and significant. All other industry-adjusted levels are insignificant.

However, we find very different results when we subdivide by quartiles in columns 2 and 3. In quartile 1, while the firm is under Chapter 11 bankruptcy protection, the average levels are positive, albeit insignificant, for four of the five years covered. In quartile 4, the average industry-adjusted productivity is negative, and significant in four of the five years.

Panel B also tests whether firms under Chapter 11 protection experience changes in productivity. The table presents the *t*-statistic for this change in productivity. For the full sample and for quartiles 1 and 4, there is no evidence of significant changes in industry-adjusted productivity. Thus, we cannot reject the hypothesis that bankrupt firms' plants do not decline in productivity while in Chapter 11, either for the whole sample or for the quartiles. These results are consistent with the hypothesis that declining productivity is not a cost for firms that enter Chapter 11 bankruptcy.

In the last column, we test for equality of means across quartiles. We find significantly lower productivity in quartile 4 than in quartile 1. In three out of five years during Chapter 11, the average industry-adjusted productivity

[17] The largest differences in average plant productivities are between quartiles 1 and 4. The results for quartiles 2 and 3 are available from the authors.

in quartile 4 is significantly lower than it is in quartile 1. These findings show that differences between industries are important in determining the relative productivity during Chapter 11. Thus, we find differences across quartiles in the frequency of bankruptcies, and in the productivity during bankruptcy. The differences in the populations of bankrupt firms across quartiles are consistent with firms in quartile 4 deciding not to enter Chapter 11 because of potential indirect bankruptcy costs.

Panel C shows the productivity of the plants of firms that emerge from Chapter 11. The number of plants that emerge from Chapter 11 bankruptcy and remain under the same ownership is low, both because plants and firms are liquidated during the bankruptcy process, and because some remained in bankruptcy at the end of the sample period. Average productivity of firms that emerge is negative and significant at the 10 percent level for both the whole sample and for those in quartile 1. Only in the year of emergence do we find that industry-adjusted average productivity is significantly different from zero. In no years do we find that the change in industry productivity, relative to the year prior to Chapter 11, is significantly different from zero.

In Table III we examine cash flows of plants of Chapter 11 firms. The overall findings are consistent with Table II. We find some interesting patterns when we look at average cash flow that is *not* adjusted for industry averages in the year prior to bankruptcy. Average cash flows of plants (0.212 in year $t - 1$) with negative industry-adjusted productivity in quartile 4, year $t - 1$ (Table II) are significantly higher (t-statistic = 2.75) than cash flows of plants of firms in quartile 1 (0.144 in year $t - 1$) whose productivity is not lower than that of the industry. Plants of less than average productivity in high-growth industries have higher cash flows than plants of firms that are of above average productivity in declining industries. This tells us that industry effects are likely to be very important in understanding which plants enter bankruptcy.

Table IV directly controls for the changing asset composition of Chapter 11 firms' assets. We present data on productivity in the year prior to Chapter 11, and for the change in productivity relative to that year. Each row of Table IV follows the same set of plants over time, based on the number of years the plants are in Chapter 11. For example, in the two-year row, we exclude all plants that are sold or closed prior to the end of year 2, or that are retained for three or more years. We present results for quartiles 1 and 4 in this table. In Panel A we show results for quartile 1 and in Panel B the results for quartile 4.

Table IV reveals significant differences between quartiles 1 and 4. In quartile 1, the industries with the lowest output growth, there is no significant decline in industry-adjusted productivity during Chapter 11. Thus, in the low-growth quartile there is no evidence of costs in the form of declines in productivity while firms are in bankruptcy status. There is evidence that plants in quartile 1 that exit within a year are on average less productive than their industry counterparts in year $t - 1$, but they do not suffer sig-

Table III

Plant-level Operating Cash Flows of Chapter 11 Firms

This table presents the cash flow of plants of bankrupt firms by aggregate industry quartiles. Quartiles are defined by the real value industry shipments over a ten-year period. Cash flow numbers are plant-level values of shipments less materials, energy, and labor costs. We present changes relative to the year prior to bankruptcy, as all averages (levels) are significantly different from zero at the 1 percent level. We determine quartiles by using aggregate industry shipment data from the NBER for manufacturing industries. The change in shipments is calculated over a ten-year period at the three-digit SIC code level, using the change in three-year averages for 1977–1979 to 1986–1988. Q1 is productivity for quartile 1, Q4 is productivity for quartile 4. (t-statistics for significant differences from zero are in parentheses.)

			Cash Flows by Industry Growth Quartile				t-statistics for Significant Difference for Q4 − Q1
	All Firms	n	Q1 (lowest quartile)	n	Q4	n	
Panel A: Years Before Chapter 11—Average Cash Flow							
Year −2	0.190[a] (19.19)	1188	0.167[a] (10.17)	308	0.233[a] (13.73)	196	(2.81)[a]
Year −1	0.203[a] (24.38)	1075	0.144[a] (7.36)	259	0.212[a] (13.90)	160	(2.75)[a]
Panel B: In Chapter 11—Change in Cash Flow from Year before Chapter 11							
Change Year −1 to 0	−0.007 (−0.48)	607	0.023 (0.81)	207	−0.002 (−0.08)	13	(−0.68)
Year −1 to +1	0.039[a] (2.96)	639	0.080[a] (2.82)	156	0.027 (1.21)	102	(−1.85)[c]
Year −1 to +2	0.021 (1.42)	345	0.067[a] (2.40)	99	−0.020 (−0.75)	61	(−2.12)[b]
Year −1 to +3	−0.016 (−0.90)	200	0.049[c] (1.68)	72	−0.043[c] (−1.64)	29	(−1.69)[c]
Year −1 to +4	0.014 (0.69)	143	0.051 (1.57)	56	−0.016 (−0.75)	24	(−1.48)
Panel C: After Emerging from Chapter 11							
Year −1 to +1	0.013 (1.29)	372	0.056 (1.32)	75	0.043 (1.27)	49	(−0.26)
Year −1 to +2	−0.010 (−0.41)	213	0.101[b] (1.96)	56	−0.024 (−0.51)	34	(−1.93)[c]
Year −1 to +3	−0.054 (−1.29)	124	0.034 (0.31)	28	−0.017 (−0.34)	30	(−0.43)

[a,b,c] Significantly different from zero at the 1 percent, 5 percent, and 10 percent levels, respectively, using a two-tailed t-test.

nificant declines while in Chapter 11. In quartile 4, the productivity of bankrupt firms' plants shows a different pattern. After controlling for composition changes, the productivity of firms' plants that remain in Chapter 11 for four

Table IV

Productivity Controlling for Composition Changes

This table presents the prior productivity of plants by the number of years in Chapter 11, for industry growth quartiles 1 and 4. The table thus directly controls for changing asset composition. Plants leave Chapter 11 because they are sold off or closed down, or because the firm emerges from Chapter 11. Numbers are plant-level total factor productivity (TFP) less the industry average TFP for firms that declared Chapter 11 in the years 1978 to 1989. TFPs are standardized by dividing each TFP by the standard deviation of the industry TFPs at the four-digit SIC code level. We determine quartiles by using the change in ten-year shipments at the aggregate three-digit SIC code level for all industries. Plant counts do not add up exactly to the yearly changes in plants in Table II because of missing plant-year data. Q1 represents productivity of plants in quartile 1, Q4 for quartile 4, respectively. Q4 − Q1 represents the difference in means between quartle 4 and quartile 1. (t-statistics for significant differences from 0 are in parentheses.)

Number of Years in Chapter 11	Average Year −1	Change				
		Year −1 to 0	−1 to 1	−1 to 2	−1 to 3	−1 to 4
Panel A: Industry Quartile 1: Productivity in Bankruptcy						
< 1 year, n = 47	−0.293[b]	0.068				
t-stat for Q1	(−2.14)	(0.31)				
1 year, n = 54	−0.287[b]	0.187	0.312			
t-stat for Q1	(−2.19)	(0.96)	(1.48)			
2 years, n = 27	−0.086	−0.110	0.252	0.240		
t-stat for Q1	(−0.67)	(−0.55)	(1.18)	(0.23)		
3 years, n = 13	0.286	−0.266	−0.172	−0.162	0.001	
t-stat for Q1	(1.44)	(−0.86)	(−0.63)	(−0.53)	(0.01)	
4 or more years, n = 56	−0.078	−0.023	0.148	0.087	0.107	0.176
t-stat for Q1	(−0.71)	(−0.21)	(1.18)	(0.88)	(1.02)	(1.55)
Panel B: Industry Quartile 4: Productivity in Bankruptcy						
< 1 year, n = 20	−0.306	−0.517				
t-stat for Q4	(−1.61)	(−1.71)[c]				
t-stat for Q4 − Q1	(−0.09)	(−1.67)[c]				
1 year, n = 39	−0.159	0.233	0.212			
t-stat for Q4	(−0.68)	(0.66)	(0.68)			
t-stat for Q4 − Q1	(0.94)	(0.12)	(0.14)			
2 years, n = 29	0.247	0.057	0.055	−0.352		
t-stat for Q4	(0.99)	(0.18)	(0.17)	(−1.02)		
t-stat for Q4 − Q1	(1.40)	(0.45)	(−0.52)	(−0.54)		
3 years, n = 6	−0.541	−0.239	−0.251	0.029	0.128	
t-stat for Q4	(−1.51)	(−0.60)	(−0.64)	(0.07)	(0.34)	
t-stat for Q4 − Q1	(−2.26)[b]	(0.06)	(−0.17)	(0.40)	(0.29)	
4 or more years, n = 24	−0.076	−0.037	−0.048	−0.228	−0.274	−0.258
t-stat for Q4	(−0.69)	(−0.27)	(−0.37)	(−1.78)[c]	(−2.35)[b]	(−2.11)[b]
t-stat for Q4 − Q1	(0.02)	(−0.08)	(−0.96)	(−1.84)[c]	(−2.16)[b]	(−2.32)[b]

[a,b,c] Significantly different from zero at the 1 percent, 5 percent, and 10 percent levels, respectively, using a two-tailed t-test.

or more years significantly declines for years −1 to +2, −1 to +3, and −1 to + 4. These declines are also significantly different from the productivity changes in quartile 1.

We cannot come to any conclusion from the results in Tables II to IV about whether or not bankrupt firms in the highest quartile should be making different economic decisions. However, we can conclude that in high-growth industries, bankrupt firms' plant-level productivity significantly declines when the firms remain in Chapter 11 for four or more years. The evidence also suggests that the populations of bankrupt firms in high- and low-growth industries differ.

C. Chapter 11 Outcomes: Asset Sales and Plant Closures

In this section we examine asset sale and closure decisions of Chapter 11 and industry firms.

C.1. Asset Sales

We examine asset sales for bankrupt firms before, during, and after Chapter 11. Using the plant-level focus of the database, we can examine the productivity of the individual plants under new ownership.

We test three predictions from our analysis about asset sales. First, relatively more asset sales will occur in high-growth industries. Second, for bankrupt firms, if there are increased conflicts of interest in bankruptcy, the frequency of asset sales will be reduced in these industries. Third, for those asset sales by bankrupt firms that do occur, in high-growth industries the increase in the productivity of assets sold will be greater under new ownership. We also test whether the average productivity of the firms' remaining assets is lower because the firm has sold off its more productive assets.

Table V shows by quartile the productivity of sold and retained plants for bankrupt and industry firms' plants. The results are presented in four panels, each of which presents results combining the top two and bottom two quartiles. We do this because there are too few asset sales by quartiles for some bankruptcy periods to allow disclosure of results by individual quartile under U.S. Census Bureau regulations.

Panels A, B, and C examine the assets sold off by Chapter 11 firms and their industry counterparts, before, during, and after Chapter 11 respectively. We construct a matching set of industry asset sales for each of these periods by getting all asset sales for the four-digit SIC code of the bankrupt firm. We assign these industry asset sales to the before, during, and after Chapter 11 periods based on the status of the bankrupt firm in that industry. Panel D examines the productivity of the plants of the purchasers in the industry, excluding the plants that they purchase.

Table V shows several findings. First, there are more asset sales by Chapter 11 firms in high-growth industries. Panel A shows that prior to Chapter 11, conditional on selling a plant, in the high-growth quartiles bankrupt firms sell 52.4 percent of their plants, compared to 41.3 percent in low-

Table V

Asset Sales by Chapter 11 Firms

This table examines the productivity of firms' plants that were sold by Chapter 11 firms and industry plants in the same four-digit SIC code. For industry quartiles, we use external industry data from the NBER and represent the change in shipments over a ten-year period at the three-digit SIC code level. Total factor productivity (TFP) is standardized by dividing each TFP by the standard deviation of the industry TFPs at the four-digit SIC code level. Years after emergence are combined for the lowest two and highest two quartiles because of disclosure restrictions. Industry numbers do not include takeovers or mergers. Asset sale firms are defined as firms selling assets while remaining in business. (t-statistics are in parentheses.)

Panel A: Before Chapter 11

	Lowest Two Quartiles				Highest Two Quartiles			
	Bankrupt Firms		Industry Firms		Bankrupt Firms		Industry Firms	
	Old Owners	New Owners	Old Owners	New Owners	Old Owners	New Owners	Old Owners	New Owners
Asset sale firms: TFP of sales	−0.014	−0.027	−0.015	0.017	−0.065	−0.052	−0.032	−0.020
t-stat for average TFP = 0	(−0.26)	(−0.46)	(−0.98)	(1.23)	(−0.91)	(−0.60)	(−2.07)[b]	(−1.16)
t-stat for improvement under new owners, relative to industry		(−2.18)[b]				(0.03)		
Number of plants [percent sold off]	193 [41.3%]		706 [18.4%]		122 [52.4%]		502 [13.1%]	
[percent based on total plant years]	[11.1%]		[6.2%]		[14.9%]		[5.8%]	
Assets retained: TFP	−0.049		0.029		−0.057		0.040	
t-stat for average TFP = 0	(−1.26)		(1.50)		(−1.25)		(2.28)[b]	
t-stat for retained–sold	(−0.54)		(1.78)[c]		(0.09)		(3.08)[a]	
Number of plants	274		3124		111		3324	
Nonasset sale firms: TFP	−0.070		−0.008		−0.016		−0.009	
t-stat for average TFP = 0	(−1.63)		(−1.15)		(−0.57)		(−1.23)	
Number of plants	434		19664		251		16967	

Panel B: Chapter 11 Period								
	Lowest Two Quartiles				Highest Two Quartiles			
	Bankrupt Firms		Industry Firms		Bankrupt Firms		Industry Firms	
	Old Owners	New Owners	Old Owners	New Owners	Old Owners	New Owners	Old Owners	New Owners
Asset sale firms: TFP of sales	−0.030	−0.057	−0.033	−0.008	0.011	0.080	−0.009	−0.051
t-stat for average TFP=0	(−0.36)	(−1.45)	(−2.24)[b]	(−0.44)	(0.11)	(1.72)[c]	(−0.65)	(−3.33)[a]
t-stat for improvement under new owners, relative to industry		(−1.20)				(2.29)[b]		
Number of plants [percent sold off]	138 [44.4%]		437 [20.2%]		47 [58.8%]		466 [19%]	
[percent based on total plant years]	[16.5%]		[8.8%]		[24.4%]		[9.9%]	
Assets retained: TFP	0.053		0.046		−0.209		0.035	
t-stat for average TFP = 0	(1.56)		(1.53)		(−2.37)[b]		(2.66)[a]	
t-stat for retained–sold	(0.93)		(2.36)[a]		(−1.66)[c]		(2.34)[b]	
Number of plants	172		1726		33		1983	
Nonasset sale firms: TFP	0.064		−0.002		−0.154		−0.005	
t-stat for average TFP = 0	(1.19)		(−0.26)		(−1.38)		(−0.68)	
Number of plants	258		21592		120		19738	

Panel C: After Chapter 11								
	Lowest Two Quartiles				Highest Two Quartiles			
	Bankrupt Firms	Number of Plants	Industry Firms	Number of Plants	Bankrupt Firms	Number of Plants	Industry Firms	Number of Plants
Productivity of Assets Retained	0.006	167	0.027	1472	−0.167	85	0.020	1807
t-stat for average TFP = 0	(0.15)		(2.50)[a]		(−1.72)[c]		(2.50)[a]	

Table V—*Continued*

Panel D: Productivity of Purchasers' Existing Assets (for the four years surrounding purchase)				
	Lowest Two Quartiles		Highest Two Quartiles	
	Quartiles 1 and 2	Number of Plants	Quartiles 3 and 4	Number of Plants
Productivity of Purchaser				
TFP before purchase	0.069	1396	0.055	1554
t-stat for average TFP = 0	(2.83)[a]		(2.74)[a]	
TFP after purchase	0.055	1274	0.030	1405
t-stat for average TFP = 0	(2.07)[b]		(1.18)	

[a,b,c] Significantly different from 0 at the 1 percent, 5 percent, and 10 percent levels, respectively, using a two-tailed *t*-test for the difference of the mean from zero.

growth quartiles. Panel B shows that during Chapter 11, bankrupt firms sell 58.75 percent of their plants, compared to 44.37 percent in the bottom two quartiles. Both of these proportions are higher than their industry counterparts.

Second, Panel B shows that the productivity of plants sold only improves in the two high-growth industry quartiles. In Chapter 11, the productivity of the 47 plants sold in quartiles 3 and 4 significantly increases under the new owners.

In both Panels A and B, we examine the plants that are retained by the firms and not subsequently sold off. We find that the plants retained by firms in high-growth industries have lower productivity than the ones sold off. For industry firms, plants retained have significantly higher productivity than those sold.[18]

In Panel D, we find that purchasing firms' existing plants are more productive than the industry average, both before and after the purchase. This finding does not differ much by quartiles.

These results show how important changes to industry output are to the asset sale decisions for all firms. More asset sales occur in high-output growth industries. Second, bankrupt firms in high-growth industries sell their relatively more productive plants and these plants improve productivity under their new owners. This evidence is consistent with a higher value of asset reallocations in high-growth industries.

In Table VI we investigate the asset sale process further by examining whether the probability of selling a plant, conditional on industry and productivity variables, is different for bankrupt and nonbankrupt firms. The logistic regressions include industry-, plant-, and firm-level explanatory variables, and interact several of these variables with indicators of bankruptcy status. We run regressions for the full sample and also for quartiles 1 and 4 of our long-run, ten-year change in industry shipments.[19]

The last column presents a test of whether coefficients are significantly different between quartiles 1 and 4. We test for differences by running a regression for all quartile 1 and 4 firms with a quartile 4 dummy variable interacted with the independent variable, and present the *p*-values for these interaction variables.

Column 1 of Table VI shows that, for the sample as a whole, there are only limited differences in the asset sale decisions of Chapter 11 and industry firms. For both firms, bankrupt and nonbankrupt, the industry variables

[18] We do not present data on the productivity of plants sold off after Chapter 11, because there are few partial firm asset sales in quartiles 3 and 4. Census rules prevent these numbers from being disclosed.

[19] As a robustness check we also estimate both the current asset sale equation and the subsequent closure equation for quartiles 1 and 4 using a random effects panel probit model (see Butler and Moffitt (1982)). We find that there are no changes in the interpretation or significance levels of the bankruptcy variables when estimating using the random probit. Only one industry variable, lagsize, changed in significance from the 8 percent level to the 14 percent level. Thus we do not report the results of this estimation.

Table VI

Asset Sale Decisions

Regressions test the effects of plant-level productivity and industry-level demand and supply variables on asset sale decisions of bankrupt firms and other nonbankrupt industry firms. We estimate the regressions using a logistic-limited dependent variable model. The dependent variable equals 1 if a plant is sold in that year. The change in industry shipments and capacity utilization are yearly at the four-digit SIC code level. Weighted industry R&D is from COMPUSTAT firm-level data and represents R&D and advertising expense divided by firm sales aggregated up to the three-digit SIC code. We calculate total factor productivity (TFP) using a translog production function. Operating cash flow is the value of shipments less labor, materials, and energy costs divided by value of shipments. Plant scale is the plant's asset size divided by the average assets for plants in each industry. Data are yearly from 1977 to 1990. (p-values are in parentheses.)

	Dependent Variable: Plant Asset Sale			Test for Significant Difference: Quartile 4 − Quartile 1 (p-value)
	Logit A: Full Sample	Logit B: Quartile 1	Logit C: Quartile 4	
Industry-level variables				
Change in industry shipments	1.141	0.983	0.538	
	(0.000)[a]	(0.006)[a]	(0.161)	(0.000)[a]
Weighted industry R&D	1.935	9.675	0.256	
	(0.000)[a]	(0.000)[a]	(0.773)	(0.000)[a]
Capacity utilization	−0.015	−0.010	−0.005	
	(0.000)[a]	(0.000)[a]	(0.129)	(0.135)
Standard deviation of industry shipments	−4.744	1.381	−3.489	
	(0.000)[a]	(0.170)	(0.001)[a]	(0.002)[a]
Plant- and firm-level variables				
Number of plants owned by firm	−0.005	−0.009	0.000	
	(0.000)[a]	(0.000)[a]	(0.839)	(0.000)[a]
Log of firm shipments	0.382	0.404	0.378	
	(0.000)[a]	(0.000)[a]	(0.000)[a]	(0.399)
Total factor productivity (TFP)	−0.168	−0.130	−0.132	
(Lagged one year)	(0.000)[a]	(0.005)[a]	(0.000)[a]	(0.207)
Plant-level operating cash flow	0.173	0.017	0.339	
(Lagged one year)	(0.007)[a]	(0.901)	(0.010)[a]	(0.115)
Relative plant scale	−0.154	−0.167	−0.171	
	(0.000)[a]	(0.000)[a]	(0.000)[a]	(0.905)
Plant age	0.020	0.037	0.019	
	(0.000)[a]	(0.000)[a]	(0.000)[a]	(0.006)
Bankruptcy variables				
Before Chapter 11 dummy variable	0.602	0.275	0.266	
(=1 for years before firm is in Ch. 11)	(0.000)[a]	(0.073)[c]	(0.209)	(0.751)
In Chapter 11 dummy variable	0.409	−0.068	0.654	
(=1 while firm is in Ch. 11)	(0.198)	(0.963)	(0.321)	(0.332)
After Chapter 11 dummy variable	−0.119	−0.950	−0.465	
(=1 after firm emerges from Ch. 11)	(0.583)	(0.184)	(0.474)	(0.693)
In Chapter 11*TFP	0.251	0.483	0.680	
	(0.135)	(0.214)	(0.082)[c]	(0.900)
In Chapter 11*cash flow	−0.737	−1.368	−3.209	
	(0.163)	(0.115)	(0.042)[b]	(0.146)

Table VI—*Continued*

	Dependent Variable: Plant Asset Sale			Test for Significant Difference: Quartile 4 − Quartile 1 (p-value)
	Logit A: Full Sample	Logit B: Quartile 1	Logit C: Quartile 4	
Bankruptcy variables				
In Chapter 11*industry R&D	0.757	22.800	−14.718	
	(0.845)	(0.080)[c]	(0.088)[c]	(0.010)[a]
In Chapter 11*change in shipments	0.467	−2.786	5.259	
	(0.801)	(0.358)	(0.012)[b]	(0.014)[b]
In Chapter 11*capacity utilization	−0.004	−0.010	0.009	
	(0.315)	(0.581)	(0.369)	(0.365)
Total plant years	371,373	60,477	85,148	
χ^2 statistic	4370.57	653.20	1255.57	
Significance level (p-value)	<1%	<1%	<1%	

[a,b,c] Significantly different from zero at the 1 percent, 5 percent, and 10 percent levels, respectively, using a two-tailed t-test.

(change in industry shipments, capacity utilization, industry R&D, and the standard deviation of industry shipments) are highly significant at less than the 1 percent level. These results show that growth in industry output positively affects both the frequency of asset sales and the productivity gain from asset sales, both outside and inside bankruptcy. Consistent with the importance of demand on asset sales, plant-level cash flows are highly significant and positively related to the probability of selling a plant.

The results in Table VI also show that asset sales are more frequent in industries with high R&D. Therefore, there is no evidence that the presumed greater asymmetry of information in these industries impedes the efficient transfer of assets.

When we examine the effect of Chapter 11 status, we find some differences between the bankrupt firms and nonbankrupt firms. The coefficient on the dummy variable for the years before Chapter 11 is positive and highly significant. Chapter 11 firms sell assets at a higher rate before they enter Chapter 11. However, the dummy variables for the during- and after-Chapter 11 periods are insignificant. This finding shows that although firms that go bankrupt sell assets at a higher rate before bankruptcy, there is no evidence that bankruptcy either increases or decreases asset sales.

We also investigate whether asset sales of bankrupt firms are more sensitive to industry and productivity variables. We interact the before- and the in-Chapter 11 dummy variables with total factor productivity, industry R&D, change in shipments, and capacity utilization. There are no significant interactions between the before-Chapter 11 dummy and our independent variables. For the full sample of bankrupt firms, there are also no significant interactions between the in-Chapter 11 dummy and the independent variables.

In columns 2 and 3 of Table VI, we present the results of asset sale logistic regressions by shipment growth quartiles. We do find differences in the in-bankruptcy interaction variables when we split our sample by quartiles. In quartile 1, plants of Chapter 11 firms in industries with high R&D are more likely to be sold, but in quartile 4 they are less likely to be sold. These results suggest that there exist differences in the types of firm that goes bankrupt in quartiles 1 and 4. The differences in the coefficient of the R&D interaction variable across quartiles are consistent with either an indirect cost of bankruptcy in quartile 4, or that R&D programs of bankrupt firms were not successful. For all firms in quartile 4, high R&D in the industry is associated with increased asset sales, for bankrupt firms the rate is lower.

Other significant interactions show up in quartile 4: Plants that are both more productive and in industries experiencing greater growth are more likely to be sold. This is consistent with our findings in Table V.[20] We also find a significant negative interaction between firm-level cash flow and the in-Chapter 11 dummy variable. These findings are also consistent with bankrupt firms in the high-growth quartile selling off their more-efficient plants to raise cash.

The last column of this table reports *p*-values for tests of the equality of coefficients between quartiles 1 and 4. The firm- and plant-specific productivity variables have a similar effect in high- and low-growth quartiles for both bankrupt and nonbankrupt firms. The only two firm-specific variables that have a differential effect by quartiles are the number of plants a firm operates and plant age. It is mainly the industry variables, including the industry variables interacted with the in-Chapter 11 dummy variable, that have significantly different effects in the high- and low-growth quartiles.

In Table VII, we report the economic significance of our results by calculating the estimated probabilities of asset sales by bankrupt and nonbankrupt firms. The probabilities are computed at the means of all variables for the bankrupt sample and at the means of the nonbankrupt sample variables.[21] TFP is then varied from the 10th to the 90th percentile to examine how productivity differences affect the probability of asset sales for both of these samples. Panel A illustrates that transition into bankruptcy does not have an important economic effect on the probability of asset sales. The probability of asset sales is slightly higher in prebankrupt year $t-1$ versus

[20] Recall that industries are classified into quartiles by growth over the whole sample period, but the change in industry shipments is calculated annually.

[21] When we calculate the probability of an asset sale for the same subsample of data, the only difference between bankrupt and nonbankrupt firms' probability in year $t-1$ will be the effect of the bankrupt firm dummy. In year $t+1$ for the bankrupt firm, we add the in-Chapter 11 variable and its interactions. This procedure thus controls for differential data, such as productivity differences.

Table VII

Plant Asset Sales: Estimated Probabilities

Estimated probabilities of an asset sale by bankrupt and nonbankrupt firms at the 10th, 25th, 50th, and 90th percentiles of total factor productivity (TFP). We compute estimated probabilities using the coefficients from the logit regressions from Table VI predicting asset sales. Panel A uses the coefficients from logit regression A from Table VI and the data for the full sample. Panel B is for quartiles 1 and 4 and uses the coefficients from logit regresssions B and C from Table VI. We compute these probabilities holding all other variables besides TFP and TFP interaction terms at the sample means of the nonbankrupt and bankrupt firms. For the year $t - 1$, nonbankrupt firms and the bankrupt firms probabilities are computed with the before-bankruptcy indicator variable equal to 0 and 1 respectively. For the year $t + 1$ for the bankrupt firm, we include the during-bankruptcy indicator variable and the interactions with the industry and productivity variables. For quartiles, the percentiles refer to that specific subsample. Thus the 50th percentile for quartile 1 is the 12.5th percentile of the overall sample.

		Probability of Plant Asset Sale at TFP:			
		10th Percentile	25th Percentile	50th Percentile	90th Percentile
Panel A: Full Sample					
Bankrupt firm:	Year $t - 1$	7.65%	7.06%	6.57%	5.59%
(data from bankrupt sample)	Year $t + 1$	4.91%	5.16%	5.39%	5.88%
Bankrupt firm:	Year $t - 1$	3.15%	2.91%	2.70%	2.25%
(data from nonbankrupt sample)	Year $t + 1$	2.16%	2.25%	2.33%	2.54%
Nonbankrupt firm:	Year $t - 1$	1.75%	1.62%	1.50%	1.25%
(data from nonbankrupt sample)	Year $t + 1$	1.85%	1.70%	1.57%	1.31%
Nonbankrupt firm:	Year $t - 1$	4.34%	3.99%	3.71%	3.14%
(data from bankrupt sample)	Year $t + 1$	4.46%	4.02%	3.68%	3.06%
Panel B: Quartiles 1 and 4					
Quartile 1: Bankrupt firm	Year $t - 1$	4.90%	4.62%	4.35%	3.74%
	Year $t + 1$	2.55%	3.23%	3.93%	5.70%
Quartile 1: Nonbankrupt firm	Year $t - 1$	4.48%	4.14%	3.81%	3.14%
	Year $t + 1$	3.64%	3.28%	2.90%	2.22%
Quartile 4: Bankrupt firm	Year $t - 1$	8.09%	7.51%	6.92%	5.74%
	Year $t + 1$	3.74%	4.22%	4.87%	6.64%
Quartile 4: Nonbankrupt firm	Year $t - 1$	4.78%	4.51%	4.25%	3.66%
	Year $t + 1$	4.86%	4.45%	4.15%	3.61%

bankrupt year $t + 1$. This higher probability results from the large, statistically significant pre-Chapter 11 indicator variable.

Bankrupt firms have a higher probability of selling assets than do nonbankrupt firms. However, this increased probability is driven mainly by differences in the mean values of our explanatory productivity, firm-level cash flows, and industry variables for bankrupt and nonbankrupt firms. Evaluating the probability of asset sales by bankrupt firms at the mean of the data of the nonbankrupt sample, we find that there is a 3 to 4 percentage points lower probability of asset sale. Evaluating the nonbankrupt firm's probability of sale at the mean of the bankrupt sample, there is a 2 to 2 1/2 percentage points increase in the probability of an asset sale. Thus, approximately two-thirds of the increased probability of sales by bankrupt firms is accounted for by differences in the sample means, and one-third by the before- and in-Chapter 11 dummy variables. The in-Chapter 11 interaction variables do not contribute significantly to the results.

The one case where an economically important difference for asset sales in bankruptcy occurs is in quartile 4. When we examine the probability of an asset sale by quartiles in Panel B, we find that for quartile 4 firms, the probability of an asset sale in the year subsequent to bankruptcy increases with TFP. This is consistent with our earlier finding that quartile 4 firms sell their better assets in bankruptcy.

The results support the prediction of a higher value of reallocation for all firms, both bankrupt and nonbankrupt, in high-growth industries. More asset sales occur for bankrupt firms but the industry and plant productivity variables are highly significant in explaining these sales. We find no evidence of an indirect bankruptcy cost in the form of a failure to sell assets. In fact, asset sales occur at a higher rate in the high-growth quartile. Thus, there is no evidence that reorganization costs are higher inside than outside of bankruptcy. However, we do find evidence that the bankrupt firms in the high-growth quartiles did not operate the sold plants as efficiently as the new owners. Thus, our evidence does not support the prediction of Shleifer and Vishny (1992) that assets of bankrupt firms are sold to less-efficient buyers.

C.2. Plant Closures and Liquidations

To analyze plant closures by and liquidations of bankrupt firms, we first present average productivity numbers for closed plants and frequencies of closures for both bankrupt and industry firms. Next, we examine whether the industry-, firm-, and plant-level factors are associated with the decision to close a plant. We examine if there is any delay in closing plants by bankrupt firms—a potential bankruptcy cost if conflicts of interest are higher in bankruptcy.

We investigate whether industry characteristics can explain the probability of plant closure using logistic regressions. Our regressions include industry-, plant- and firm-level variables, and interactions of several of these variables with indicators of bankruptcy status. We present logistic results for the full sample and for quartiles 1 and 4. As in Table VI, the last column presents a test of whether coefficients are significantly different between quartiles 1 and 4. We test for differences by running a regression for all firms in quartiles 1 and 4 with a quartile 4 dummy variable interacted with the independent variables, and present the *p*-value for this interaction variable.

In the results for all quartiles, presented in column 1 of Table VIII, we do not find evidence of costs of bankruptcy in the form of delay or failure to close plants. The logistic regressions in column 1 show that for all firms, the industry-level variables—change in industry shipments and weighted industry R&D—are highly significant at less than 1 percent. We find that the probability of closure is negatively related to the change in industry shipments. Plant-level cash flows and productivity are also significantly and negatively related to closures. Both results are consistent with economic efficiency.

Though there are some differences between firms that experience and firms that do not experience bankruptcy, we find limited evidence that Chapter 11 status affects closing decisions. After controlling for other variables, firms that experience bankruptcy have increased rates of closures before and after, but not during, Chapter 11. The coefficients on the dummy variables for before- and after-Chapter 11 are positive and highly significant. However, the variable indicating that the firm is in Chapter 11 is not significant.

We interact the before-, in-, and after-Chapter 11 dummy variables with total factor productivity, cash flow, industry R&D, change in shipments, and capacity utilization. There are no significant interactions between the before- and after-Chapter 11 bankrupt-firm dummy variables and the industry variables. We do not report these interactions.

There are significant interactions between the in-Chapter 11 dummy variable and our independent variables. While they are in Chapter 11, firms' closing decisions are more sensitive to the change in industry shipments and the level of industry R&D. The interaction with the change in industry shipments is negative and significant, showing that a decline in shipments causes the probability of closure to increase. The increased sensitivity to industry shipments suggests that the bankrupt firms' plants are marginal in the industry. The negative association between the interaction of bankruptcy and industry R&D shows that firms in industries with low R&D close more plants. This finding is consistent with the perception of fewer growth options in these industries.

In columns 2 and 3 of Table VIII, we investigate closing decisions by quartiles. Except for the case of quartile 4 firms, we find no evidence that the productivity of plants closed by bankrupt firms differs from that of plants closed by other industry firms. In quartile 4, there is a negative interaction, significant at the 10 percent level, between total factor productivity and the in-Chapter 11 variable: As productivity increases, these plants are less likely to be closed. There are no significant interactions between firm cash flow and the in-Chapter 11 variable. This indicates that cash flows do not affect closure decisions of bankrupt firms differently.

The last column of this table tests whether coefficients are significantly different between quartiles 1 and 4. We report *p*-values for this test in the last column. For bankrupt firms, we find significant differences between quartiles 1 and 4 for the effect of the industry R&D. In high-growth quartiles, increased industry R&D is associated with a lower probability of closing a plant.

Table VIII

Plant Closing Decisions

Regressions test the effects of plant-level productivity and industry-level demand and supply variables on plant closing of bankrupt firms and other nonbankrupt industry firms. We estimate the regressions using a logistic-limited dependent variable model. The dependent variable equals 1 if a plant is closed in that year. The change in industry shipments and capacity utilization are yearly at the 4-digit SIC code level. Weighted industry research and development (R&D) is from COMPUSTAT firm-level data and represents R&D and advertising expense divided firm sales aggregated up to the 3-digit SIC code. Total Factor Productivity (TFP) is calculated using a translog production function. Operating cash flow is the value of shipments less labor, materials and energy costs divided by value of shipments. Relative plant scale is the plant's asset size divided by the average assets for plants in each industry. Capacity utilization is at the 4-digit SIC code and is from the Bureau of the Census. Data are yearly from 1977 to 1990. (p-values are in parentheses.)

	Dependent Variable: Plant Closing			Test for Significant Difference: Quartile 4 − Quartile 1 (p value)
	Logit A: Full Sample	Logit B: Quartile 1	Logit C: Quartile 4	
Industry-level variables				
Change in industry shipments	−1.581	−1.304	−2.135	
	(0.000)[a]	(0.002)[a]	(0.000)[a]	(0.018)[b]
Weighted industry R&D	−7.360	−3.286	−2.904	
	(0.000)[a]	(0.014)[b]	(0.038)[b]	(0.015)[b]
Capacity utilization	−0.006	−0.007	0.001	
	(0.000)[a]	(0.006)[a]	(0.214)	(0.396)
Standard deviation of industry shipments	3.783	3.256	12.00	
	(0.000)[a]	(0.000)[a]	(0.000)[a]	(0.000)[a]
Plant- and firm-level variables				
Number of plants owned by firm	0.006	0.005	0.007	
	(0.000)[a]	(0.000)[a]	(0.000)[a]	(0.556)
Log of firm shipments	−0.048	−0.066	−0.027	
	(0.000)[a]	(0.000)[a]	(0.160)	(0.429)
Total factor productivity (TFP)	−0.173	−0.162	−0.279	
(Lagged one year)	(0.000)[a]	(0.000)[a]	(0.000)[a]	(0.000)[a]
Plant-level operating cash flow	−0.147	−0.158	−0.097	
(Lagged one year)	(0.002)[a]	(0.014)[b]	(0.296)	(0.226)
Relative plant scale	−0.276	−0.286	−0.463	
	(0.000)[a]	(0.000)[a]	(0.000)[a]	(0.000)[a]
Plant age	−0.022	−0.026	−0.030	
	(0.000)[a]	(0.000)[a]	(0.000)[a]	(0.261)
Bankruptcy variables				
Before Chapter 11 dummy variable	0.681	0.692	0.944	
(=1 for years before firm is in Ch. 11)	(0.000)[a]	(0.000)[a]	(0.000)[a]	(0.663)
In Chapter 11 dummy variable	−0.123	−2.019	−0.473	
(=1 while firm is in Ch. 11)	(0.916)	(0.384)	(0.889)	(0.899)
After Chapter 11 dummy variable	0.382	−0.136	0.529	
(=1 after firm emerges from Ch. 11)	(0.007)[a]	(0.787)	(0.002)[a]	(0.056)[b]
In Chapter 11*TFP	−0.543	−0.394	−0.808	
	(0.146)	(0.351)	(0.047)[b]	(0.417)

Table VIII—*Continued*

	Dependent Variable: Plant Closing			Test for Significant Difference: Quartile 4 − Quartile 1 (p value)
	Logit A: Full Sample	Logit B: Quartile 1	Logit C: Quartile 4	
Bankruptcy variables				
In Chapter 11*cash flow	−0.804	−0.293	−0.418	
	(0.189)	(0.751)	(0.351)	(0.966)
In Chapter 11*industry R&D	−23.915	−70.289	−41.85	
	(0.015)[b]	(0.008)[a]	(0.069)[c]	(0.008)[a]
In Chapter 11*change in shipments	−3.072	−9.213	−10.51	
	(0.035)[b]	(0.054)[c]	(0.025)[b]	(0.393)
In Chapter 11*capacity utilization	0.007	0.032	0.031	
	(0.216)	(0.262)	(0.452)	(0.337)
Total plant years	371,373	60,477	85,148	
χ^2 statistic	1299.79	145.33	463.81	
Significance level (p-value)	<1%	<1%	<1%	

[a,b,c] Significantly different from zero at the 1 percent, 5 percent, and 10 percent levels, respectively, using a two-tailed t-test.

In Table IX we investigate the economic significance of our results. As with asset sales, we compute the estimated probabilities of plant closures at the means of all variables for the bankrupt sample, and at the means for the nonbankrupt sample. We examine how the change in industry shipments affects the probability of closure for the bankrupt and nonbankrupt samples, and find that the probability of closure is higher for bankrupt firms. At the 50th percentile, the probability of closing in the year prior to bankruptcy is 3.23 percent for bankrupt firms and 1.65 percent for nonbankrupt firms. We evaluate both at the mean of the variables of the bankrupt firm sample. The increased probability relates to the higher sensitivity of bankrupt firms' closure decisions to the industry variables interacted with the during-bankruptcy dummy variable.

We also find a striking difference between quartile 1 and quartile 4. At the 50th percentile of these quartiles, the probability of closing is 9.5 percent for quartile 1 and only 0.25 percent for quartile 4. These results show that average closure rates are significantly higher and economically more important for bankrupt firms in the declining quartile. In declining industries, Chapter 11 appears to be a mechanism for fostering the exit of capacity.

We also explore how asset sales and closures may relate to each other. First, we estimate a multinomial logit for quartiles 1 and 4. The differences between the multinomial estimates and the ones we present in the paper are immaterial: They are in the third decimal place. This is consistent with our priors that the shocks that affect closing and asset sales are different.

Table IX

Plant Closures: Estimated Probabilities

Estimated probabilities of a plant closure by bankrupt and nonbankrupt firms at the 10th, 25th, 50th, and 90th percentiles of change in industry shipments. We compute estimated probabilities using the coefficients from the logit regressions from Table VIII using logit regression A for the full sample and logit regressions C and D for the quartiles. We compute these probabilities holding all other variables besides change in industry shipments and its interaction terms at the sample means of the nonbankrupt and bankrupt firms. For the year $t - 1$, nonbankrupt firms and the bankrupt firms' probabilities are computed with the before-bankruptcy indicator variable equal to 0 and 1 respectively. For the year $t + 1$ for the bankrupt firm, we include the during-bankruptcy indicator variable and the interactions with the industry and productivity variables. For quartiles, the percentiles refer to that specific subsample. Thus the 50th percentile for quartile 1 is the 12.5th percentile of the overall sample.

		Probability of Plant Closure Varying Change in Industry Shipments			
		10th Percentile	25th Percentile	50th Percentile	90th Percentile
Bankrupt firm: All quartiles	Year $t - 1$	3.65%	3.38%	3.23%	2.86%
(data from bankrupt sample)	Year $t + 1$	1.92%	1.62%	1.43%	1.22%
Quartile 1	Year $t + 1$	12.69%	9.81%	9.50%	6.29%
Quartile 4	Year $t + 1$	0.46%	0.30%	0.25%	0.15%
Bankrupt firm: All quartiles	Year $t - 1$	3.23%	3.04%	2.89%	2.45%
(data from nonbankrupt sample)	Year $t + 1$	1.66%	1.33%	1.19%	1.04%
Quartile 1	Year $t + 1$	11.76%	8.55%	8.60%	6.09%
Quartile 4	Year $t + 1$	0.39%	0.29%	0.19%	0.05%
Nonbankrupt firm:	Year $t - 1$	1.65%	1.55%	1.48%	1.25%
(data from nonbankrupt sample)	Year $t + 1$	1.57%	1.45%	1.40%	1.23%
Nonbankrupt firm:	Year $t - 1$	1.87%	1.73%	1.65%	1.45%
(data from bankrupt sample)	Year $t + 1$	1.83%	1.73%	1.66%	1.47%

Second, we estimate the interaction between asset sales and closures over time. We include two variables to capture the extent of past closures and asset sales. These variables measure the percentages closed and sold, respectively, in the previous five years. We interact these variables with the bankruptcy indicator variable to test if bankrupt firms are affected differently by past sales and closures.

Including these variables does not change the significance or sign on the other variables in our previous regressions. For all firms, past asset sales and closures reduce the probability of a current asset sale, but past closures increase the likelihood of a current closure. There is a very limited difference between bankrupt and nonbankrupt firms. The bankruptcy interaction variables are not significant in quartiles 1 and 4 for asset sales. For closures, the bankruptcy interaction variable with past asset sales is significant at 4.9 percent only in quartile 4, and insignificant in quartile 1.

Table X compares the subsample of bankrupt firms that convert to Chapter 7 from Chapter 11 with Chapter 11 firms that do not convert to Chap-

Table X

Transfers to Chapter 7 Liquidation

This table examines the productivity of firms' plants that transferred into Chapter 7 liquidation from Chapter 11 compared to the remaining Chapter 11 firms that did not enter Chapter 7. Numbers are relative total factor productivity (TFP) for plants less the industry-average TFP for each year. TFPs are standardized by dividing by the standard deviation of industry TFP at the four-digit SIC code level. Quartiles are determined by using the change in the real value of shipments at the three-digit SIC code from the NBER. Productivity (TFP) numbers are presented combining the lowest two and highest two quartiles to obtain sufficient numbers of plants to allow disclosure under government criteria. — means that the cell cannot be disclosed because there are too few plants in this relative year. The Chapter 11 firms in columns 1 and 3 are the subset of Chapter 11 firms that do not transfer to Chapter 7. Columns 2 and 4 represent the years in Chapter 7 after transferring from Chapter 11, for the lowest two and highest two quartiles, respectively. We assign firms to Chapter 7 based on the year-end status; thus some firms transfer to Chapter 7 in the same year they declare Chapter 11. (*t*-statistics for significant differences from zero are in parentheses.)

	Growth in Shipments							
	Lowest Two Quartiles				Highest Two Quartiles			
	Chapter 11 Firms	*n*	Ch. 11 Firms transferred to Chapter 7	*n*	Chapter 11 Firms	*n*	Ch. 11 Firms transferred to Chapter 7	*n*
Panel A: Years before Chapter 11								
Year −2	−0.031	636	−0.219	146	0.046	330	−0.198	76
	(−0.82)		(−2.81)[a]		(0.88)		(−1.75)[c]	
Year −1	−0.036	607	−0.098	109	−0.019	295	−0.189	64
	(−1.04)		(−1.20)		(−0.33)		(−1.38)	
Panel B: After Declaration of Chapter 11								
Year 0	−0.100	514	−0.070	24	−0.046	299	−0.347	36
t-stat for average	(−2.35)[c]		(−0.40)		(−0.77)		(−2.58)[a]	
t-stat for −1 to 0	(−1.15)		(0.15)		(−0.32)		(−0.82)	
Year +1	0.046	412	−0.105	13	0.016	209	—	
t-stat for average	(0.89)		(−0.41)		(0.19)			
t-stat for −1 to +1	(1.32)		(−0.03)		(0.37)			
Year +2	0.026	208	—		−0.073	129	—	
t-stat for average	(0.46)				(−0.78)			
t-stat for −1 to +2	(0.93)				(−0.58)			
Year +3	0.048	133	—		−0.336	59	—	
t-stat for average	(0.62)				(−2.49)[a]			
t-stat for −1 to +3	(0.99)				(−2.96)[a]			
Year +4	0.072	85	—		−0.177	49	—	
t-stat for average	(0.76)				(−1.32)			
t-stat for −1 to +4	(1.07)				(−1.28)			

Table X—*Continued*

	Growth in Shipments							
	Lowest Two Quartiles				Highest Two Quartiles			
	Chapter 11 Firms	*n*	Ch. 11 Firms transferred to Chapter 7	*n*	Chapter 11 Firms	*n*	Ch. 11 Firms transferred to Chapter 7	*n*
Panel C: After Leaving Chapter 11, Emerged Firms versus Firms Transferred to Chapter 7								
Year +1	−0.087	260	−0.274	80	−0.207	112	−0.131	38
t-stat for average	(−1.41)		(−2.89)[a]		(−2.32)[b]		(−0.97)	
t-stat for −1 to +1	(−0.71)		(−1.40)		(−1.78)[c]		(0.31)	
Year +2	−0.104	136	−0.197	69	−0.073	77	−0.409	17
t-stat for average	(−1.21)		(−1.65)[c]		(−0.86)		(−1.99)[c]	
t-stat for −1 to +2	(−0.73)		(−0.68)		(−0.53)		(−0.64)	
Year +3	−0.126	75	−0.389	69	−0.226	49	−0.583	15
t-stat for average	(−0.92)		(−3.50)[a]		(−1.51)		(−2.67)[a]	
t-stat for −1 to +3	(−0.63)		(−2.11)[b]		(−1.29)		(−1.53)	

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

ter 7. Columns 1 and 3 represent the firms that never switch to Chapter 7, for the top and bottom two quartiles, respectively. Columns 2 and 4 represent the firms that do convert to Chapter 7 from Chapter 11.[22] The firms in the Chapter 7 subsample do not emerge. Eventually they either sell or close all their plants. We assign firms to Chapter 7 based on the year-end status, thus some firms transfer to Chapter 7 within the same year of declaring Chapter 11. Year 0 is not included in this table because in this year firms spend part of the year in Chapter 11 and part of the year in Chapter 7. Panel A covers the years before declaring Chapter 11 and separates out those firms that eventually switch to Chapter 7 from Chapter 11. Panel B covers the years while the firms are in Chapter 11, again separating out firms that switch to Chapter 7. Panel C covers the years after firms leave Chapter 11, either emerging from bankruptcy (columns 1 and 3) or transferring to Chapter 7 (columns 2 and 4).

Panel B shows that while firms are in Chapter 11, the productivity of plants of those firms that eventually convert to Chapter 7 is much lower than the productivity of plants of firms that do not. Panel C shows that the productivity of those that convert to Chapter 7 is also much lower than the productivity of those that emerge from Chapter 11. There are also more Chapter 7 liquidations in the lowest two shipment growth quartiles. The

[22] All the prior tables include these Chapter 7 firms while they are in Chapter 11, thus avoiding survivorship bias.

lower productivity of Chapter 7 plants shows that, consistent with economic efficiency, plants selected for liquidation are indeed significantly less productive than their industry counterparts. This suggests that the bankruptcy process does discriminate between inefficient and efficient firms. Overall, we find a higher incidence of Chapter 7 liquidations, and a higher probability of closure and Chapter 11 bankruptcies in the declining-industry quartiles. This emphasizes the importance of industry effects in determining which firms become bankrupt.

IV. Conclusions

We investigate how industry shipments and other industry characteristics affect firms' performance in bankruptcy and the decision to redeploy assets. We do not find much evidence of indirect bankruptcy costs. Chapter 11 bankruptcy status is relatively less important than industry and plant-level productivity factors in influencing bankrupt firms' decisions.

Our evidence shows that the decision to sell and close plants depends on industry demand and capacity utilization, which determine the opportunity costs of assets. Firms can enter bankruptcy and sell and/or close plants because the number of plants that can operate profitably in the industry can change. Under plausible assumptions, the value of reorganizing is highest when industry growth is highest. However, in these industries, the likelihood of bankruptcy could be lowest because the overall level of industry cash flows is high.

Our results show that the frequency of bankruptcy is indeed lowest in high-growth industries. We find that the proportion of plants going bankrupt is more than three times higher in declining industries than in high-growth industries. However, the productivity of plants in declining industries does not significantly decrease relative to their industry counterparts. Thus, we find no evidence of any bankruptcy costs in these industries. For firms in declining industries, Chapter 11 protection does not seem to be used by low-productivity firms to avoid closing or selling inefficient plants.

The results are different for plants belonging to firms that declare Chapter 11 in high-growth industries. Although these represent a lower proportion of plants in their industries, their average productivity is significantly lower than that of their industry counterparts. After correcting for survivorship bias because of plant sales and closures, the productivity of plants of bankrupt firms in high-growth industries, although low, decreases over time only for those firms that remain in Chapter 11 for four or more years. These findings show that asset composition and survivorship bias are serious problems that must be accounted for before comparisons can be made between ex post and ex ante performance. Changes in bankrupt firms' performance can be explained for the most part by asset sales and closures, not by changes in the efficiency of retained assets. As a result, the evaluation of the bankruptcy process must track all of these outcomes and must not focus solely on the productivity of survivor firms.

When we analyze the redeployment of plants of Chapter 11 firms, several conclusions emerge. First, in high-growth industries, the productivity of purchased plants increases under new ownership, but in declining industries it does not. This finding is consistent with the hypothesis that the value of asset transfers is higher in high-growth industries. Second, the purchasers of bankrupt firms' plants are more efficient than the average firm in their industry. Overall, there is no evidence that indirect reorganization costs in Chapter 11 are higher than outside of bankruptcy.

The logistic regressions show that for both bankrupt and nonbankrupt firms, the probabilities of closures and asset sales are significantly related to the change in industry output and productivity. Bankruptcy status has a minimal effect on the probability of selling a plant. The probability of closures is higher for bankrupt firms in declining industries. This higher probability arises from the increased sensitivity of closures to changes in industry shipments during Chapter 11.

Our logistic regressions also show that industry-level research and development is significant in explaining the asset sale and closure decisions. In industries with high R&D and high growth in shipments, firms in bankruptcy are less likely to close and sell plants. These results suggest that asset specificity and technological change might affect the value of assets and whether these assets are sold.

The results suggest that in industries in which the opportunity costs of assets are high and positively correlated with cash flows, mechanisms other than bankruptcy might have a more important role in restructuring inefficient firms. The small size of realized indirect costs for firms that elect to enter bankruptcy does not necessarily imply that other distressed firms would not incur indirect bankruptcy costs if they enter Chapter 11. The differences across quartiles in the frequency of bankruptcy, in the efficiency of firms prior to bankruptcy, and in the population of bankrupt firms suggest that some firms in high-growth industries may not take advantage of Chapter 11 reorganization because of indirect costs. In future research we plan to examine these factors, and whether financial distress and the threat of bankruptcy affect the asset redeployment process under different demand conditions.

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