

Private Equity, Jobs and Productivity

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1. Introduction

The productivity effects of private equity are a matter of considerable controversy. Much of the popular press, and many labour and political leaders, characterize private equity as engaged mainly in financial engineering that delivers few productivity gains or other benefits to the firms they acquire. Some critics go further and claim that private equity harms the firms that they acquire and their workers. Even among sympathetic observers, the mechanisms through which private equity groups improve operations at portfolio firms often are seldom well-articulated and well-documented.

In this paper, we develop evidence about whether and how productivity changes at firms that are targets of private equity transactions. We also provide evidence about the joint behaviour of productivity, jobs and worker earnings at private equity targets compared with other firms. We build on our recent study of employment outcomes at firms and establishments that were targets of private equity transactions in the United States from 1980 to 2005 [Davis et al., 2008]. As in our earlier study, we exploit detailed data on private equity transactions that we have integrated with longitudinal micro datasets at the US Census Bureau.

Specifically, we rely on the Longitudinal Business Database (LBD) to follow employment at virtually all private equity-backed companies in the US, before and after the private equity transactions, as well as at matching firms with similar observable characteristics. We follow activity at the level of firms *and* establishments – that is, specific factories, offices and other distinct physical locations where business takes place. We restrict attention to the manufacturing sector for the productivity part of our analysis, because productivity measures are more widely available and of better quality for the manufacturing sector. To measure productivity, we rely on micro data from the Annual Survey of Manufactures (ASM).

We combine these Census Bureau data sources with data from CapitalIQ and other sources to identify and characterize private equity transactions. We identify about 5,000 US firms acquired in private equity transactions from 1980 to 2005 ('target firms') and about 250,000 US establishments operated by these firms at the time of the private equity transaction ('target establishments'). About 1,400 target firms and 14,000 target establishments are in the manufacturing sector. To construct controls, we match each target establishment to other establishments in the transaction year that are comparable in terms of industry, firm size and firm age. We follow a similar approach to controls for target firms.

To clarify the scope of our study, we consider later-stage changes in ownership and control executed and partly financed by private equity firms. In these transactions, the (lead) private equity firm acquires a controlling stake in the target firm and retains a significant oversight role until it 'exits' by selling its stake. The initial transaction usually involves a shift towards greater leverage in the capital structure of the target firm and, sometimes, a change in its management. We exclude management-led buyouts that do not involve a private equity firm. We also exclude start-up firms backed by venture capitalists.

Our ability to track both establishments and firms over time allows us to examine three competing hypotheses about the effects of private equity on productivity at target firms:

Hypothesis 1: Private equity groups do not systematically improve productivity at target firms, because their main focus is to generate profits through leverage and other tools of financial engineering. In fact, if the financial engineering leads management to focus on debt service and short-term financial goals at the expense of operating performance, or if it deprives management of the resources needed to enhance operations, private equity transactions negatively affect productivity at target firms.

Hypothesis 2: Private equity groups raise productivity at target firms by working with their managers to improve operations and realign incentives and by substituting better executives. Under this hypothesis, most productivity gains at private equity targets (relative to controls) involve improvements within continuing establishments rather than divestitures and closures of underperforming units or, more generally, the reallocation of resources across establishments.

Hypothesis 3: Private equity groups raise productivity at target firms by deciding which facilities to retain, expand, sell off, shrink or close. Under this hypothesis, most productivity gains at private equity targets (relative to controls) arise from the reallocation of factor inputs from less productive to more productive establishments.

Our previous study finds that, compared with controls, target firms exhibit substantially greater rates of gross job destruction and gross job creation in the wake of private equity transactions. We know from other research that a large fraction of industry-level productivity gains reflects factor reallocation from less productive to more productive establishments². These observations suggest that perhaps private equity transactions act as accelerants for this source of productivity gains. One possibility is that private equity investors have a greater ability to identify underperforming units in portfolio firms, a greater willingness to curtail their operations, or both. If so, then cutting back at underperforming units can free up resources to expand activity at better performing units and new facilities. This possibility is consistent with recent suggestions by Jovanovic and Rousseau [2008], who argue that takeovers lead to a shift of firm resources to more efficient uses and to better managers.

The main findings of our study can be summarized as follows:

1. Target manufacturing firms experience an intensification of job creation and job destruction activity, establishment entry and exit, and establishment acquisition and

² See Foster, Haltiwanger and Krizan [2001, 2006] and the references therein.

- divestiture (all relative to controls) in the wake of private equity transactions. The same patterns hold for private equity targets in the private sector as a whole.
2. At the time of private equity transactions, labour productivity is 3.7 log points (3.8%) higher on average at continuing establishments of target firms than at continuing establishments of comparable firms in the same industry and of similar size and age. Two years later, the productivity gap between such continuing establishments of target firms and comparable firms has widened to 5.1 log points (5.2%). This increased gap is on an employment-weighted basis so it reflects both within- establishment effects and the effects of changing allocation of activity across establishments within firms.
 3. The probability of establishment shut-down falls with productivity for both private equity targets and comparable firms, but the relationship is much steeper for targets. In other words, target firms are much more likely to close underperforming establishments, as measured by labour productivity.
 4. In the first two years after private equity transactions, productivity grows on average by about two percentage points more at target firms than at controls. About 72% of this differential reflects greater productivity gains at continuing establishments, including gains from accelerated reallocation of activity among the continuing establishments of target firms. About 36% of the differential reflects the productivity contribution of more establishment entry and exit at target firms. A greater pace of acquisitions and divestitures at target firms makes a small negative contribution to the differential in productivity growth.
 5. Cumulating the extra value-added implied by the differential in productivity growth, the roughly 1,400 private equity transactions involving US manufacturing firms from 1980 to

2005 raised output by US\$ 4 billion to US\$ 15 billion per year as of 2007 (expressed in inflation-adjusted 2007 dollars), depending on whether and how rapidly the productivity gains dissipate after the buyout.

6. Continuing establishments at target firms pay a wage premium, with average earnings per worker 1.1% greater than continuing establishments at comparable firms, at the time of private equity transactions. Two years later, average wages at the continuing establishments of target firms are the same as at the continuing establishments of comparable firms. This changing gap is on an employment-weighted basis and thus reflects within-establishment changes as well as changing allocation across continuing establishments³.
7. Both targets and controls tend to share productivity gains with workers in the form of higher wages, but the relationship between productivity gains and wage increases is slightly stronger at targets⁴.

In the current economic climate, a special concern is whether leveraged transactions have different effects in a severe downturn with limited credit availability. For example, even if private equity investments have beneficial productivity effects during our sample period as a whole, debt-heavy capital structures at target firms may lead to unfavourable outcomes in a downturn characterized by a sharp contraction in credit availability. We cannot yet investigate outcomes in the current downturn, but we can investigate outcomes in earlier periods that saw a recession and a contraction in credit availability. In this regard, we find the following:

8. The positive productivity growth differential at target firms (relative to controls) is larger in periods with an unusually high interest rate spread between AAA-rated and BB-rated

³ Note that we know very little at this point about the impact of private equity transactions on wages for individual workers inside the establishments of target firms. Understanding the wage dynamics of private equity transactions requires the use of linked employer–employee datasets, which is beyond the scope of this paper.

⁴ This pattern reflects cross-sectional variation in growth rates across establishments. That is, the establishments with higher than average productivity growth have higher than average earnings per worker growth.

corporate bonds. The higher productivity growth at target firms during periods of higher credit risk spreads reflects greater reallocation of activity to more productive establishments and a higher rate of closure at less productive ones.

These findings suggest that private equity firms are more prone to take difficult, but productivity-enhancing, decisions to restructure businesses during a credit market ‘crunch’.

The paper proceeds as follows: In Section 2 we review previous studies that consider the impact of private equity transactions on productivity outcomes. We then describe the construction of the data in Section 3. Section 4 describes our empirical methodology. We present our main analyses in Section 5. The final section offers concluding remarks and discusses directions for future work.

2. Previous literature

Economists have a longstanding interest in how ownership changes affect productivity (e.g., Lichtenberg and Siegel [1987], Long and Ravenscraft [1993], McGuckin and Nguyen [2001]). However, few empirical works explicitly consider the impact of private equity on productivity. In this section, we review the existing large-sample studies and then discuss several clinical studies of particular transactions.

A. Large-sample studies

Kaplan [1989a] focuses on public-to-private leveraged buyouts (LBOs) during the 1980s. In 48 firms for which he can obtain post-buyout financial information, he finds increases in operating income (before depreciation) and net cash flow, as well as reductions in capital expenditures. When normalized by assets or sales to control for post-buyout asset sales, the

increases in income and cash flow are between 20% and 50%. He interprets these findings as consistent with Jensen [1989], who argues that the combination of incentives, control and leverage imposed by private equity significantly enhances operating performance at target firms.

The analysis closest in spirit to our study is Lichtenberg and Siegel [1990], who use Census Bureau data to examine changes in productivity at the manufacturing plants of 131 firms undergoing buyouts between 1981 and 1986. They find more rapid productivity growth at these plants post-buyout than at other plants in the same industries, even though buyout plants were already more efficient before the transaction. Interestingly, they find no significant productivity changes in the 38 LBOs that occurred in 1981 and 1982, a recessionary period, while the post-1982 LBOs had a strong positive impact.

Two other studies examine private equity transactions in Great Britain, historically the second-largest market for buyout activity. Amess [2002] examines 78 buyouts of entire British firms between 1986 and 1997, and Harris, Siegel and Wright [2005] examine 979 buyouts of British firms between 1994 and 1998. The results in both studies suggest that private equity transactions are associated with productivity increases⁵.

These earlier studies share certain features. First, there is little effort to distinguish among sources of productivity changes, that is, how much of any gains reflects productivity improvements within continuing establishments and how much reflects divestiture or closures of underperforming establishments or, more generally, reallocation from less to more productive establishments. Some of the studies seek to partly address this issue by eliminating buyouts involving substantial asset sales, but it is unclear how this type of sample restriction affects the results given the extent of

⁵ These studies of British transactions also include management-led deals (which they term management buyouts). Some of these transactions may not have a financial sponsor playing a key role in governing the firm, and thus may be quite different from traditional private equity transactions.

‘asset shuffling’ by private equity-backed and other firms. Such an approach is also unable to address the broader contribution of factor reallocation to productivity in the wake of private equity transactions.

Second, previous US studies consider a relatively modest number of deals in the 1980s. Since that time, the private equity industry has become much larger. Using inflation-adjusted dollars, fundraising by US private equity groups was 36 times greater in 1998 than in 1985 and more than 100 times greater in 2006⁶. The tremendous growth in private equity activity allows us to examine a much larger sample. It also suggests that earlier relationships might no longer hold because of increased competition for transactions or greater operational orientation of many private equity groups.

Third, many previous studies restrict attention to whole-firm and public-to-private transactions. Divisional buyouts, secondary buyouts and private equity investments in firms that were already private may produce quite different results.

B. Clinical studies

Another group of studies provide detailed descriptions and analyses of particular private equity transactions. These studies find productivity effects and other outcomes in particular transactions that may have broader implications. By our reading, these studies deliver four sets of insights.

First, some private equity transactions generate limited or no productivity gains. In several cases, and for various reasons, private equity groups sometimes fail to achieve their goals for target firms. For instance, when Berkshire Partners bought Wisconsin Central, it had an ambitious plan to increase productivity. However, technological problems arose soon after the buyout transaction

⁶These statistics are from the VentureXpert datanase. See <http://www.venturexpert.com> (accessed 6 October 2008).

and prevented the deployment of a computerized control system that was crucial to the plan. Moreover, the original business plan overlooked certain costs and greatly overestimated the target's ability to cut expenditures. As a result, the numbers in the ambitious business plan were never met (Jensen, Burkhardt and Barry [1990]). In other cases, such as the Revco transaction, a crippling debt load, along with management disarray, a weak and inexperienced LBO sponsor and a disastrous midstream shift in strategy led to a failure to achieve performance goals (Wruck [1991]). As these examples illustrate, some private equity transactions fail in the sense of not achieving the goals of the private equity investors. Positive productivity effects are unlikely in such cases.

Second, the Revco case also suggests that the primary source of private value creation in at least some buyouts involves tax savings rather than operational improvements. Consistent with this view, the large-sample study of Kaplan [1989b] provides evidence that greater leverage and other organizational shifts imposed by private equity investors can yield substantial tax savings that represents "an important source of the wealth gains in leveraged buyouts". If tax savings are the principal motive for private equity transactions, there is no compelling reason to anticipate positive effects on productivity at target firms and, as we suggested in the introduction, some reason to fear negative productivity effects.

Third, many case studies find substantial productivity gains at target firms in the form of improvements to existing operations. For instance, in the Hertz buyout, Clayton, Dubilier and Rice (CD&R) addressed inefficiencies in pre-existing operations to help increase profitability. Specifically, CD&R lowered overhead costs by reducing inefficient labour expenses and cutting non-capital investments to industry standard levels, and more closely aligned managerial incentives with return on capital (Luehrman [2007]). Similarly, the buyout of O.M. Scott & Sons

led to substantial operating improvements in the firm's existing operations, partly through powerful incentives offered to management and partly through specific suggestions by the private equity investors (Baker and Wruck [1989]). In examples like these, profitability increases and private value creation are likely to go hand in hand with productivity gains.

Finally, in a number of other cases, private equity targets achieved substantial efficiency improvements not by enhancing existing operations, but rather by divesting units. Beatrice had acquired a large number of unrelated businesses as part of a conglomerate strategy, many of which operated in segments in which it had little expertise. Its private equity investor, Kohlberg, Kravis and Roberts, divested many of these laggard operations, leaving behind a core of well-integrated businesses (Baker [1992]). Similarly, the buyout group that purchased Kaiser Steel shut down its outdated and inefficient steel operations. The group focused its operational attention at Kaiser on the firm's coal mines, which it regarded as the "hidden jewel" in the firm. Little effort, though, was devoted to improving the operations of mining facilities (Luehrman [1992]). Greater profitability and private value creation are also likely to involve productivity gains in these types of examples, though mainly through productivity-enhancing reallocation rather than operational improvements within continuing units.

These case studies illustrate a wide range of motives for and effects of private equity transactions. They can be used to support a variety of hypotheses about the favourable or unfavourable economic impact of private equity. Our study can be seen as an effort to determine which of these stories best characterizes the impact of private equity transactions on average, especially with respect to productivity outcomes.

3. The sample

A. *Identifying private equity transactions*

To identify private equity transactions, we begin with the CapitalIQ database. CapitalIQ has specialized in tracking private equity deals on a worldwide basis since 1999 and, through extensive research, attempts to ‘back fill’ earlier transactions⁷. We download all recorded transactions in CapitalIQ that closed between January 1980 and December 2005.

We impose two sample restrictions. First, we restrict attention to transactions that entail some use of leverage. Many of the CapitalIQ transactions that do not involve leverage involve venture capital rather than private equity investments in mature or later-stage firms. To focus on private equity, we delete transactions not classified by CapitalIQ as ‘going private’, ‘leveraged buyout’, ‘management buyout’, ‘platform’, or a similar term. This approach excludes some private equity-backed ‘growth buyouts’ and ‘expansion capital’, transactions that involve little or no leverage in the purchase of a minority stake⁸. While such transactions do not fit the classic profile of leveraged buyouts, they share other characteristics of private equity transactions.

Second, the CapitalIQ database includes a number of transactions that did not involve a financial sponsor (that is, a private equity firm). We eliminate these deals as well. While transactions in which a management team takes a firm private using its own resources are interesting, they are not the focus of this study. After restricting the sample in these two ways, the resulting database contains about 11,000 transactions worldwide and about 5,000 transactions for target firms in the United States.

⁷ Most data services tracking private equity transactions were not established until the late 1990s. The most geographically comprehensive exception, SDC VentureXpert, was primarily focused on capturing venture capital transactions until the mid-1990s.

⁸ It also excludes private equity acquisitions of majority stakes without leverage. These deals typically involve very small targets and funds. The funds that carry out these transactions are often US government-subsidized Small Business Investment Corporations, which are limited by regulators in their use of leverage. These no-leverage buyout transactions are much smaller on an aggregated US dollar-weighted basis than leveraged buyouts.

We supplement the CapitalIQ data with data from Dealogic. In many cases, Dealogic has better information about certain features of private equity transactions, such as the multiple of earnings paid and the capital structure. It also frequently records information on alternative names associated with the firms, add-on acquisitions and exits. We also draw on Securities Data Company (SDC) databases and compilations of news stories to identify the characteristics of the transactions and the nature of exits from the investments.

B. Integrating data on private equity transactions with the LBD

The LBD is a longitudinal database of US establishments and firms with paid employees. It is constructed from the US Census Bureau’s Business Register and enhanced with survey data collections (see Jarmin and Miranda [2002]). The LBD covers all sectors of the US economy and all geographic areas and currently runs from 1976 to 2005. In recent years, it contains over 6 million establishment records and almost 5 million firm records per year.

To merge data on private equity transactions with the LBD, we match the names and addresses of the private equity portfolio firms (that is, the targets) to name and address records in the LBD⁹. For each transaction identified in our CapitalIQ/Dealogic private equity dataset, we search for a match to the LBD in a three-year window centred on the transaction year. A three-year window helps us deal with timing differences between the private equity data sources and the LBD, which records March values for most variables.

⁹ For some of the non-matched cases, we have been successful in matching the name of the seller in the CapitalIQ database to the corresponding LBD firm. We plan to use such seller matches to fill out our matches of target firms, but the use of these matches requires us to determine which components of the seller firm are involved in the private equity transaction.

Once we match a target firm to the LBD, we use firm-establishment links in the LBD to identify all establishments owned by the target firm at the time of the private equity transaction. We then follow target firms and their establishments before and after the private equity transaction.

Of the approximately 11,000 target firms in our private equity sample, a little more than half are not headquartered in the United States. After dropping foreign firms, our dataset contains slightly more than 5,000 US target firms acquired in private equity transactions between 1980 and 2005¹⁰. We currently match about 86% of these targets to the LBD, which yields an analysis sample of about 4,500 target firms. This sample of target firms serves as the basis for our earlier study of firm and establishment employment outcomes at private equity targets and a portion of our analysis below.

Figure 1 shows the number of US private equity targets by year and the number that we currently match to the LBD. It is apparent from Figure 1 that the number of transactions grew rapidly in the late 1990s. Figure 2a shows the amount of employment accounted for by target firms in the transaction year. Firms that became private equity targets in 2005 alone account for about 2% of all employees in the non-farm private sector. Figure 2b shows the amount of employment accounted for by target manufacturing establishments. While the magnitude in terms of number of jobs is much smaller than in Figure 2a, the broad patterns are similar. Moreover, private equity targets account for a larger fraction of manufacturing employment – almost 3%, for example, in 2003 alone. Remarkably, nearly one-tenth of US manufacturing workers were employed in firms that became private equity targets from 2000 to 2005.

Our productivity analysis considers the subset of manufacturing establishments covered by the Annual Survey of Manufacturers (ASM). Basic data items collected about each manufacturing

¹⁰ Some foreign firms targeted in private equity transactions likely operate US establishments. We will explore this issue and seek to capture US-based establishments operated by foreign-owned private equity targets in a future draft.

establishment in the ASM include employment, payroll, materials usage, value added, detailed industry codes, employer identification numbers, business name and information about location¹¹. Identifiers in the LBD files enable us to compute growth rate measures for establishments and firms, to track entry and exit of establishments and firms, and to identify changes in firm and establishment ownership. The LBD defines firms based on operational control, and all establishments that are majority owned by the parent firm are included as part of the parent's activity measures. Because the ASM over-samples larger manufacturing firms and establishments, we present all analyses in this paper using sample weights that adjust for the propensity of a given firm or establishment to be included in the ASM.

1. Methodology

A. Key choices in the empirical design

The Census data permit analysis at both the establishment and firm level. Our first choice, thus, relates to the unit of analysis. In our empirical analysis, our unit of analysis is typically the establishment, but we use the link to the parent firm to classify the status of establishments. That is, we identify whether establishments are part of target firms or controls. In addition, we identify whether an establishment is a continuing plant within a firm, is being shutdown, is a newly opened 'greenfield' plant, has been acquired or is being divested. We also use the link to the parent firm to aggregate our establishment-level results to the firm level to quantify the differences in productivity growth between targets and control firms. Second, we measure productivity by real value added per worker, where value added is the value of output minus the cost of intermediate

¹¹ Administrative revenue data can be appended to the LBD from 1994 onwards. However, these data are recorded at the level of employer identification numbers and not necessarily at the establishment level. Establishment-level sales data from the Economic Censuses are available every five years.

inputs. Total factor productivity, an alternative measure frequently encountered in the literature and that also accounts for capital services, is more difficult to compute using data available from the ASM and LBD.

A third key choice relates to the use of controls. Suitable controls are important because the distribution of private equity transactions across industries and by firm and establishment characteristics is not random. For example, practitioner accounts often suggest that transactions are concentrated in industries undergoing significant restructuring, whether due to regulatory action, foreign competition or technological changes. In what follows, we control for detailed industry of the establishment interacted with year – the four-digit Standard Industrial Classification (SIC) interacted with year in the 1980-2001 period, and the six-digit North American Industrial Classification (NAICS) interacted with year in the 2002-2005 period. This means we control for more than 400 industry effects per year in the manufacturing sector.

We know from our earlier study that target firms tend to be larger and older than other firms in the same industry. Furthermore, many previous studies report that productivity growth differs systematically with firm size and age. Motivated by these observations, we also control for detailed firm age and firm size categories. For each establishment, we measure the firm age and firm size of its parent firm. We measure firm age by the age of its oldest establishment and firm size by the number of employees of the parent firm. We construct these measures using the full LBD, since it contains data for the entire firm and not just its establishments in the manufacturing sector.

Figure 3 shows the employment distribution by firm age, firm size and industry for private equity targets and the universe of manufacturing establishments. For targets, we use all the establishments operating in manufacturing for the target firm. Using the establishment-level data,

we classify each establishment into a firm age, firm size and detailed industry category. We then tabulate the share of employment in each of the categories for both targets and the universe of manufacturing establishments. It is apparent that targets are indeed older, much larger and have a different distribution of employment across industries¹². Our statistical analyses control for these factors so that we compare targets with other firms in the same industry that are also similar in terms of size and age.

Another key choice relates to the time frame of our analysis. Tracking productivity performance for many years after private equity transactions has clear attractions. For instance, a five-year horizon corresponds to the typical holding period of portfolio firms by private equity groups (Stromberg [2008]). In addition, research on productivity dynamics in new plants and firms finds evidence of important learning and selection effects over at least the first five years. At the same time, we must confront some practical issues. First, firms get reorganized over time through mergers, acquisitions and divestitures, as well as whole-firm changes in ownership. Second, establishments exit the ASM sample over time through panel rotation, and the ASM is our source of establishment-level productivity measures¹³. Third, a large share of all private equity transactions occurred in the last few years of the period covered by our data. In light of these practical considerations, we focus our analysis on the first two years after buyout transactions. Our earlier work (Davis et. al. [2008]) finds considerable restructuring of target firms in the first two years post-buyout, suggesting that a two-year horizon captures much of the action.

¹² The industry codes in Figure 3 are SIC codes and the patterns for the industry distributions reflect only the years 1980-2001. In our empirical analysis, we control for detailed industry codes interacted with year at the SIC level from 1980-2001 and NAICS codes from 2002-2005.

¹³ Although we rely on the ASM for establishment-level productivity measures, we are careful to define all entry, exit, acquisition and divestiture events using the full LBD. We use propensity score weights to account for sample rotation in our statistical analyses. The propensity score model uses an interacted model of variables including detailed industry interacted with year, multi-unit status, size and age effects.

We classify plants operated by the target firm as of the event year into three groups, depending on whether the plant continues operations under the target's ownership, continues operations but is divested, or is shut down. Similarly, we classify plants operated by the target firm two years later into those that have remained in operation under the target's ownership since the event year, those acquired by the target after the event year and plants that are newly opened by the target firm after the event year. We use the same type of classification of establishments in control firms.

B. Measuring productivity and decomposing productivity growth differentials

We compute real value-added per worker at establishment e in year t as¹⁴

$$\omega_{et} = (VA_{et} / TE_{et}) = (Y_{et} - M_{et}) / TE_{et}, \text{ where}$$

VA_{et} = real value-added

Y_{et} = real gross output

M_{et} = real materials (including energy), and

TE_{et} = total employment.

To obtain productivity for firm i , we aggregate over its establishments according to

$$P_{it} = \sum_{e \in i} s_{et} \omega_{et},$$

where s_{et} is the employment share of establishment e , and ω_{et} is (log) value added per worker¹⁵.

One of our chief goals is to quantify the contribution of continuing plants, exits, divestitures, entrants and acquisitions to firm-level productivity growth. Classifying establishments

¹⁴ We use CES-NBER industry level deflators from the NBER Productivity Database (www.nber.org) updated through 2005.

¹⁵ We use employment as the activity weight because the employment-weighted average of labour productivity growth across production units closely approximates standard industry-level measures of labour productivity growth (see Baily, Hulten and Campbell [1992] and Foster, Haltiwanger and Krizan [2001]).

into these five groups, we can obtain the following simple decomposition of firm-level productivity growth from t to $t+k$ ¹⁶:

$$(1) \quad \begin{aligned} \Delta P_{it} \equiv P_{it+k} - P_{it} = & s_{it+k}^C P_{it+k}^C - s_{it}^C P_{it}^C \text{ (contribution of continuers)} \\ & + s_{it+k}^N P_{it+k}^N - s_{it}^X P_{it}^X \text{ (contribution of entry and exit)} \\ & + s_{it+k}^A P_{it+k}^A - s_{it}^D P_{it}^D \text{ (contribution of acquisition and divestiture)} \end{aligned}$$

where the superscript C denotes continuers, N entrants, A acquisitions, X exits and D divestitures. For example, P_{it}^C is the employment-weighted average productivity at time t for establishments operated by the firm in both t and $t+k$, and s_{it}^C is the employment share of those establishments in t . Note that this decomposition is at the firm level.

Equation (1) tells us how to apportion productivity changes in a single firm among the continuing establishments it operates from t to $t+k$, the entry and exit of its establishments during the time interval, and its acquisitions and divestitures from t to $t+k$. The contribution of the different categories of plants depends on their productivity outcomes and their employment shares in the firm. We apply equation (1) to private equity targets and then aggregate over firms using employment weights. We do the same for controls. By comparing productivity growth between targets and controls, and by using (1) to decompose the sources of any differences, we can evaluate the three hypotheses set forth in the introduction. That is, we can measure the productivity growth differential between targets and controls after private equity transactions and decompose the sources of any growth differential.

As an example, consider how a productivity growth differential might arise in connection with establishment exits. In general, productivity can differ between exiting target firms and exiting control firms for several reasons:

¹⁶ Since P_{it} is the weighted average of log productivity, the change in P_{it} is a log-based index of growth.

- Targets and controls have different levels and distributions of productivity in the event year,
- Targets and controls have different probabilities of exiting, conditional on initial productivity, and
- Interactions between the initial productivity distributions and the conditional exit probabilities.

Figure 4 illustrates the simple case with identical productivity distributions for targets and controls in the event year but different exit thresholds. In this example, the conditional exit probability is one for all plants below the indicated threshold, and zero otherwise. The figure shows the case where private equity targets apply a higher productivity threshold for plant closure¹⁷. By chopping off more of the lower tail, exits are a bigger source of productivity gains at targets than controls in this case. This type of outcome could arise because private equity groups are better at identifying underperforming establishments in their portfolio firms; because they are more willing and able to shut them down; or some combination of both.

Another simple case, not illustrated in the figure, is that target and control firms have identical exit thresholds, but the private equity targets have a larger share of employment at low-productivity establishments in the event year. In this situation as well, exits contribute to a positive productivity growth differential for private equity targets relative to controls but for a different reason.

C. Measuring real earnings per worker

¹⁷ Theoretical models that deliver a productivity threshold rule for exit include Hopenhayn [1992], Hopenhayn and Rogerson [1992] and Melitz, Gianmarco and Ottaviano [2005]. Productivity is the only source of idiosyncratic profit variation in these models, and establishments face a fixed cost of operating and potentially a cost of exit. Productivity shocks follow a first-order Markov process: profit maximizing firms base their exit decisions on the present discounted value of net profits. Such an environment yields an exit rule like the one illustrated in Figure 4.

We measure earnings per worker as the ratio of payroll to employment, deflated by an index for the price of the firm’s output. In particular, we compute the real wage as the nominal wage divided by an industry-level index for the output price. This type of real wage measure is readily compared with our measure of real value added per worker, because both measures involve the same price deflator for nominal output.

2. Analysis

A. The pace of entry, exit, acquisitions and divestitures at target firms

Table 1 summarizes a key finding in our earlier study (Davis et al. [2008]): Private equity targets have a higher pace of employment-weighted entry, exit, acquisition and divestiture than controls in the first two years after buyout transactions. Table 1 covers private equity transactions in the US private sector from 1980 to 2005. Table 2 presents analogous results for the manufacturing sector, the focus of the current study¹⁸. The patterns are similar qualitatively to those in Table 1, but the magnitudes are somewhat muted. Manufacturing is a sector with larger and more stable establishments than other sectors, and with lower but still substantial entry and exit rates.

B. Results from two-year horizon analysis

We estimate descriptive regressions for establishment-level outcomes on productivity and real earnings per worker in the event year and two years later. For any pair of years, the sample contains ASM establishments owned by firms in the event year and two years later. Each establishment is linked to its parent firm and classified as part of a private equity target firm or part

¹⁸ In constructing Table 2, we include the non-manufacturing activity of firms that engage primarily in manufacturing activity. The results are very similar (with slightly smaller magnitudes but similar differences between targets and controls) when we exclude non-manufacturing activity.

of a control firm¹⁹. Classification as part of a private equity target means that the establishment was owned by the target firm in the event year and two years later. We use the five-way classification of establishments into continuers, entrants, exits, acquisitions and divestitures described above, and we control for industry-year effects, firm age and firm size for the establishment. We weight by employment in all regressions²⁰. The event year regressions (Table 3) pool all years from 1980 to 2003. The two years after the event regressions (Table 4) pool all years from 1982 to 2005. The omitted group is always the continuing establishments of control firms.

Table 3 reports results for the event year regressions on productivity. Continuing plants for private equity firms have productivity that is 3.7 log points higher than continuers operated by control firms – the reference group in our regressions. Private equity exits have productivity that is 19.8 log points lower than the continuing plants of the control firms, while control exits have productivity that is 15.2 log points lower than continuing control plants. Productivity at private equity divestitures (that is, establishments sold by private equity-backed firms) is similar to continuing plants in control firms, but it is 10.6 log points lower at control firm divestitures. All of the differences we have noted are statistically significant at the 5% level.

To investigate whether target firms are more likely to close low productivity establishments, we fit a logit specification for the probability of a plant exit as a function of its decile in its industry productivity distribution in the event year. Figure 5 plots the fitted relationship separately for targets and controls. It shows that private equity targets have higher exit probabilities in the lower deciles of the productivity distribution; much higher in the bottom

¹⁹ Once a firm has been in the sample as a private equity target for the period between the transaction year and two years later the establishments of this firm are not included in any other years of the analysis.

²⁰ We also use propensity score weights to ensure that our weighted sample is representative of two-year continuing firms for each pair of years considered in our regressions. The propensity score weights control for the fact that certain types of establishments are more likely to be in the ASM sample than others.

decile²¹. In other words, target firms are more likely than controls to shut down poorly performing establishments as measured by labour productivity.

The results for two years after the event are presented in Table 4. We find that private equity continuing establishments have productivity that is 5.1 log points higher than continuing control establishments. Private equity entering establishments have a slightly lower productivity for entering establishments relative to continuing control establishments, although the difference is not statistically significant. In contrast, entering establishments of controls have much lower (and statistically significant) productivity than continuing establishments for controls, with a gap of 17.7 log points. The acquisitions for private equity firms have 10.4 log point lower productivity than control continuing establishments, while acquisitions for control firms have 7.7 log point lower productivity relative to control continuing establishments.

In comparing the results of Tables 3 and 4, several interesting patterns stand out. First, the comparison of the productivity advantage of continuing establishments of targets in year $t+2$ and t is of interest. This advantage increases from 3.7 log points to 5.1 log points, indicating that continuing establishments of private equity targets have a substantial gain in productivity relative to controls. Second, the gap between the productivity of exiting establishments and entering establishments for private equity targets is very large in absolute magnitude (16.6 log points) and substantially larger than the analogous gap for controls (-2.5 log points). Third, the gap between the productivity of acquired and divested establishments for private equity targets is actually negative (-8.3 log points) and lower than the gap for controls (-2.9 log points). As we show below, the gains from continuing establishments and net entry for targets are sufficiently large that they more than offset the drag on productivity from net acquisitions so that the net effect on productivity growth for targets is positive.

²¹ Differences are statistically significant at the 5% level for the bottom four deciles.

Appropriate caution is required on interpreting the role of entry and acquisition since the analysis is only over a two-year horizon. The literature on tracking the productivity dynamics of entering establishments (see Foster, Haltiwanger and Krizan [2001, 2006]) highlights the important learning and selection effects that are critical for interpreting the productivity dynamics of young establishments. The standard pattern for each entering cohort of entrants is that their productivity grows more rapidly than incumbents in the first 10 years of existence, both because of selection effects (the low productivity entrants have a high rate of exit) and learning-by-doing effects (surviving young establishments have rapid productivity gains). Our analysis is not able to capture those learning and selection effects directly, but we include some analysis below that discusses the longer-run implications of the productivity gains already evident in Tables 3 and 4.

Turning to the earnings per worker results for Tables 3 and 4, many of the same qualitative patterns hold as with productivity. This makes sense, as earnings per worker at an establishment are closely related to real value added per worker. For example, private equity exits have productivity that is 19.8 log points and earnings per worker that is 10.7% lower than continuing control establishments. Control exits have productivity that is 15.2 log points and earnings per worker that is 7.8 log points lower than continuing establishments.

While the qualitative patterns are similar, comparing and contrasting the productivity and earnings per worker findings yields some interesting results. For example, private equity continuing plants in the event year have a productivity and earnings per worker positive difference relative to control establishments. Two years later the productivity advantage has increased but the earnings per worker difference has disappeared. The results for exits indicate that private equity firms are shutting down low-productivity, low-earnings-per-worker plants with productivity even

lower than earnings per worker. These patterns together suggest that private equity firms are increasing the gap between productivity and earnings per worker.

Based on Tables 3 and 4, private equity continuing establishments gained in productivity in relative terms compared with controls, but experienced some reduction in earnings per worker. The within-establishment relative growth rates of productivity and earnings per worker for continuing establishments for targets and controls are presented in Table 5. The results in Table 5 show that in terms of growth rates at the establishment level, continuing establishments of target firms did not exhibit statistically significant differences in growth rates relative to controls for productivity, but exhibited a 3 log point decline in earnings per worker relative to controls. Thus, from either exercise, the productivity-earnings gap increased for continuing plants for targets relative to controls.

It might seem to be a puzzle that Tables 3 and 4 show a substantial productivity gain for continuing establishments of targets while Table 5 shows no such gain. The productivity gain reflected in Tables 3 and 4 incorporates both any within-establishment growth rate effects as well as any improved allocation of activity across continuing establishments. Thus, comparing the results in Tables 3, 4 and 5 indicates that the gains in productivity for continuing establishments stems mainly from the improved allocation and not from within establishment increases. That is, private equity firms improve productivity at target firms by more efficiently organizing activity across target establishments rather than improving productivity within plants²².

Table 5 shows the average patterns for targets vs controls for productivity and earnings per worker growth per worker. It is instructive to characterize the establishment-level relationship

²² There is a similar positive allocation effect on earnings. Within establishment earnings per worker growth is 3.2 log points less for targets relative to controls from Table 5 but Tables 3 and 4 show targets have 1.1 log point less growth in earnings per worker. The difference between these reflects increasing activity at the higher earnings (and higher productivity) per worker plants for targets.

between productivity and earnings growth for the whole distribution, as depicted in Figure 6. It is apparent that for both targets and controls, there is a positive correlation – that is, plants with increases in value added per worker also show an increase in earnings per worker. Interestingly, the correlation between productivity and earnings growth per worker is somewhat higher for targets than controls – for targets, the correlation is 0.17 while it is 0.11 for controls. These correlations suggest that both targets and controls share productivity gains with workers, but there is a stronger positive relationship for targets relative to controls.

Before turning to the overall productivity implications of our findings, it is useful to note that in unreported results, we have examined whether the results in Tables 3, 4 and 5 are systematically different by type of private equity transaction. Using a simple two-way classification of transactions distinguishing between public-to-private and all other deals, we found little in the way of systematic, significant differences across this classification of deals. We note, however, that small sample problems make inferences from additional sub-divisions difficult. In Tables 3, 4 and 5, we are restricted to private equity transactions in manufacturing for multi-unit, two-year continuing firms that are also in the ASM sample. In addition, we are already decomposing establishments into continuing, entering, exiting, acquired and divested establishments.

C. Micro and aggregate net effects of private equity transactions on productivity

In this section, we quantify the total productivity gains from private equity transactions using the results from Tables 2, 3 and 4 along with the productivity decomposition in equation (1). Recall that the productivity effects identified in Tables 2 and 3 are all deviations from the productivity levels of continuing establishments for controls in years t and $t+2$ respectively. As

such, it is useful to take an aggregated version of the decomposition (1) using such deviations as follows (see pages 17 and 18 for the variable definitions)²³:

$$\Delta P_t = s_{t+k}^C (P_{t+k}^C - \tilde{P}_{t+k}^C) + s_{t+k}^N (P_{t+k}^N - \tilde{P}_{t+k}^C) + s_{t+k}^A (P_{t+k}^A - \tilde{P}_{t+k}^C) - s_t^C (P_t^C - \tilde{P}_t^C) - s_t^X (P_t^X - \tilde{P}_t^C) - s_t^D (P_t^D - \tilde{P}_t^C) + \tilde{P}_{t+k}^C - \tilde{P}_t^C$$

Each of the terms in this expression is examined relative to the (average) productivity of continuing establishments of controls, where the latter are denoted by a tilde. This same decomposition can be used for both targets and controls; taking the difference between the two yields an estimate of the productivity growth gains of targets relative to controls. The deviation terms for both targets and controls are provided in Tables 3 and 4 for years t and $t+2$ respectively, so that we can quantify each of the terms in the above expression for k equal to 2. The shares of continuers, entrants, exits, acquisitions and divestitures are provided in Table 2 for t and $t+2$ respectively.²⁴

The resulting difference-in-difference (that is, the difference in productivity growth over the two-year horizon for targets relative to controls) is presented in Table 6. Our findings indicate that on average two years after the private equity transaction, private equity firms have a 1.84 log point productivity growth gain relative to controls. About 72% of this gain is due to the improved productivity growth of continuing establishments and about 36% of this gain is due to net entry (entering plants having higher productivity than exiting plants). Net acquisitions contribute negatively. If we exclude net acquisitions, the gain is about 2 log points²⁵.

²³ This transformation of equation (1) takes advantage of the fact that the shares across groups within a year sum to 1 so that the productivity terms in each year can be deviated from a reference group in a given year – in this case the productivity of continuing establishments of control firms.

²⁴ All we are really doing here is taking the regression results from Tables 3 and 4 and generating a combined effect using the weights from Table 2.

²⁵ In using the shares from Table 2, we are including the activity of firms whose primary activity is in manufacturing but who also may have activity in non-manufacturing. This would imply that we are imputing our findings for manufacturing establishments to non-manufacturing establishments. We have checked the robustness of our results to using shares based only on the manufacturing activity of targets and controls. We find a very similar pattern with the

In interpreting these productivity growth gains, it is important to emphasize that this is not the average productivity growth of targets but rather the productivity growth differential of targets relative to controls. A productivity growth differential of about 2 log points is substantial since the average productivity growth over a two-year horizon for all of manufacturing is about 7 log points for the period from 1980 to 2005.

To provide further perspective on the magnitude of the contribution of the productivity growth differential, Figure 7 illustrates the cumulative real output (value-added) gains from the transactions between 1980 and 2005 under alternative assumptions about the duration of the gains. To calculate the tabulations in Figure 7, we use the 1.99 productivity differential, as it seems appropriate to exclude the contribution of net acquisitions for this purpose (as net acquisitions involve changing the ownership of existing plants and so any gains/losses are offset by losses/gains by other firms)²⁶. We apply the same estimated differential for all years for this exercise²⁷.

Using the estimated productivity growth differential, we calculate the extra real output from each cohort of targets. An open question is how long-lasting these gains turn out to be. In Figure 7, we show the cumulative gains across a range of ‘depreciation factors’ from 0 to 1. A depreciation factor of 0 assumes that the gains are permanent. A depreciation factor of 1 assumes

net growth differential (excluding net acquisitions) of 1.91 log points (compared with the 1.99 log point difference when using the shares from Table 2). This difference has only modest effects on the tabulations in Figure 6. Note the latter reflects the output gains only for the manufacturing components of the firm.

²⁶ Using the 1.84% productivity differential yields similar quantitative implications. For example, the cumulative value added creation under the zero depreciation scenario is about US\$ 14 billion using the 1.84% differential.

²⁷ We apply the 1.99% productivity differential to all deals from 1980 to 2005. Recall that in estimating this differential we have included industry-year controls, as well as controls for the firm size and firm age distribution. We apply the differential to all private equity transactions in manufacturing captured in Figure 2b that are in the ASM sample. We use propensity score weights to generate aggregates (we have checked and our propensity score-weighted version of Figure 2b closely mimics that in Figure 2b). Note that this means we are using this 1.99 differential for all manufacturing transactions, regardless of whether the transaction is part of the regression analysis. That is, we use the regression analysis sample to generate the productivity deviation estimates and then apply this to the entire set of manufacturing private equity transactions.

the gains are temporary – that they disappear immediately after the two-year horizon. A depreciation factor of 0.5 assumes that half of the gains are eliminated for each year beyond the two-year horizon.

Figure 7 shows that if the gains are permanent, private equity transactions from 1980 to 2005 created an additional US\$ 15 billion (in inflation-adjusted 2007 dollars) of real output in 2007. If the gains are completely transitory, then the additional gains are about US\$ 4 billion (representing only the gains from 2005 itself). Under a modest depreciation factor of 0.1, the additional real output created is about US\$ 10 billion.

D. The impact of private equity on productivity as credit conditions vary

The analysis in the prior sections quantifies the average effect of private equity transactions on productivity, jobs and earnings using the pooled set of transactions from 1980 to 2005. Economic conditions obviously varied over this period. Given the current financial crisis in 2008, an obvious question is whether the impact of private equity transactions on productivity varies with economic conditions in general and with credit market conditions in particular. The economic downturn in 2008 has been driven by the meltdown of financial markets and an associated ‘credit crunch’. While our analysis does not include the 2008 data, there is considerable variation over the 1980-2005 period in the state of credit markets. In this subsection, we explore the sensitivity of our results to variation in credit market conditions.

One of the features of the 2008 crisis, as well as earlier credit crunches, is that interest rate spreads across different types of debt increase. There is a flight to quality in debt markets, so the spread between corporate bonds and Treasuries increases. In like fashion, there is an increase in the spread between bonds with different quality ratings. As illustrated in Figure 8, the spread between AAA- and BB-rated corporate bonds varies substantially over time. In the current crisis,

the spread has increased substantially. The same pattern appears in earlier credit crunches, with an especially high spread around 1990.

The separate AAA and BB interest rate series depicted in Figure 8 are monthly averages of the relevant interest rates, while our productivity and jobs data for targets and controls are on an annual basis. We take the annual average of the monthly series and take the difference between these annual averages, which we denote as the Diff Annual Average in Figure 8. For our analysis in this section, we create a variable called ‘spread’, which is the deviation of annual spread measured from its overall time series mean from 1980 to 2005. The mean annual average spread is 3.7% over the 1980-2005 period (our sample period). The deviation of the spread from this mean over our sample period reaches a high of 4.97% in 1990. As is clear from Figure 2, most of the private equity transactions in our sample are in the 1990-2005 period. The average mean deviation over this latter period is 0.44%.

We merge this spread series into our 1980-2005 analysis sample and explore extensions of our regression specifications in Tables 3 and 4 that permit the effects in Tables 3 and 4 to vary with the interest rate spread. For each type of effect estimated in Tables 3 and 4, we include an additional interaction term with the spread variable. For example, we include terms such as ‘Private Equity Continuer*Spread’. This specification yields estimates of each of the effects in Tables 3 and 4 that vary with the interest rate spread. In estimating these extended specifications, we use the same samples and controls as in Tables 3 and 4²⁸.

²⁸ A challenge in permitting the effects to vary with credit market conditions is that the specifications in Tables 3 and 4 already include a very rich set of controls, namely, we control for the detailed industry (roughly 450 industries) interacted with year, firm size and firm age controls. We found that when we attempted to estimate the same model, but allowing the target and control effects for continuing, exiting, entering, acquisitions and divestitures to vary with the interest spread, that some of the interaction effects were not identified (namely those for private equity acquisitions and divestitures). To estimate the effects in Figure 9, we made our controls somewhat coarser. Specifically, we used detailed industry interacted with a period variable that changed only every two years while keeping the firm size and age controls the same. We found that the results reported in Tables 3 and 4 are largely robust to this change and we

We illustrate the implications of the variation in the estimated coefficients in Figure 9²⁹. To generate Figure 9, we compute the estimated difference in the productivity growth of continuing establishments between targets and controls, as well as the difference in productivity between entering and exiting establishments for different levels of the interest rate spread in the relevant current year. Recall that from Tables 3 and 4 the average difference in the productivity growth from continuing establishments between targets and controls is about 1.4 log points. Figure 9 shows that this difference increases with the interest rate spread variable. At a value of the spread equal to zero (that is the spread equal to its long-run mean), the gain is essentially zero. At a value of 0.44 (the mean deviation over the 1990-2005 period), the gain from continuing establishments is about 1.4 log points (the value we report from Tables 3 and 4). At a value of 1, the gain for continuing establishments is 3.3 log points. At a value of 4, the gain from continuing establishments is about 13.5 log points. Thus, interestingly, private equity transactions conducted during times of credit crunches yield an even larger gain from the restructuring and reallocation among continuing establishments.

From Table 3, the average difference between targets and controls in the productivity of exiting establishments is 4.6 log points, with target exits having lower average productivity. This effect contributes to the positive net productivity gain for targets since doing a better job of shutting down low-productivity establishments raises average productivity. Figure 9 shows that

were able to identify all of the interaction effects with the interest rate spread. We also note that all of the interaction effects we estimated are significant at least at the 10% level (and most at the 5% level).

²⁹ We do not report results on interest spreads for acquisitions and divestitures because, as noted in the previous subsection, these transactions reflect gains for one firm but offsetting losses for another firm. Also, note that in interpreting Figure 9 the productivity differentials have not been weighted by the respective share of activity accounted for by continuing, entering and exiting establishments (as was done in Table 6). We know from Table 2 that most activity is accounted for by continuing establishments. We did not weight the results in Figure 9 by the activity shares (although the regression results are appropriately employment-weighted), as this would require an in-depth analysis of how the patterns of entry and exit vary for targets vs controls across economic conditions. We leave this latter analysis for future work.

this difference in the productivity gain from exit also increases with the interest rate spread. At a value of the spread equal to zero, there is no gain. For a value equal to 1, the gain is already substantial at 4.1 log points. For a value of 4, the gain is very large at 20.1 log points.

Finally, the results in Table 4 show that there is a sizeable gap in the productivity of entrants for targets relative to controls. The average gap as estimated in Table 4 is 13.5 log points. This also contributes positively to the net productivity growth gain of targets relative to controls. Figure 9 shows that this positive entry differential diminishes with the interest rate spread. At a value of the spread at zero, the gain is very large at 21.5 log points but falls to -5.1 log points at a value of the spread equal to 4.

In sum, we find evidence that in terms of the restructuring of continuing establishments and the shutting down of low-productivity establishments, transactions done during credit crunches yield even larger productivity gains at target firms relative to controls. We also find, however, that the productivity gap of entrants between targets and controls diminishes in times of credit crunches. Overall, though, the evidence is at least suggestive that private equity targets are better than controls in making the difficult choices needed to restructure businesses and increase productivity in times of financial crisis.

3. Conclusions

This paper explores the productivity, earnings and employment outcomes for private equity transactions in the US using firm- and establishment-level data. Our findings highlight the importance of analyzing the restructuring and reallocation effects within firms, as well as the changes through entry, exit, acquisitions and divestitures.

We find that target firms of private equity transactions experience an intensification of job creation and destruction activity, establishment entry and exit, and establishment acquisition and divestiture. On net, we find that this intensification of reallocation yields a substantial productivity growth differential (about 2%) within two years following the transaction. About two-thirds of this differential is due to improved productivity among continuing establishments of the firm (including the effects of improved allocation among continuing establishments of the firm) and about one-third due to the contribution of net entry. The contribution of net entry is dominated by our finding that target firms are much more likely to close underperforming establishments than comparable firms. The resulting effect on real output for target firms is large. We estimate that private equity transactions completed between 1980 and 2005 yielded as much as US\$ 15 billion of extra output in 2007 at target manufacturing firms.

We find similar patterns for earnings per worker, although we find less of a positive impact on earnings per worker from continuing establishments of the target firms. We do find that the correlation between the growth in productivity and earnings per worker after private equity transactions is higher at target firms than at comparable firms.

Our analysis focuses on private equity transactions from 1980 to 2005. As such, our analysis sample does not include transactions and activity during the current financial crisis (in 2008). While we cannot yet address this question directly, we examine fluctuations in credit market conditions, for example the deterioration in credit conditions in the early 1990s, over the course of the 1980 to 2005 period to get a sense of how the current crisis might affect private equity targets. Interestingly, we find evidence that the relative productivity gains at targets from the restructuring of continuing establishments, as well as the productivity gains from shutting down poorly performing establishments, actually increase in credit market crunches. These

findings suggest that private equity firms are better than comparable firms in making the difficult choices of restructuring and shutting down poorly performing establishments in times of economic downturns.

Our findings on the intensification of restructuring and reallocation hold for the entire private sector, while our findings for productivity are restricted to the manufacturing sector and also restricted to measures of labour productivity. The manufacturing sector has been an important area of activity for private equity transactions, but it would clearly be of interest for many reasons to extend our analysis of productivity effects beyond manufacturing in future work. The data infrastructure for productivity analysis is much richer for manufacturing, but extending the analysis to other sectors would permit even richer analysis of the productivity, earnings and employment outcomes – for example, digging deeper into the effects of different types of transactions (for example, are the consequences of public-to-private deals different?) and analyzing the outcomes over longer horizons. Analyzing outcomes over longer horizons would permit studying the longer-run implications of private equity transactions. Extending our analysis to explore total factor productivity, as well as the restructuring and reallocation of physical capital, would also be of clear interest.

References

- Amess, K. Management Buyouts and Firm-Level Productivity: Evidence from a Panel of UK Manufacturing Firms. In *Scottish Journal of Political Economy*, 2002, 49: 304-317.
- Baily, M., Hulten, C., and Campbell, D. Productivity Dynamics in Manufacturing Plants. In *Brookings Papers on Economic Activity, Microeconomics*, 1992, 187-249.
- Baker, G. and Wruck, K. Organizational Changes and Value Creation in Leveraged Buyouts: The Case of the O.M. Scott & Sons Company. In *Journal of Financial Economics*, 1989, 25: 163-190.
- Baker, G. Beatrice: A Study in the Creation and Destruction of Value. In *Journal of Finance*, 1992, 47: 1081-1119.
- Davis, S., Haltiwanger, J., Jarmin, R., Krizan, C., Miranda, J. Nucci, A. and Sandusky, K. 'Measuring the Dynamics of Young and Small Businesses: Integrating the Employer and Non-employer Business Universes', National Bureau of Economic Research Working Paper No. 13266, 2006. Forthcoming in Dunne, T., Jensen, J. and Roberts, J. (eds.). *Producer Dynamics: New Evidence from Micro Data*, Chicago: University of Chicago Press.
- Davis, S., Haltiwanger, J., Jarmin, R., and Miranda, J. Volatility and Dispersion in Business Growth Rates: Publicly Traded versus Privately Held Firms. In Acemoglu, D., Rogoff, K. and Woodford, M. (eds.). *NBER Macroeconomics Annual*, 2007, 21: 107-180.
- Davis, S., Haltiwanger, J., Jarmin, R., Lerner, J., and Miranda, J. 'Private Equity and Employment', Center for Economic Studies Working Paper No. CES-07-08, 2008.
- Davis, S., Haltiwanger, J. and Schuh, S. *Job Creation and Destruction*. Cambridge, MA: MIT Press, 1996.
- Foster, L., Haltiwanger, J. and Krizan, C. Aggregate Productivity Growth: Lessons from Microeconomic Evidence. In Dean, E., Harper, M. and Hulten, C. (eds.). *New Directions in Productivity Analysis*. Chicago: University of Chicago Press, 2001.
- Foster, L., Haltiwanger, J. and Krizan, C. Market Selection, Reallocation and Restructuring in the US Retail Trade Sector in the 1990s. In *Review of Economics and Statistics*, 2006, 88: 748-758.
- Harris, R., Siegel, D. and Wright, M. Assessing the Impact of Management Buyouts on Economic Efficiency: Plant-Level Evidence from the United Kingdom. In *Review of Economics and Statistics*, 2005, 87: 148-153.
- Hopenhayn, H. Entry, Exit and Firm Dynamics in Long-Run Equilibrium. In *Econometrica*, 1992, 60: 1127-50.

- Hopenhayn, H. and Rogerson, R. Job Turnover and Policy Evaluation: A General Equilibrium Analysis. In *Journal of Political Economy*, 1992, 101: 915-938.
- Jarmin, R. and Miranda, J. 'The Longitudinal Business Database'. Center for Economic Studies Working Paper 02-17, 2002.
- Jensen, M. The Eclipse of the Public Corporation. In *Harvard Business Review*, 1989, 67 (September-October): 61-74.
- Jensen, M., Burkhardt, W. and Barry, B. Wisconsin Central Ltd. Railroad and Berkshire Partners (A): Leveraged Buyouts and Financial Distress. Harvard Business School Case no. 9-190-062, 1990.
- Jovanovic, B. and Rousseau, P. Mergers as Reallocation. In *Review of Economics and Statistics*, 2008, 90: 765-776.
- Kaplan, S. The Effects of Management Buyouts on Operating Performance and Value. In *Journal of Financial Economics*, 1989 (a), 24: 217-254.
- Kaplan, S. Management Buyouts: Evidence on Taxes as a Source of Value Source. In *Journal of Finance*, 1989 (b), 44: 611-632.
- Lichtenberg, F. and Siegel, D. Productivity and Changes in Ownership of Manufacturing Plants, In *Brookings Papers on Economic Activity: Microeconomics*, 1987, 643-683.
- Lichtenberg, F. and Siegel, D. The Effects of Leveraged Buyouts on Productivity and Related Aspects of Firm Behavior. In *Journal of Financial Economics*, 1990, 27: 165-194.
- Long, W. and Ravenscraft, D. 'The Financial Performance of Whole Company LBOs'. Center for Economic Studies Working Paper no. CES-WP-93-16, 1993.
- Luehrman, T. 'Kaiser Steel Corporation, 1987'. Harvard Business School Case No. 293-019, 1992.
- Luehrman, T. 'The Hertz Corporation (A)'. Harvard Business School Case No. 208-030, 2007.
- Melitz, M., Gianmarco, I. and Ottaviano, P. 'Market Size, Trade and Productivity'. Unpublished working paper, Harvard University, 2005.
- McGuckin, R. and Nguyen, S. The Impact of Ownership Changes: A View from Labor Markets. In *International Journal of Industrial Organization*, 2001, 19: 739-762.
- Stromberg, P. 'The New Demography of Private Equity'. Unnumbered working paper, Swedish Institute for Financial Research, 2008.
- Wruck, K. What Really Went Wrong at Revco?. In *Journal of Applied Corporate Finance*, 1991, 3: 79-92.

Figure 1: Matches of Private Equity Targets to the LBD

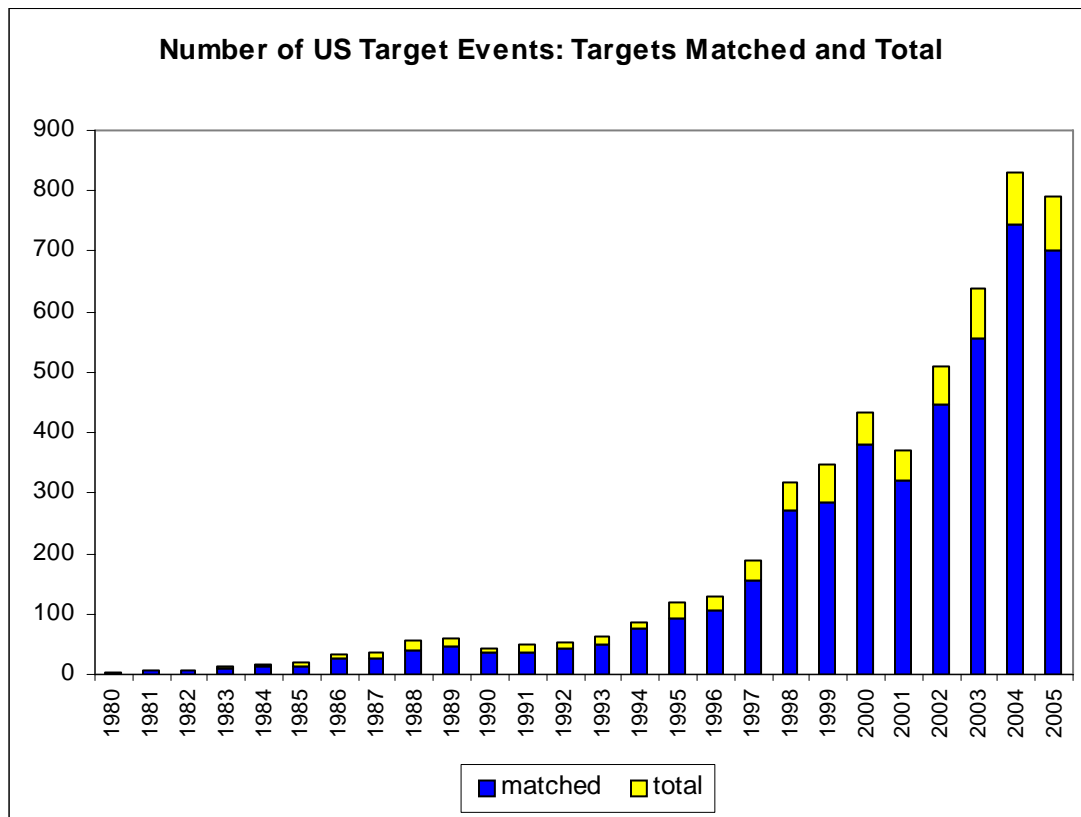


Figure 2a: Employment of Matched Targets (Level and Percent of LBD Total)

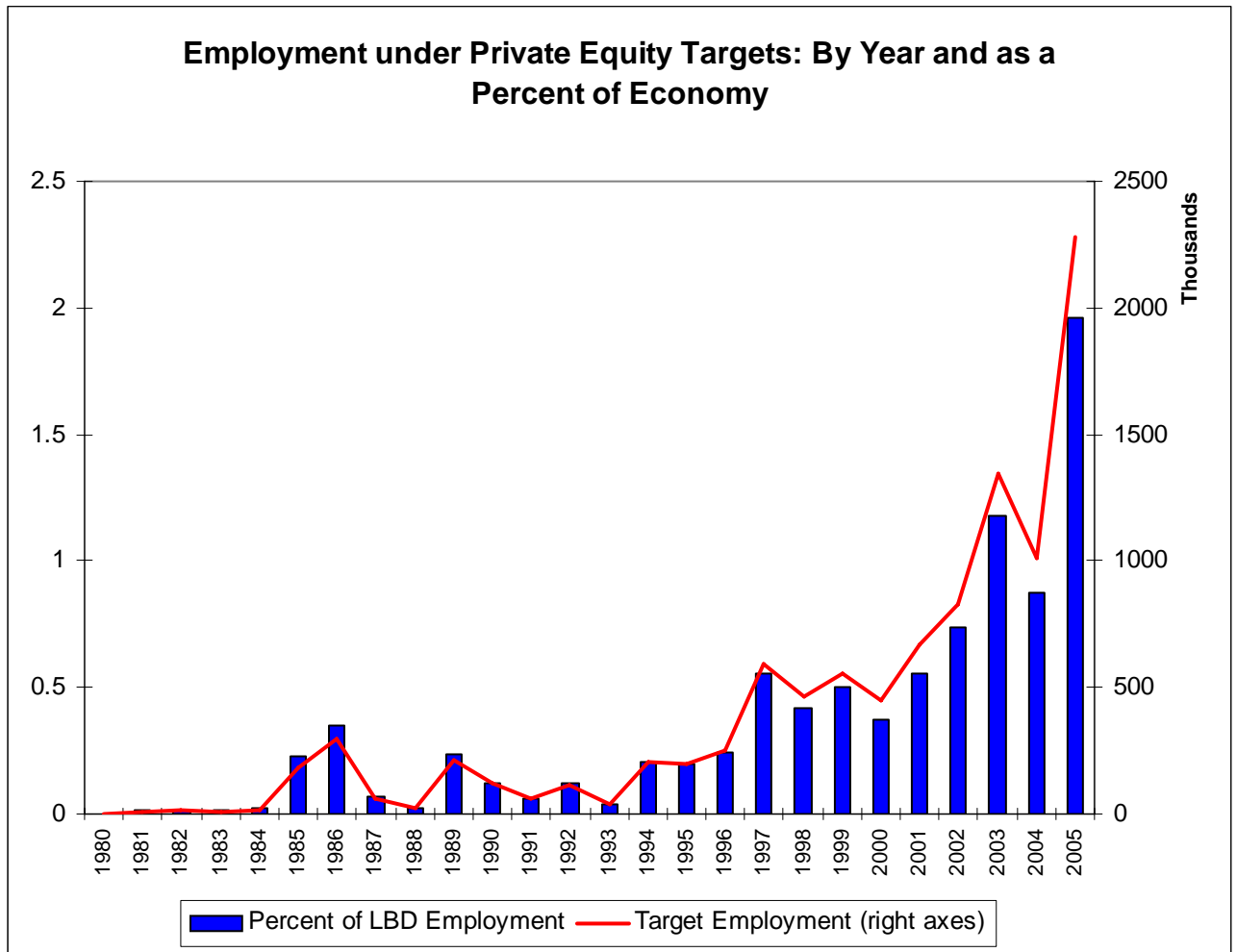


Figure 2b: Employment of Matched Targets (Level and Percent of LBD Total) – Manufacturing

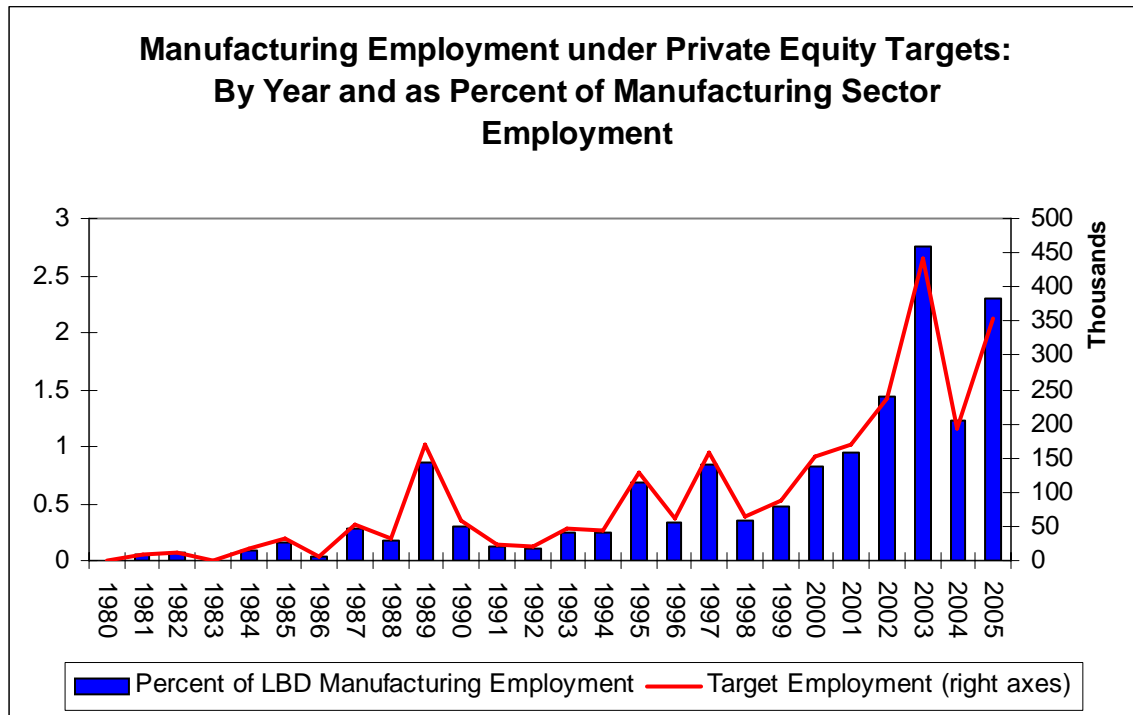


Figure 3: Summary Statistics on Distribution by Employer Age, Size, and Industry

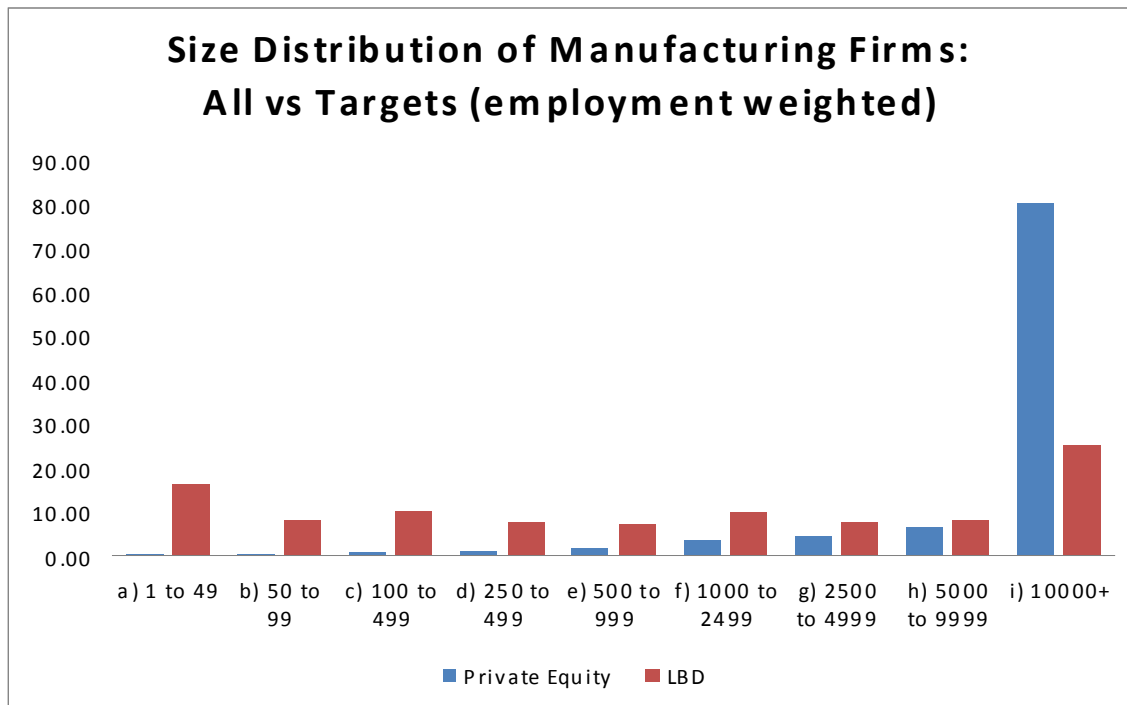
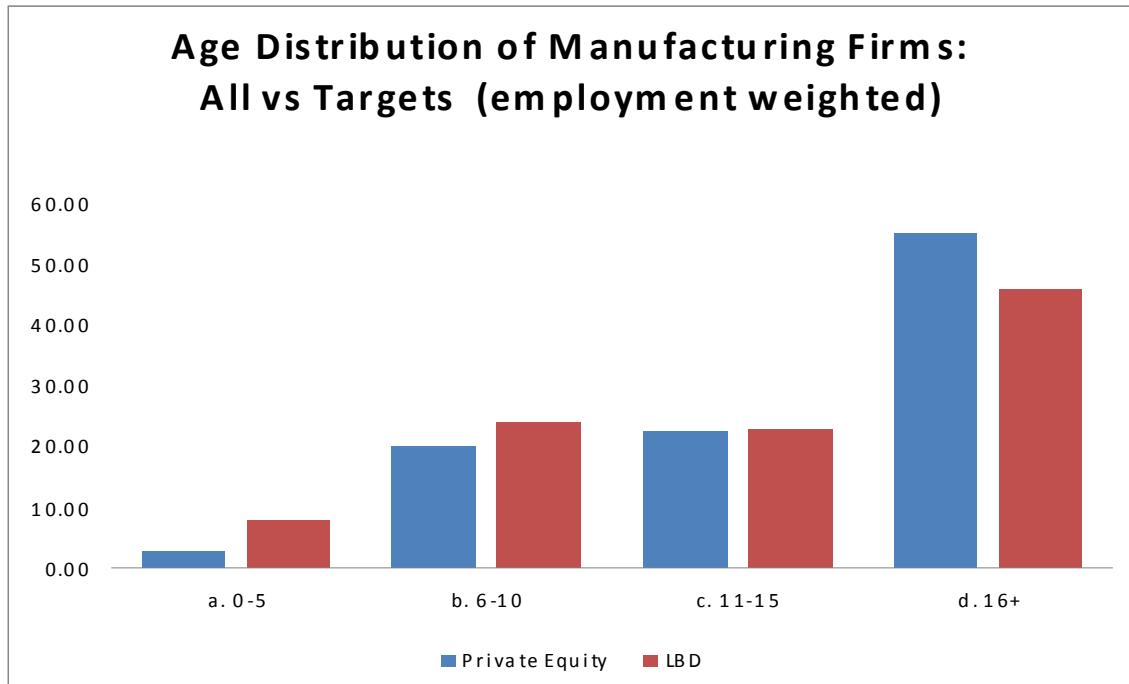


Figure 3 (Continued)

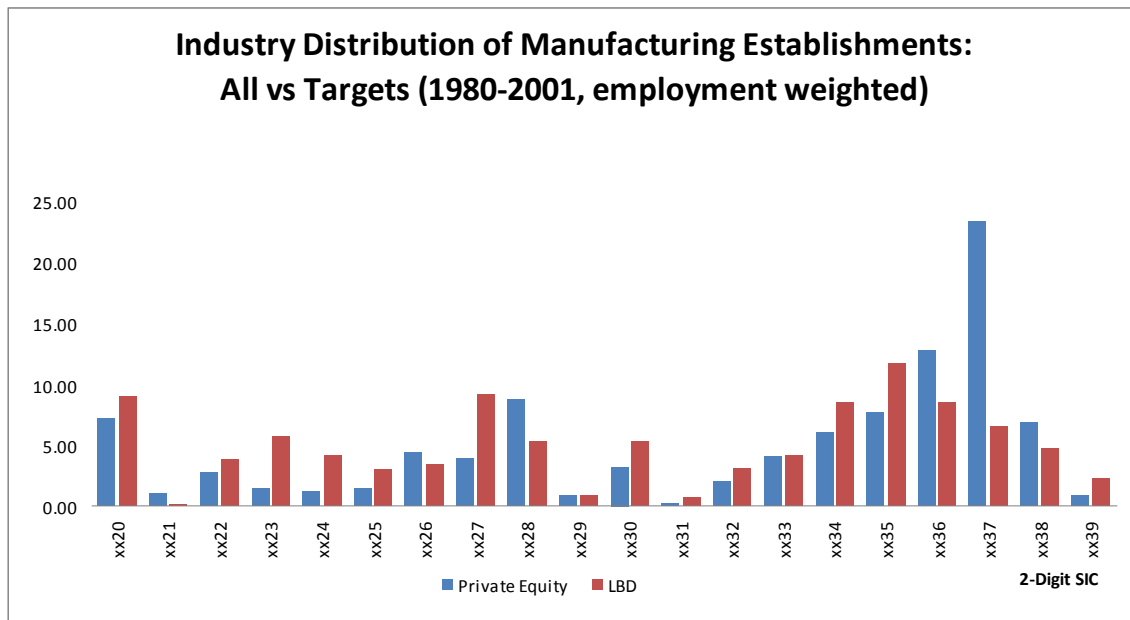


Figure 4: Hypothetical Establishment Exit Thresholds for Private Equity Target Firms and Controls with Identical Productivity Distributions

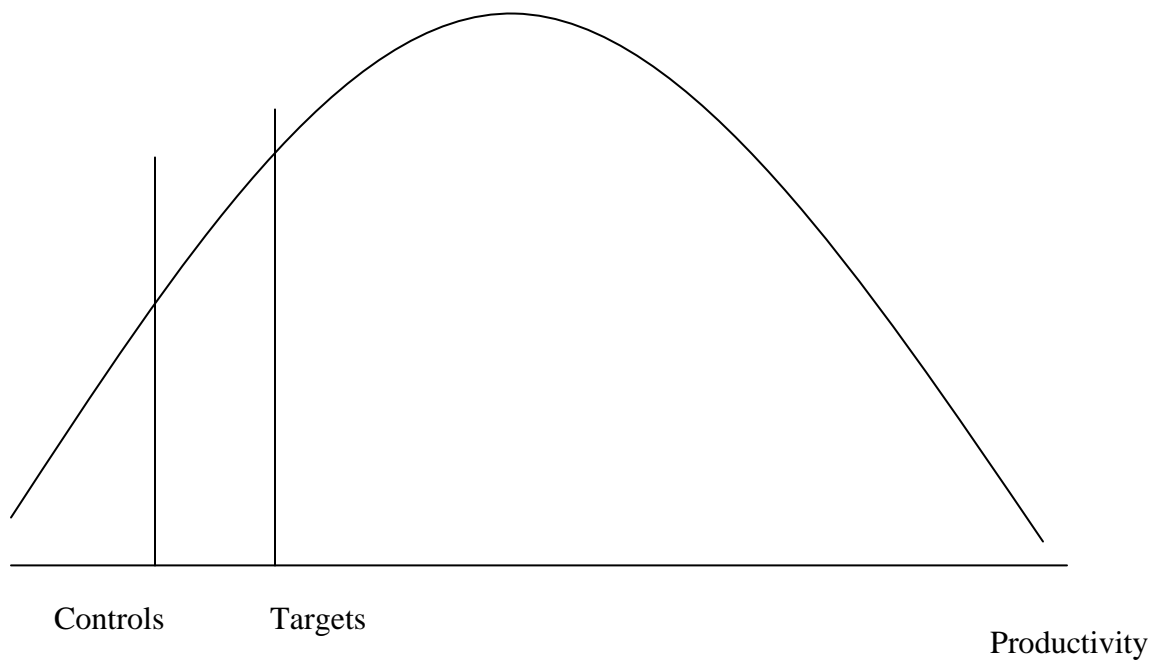


Figure 5: Probability of Exit and Productivity for Targets and Controls

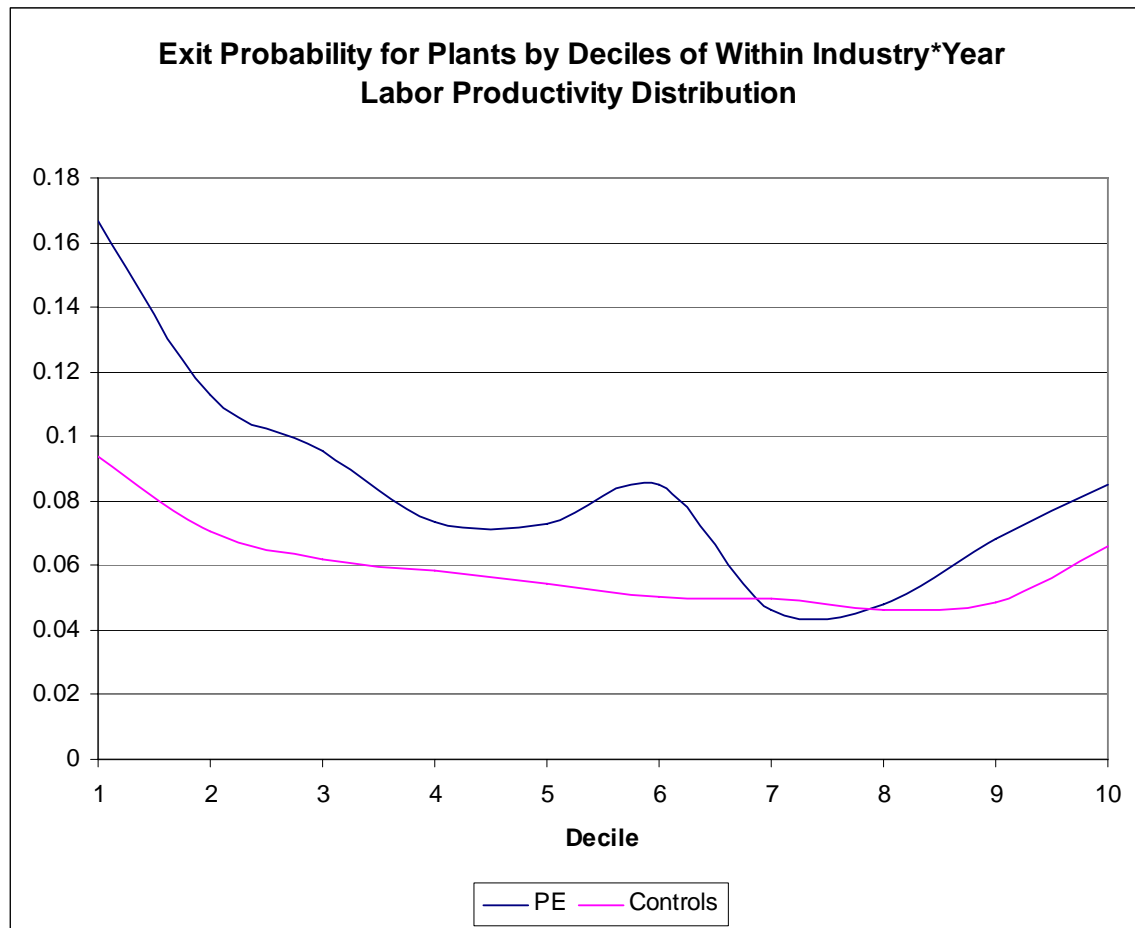
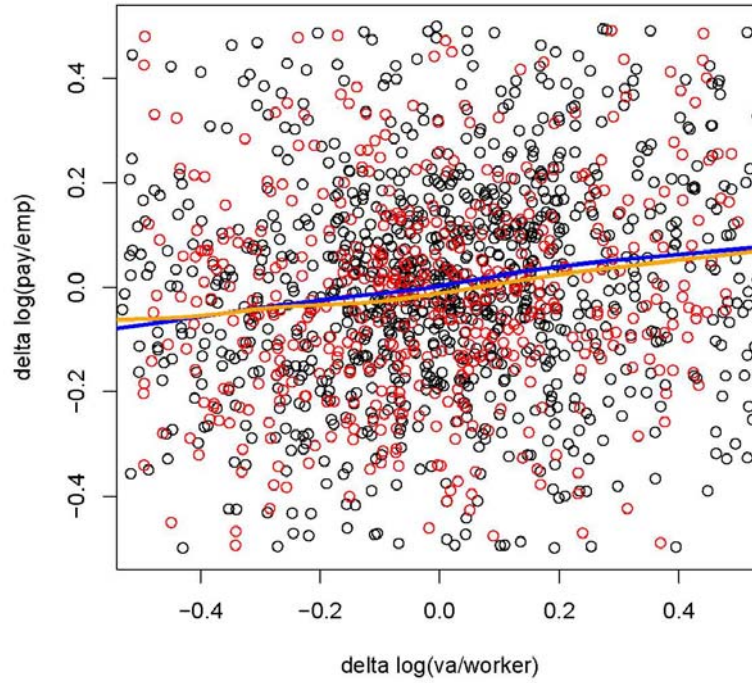


Figure 6: Plant-Level Log Changes in Value-Added Per Worker and Earnings per Worker



Note: Depicted are two-year differences in log value added per worker and log earnings per worker for targets (red circles) and controls (black circles). A random sample of controls is depicted. The orange line is a non-parametric curve fit through targets and the blue line is a non-parametric curve fit through controls.

Figure 7: Estimated Impact of Private Equity Transactions

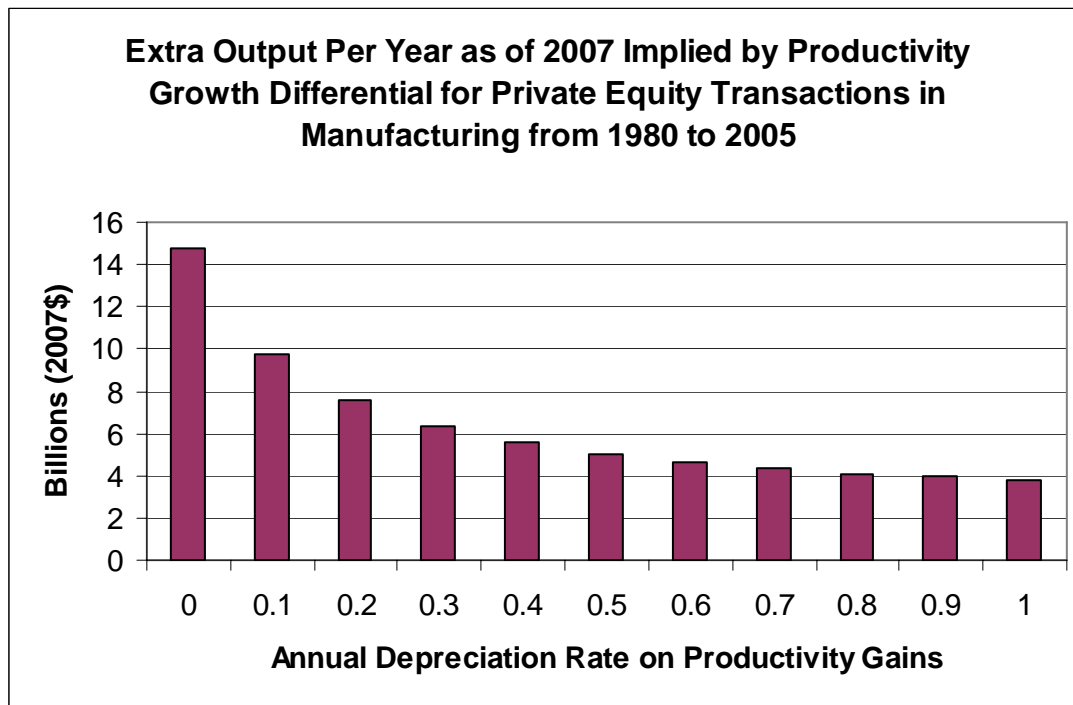


Figure 8: Interest Rate Spread between AAA and BB Bonds

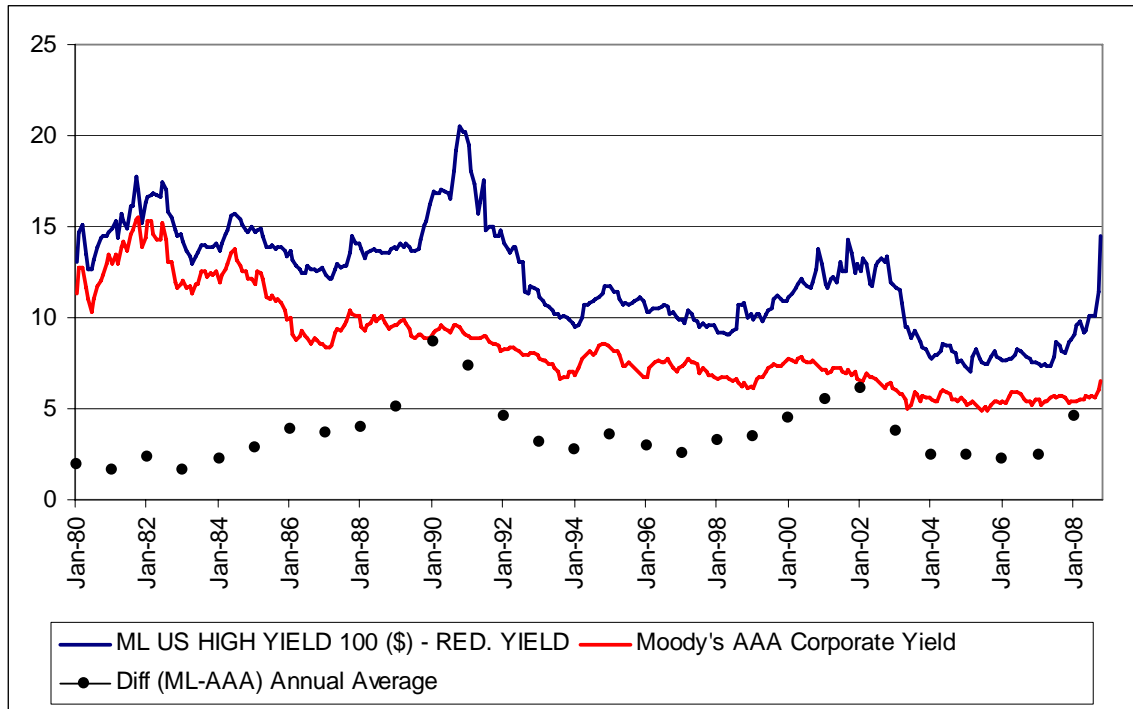
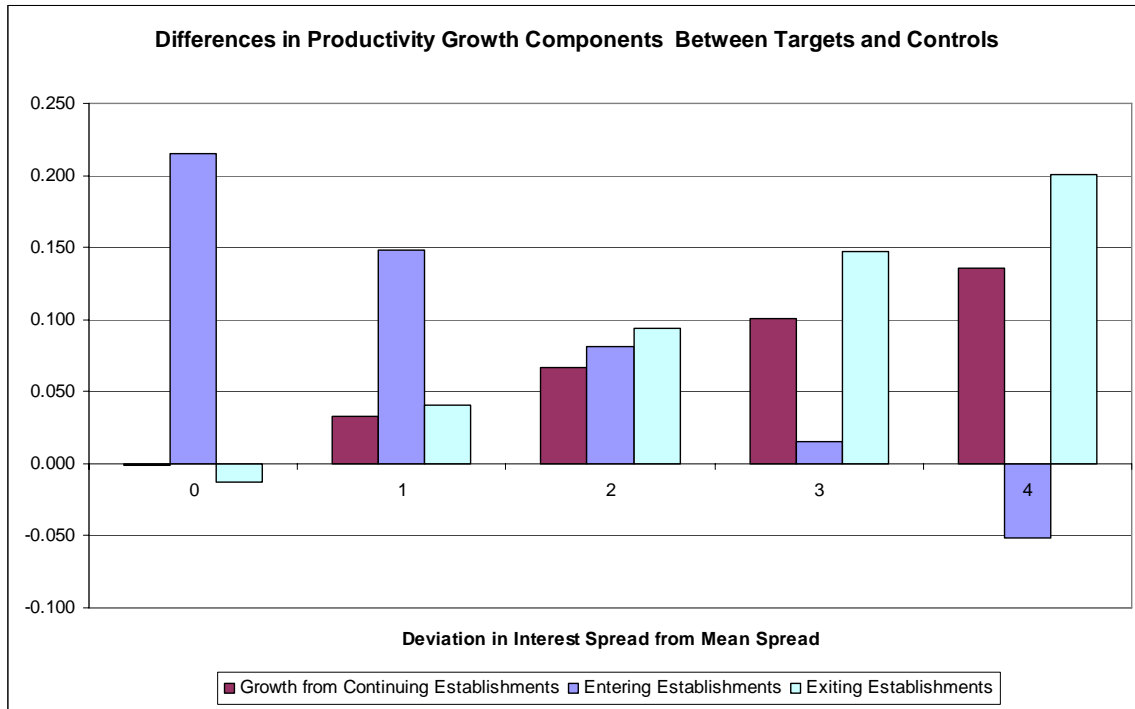


Figure 9: Target vs. Control Differences in Productivity Components of Growth by Interest Rate Spread during Times of Financial Stress



Note: The interest rate spread is the annual average of the difference between the BB and AAA rated bonds. The reported values on the x-axis are the deviations from the mean spread over the 1980-2005 period.

Table 1: Greenfield Entry, Establishment Exit, Acquisitions and Divestitures (Two Year Employment-Weighted Rates) – All Sectors

	Targets	Controls
Greenfield Entry Rate	14.9	9.0
Establishment Exit Rate	-16.7	-8.1
Establishment Acquisition Rate	7.4	4.7
Establishment Divestiture Rate	-5.8	-2.9
Continuing Establishment Net Growth Rate	-1.7	-0.1
Weighted Two-Year Growth Rate	-1.9	2.6
Reported are Employment-Weighted Means of Rates as Percent of Average of Firm Employment in Event Year and Event Year + 2.		

Table 2: Greenfield Entry, Establishment Exit, Acquisitions and Divestitures (Two Year Employment-Weighted Rates) – Manufacturing Firms

	Targets	Controls
Greenfield Entry Rate	5.5	4.4
Establishment Exit Rate	-6.9	-6.1
Establishment Acquisition Rate	5.6	5.1
Establishment Divestiture Rate	-6.6	-3.7
Continuing Establishment Net Growth Rate	-0.9	-2.7
Weighted Two-Year Growth Rate	-3.2	-3.0
Rates are based on Employment-Weighted Contributions of Category as Percent of Average of Employment in Event Year and Event Year + 2.		

Table 3: Productivity and Earnings Per Worker Differences in Event Year

Parameter	Labor Productivity	Earnings Per Worker
Private Equity Continuer	0.037*** (2.81)	0.011* (1.93)
Control Exit	-0.152*** (-35.98)	-0.078*** (-44.15)
Private Equity Exit	-0.198*** (-3.87)	-0.107*** (-4.95)
Control Divestiture	-0.106*** (-25.19)	-0.035*** (-19.74)
Private Equity Divestiture	-0.021 (-0.63)	0.006 (0.43)
Number of Observations	672,183	672,560
R2	0.489	0.733

All specifications control for Industry-Year Effects, Firm Size and Firm Age Effects.

Estimation is weighted using employment and propensity score weights. T-statistics in parentheses. *** represents significant at 1 percent level, ** at 5 percent level and * at 10 percent level.

Table 4: Productivity and Earnings Per Worker Differences Two Years After Event

Parameter	Labor Productivity	Earnings Per Worker
Private Equity Continuer	0.051*** (3.84)	0.000 (0.05)
Control Entry	-0.177*** (-30.24)	-0.103*** (-42.81)
Private Equity Entry	-0.042 (-0.52)	-0.017 (-0.51)
Control Acquisition	-0.077*** (-19.22)	-0.030*** (-18.10)
Private Equity Acquisition	-0.104*** (-2.61)	0.006 (0.35)
Number of Observations	665,922	666,263
R2	0.497	0.713

All specifications control for Industry-Year Effects, Firm Size and Firm Age Effects.

Estimation is weighted using employment and propensity score weights. T-statistics in parentheses. *** represents significant at 1 percent level, ** at 5 percent level and * at 10 percent level.

Table 5: Differences in Growth Rates of Productivity and Earnings Per Worker for Continuing Plants

Parameter	Labor Productivity	Earnings Per Worker
Private Equity	-0.008 -(0.47)	-0.032** -(2.49)
Number of Observations	292,936	337,108
R2	0.241	0.396

All specifications control for Industry-Year Effects, Firm Size and Firm Age Effects.

Estimation is weighted using employment and propensity score weights. T-statistics in parentheses. *** represents significant at 1 percent level, ** at 5 percent level and * at 10 percent level.

Table 6: Two Year Productivity Growth Gain From Private Equity	
Total Productivity Growth Gain	1.84
Total Excluding Acquisition/Divestiture	1.99
Share of Total from:	
Continuing Establishments	0.72
Net Entry	0.36
Net Acquisition	-0.08