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Private and Public Merger Waves

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ABSTRACT

We examine the participation of public and private firms in merger waves and productivity outcomes. We show that public firms participate more than private firms as buyers and sellers of assets and their participation is more cyclical. Public firms are affected more by credit spreads and aggregate market valuation. Public firm transactions are also impacted positively by their stock market valuations and liquidity. Public firm acquisitions realize higher gains in productivity, particularly when their transactions occur on-the-wave and when their firms' stock is liquid and highly valued. We show that our results are not just driven by the fact that public firms have better access to capital. Using productivity data from early in the firm's life, we find that better private firms subsequently select to become public and that these initial conditions predict higher participation in asset purchases and sales five and more years later.

I Introduction

It is by now well established that the market for corporate assets is pro-cyclical. Mergers and acquisitions tend to cluster in time.[1] However, less is understood on what causes firms to participate in these waves and whether acquisitions that occur on the waves lead to the same efficiency outcomes as mergers that occur off the waves. Also unknown is the extent to which private firms participate in merger waves and whether their participation is affected by similar demand and supply factors that affect public firms. At one extreme, acquisitions waves may occur because investment opportunities also occur in waves. At the other extreme, waves are driven by changes in liquidity and investment climate which enable certain types of firms to obtain capital more easily or cheaper than other firms. Thus, public firms may take advantage of high valuations in the stock market to buy assets.

The central contribution of this paper is to show how and why real and financial factors affect public and private firms differently in their acquisition and asset sale behavior. We examine the impact of real and financial factors by comparing the participation of public and private firms in merger waves and their outcomes. Using plant-level data on a sample of about 40,000 firms over the period of 1977-2004, we compare how public and private firms participate in merger waves and the outcomes of the mergers. We find sharp differences between these two groups. Public firms purchase and sell assets at a higher intensity than private firms. This is true even after controlling for firm size and plant productivity. Moreover, there exists a notable difference between these two types of firms in their acquisition decisions over the business cycle. Public firms are almost twice more likely to buy *and* sell assets in wave years than in non-wave years, while the transactions of private firms are relatively much flatter over time. To a large extent, the observed merger and acquisition waves are driven by higher participation of public firms.

Both efficiency and valuation affect acquisition decisions. Firms with higher productivity are more likely to buy assets and firms with lower productivity are more likely to sell assets. The productivity-acquisition sensitivity is stronger for public firms than for private firms. In addition, for public firms, acquisition decisions are also influenced by stock market conditions. Public firms with higher unexplained valuation (or misvaluation) and stock liquidity participate more in acquisitions.

We show that credit market liquidity, as measured by the spread between Commercial and Industrial (C &I) loans and Fed Funds rate, has a significant effect on merger intensity. In addition to productivity, private firms are less sensitive to credit spreads than public firms, suggesting that while productivity matters, private firms financing constraints may also be sufficiently binding and cannot be relaxed even at

[1] Mitchell and Mulherin (1996) and Harford (2005) analyze merger waves by public firms. See Andrade, Mitchell and Stafford (2001) and Betton, Eckbo, Thorburn (2008) for two surveys on the overall merger market.

times of high liquidity.

To further study how the credit spread interacts with financial constraints in affecting acquisition decisions, we divide our sample of public firms into different groups based on the level of potential borrowing constraints. We use the credit rating status (investment grade, below investment grade and non-rated) to measure the firm's liquidity in the debt market and use the stock liquidity (based on Amihud illiquidity index) to measure the firm's liquidity in the stock market. We find that public firms with intermediate access to financial markets (debt or equity) have the highest sensitivity. However, public firms that are more likely to be constrained (non-rated and with high illiquidity index) have the greater sensitivity to industry-level financial factors than do private firms. Thus, our finding suggests that access to financial market and market liquidity are important drivers for merger waves through the cost of accessing external financing.

We also take direct account of the fact that the decision to acquire public status is itself a choice variable. If public status confers advantages in financing mergers or accessing capital, firms may select into public status in anticipation of future acquisitions. Indeed, we find that firms that born large and more productive choose to become public, participate more in acquisitions, and are more wave-driven. Controlling for the probability of being public (or "public quality") based on initial conditions, the difference in participation rates between public and private firms diminishes. Specifically, public quality explains more than 27% of the difference in acquisitions and 91% of the difference in asset sales between public and private firms.

Thus, our results suggest that the difference in public and private firms' acquisition activity is not simply due to the public firms' better access to financial markets. While better access to markets and lower cost of capital may help public firms participate in acquisitions; they are not the fundamental reasons why public and private firms differ in their acquisition behavior. Rather, differences in firm quality enable some firms to grow through productivity-enhancing acquisitions, and these differences are reflected in their earlier choice of obtaining public status.

We find that acquisitions are efficiency improving, both on and off the wave. Plants acquired gain more in productivity compared to similar plants that are not sold. Productivity increases are higher for on-the-wave mergers, and in particular, when buyer and seller are both public firms and when the buyer is highly valued with more liquid stock. We thus do not find evidence that the increased occurrence of public mergers in waves leads to misallocation of assets. Instead, our findings suggest that periods of more frequent transactions and greater stock valuation are associated with ex-post efficiency improvements. The evidence is consistent with public buyers paying for synergies as they are more likely to buy with highly valued stock but still make productivity improvements ex post.

We find that firms with high unexplained valuation relative to current fundamentals indeed are more likely to buy assets. This result is consistent with the notion in Rhodes-Kropf and Viswanathan (2005) that firms cannot tell the difference between overvalued stock and high productivity of other firms and therefore

high valuations facilitate acquisitions, even if potentially at the wrong price. We find that acquirers with high unexplained valuation also experience greater subsequent productivity gains following the acquisitions. Thus while acquirers may pay or fund their purchases with highly valued equity, the purchases are not without merit and have improved the allocation of resources in the economy.

As a robustness check, we also separate the transactions into partial- and whole-firm acquisitions and find that firms with high unexplained valuation are equally likely to engage in partial-firm purchases as they are with whole-firm acquisitions. Since the former is more likely to be paid in cash and less affected by stock valuation, our finding supports the idea that firms with high valuation face better opportunities and are more likely to engage in acquisitions.

Our paper builds on the rapidly growing literature on merger waves. Clustering of mergers by public firms in time and industry has been studied by Mitchell and Mulherin (1996), Mulherin and Boone (2000), Andrade et. al. (2001) and Harford (2005). More recently, Dittmar and Dittmar (2008) and Rau and Souraitis (2008) show that corporate financing events including mergers come in waves. Shleifer and Vishny (2003) and Rhodes-Kropf, Robinson, and Viswanathan (2004) argue that merger waves are driven by misvaluation in financial markets, while Harford (2005) places greater reliance on availability of liquidity. Schlingemann, Stulz, and Walkling (2002) find that firms are more likely to sell assets in periods of high industry liquidity. Eisfeldt and Rampini (2006) identify liquidity as the reason why asset sales are pro-cyclical.

Our paper differs from the existing studies in several aspects. First, we study both public and private firms using a comprehensive data set from the Census Bureau. By comparing participation and outcomes of public and private acquisitions on and off the merger waves, we can directly analyze the effect of market valuation, liquidity and access to financial market on acquisition decisions.

Second, we use detailed plant-level input and output data to estimate productivity for both public and private firms. As a result, we can obtain estimates of the economic value created by mergers and are not affected by over- or under-payment between buyers and sellers. It gives us a better platform to compare efficiency implication of mergers on and off the wave, and by public and private firms.

Third, through the unique and separate plant and firm identifiers in the Census data set, we are able to pin down exactly which plants within a firm have changed ownership so that we can directly access the outcome of an acquisition by comparing productivity changes for those plants. In comparison, most of existing studies draw their conclusions based on performance changes in the entire acquirer firm which confounds the performance changes of the acquired units with the pre-existing units.

Our work is related to several recent papers. Yan (2006) and Duchin and Schmidt (2008) analyze the value created by on- and off-the-wave mergers. They find that on-the-wave mergers are more likely to be value destroying judged by acquirer stock returns. By contrast, we find that on average on-the-wave

mergers of public firms increase productivity of the acquired plants. The two findings are not inconsistent, in that acquiring firms may overpay for real synergies.

Our results are also related to several papers that document higher acquisition activity for firms that recently had IPOs (Brau and Faucet (2006), Celikyurt, Sevilir, and Shivdasani (2010) and Hovakimian and Hutton (2008)). While their finding does not prove that a primary motivation for IPOs is to enable firms to make acquisitions, they do suggest that for young firms, at the very least, public status facilitates acquisitions. Our paper complements and extends these papers in several important ways. Consistent with those papers, we also find that firms undertake more acquisitions in the first five years after going public. In addition, we find that acquirers that recently become public realize similar productivity gains on their purchased plants, compared to other public firms, on or off-the-wave. Also different from those papers, we show that initial conditions in the early pre-IPO stage can predict both public status and subsequent acquisition activities years afterwards. Furthermore, we also analyze decisions to sell assets, and find significant differences between public and private firms based on fundamentals and financial conditions consistent with our arguments.[2]

Our paper joins the emerging literature on private firms. Brav (2009) examines financing decisions of private firms and Asker, Farre-Mensa, and Ljunqvist (2010, 2011) compare investment decisions of public and private firms. In contrast to the Asker et. al. studies, we show a benefit of public market status. We show that public firms increase the productivity of the assets they purchase more than private firms. We thus contribute to the literature by providing evidence on acquisition decisions between public and private firms and the differential effect over the business cycle.

The remainder of the paper proceeds as follows. Section 2 presents our empirical framework including research questions addressed by our study and our estimation strategy, together with theoretical predictions related merger waves Section 3 provides a description of the data, variables, and summary statistics. We endogenize the public status and predict decisions to become public in Section 4. Section 5 compares decisions to participate in mergers and acquisitions by public and private firms. Section 6 examines changes in productivity around transaction and Section 7 concludes.

II The Empirical Framework

One explanation for the phenomenon of procyclical merger waves is that the gains from the reallocation of assets across firms are also procyclical. However, merger waves may also be driven by conditions in the financial markets. Harford (2005) argues that waves occur in part because it is easier to raise external capital at a lower cost when the economy is improving. For public firms, periodic stock-market misvaluation can

[2] Our empirical results are not driven by mergers of recently public firms. In unreported results, we confirm that recently public firms have a higher rate of acquisitions. However, such transactions are only a small portion of our sample of public firm acquisitions and the outcomes of those transactions are not different from those of the rest of the sample.

be an alternative cause of merger waves. Shleifer and Vishny (2003) and Rhodes-Kropf and Viswanathan (2004) suggest that higher valuations in the equity market makes equity-financed acquisitions more attractive. Using samples of publicly traded firms in the US, Harford (2005) and Rhodes-Kropf, Robinson and Viswanathan (2005) find support for liquidity and misvaluation hypotheses, respectively.

Much less is known about mergers by private firms.[3] Comparing the acquisition activities between public and private firms over the business cycle helps us to shed light on how fundamentals and financial markets may affect firms' decisions. From our data (described fully in the next section), we are able to identify merger and acquisition decisions of both public and private firms. Figure I plots the time series for the rate of purchases and sales of US manufacturing plants over the period of 1977-2004.

Insert Figure I here

There exists a remarkable difference between public and private firms in their acquisition rates over the business cycle. As shown in Figure 1, public firms are almost twice more likely to buy assets in aggregate wave years than in non-wave years while purchases by private firms are much flatter. To a large extent, the observed aggregate merger waves are mostly driven by higher participation of public firms. This finding is also consistent with the pattern found by Betton, Eckbo, and Thorburn (2008), using the publicly available data on public and non-public bidders.

A Initial Statistics: Public and Private Participation in Merger Waves

In this section we provide basic summary statistics on merger and acquisition activities of both public and private firm using our data - described fully in the next section - from U.S. manufacturing industries.

We identify merger and acquisition waves at the aggregate economy level as well as on the industry level using the following procedures. For each industry, based on 3-digit SIC code, we first calculate the percentage of plants traded between firms in each year. Then, we calculate the standard deviation of this annual percentage over all years. Industry merger wave years are defined as years in which the percentage of plants traded is at least one standard deviation higher above the industry mean rate. To identify the aggregate wave years, we use a similar method, except that the mean rate and the standard deviation are calculated using all plants in the economy. Aggregate merger wave years are years in which the percentage of plants traded is greater than one standard deviation above the aggregate mean rate. Using the Census data of 2,957 industry-years from 1977 to 2004, we have identified six aggregate wave years: 1986, 1987, 1996, 1998, 1999, and 2000, and 432 industry wave years.

Table I presents summary statistics on aggregate merger waves.

[3] Brav (2009) shows that British public and private firms differ systematically in their financial and investment policies, but does not address their merger activity.

Insert Table I Here

First, public firms participate more in acquisitions than private firms in general, and the difference is bigger for on-the-wave years. On average, public firms operate 20% of the firms in our sample, but account for 37% of the total transactions. During the aggregate wave years, 42% of the buyers and 40% of the sellers are public firms, as compared to 35% and 30% off the wave, respectively.

Second, the number of public-to-public transactions increases more than any other type of transactions during aggregate wave years. 19% of all transactions on the wave are between public firms, up from 12% off the wave. On the other hand, private-to-private transactions account for 37% all transactions on the wave, a sharp decrease from 48% off the wave.

The increase in the proportion of public buyers is consistent with the conjecture that during waves the financial constraints on public firms are relaxed. However, the proportion of transactions from public firms to private firms increases from 18% to 21%, whereas the reverse flow, from private sellers to pubic buyers increases by only 1%, from 23% to 24%. Thus, we don't find evidence that more assets transfer from private to public firms during merger waves. On-the-wave transactions cannot just be explained by a relative increase in access to capital by public firms relative to private firms but may also be affected by changes in relative productivity between public and private firms.

Public firms also do bigger transactions than private firms - the average number of plants sold in a public-to-public transaction is 3.19 on the wave and 2.48 off the wave, compared to 1.38 and 1.42 in private-to-private transactions. About 26% of all public-to-public transactions on the wave involve full ownership transfer (mergers), while only 18% off the wave do so. In contrast, about three quarters of all private-to-private transactions are mergers, both on and off the wave.

Industry wave years and aggregate wave years are highly correlated. The aggregate waves are driven by many industries having waves at the same time. The probability of having an industry wave is about one third (33%) when the aggregate economy is on wave, and is less than one tenth (9.4%) in off-the-wave years. In unreported table, we show that one additional industry being on the wave increases the odds ratio of other industries being on the wave by 6%.

B Public Status and Participation in Merger Waves

The fact that public firms' merger activity is more cyclical suggests that access to financial markets facilitates merger waves. However, public status is endogenous. Firms may have chosen to become public to have better access to financial markets. More specifically, on going public a firm acquires an option to obtain public financing at some future date at the prevailing rates, thereby lowering the cost of capital for acquisitions. This option is more valuable when a firm perceives greater future needs for external capital, either for investment or acquisitions. Thus, the observed difference between public and private firms in

acquisition can also reflect the difference in initial firm quality. In this section, we outline a framework that permits us to empirically examine how access to public financial markets and investment opportunities affect mergers decisions given initial firm quality and demand and financing shocks.

Firms are founded by entrepreneurs who differ in their vision, managerial talent or initial capital. Some firms have the potential to become significant players in their industries. Others, with less able entrepreneurs, niche products, or small-firm dominated industries will most likely stay small. Early in the life of the firm, the entrepreneur receives a signal about the firm's prospects and decides whether to become public either now or later with a high probability. On one hand, public status offers financing advantages such that if the firm becomes public it has the option to access public markets at a future date and acquire other firms at a lower cost.[4] On the other hand, public status is costly to acquire initially (i.e. this includes the direct and indirect cost of an IPO) and, due to reporting and governance regulations, has a per-period cost to maintain. Given these trade-offs, entrepreneurial firms that are initially larger, more productive, and in industries with higher capital intensity or significant growth opportunities are more likely to become public.

Since public status is an endogenous choice, to compare public and private firms in their acquisition decisions, it is important to separate out the following three distinct sources of differences between them.

First, we expect differences in acquisition activity purely on the basis of differences in fundamentals. Because larger and more productive firms may select public status, we expect that a sample of public firms engages in more acquisitions, all other things being equal. This is purely a selection effect and will be reflected in the differences in the values of the explanatory variables in the subsample of public and private firms.

Second, public status may cause a disparity in the elasticity of acquisition activity with respect to demand shocks in the industry. Maksimovic and Phillips (2001, 2002) and Yang (2008) argue that demand and productivity shocks cause firms' comparative advantage in an industry to shift. Specifically, positive demand shocks cause the optimal capacity of productive firms to expand relative to that of less productive firms. As a result, assets will flow from less to more productive firms following the positive demand shock. To the extent that more productive firms self-select into public status, following a positive industry shock the rate of public acquisitions will increase relative to private acquisitions.

Third, public and private firms may be affected differently by financial market shocks. Public firms can access public financial markets, especially for long-term capital, at more favorable or easier terms while private firms rely more on short-term financing from financial intermediaries (Brav (2009)). Faulkender and Peterson (2006) show that public firms with higher bond ratings also have better access to public

[4]The firm has option to postpone an IPO to a future date. This is inessential to our main argument and empirical tests. However, it is consistent the finding by Celikyurt, Sevilir, and Shivdasani (2008) and Hovakimian and Hutton (2008) that IPOs are frequently followed within a short span by acquisition activity.

bond markets. Such access might be needed both to finance cash offers and to refinance the debt of target firms that comes due upon a change of control. Public firms incentives to merge may also be driven by mispricing in public markets, analyzed by Rhodes-Kropf and Viswanathan (2004), possibly in conjunction with agency problems (Shleifer and Vishny (2003)). In addition, public firms, especially those with liquid stock, can use equity as a medium of exchange to finance their acquisitions while the same option usually is not available for privately held firms.

However, the comparative effect of shocks such as the narrowing credit spreads on private and public firms cannot be predicted a priori. If increased liquidity in the market relaxes private firms' financing constraints more than those of public firms, then all else equal, macro liquidity shocks will have a greater effect on the participation of private firms. However, if liquidity shocks occur when private firms have fewer growth opportunities relative to public firms as a result of differences in their respective productivity, increases in market liquidity will be associated with an increase in the ratio of public to private acquisitions.

We use the following basic model to examine the decision to buy or sell assets:

$$m_{it+1} = F(\delta_0 P_{it} + \delta_1 X_{it} + \delta_2 Z_t + \delta_3 (P_{it} X_{it}) + \delta_4 (P_{it} Z_t) + \varepsilon_{it}) \tag{1}$$

where m_{it+1} is 1 if firm i engages a purchase (sale) of assets at time $t+1$ and 0 otherwise. X_{it} includes firm-specific variables, including productivity, size, stock market valuation, liquidity, together with industry variables. Z_t includes macro economic conditions or indicators for merger waves, and P_{it} is an indicator variable for public status. ε_{it} is a random error, and $F(.)$ is a non-linear limited dependent variable parametric form.

Model (1) divides the difference in acquisition decisions between public and private firms into three distinct sources as mentioned above. First, the coefficient δ_1 captures the effect of firm characteristics, such as size and productivity firms. These characteristics will differ across the population of private and public firms as firms self-select to become public. Second, public status may cause a difference in the elasticity of acquisition activity with respect to measured firm fundamentals or macro-economic shocks. These effects would be reflected in the coefficients of δ_3 and δ_4, respectively. Lastly, the coefficient δ_0 will pick up the marginal effect of public status on acquisition decisions based on factors that are not fully covered by our framework.

C Firm quality, Decision to Become Public and Participation in Merger Waves

The key to our framework is the prediction that firms' self-select into public status based on their potential for long-run profitable growth and that the difference in firm quality, rather than the actual public status, may explain the difference in their participation in acquisitions. To establish this link, we need to separate the latent quality of a firm from its public status. If this potential is evident early in the life of the firm than

initial characteristics can predict both the selection into public status and merger activity in subsequent years.

We proceed in two steps. First, we take a subsample of firms that are born after the beginning of our sample, and use their characteristics at time t_{0i}, the date of firm i's first appearance, as explanatory variables to predict whether the firms is public at time t, from five (or alternatively ten) years later until the end of the sample. We use the following specification:

$$y_{it} = G\left(\pi_1 X_{it_{0i}} + \nu_{it}\right) \tag{2}$$

and

$$\begin{aligned} P_{it} &= 1 \text{ if } y_{it} > P_{i^*} \\ P_{it} &= 0 \text{ if } y_{it} \leq P_{i^*} \end{aligned}$$

where P_{it} equals 1 if firm i is public at time t and zero otherwise, X_{it_0} captures the initial firm characteristics that are observable at birth. $G\left(.\right)$ is a non-linear limited dependent variable parametric form.

In the second step, we replace P_{it} , the public status indicator in equation (1), with the predicted probability $\widehat{P_{it}}$ estimated from (2) to predict participation in the market for corporate assets:

$$m_{it+1} = F(\delta_0 \widehat{P_i} + \delta_1 X_{it} + \delta_2 Z_i + \delta_3 (\widehat{P_i} X_{it}) + \delta_4 (\widehat{P_i} Z_t) + \varepsilon_{it}). \tag{3}$$

By examining the significance of coefficients δ_0, δ_3, and δ_4, this specification allows us to analyze how initial conditions such as productivity and size affect a firm's decisions to buy or sell assets in subsequent years. The specification (2) also addresses two potential econometric problems. First, an estimate of the relation between contemporaneous public status and acquisition activity can be confounded by market shocks as firms may become public during a merger wave in order to more efficiently accomplish a specific planned transaction. This is suggested by Celikyurt, Sevilir, and Shivdasani (2010) and Hovakimian and Hutton (2008). We can eliminate this problem by using firms' initial conditions at birth. It is unlikely that micro and macro shocks that occur at the time of the firm's initial appearance directly affect merger decisions five or ten years later.

Second, public and private firms differ in size and productivity. A straight comparison of acquisition activity between these two groups may be confounded by differences in contemporaneous characteristics that are hard to control effectively using a standard econometric model. To avoid these issues, we also perform a matching exercise using the propensity score based on initial characteristics and the predicted probability of being public $\left(\widehat{P_{it}}\right)$. For firms with comparable propensity score, we estimate the average treatment effect due to the public status in participation of mergers and acquisitions on- and off-the-wave.

This non-parametric approach provides an alternative way to separate the effect due to selection from the effect due to public status.

D Gains in Productivity: On- and Off-the-Wave Mergers

Comparing the changes in productivity for transacted plants in public and private acquisitions helps us to study the relative importance of fundamentals, financial access and agency problems. If merger waves occur because growth opportunities also come in waves, then we would observe greater improvement in economic efficiency in periods when there are more transactions. Moreover, if the higher participation of public firms on the wave is driven by their difference in productivity and growth opportunities, then acquisitions of public firms should perform at least as well (or better) than acquisitions by private firms. Better access to financing by public firms can facilitate transactions by these firms.

On the other hand, since public status is associated with dispersed ownership and potentially entrenched management, public firms may be more likely to engage in empire building. If so, we would expect to see lower productivity gains for assets acquired by public firms compared to those purchased by private firms. As such, changes in productivity for acquired assets provide a measure of the relative importance between agency problems and inherent quality (i.e. productivity) in public and private firms.

The timing of the transaction may also drive changes in productivity for acquired assets. Merger waves often coincide with higher liquidity and valuation in the financial market. If waves are largely driven by valuation or liquidity in the financial market, then large transaction volume would not necessarily lead to higher operational efficiency. Moreover, if public firms acquire more on the wave to take advantage of their more favorable access to financial markets rather to realize synergies, then we would observe worse performance from public acquirers on the wave. In contrast, if merger waves are driven by expected productivity gains, we would expect to observe greater productivity gains in periods when there are more transactions, i.e., on the wave. To test these hypotheses, we compare changes of productivity for plants bought by public and private firms on- and off-the-wave.

III Data and Basic Statistics

A Plant-level Census Data

We use data from the Annual Survey of Manufactures (ASM), Census of Manufactures (CMF), and Longitudinal Business Database (LBD), maintained by the Center for Economic Studies (CES) at the Bureau of the Census to identify and track mergers and asset sales for both public and private firms. The Census data tracks approximately 50,000 manufacturing plants every year. It contains detailed plant-level data on the value of shipments produced by each plant, investments broken down by equipment and buildings,

and labor input such as number of employees and hours worked.[5] 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. Even though it is called the Annual Survey of Manufactures, reporting is mandatory for large plants and is mandatory for smaller plants once they are selected to participate. All data are reported to the government by law and fines are levied for misreporting.

The data we use covers the period from 1972 to 2004. To be included in our sample, firms must have manufacturing operations in SIC codes (2000-3999). We require each plant to have a minimum of three years of data. For each firm, we also exclude all its plants in an industry (at the three-digit SIC code) if its total value of shipments in that industry is less than $1 million in real 1982 dollars. Since we construct measures of productivity (described later) using up to 5 years of lagged data, our regressions cover the period from 1977 to 2004. We lose the initial year that a firm or a firm-segment enters the database and observations that are non-continuous since we use lagged capital stock to compute rate of capital expenditure and use lagged sales to compute sales growth. Our final sample has about 665,000 firm-industry years and more than 1 million plant years.

The Census databases keep unique identifiers for both firms and plants which allow us to track ownership change over time. For example, if the plant #1000 is under firm A in year 2000, but firm B in year 2001, we identify it as a transaction from firm A to firm B during 2001. Census staff (Javier Miranda and Ron Jarmin) verified to us that the information on ownership transfers is updated in a timely manner for nearly all public and private transactions in the company organization survey. The survey form is sent in December and companies are required by law to return the form back in 30 days to report any ownership changes during the reference year.[6] To identify public firms, we use an existing bridge file created by the CES staff that links the Census firm identifiers with identifiers of public firms in Compustat. To construct the bridge file, firms are matched by employer identification number (EIN) and name in each year from 1980 to 2005.

In our final sample, 20% of the plants are owned by public firms, and they produce about 35% of total output. Public firms are bigger - on average, public firms operate 3.1 plants compared to 1.4 plants owned by private firms. The median value of shipment (in $1982 dollar) is about $9 million for private firms, and $48 million for public firms. Public firms are also more productive than private firms and have higher operating margins. Using this data we calculate productivity for each plant using a translog production function. Kovenock and Phillips (1997) describe the productivity calculations, the data used as inputs

[5] For a more detailed description of the Longitudinal Research Database (LRD) see McGuckin and Pascoe (1988) and also Maksimovic and Phillips (2002).

[6] For more detailed information on the survey, please refer to http://www.census.gov/econ/overview/mu0700.html
Evidence on the quality of ownership change reporting is provided by Davis, Haltiwinger, Jarmin, Lerner and Miranda (2010) who examine reported transaction dates for a series of LBO transactions. While they do discover limited discrepancies in the reporting of some LBO transactions, they find in their recent work that their results are qualitatively the same as the results with original transaction dates with similar signs and significance levels.

and the method for accounting for inflation and depreciation of capital stock in more detail.

B Economy and Industry Conditions

We focus on supply and demand factors that may affect acquisition decisions over time. To capture the supply of capital, we use the spread between the rate on Commercial & Industrial (C&I) loans and the Fed Funds rate as a measure for aggregate liquidity following Harford (2005). Lown et. al. (2000) find that this spread is strongly correlated with the tightening of liquidity measured from Federal Reserve Senior Loan Officer (SLO) survey. When credit spread is low, acquisitions become easier to finance and are more likely to be carried out. However, the comparative effect of narrowing credit spreads on private and public firms cannot be predicted a priori. On one hand, narrowing spreads might allow public firms to take advantage of their access to public markets and increase their acquisition activity both absolutely and relative to private firms. On the other hand, the increased liquidity associated with low spreads might also make it comparatively cheaper for private firms to obtain loans. This second effect would increase the rate of private acquisitions relative to public acquisitions.

We use several variables to capture the level of demand and investment opportunities in the industry. When investment opportunities and demand increase and the supply of new capital is inelastic, highly efficient firms may choose to buy other firms instead of building new capacity. This relation is predicted by Maksimovic and Phillips (2001), Harford (2005), and Yang (2008), among others. We use the industry Tobin's q and the aggregate return on the S&P industrials index as a proxy for industry and aggregate level of investment opportunities respectively and examine their impact on merger activities. Tobin's q is calculated from Compustat data and is measured as the sum of the market value of equity and the book value of debt divided by the book value of assets.

Not surprisingly, these factors are correlated. For example, the correlation between credit spread and S&P industrial return is 47%. For robustness checks, we estimate the effects of these factors both separately and jointly in all of our specifications. For brevity, we only report results on joint estimation. Unless mentioned explicitly in the paper, results based on individual factors are qualitatively the same.

We also include the industry Herfindahl index in the specifications to control for the incentive to buy competitors to increase the firm's market power or the ease of finding a trading partner. It is calculated as the sum of squared firm-industry market shares using sales which are based on both public and private firms in the industry.

IV Participation in Merger Waves: Public and Private Firms

A Decisions to Buy and Sell Assets

We compare decisions to buy or sell assets for both public and private firms in this section, focusing on the effect of firm characteristics, industry conditions and conditions in the financial market. We test whether public and private firms respond to fundamentals and financial conditions differently as we hope to understand how fundamentals and financial conditions influence merger activity and the sources of differences in such activity.

Table II examines the probability of buying and selling assets for both public and private firms using indicators of credit market conditions, firm productivity and industry variables. In Panel A, our dependent variable, D_Buy, takes the value of 1 if a firm buys a plant in the next period and 0 otherwise. In Panel B, our dependent variable, D_Sell, takes the value of 1 if a firm sells a plant. In each panel, we run two specifications, one with macro variables such as credit spread and S&P return (column 1 and 2), and the other with the aggregate wave indicator (columns 4 and 5).[7] We estimate each specification separately for public and private firms to allow different coefficients on all variables. Columns 3 and 6 report the p-value for testing the difference in coefficients between two groups. Table IIA reports the estimated marginal effects using a logit specification. In Table IIB, we also present results using a linear probability model. The results are qualitatively similar and actually slightly stronger for the linear probability model.

We control for firm size using the total value of shipment across all industries in which it operates, as large firm may have higher financing capacity when it comes to acquire assets. We also include firm productivity, TFP, to control for operating efficiency. On the industry level, we include the industry Tobin's q to control for demand for assets and the Herfindahl index (based on sales) to control for industry structure. We also include a proxy for industry-level misvaluation based on public firms following Rhodes-Kropf, Robinson and Viswanathan (2005) and Hoberg and Phillips(2010). First, for each industry, we regress the log market value of equity on the log book value of equity, net income, an indicator for negative net income and leverage ratio using a historical 10-year rolling window. Then, the "misvaluation" measure is computed as the difference between the actual and the predicted market value of equity using the estimated coefficients. Following Hoberg and Phillips, we use only lagged data in the calculation of coefficients to avoid any look-ahead bias.[8] Since this measure captures the component of valuation that cannot be explained by a model using firms' financial data, we will refer to it as unexplained valuation (or UV) henceforth. To

[7] This variable is equal to one for the six wave years identified in Section 1(1986, 1987, 1996, 1998, 1999, and 2000), and zero otherwise.

[8] As discussed by Rhodes-Kropf, Robinson, and Viswanathan (2005), the key to investigating these effects is obtaining a good measure of misvaluation. Measures of unexplained valuation are of necessity valuation anomalies relative to a model of market expectations. While intended to measure misvaluation they may also pick up the market's expectation of future performance. The discussion of the valuation models in general is beyond the scope of this paper.

capture conditions in the financial market, we include two macro variables - credit spread for C&I loans and return on S&P industrial index.

Insert Table IIA and IIB Here

Inspection of Tables IIA and IIB show that public firms participate more in acquisitions, in both purchases and sales. On average, 7.36% (7.91%) of all public firms buy (sell) assets every year, compared to 1.75% (4.08%) of all private firms. For both groups, size is positively related with participation - larger firms are more likely to buy and sell assets. Productivity has a positive effect on purchases, but a negative effect on sales - more productive firms tend to buy assets and less productive firms choose to sell assets. The sensitivity of purchase or sales to productivity is much higher for public firms. The estimated marginal effect of TFP is ten times larger in purchase decisions, and five times larger in sales decisions for public firms than for private firms.

Public firms are also much more sensitive to credit spreads and to aggregate wave indicator. In both panels, the difference between two groups is significant at one percent level and economically significant. For both groups, higher levels of the S&P index are associated with a higher rate of transactions (in both purchases and sales). Private firms are slightly more likely to sell assets when aggregate stock prices are high, while the difference is not statistically significant in purchase decisions. We also see that higher industry unexplained valuation increases the probability of asset sales for both public and private firms although the marginal effect is much stronger for public firms. On the purchase side, when we include the S&P index the findings show public firms are less likely to purchase assets when industry unexplained valuation is high, as the S&P index and the credit spread are picking up the general procyclical stock market and business cycle effects.

To better understand factors that are driving the observed differences between public and private firms in their acquisition decisions, in Table III we calculate the economic effects based on the estimated model in Table IIA. We predict rates of purchases and sales by varying the credit spread variable from the 10th to the 90th percentile and also our wave indicator variable from zero to one while holding all other variables at their sample median. The results for public and private firms are presented in rows 1 and 2, respectively, of Table III. In addition, in row 3 of Table III, we also use the estimated coefficients from the private firm regressions and apply them on the median data of public firms and compute the predicted rates of purchases of public firms using the estimated sensitivities of private firms. This way, we can decompose the differences in the outcome variable (in this case, rate of purchases or sales) between two groups (private and public firms) into a part that is due to differences in the explanatory variables and a part that is due to differences in sensitivity to those explanatory coefficients. For example, public firms may participate more in acquisitions because they are more sensitive to aggregate economic conditions, or because they are bigger and bigger firms are better equipped to absorb the fixed transaction costs.

Insert Table III Here

Table III shows that the rate of purchase is vastly different between public and private firms at every percentile of the credit spread data. For example, when the credit spread is at its median, the rate of purchases is 5.42% for public firms, but only 0.49% for private firms. Public firms are also more sensitive to credit spreads. For public firms, the rate of purchase increases from 4.84% to 6.23% when credit spread moves from its 90^{th} to the 10^{th} percentile. In comparison, for private firms, the change is much flatter - from 0.48% to 0.50%.[9]

The difference in the transaction rate between public and private firms shrinks significantly when we apply the estimated coefficients from the private firm regressions to data based of the public firms. For the median credit spread, the predicted rate of purchases by private firms is 9% of the rate for public firms (0.49% versus 5.42%). However, when we apply the estimated coefficients from the private regression (column 2) using the medians of the data from the public firms, we find that differences in firm characteristics explain about 74% of the observed difference between public and private firms (4% versus 5.42%). Thus, the differences between public firms and private firms in their acquisition behavior are partially due to their differences in fundamentals. Public firms are larger and more productive, and large and more productive firms are more likely to buy assets. Nevertheless, a sizable gap (26%) still remains even after we control for firm characteristics. This gap is attributable to the differences in sensitivities to firm characteristics between these two groups. More interestingly, the gap is bigger when credit spreads are low and during wave years, suggesting that public and private firms also have a different sensitivity to macro conditions.

We find similar patterns in decisions to sell assets. When the credit spread moves from the 90th to the 10th percentile, the rate of sales increases from 2.10% to 2.34% for private firms, compared to 5.49% to 8.34% for public firms. When we apply the estimated coefficients from the private regression (column 2) to the public firm data, we find that differences in firm characteristics explain about 75% of the observed differences between public and private firms. Controlling for firm characteristics, the differences between public and private firms becomes bigger when credit spreads are low and aggregate acquisition activity is high.

As an alternative robustness check for the size effect, we divide our sample into quintiles based on firm size, and repeat our analysis using only firms in the largest quintile. Compared to the overall sample, the largest quintile has a much more balanced panel of public and private firms - 43% of the firms are public firms and the rest are private firms. Our results remain qualitatively the same. Among firms in the largest size quintile, public firms are still more sensitive to liquidity in the capital market and aggregate merger activity than private firms in decisions to buy and sell assets. Thus a substantial portion of the differences

[9] For this exercise, we estimate the predicted probability using the sample median for respective sample (public and private firms). Since large firms are far more likely to participate in purchases and sales in both samples, the resulting predicted probability is lower than the reported sample mean.

in the level of transactions between public and private firms is driven by differences in fundamentals, while the responsiveness to credit market conditions is affected by public status.

B The Effect of Market Valuation and Liquidity

We have shown so far that public firms are more sensitive than private firms to financial market conditions such as industry valuation, stock market return and credit spreads. In this section, we extend our analysis to include firm-level valuation (in addition to the industry-level measures) and stock-market liquidity. Our goal is to understand how differences in relative valuation within an industry affect merger and acquisition activities. Since market valuations for private firms are not observable, we use the subsample of public firms in our sample for this analysis.

For public firms, the valuation and liquidity of their own equity play very important roles in acquisition decisions because equity can be used as a medium of exchange to finance acquisitions. Rhodes-Kropf, Robinson and Viswanathan (2004) point out that while economic shocks might be fundamental determinants of merger activity, misvaluation in the stock market may determine who buys whom and explain why mergers cluster over time. They also emphasize that managers of public firms themselves may suffer from asymmetric information about potential synergies and thus will be more likely to buy with positive signals from the stock market. In our context, overvaluation in the stock market may be associated with more transaction but does not necessarily lead to productivity decreases as firms may use their highly valued equity to facilitate productivity increasing transactions.

In order to test these ideas, in Table IV, we add variables capturing firm-level valuation and liquidity to our earlier specifications from Table II to capture firm-level valuation and liquidity such as unexplained valuation (UV), annualized stock return (Ret) and the Amihud illiquidity index (Illiq).[10] For all three variables (UV, Ret and Illiq), we also include industry averages based on all public firms within the industry.[11] [12] Panel A and B present our results for decisions to buy and sell assets, respectively. In each panel, column (1) and (3) contain the baseline results - one with macro variables and the other with the wave indicator. Column (2) and (4) include further control for stock market return and stock illiquidity.

Insert Table IV Here

Panel A reveals that our base line results for the decision to buy in Table II are largely unaffected by adding the valuation, return and liquidity measures. However, the firm-level stock-related variables

[10] We download the Amihud illiquidity measure directly from Joel Hasbrouk's web site at NYU.
All firm-level measures have been de-meaned by industry.

[11] To calculate industry-level measures, we aggregate firms based on their main industry reported in Compustat.

[12] We also adjust industry return by S&P return to filter out the aggregate effect. In the regression, industry return is the industry raw return adjusted for S&P return, and the firm return is the firm raw return adjusted for industry return.

are significant themselves in explaining decisions to buy for public firms. In all the specifications, firm unexplained valuation is significant and positive, while industry unexplained valuation is only significant for the specification with the global wave dummy variable, and becomes insignificant when illiquidity is added. Stock illiquidity is significant and negative for all specifications, both on the firm- and industry level. Stock return is positively related to purchase decisions on the firm level, although it is only significant without the wave indicator.

These results indicate that stock market valuation and liquidity have significant independent effects on the decision to buy assets for public firms. Firms that are valued beyond the predicted level based on their fundamental variables are more likely to engage in acquisitions. Stock liquidity also has an important role in facilitating acquisitions for public firms. Firms that have less liquid stock (or high Amihud Illiquidity Index) are less likely to be acquirers, perhaps reflecting their target's hesitation to hold illiquid stock.

Examining the results for the decision to sell in Panel B of Table IV, we notice one important difference relative to the decision to buy. Firms are more likely to sell assets when industry unexplained valuation is high (significant at one percent in all specifications) while firm-level unexplained valuation is mostly insignificant. It suggests that when industries become highly valued, less productive firms are more likely to sell out to their highly-valued counterparts (as evident from Panel A). The sellers, on the other hand, do not seem to be over or under-valued. Illiquidity remains negative as that in the decision to buy.

It is worth noting that the unexplained valuation measures used here can either capture deviations from the true value (or misvaluation) or market expectations of unmeasured future productivity. One way to shed light on this question is to examine whether and how stock valuation affects firms' decisions to engage in different types of transactions. We perform two additional tests. First, since most of the partial-firm acquisitions are financed with cash, if acquisitions are driven by overvalued equity, we would observe lower valuation-acquisition sensitivity in partial-firm acquisitions, as compared to whole-firm mergers which are more often paid by stock. Second, diversifying mergers are often viewed as signs of agency problems or waste of resources ((e.g., Morck, Shleifer and Vishny (1990), Servaes (1997)), if acquisitions on the wave are motivated by the use of overvalued equity rather than to improve efficiency, then we would expect to see higher valuation-acquisition sensitivity in diversifying acquisitions, as compared to horizontal acquisitions.

We present these results in Table I in our online appendix. We show that the estimated odds ratio (from a multinomial logit model) for unexplained valuation is greater than one for all types of transactions. More interestingly, unexplained valuation has almost the same effect on partial-firm acquisitions as it has on mergers; and the same effect on horizontal acquisitions as on diversifying acquisitions. These results, while consistent with a model of efficient mergers, are at odds with models that attribute overvaluation as the main driver for merger waves.

To the extent that partial firm purchases are easier to finance than full firm purchases, and financing constraints are more likely to be binding for private firms, we would expect that private firms do relatively

more partial firm purchases than full firm acquisition.[13] We do not find that to be the case. The incidence of public purchases is higher (at 3.53% for partial firm and 3.83% for full firm purchases) than the incidence of private purchases (at 0.84%% for partial firm and 0.92% for full-firm purchases). However, the ratios of full and partial purchases for the two types of sales are very close. The coefficients of the equations predicting partial and full-firm purchase regressions are qualitatively similar. These findings suggest that the lower overall rate of private transactions is in part determined by differences in skill and the ability to exploit investment opportunities as well differences in financing constraints.

C Credit Ratings and Stock Liquidity

In this section, we examine how public firms with different levels of financial constraints respond differently in their acquisition decisions to changes in economic fundamentals and financial conditions. If the difference in acquisition activities between public and private firms is partly attributable to their differences in access to financial market, then we would expect that public firms with the least access to financial markets behave similarly to private firms.

We consider both bond market and stock market liquidity. Faulkender and Petersen (2006) show that firms with higher bond ratings have better access to public bond markets. If we find that unrated or low-rated firms' merger activity is the most sensitive to credit spreads and the overall economy, it would be consistent with the notion that increased liquidity in the market has a bigger impact on firms that are more financially constrained. In contrast, a lower sensitivity of unrated or low-rated firms indicates that financial constraints are sufficiently binding for those firms and cannot relaxed even at times of high liquidity. Stock market liquidity is relevant because firms with low stock liquidity may find it harder to issue equity or use the existing equity as a means for payment in acquisitions. We would expect these firms are also likely to be financially constrained.

First, we split our sample of public firms into three groups based on S&P long-term debt ratings (Compustat data item 280): firms with investment grade credit rating (above BBB), below investment grade (BBB and below), and un-rated firms. Within our sample, 28% of the public firms have investment grade rating (HR), 14% have below investment grade rating (LR), and the rest are un-rated (NR). We then run regressions to predict decisions to buy and to sell assets for each rating group.

Similarly, we also separate public firms into three equal-sized groups based on their stock liquidity using the Amihud Illiquidity measure. We then apply a similar specification used in Table IV column (1) to each group. Table V reports our results.

Insert Table V Here

[13] Both full and partial purchases by private firms are normally cash transactions, so there is little countervailing tendency for private firms to make whole firm purchases using stock to avoid using cash in partial sales.

For all credit rating groups, credit spreads have a significant negative effect on acquisition decisions, and they affect firms with below investment grade rating (LR) the most. The estimated marginal effect of credit spread on acquisitions for LR firms is almost three times as high as the marginal effect for HR or NR firms. On the sales side, LR firms, especially those with lower productivity, are also more likely to sell assets when credit spreads are low. Therefore, credit spreads appear to have a double effect on LR firms: On one hand, more liquidity on the market helps to relax the constraints faced by LR firms and enables them to borrow more or at lower rate to finance acquisitions. On the other hand, liquidity may also affect LR firms by lifting covenants on previous bank loans which prevent them from selling assets. We find that the effect of credit spreads is the smallest for low rated firms. We also find that acquisition activity by non-rated firms and firms with low stock-market liquidity are more sensitive to size. These result also parallels the results in Hovakimian, Kayhan, and Titman (2009) which show that controlling for whether or not firms have debt ratings, size can have a differential effect on firm decisions, with larger effects for size among smaller non rated firms.

Our results also show that the effect of productivity (TFP) on acquisition decisions is the strongest for the high credit rating group. Together with our earlier findings, this finding indicates that the constrained low-rated firms are more affected by market liquidity, while the less constrained high-rated firms are more affected by productivity. Public firms with no rating are most similar to private firms with low sensitivity to productivity and credit spreads.

Examining the results for stock liquidity groups, we observe similar patterns as those described for the credit rating groups. Although credit spreads have a negative effect for all liquidity groups, the effect on acquisitions is the largest for the mid-level liquidity group. Productivity (TFP) has the largest effect for high-liquidity group. In addition, size has the largest effect in the low liquidity group suggesting that size can compensate for the lack of liquidity. On the sales side, credit spreads affect the high-liquidity group the most.

We also compute the economic significance of these results. For low-rated firms, the probability of buying and selling assets increases by 62% when credit spread moves from the 90th to the 10th percentile. In comparison, the increases are 19% and 23%, respectively for highly-rated firms and for non-rated firms, respectively. Similarly, for firms with low stock liquidity, the rate of buying assets increases by 42% when credit spread moves from the 90th to the 10th percentile. In comparison, the increases are 18% and 12% for firms in low and high stock liquidity groups respectively.

In sum, although public firms with better access to credit or equity market (the highly-rated group and the high stock liquidity group) do more acquisitions in general, firms with intermediate access (the low-rating group and the medium stock liquidity group) have the highest sensitivity to changes in credit spreads and are most affected by changes in market liquidity in their acquisition decisions. Among all groups, the acquisitions and sales of public firms with no credit rating and high illiquid stocks most resemble private

firms. As such, our finding suggests that the observed difference between public and private firms is partly due to their difference in access to financial markets.

V Endogenizing Public Status

A Predicting the Decision to go Public

The preceding sections have established that public firms participate more in acquisitions, especially during merger waves. But, the decision to acquire public status is itself a choice variable. If public status confers advantages in financing acquisitions, then firms with superior growth opportunities can select into public status prior to take advantage of the easier financing. Thus, the greater merger activity of public firms could be primarily due to inherent characteristics, such as superior corporate culture or technology, rather than to the advantages of public status in acquisitions. To separate out these two effects, we next analyze the decision to obtain public status, and compare the subsequent merger activity of public and private firms with the same productivity and size at birth. Our hypothesis is that the quality of a firm is evident very early in its life, and that firms with greater growth potential select to become public to better engage in mergers and acquisitions later. As such, the decision to become public can be predicted using initial quality of the firm (model (2)).

We use the Longitudinal Business Database (LBD) from the Census Bureau to confirm the birth year for firms in our sample. LBD is a Census data set constructed using information from the Business Registry. It covers firms with any paid employees in the US (>10 million establishments per year).[14] The LBD starts in 1976, thus, to correctly identify the birth year, we only include a subsample of firms that first appeared in the LBD after 1976. As in the overall sample, both public and private firms are included when their segment sales are 1 million dollars or larger in their initial year. Since we want to examine the decision to obtain public status based on initial conditions, in these sub-tests we also exclude firms that were public the first time they appear in the database.

For the firms that are born after 1975 we create an exclusion window to remove the first five (or, in some specifications, ten) years after birth from our sample. We then run probit models to predict firms' public status after this exclusion window as a function of the firm's initial characteristics at birth, and in some specifications, industry conditions. The exclusion window removes the concern that contemporaneous shocks affect both the incentives to be public and to trade assets. Instead, the specification captures the fundamental quality of a firm which affects both the incentives to go public as well as the incentives to trade assets.

Initial conditions are very persistent. For example, ten years after birth, 44% of the firms that start in

[14] See Jarmin and Miranda (2002) for a detailed description of the LBD (http://ideas.repec.org/p/cen/wpaper/02-17.html).

the smallest size quintile remain in the same quintile, and 90% of the firms that start in the largest size quintile remain in the same quintile. Similar patterns also exist in productivity, although not as strong. Ten years after the birth, 36% (40%) of firms that start in the least (most) productive quintile remain in the same productivity quintile.

Table VI presents our results of predicting public status - column 1 to 3 use a five-year window and column 4 to 6 use a ten-year window.

Insert Table VI Here

In column 1, we include the initial size and productivity ($Size_0$, TFP_0) and their square terms ($Size_0 2$, $TFP_0 2$) to measure the initial quality of a firm, and use the change of aggregate industry shipments in the next 25 years($CDTVS_{25}$) to measure the long-term growth in industry demand. Both linear and square terms of productivity and size are positive suggesting that firms that were born large and more productive are more likely become public later in life. In our sample, five years after birth, firms that begin in the highest quintile in both size and productivity have a 27% probability of being public, while less than 1% of the firms that begin in the lowest quintile in both size and productivity become public. Industry long-term demand also plays an important role. Firms in industries with increasing long-term demand are more likely to be public. The initial conditions, together with the industry long-term demand, explain about 18% of the total variation in firms' public status five years after birth.

In column 2, we add lagged industry and macro variables to account for cases that firms may change their public status over time. Firms in industries with high capital expenditure and more growth opportunity may have higher demand for capital. We capture those effects by including the industry capital expenditure rate (I_Capex) and the industry Tobin's q (I_Tobinq). We include the Herfindahl index (HERF) to measure industry concentration ratio. It is defined based on sales from both public and private firms.

Some industries may be more suitable for small private firms than others due to the characteristics of the industry. We use the percentage of firms with less than 50 employees, S50, as a proxy to capture industry business conditions.[15] Becoming public may be more likely for initially productive firms if productivity is persistent over time. We therefore include a measure for productivity persistence (Persistence) based on the rank correlation between the lagged and the current TFP for all firms in the industry in a year**.** Lastly, we include the log number of IPOs in a year to control for economic conditions for IPOs.[16] All the variables have predicted signs. Firms in industries with higher capital expenditure, better growth prospects, higher concentration ratio, fewer smaller firms and higher persistence in TFP are more likely to become public. Firms are also more likely to become public during an IPO wave. In this expanded specification the initial firm conditions (size, productivity and their squared terms) remain positive and significant at 1% level.

[15] We use the employment numbers provided in LBD to compute this percentage.

[16] The series is calculated based on data provided on Jay Ritter's website: http://bear.cba.ufl.edu/ritter/ipoisr.htm

In column 3, we use initial size quintiles and interact them with initial productivity. The marginal effect on public status is monotonically increasing in size quintiles. Moreover, TFP matters for large size quintiles. In columns 4 through 6, we estimate the same specification using initial firm quality and firm size from at least 10 years prior to subsequent years. The results from these specifications are similar to the one with initial quality and size from five years prior.

B Endogenous Selection: Reexamining the Decisions to Buy and Sell Assets

Firms with higher productivity and greater anticipation of future growth may choose to become public to participate more in acquisitions when opportunities emerge. We have shown in Section 4 that initial conditions at birth are good signals for firm quality - firms born bigger and more productive are more likely to become public later in their lives. If the same quality also affects later decisions in participating acquisitions, then we should observe a positive relationship between initial conditions (or probability to become public) and probability of engaging in acquisitions. In this section, we control for the endogeneity of public status using first a selection model and then a matching model to reexamine the decision to buy and sell assets.

First, we examine how the selection into public status affects purchase and sale decisions. We estimate the probability of being public using the specification in Table VI, column 1. In predicting probability of being public we use as independent variables firm characteristics at birth and remove observations in a five-year exclusion window following the firm's birth. Since all the explanatory variables are time-invariant, the predicted probability truly captures the firms' initial condition. Because the predicted public probability is only available for firms that were born after 1976, the first year that the LBD is available, our sample with predicted public status is more representative of younger firms.[17]

In Table VII, we perform a matching exercise based on the predicted probability of being public as a propensity score. We then compare decisions to buy and sell assets between the treated group (public firms) and the control groups (private firms) using stratification matching. The estimated average treatment effect on the treated (ATT) then captures the effect that public status has on acquisition decisions controlling for initial public quality. We also enforce the computation of the ATT only in the region of common support. We report the estimated ATT over the whole sample period and also on and off the wave.

Insert Table VII Here

On the purchase side, matching based on initial public predicted probability explains about 27% of the difference between public and private firms. When we separate our sample periods into wave and non-wave years, we find that public status matters more during merger waves - initial conditions explains 23% of the

[17] The predicted probability is available for 15% of public firms and 29% of private firms in our dataset.

difference on-the-wave while 33% of the difference off-the-wave. On the sales side, most of the differences between public and private firms can be explained by initial selection. Controlling for initial public quality, public firms are no longer more likely to sell assets than private firms. Initial quality selection explains almost all of the differences for off-the-wave sales and 80% of the differences for on-the-wave sales.

Two factors may explain our findings. First, through the initial quality (such as size and productivity), we are able to capture the capacity to become public, but not the willingness. Some entrepreneurial firms may have the same initial quality for being public, but choose to stay private for control or quiet life (Bertrand and Mullainathan (2003)). In that case, the public status is a signal of both quality and preference.

Alternatively, our results can also suggest that being public does make a difference when it comes to access to financing. Public firms have better access to capital markets in general, and benefit even more when credit becomes more readily available. Therefore, they are more likely to engage in acquisitions in the presence of good opportunities. The asymmetry in our findings between sales and purchases suggests that, as expected, the advantage of being public through better access to capital is more prominent for acquisitions, while asset sales are more driven by firm fundamentals and initial conditions.

In addition to this matching exercise, in order to further examine endogenous selection into public status, we also present run our regression model of Table II for by quartiles of firms based on their predicted probability of being public. We first separate firms in quartiles (Q1 to Q4 henceforth) based on the predicted probability of being public, with Q1 firms having the lowest probability and Q4 having the highest probability. Not surprisingly, the percentage of public firms increases over the quartiles. For example, less than 2% of the firms in Q1 are public, compared to 27% of the firms in Q4. The transaction rate (in both purchases and sales) is monotonically increasing from Q1 to Q4.

We use these quartiles of predicted public status to re-estimate the decision to buy and sell assets based on firm, industry and macro factors for each group separately using the same specification as in Table II. These results allow us to asses if firms based on their predicted probability of being public (and not actual public status) have differential sensitivity to credit spreads and the S&P stock market index. We present these results in Tables 2A (logit model) and 2B (OLS linear probability model) of our online appendix.

The results in the online appendix show that the Q4 group has a much higher sensitivity to credit spreads as compared to the Q1 group in both purchase and sales of assets. These results parallel our earlier findings using samples of firms which were actually public and private, suggesting that a large portion of the difference in observed acquisition behavior between public and private firms is indeed driven by differences in fundamentals early in the life of the firm. Larger and more productive firms select to become public, and later, these firms participate more in asset purchases and sales when opportunities arise.

We further control for selection effects when we focus on the subsample of Q4 firms with high probability of being public and divide them based on their actual public status. Private Q4 firms are those firms that we predict, based on initial fundamentals, to be public in future years, but are in fact private when observed five or more years later. For acquisition decisions, they have higher sensitivity to macro conditions, such as credit spreads or aggregate wave indicator, than private firms, but lower sensitivity than public Q4 firms that are, in fact, public. However, this difference between public and private firms in the Q4 subsample is smaller than the difference between public and private firms overall. The results thus show that actual public status affects acquisitions decisions but to a smaller degree after accounting for selection.

We find even smaller differences between public and private Q4 firms for decisions to sell assets. Private Q4 firms have a much higher sensitivity to credit spreads and to the aggregate wave indicator than do the full sample of private firms. The marginal effect of credit spreads on sales decisions for private Q4 firms is much closer to public firms. Our results remain qualitatively the same when we use an exclusion window of ten years.

VI Post-Sale Performance on Merger Waves: Private and Public Firms

A Public Status and Changes in Productivity

To further pinpoint the effect of fundamentals and financial markets in driving merger waves, we now examine changes in productivity for the transacted plants on- and off-the wave. If the higher participation of public firms on the wave is driven by their difference in productivity and growth opportunities, then acquisitions of public firms should perform at least as well or better than acquisitions by private firms. Alternatively, if public firms acquire more on the wave just to take advantage of their more favorable access to financial markets rather than to realize synergy, then we should observe worse performance from public acquirers than private acquirers on the wave.

Table VIII examines changes in productivity for transacted plants around acquisitions for both off- and on-the-wave mergers. We measure changes of productivity at the plant-level using three windows, (-1, 1), (-1, 2) and (-1, 3), with year 0 being the transaction year. Since firms may choose to sell a certain type of plant, we correct for the selection bias following Heckman (1979) in all of our regressions. We first use a similar specification as in Table II Panel B column 1 and 2 to predict the outcome of being sold on the plant level. As in Table II, we also estimate the model separately for public and public firms to allow for differences in sensitivity to firm, industry and macro factors between two groups. Then, we include the inverse mills ratio or Heckman's lambda in our second-stage regressions when we examine changes in productivity for transacted plants. In all of our specifications, Heckman's lambda is negative and significant, suggesting that it is necessary to correct for the selection bias.

Insert Table VIII Here

Panel A shows that on average transacted plants have bigger improvements in productivity than non-transacted plants. The coefficient for D_Sale, the indicator for whether the plant is sold, is significantly positive at 1% level in all of our specifications, consistent with acquisitions being on average value enhancing. Moreover, the interaction between D_Sale and D_Wave, the indicator for aggregate wave years, is positive and significant, suggesting that on-the-wave acquisitions experience even greater improvement in productivity. For example, two years after the acquisition, plants that are sold have a 3.4% increase in productivity compared to non-transacted plants, and on-the-wave transactions realize a 2% additional productivity increase compared to off-the-wave transactions.

Rhodes-Kropf and Robinson (2008) provide evidence that synergies from mergers are the greatest when high productivity firms take over other high productivity firms. We find that public firms are more productive than private firms in general and their sensitivity to productivity is higher. Yan (2006) and Duchin and Schmidt (2008) find that on-the-wave horizontal mergers are followed by poor stock and operating performance. By contrast, we find that on-the-wave transactions create bigger efficiency gains. There are several notable differences between our study and theirs. First, we examine efficiency gains rather than stock returns. The two findings are not necessarily inconsistent, in that acquiring firms may overpay for real synergies. Second, due to the unique feature of the Census data set, we are able to track the transacted plants before and after the acquisition whereas the other studies examine changes of operating performance for all of the assets managed by the acquirer. In unreported tests, we find that the acquirers' existing plants do not do worse compared to other plants within the industry.

Panel B presents results when we divide transactions based on the public status of the buyer and the seller. Except for private-to-private transactions (PrvtoPrv), all other three types of transactions have significant positive productivity post-transaction gains at 5% level. Across all the groups, changes in productivity for on-the-wave acquisitions are positive and either significantly higher than or statistically indistinguishable from changes in productivity for off-the-wave acquisitions. In particular, on-the-wave transactions between public firms are associated with post-transaction productivity gains - plants sold between public firms increase productivity by 5-10% in the next three years. Both results, on-the-wave merger generating more efficiency gains and public-to-public transactions having bigger improvements in productivity, suggest that the higher incidence of such mergers may the consequence of higher expected synergies. In addition, our findings provide implications for corporate governance in public and private firms. Acquisition decisions made in public firms may result in productivity gains from more efficient or skilled management.

B Valuation and Changes in Productivity

Our previous results in Table IV shows that public firms are more likely to make acquisitions when their unexplained valuation is high. If highly valued firms make inefficient acquisitions using their overvalued stock, then we would observe they realize lower subsequent productivity gain in purchased plants. On the other hand, if higher unexplained valuation reflects higher expected future productivity, then we would observe acquisitions by highly valued firms do better.

We test the relation between unexplained valuation and subsequent merger productivity gains in Table IX. We separate all purchased plants into three groups by their acquirer type – private acquirers (Prv Buyer), public acquirers with low unexplained valuation (Pub Buyer * (D_UV=0)) and public acquirers with high unexplained valuation (Pub Buyer * (D_UV=1)) and estimate the same specification as in Table IX Panel A using three event windows. The low and high unexplained valuation groups are defined based on the median of the unexplained valuation measure calculated using all public firms in Compustat following method described in Section 4.1. For robustness checks, we repeat our analysis using several alternative grouping methods such as (1) using industry-adjusted unexplained valuation and (2) defining high unexplained valuation group based on the 75th percentile rather than the median. The results are qualitatively the same.

Insert Table IX Here

Table IX shows that transacted plants in all three groups experience gains in productivity following the acquisition, and the gains are the largest for public buyers with high unexplained valuation. Three years following the transaction, plants purchased by public acquirers with high unexplained valuation realize a 5% gain in productivity, compared to 2.1% and 4.1% when acquirers are private firms and public firms with low unexplained valuation, respectively. Moreover, when we interact the indicator of acquirer group and the indicator of aggregate wave years, we see an additional large incremental effect for public buyers on the wave when they have high unexplained valuation. This effect persists for up to two years after the transaction.

For robustness, in Table III of our Internet appendix, we use the annualized stock return as an alternative measure for valuation. Similar to Table IX, we separate all purchased plants into three groups by their acquirer type – private acquires, public acquirers with low return and public acquirers with high return. We find that for public firms, the efficiency gains are bigger for acquirers with high recent stock returns. For example, three years following the transaction , plants purchased by public acquirers with high returns realize a 7.4% gain in productivity, compared to 2.6% for acquirers with low past returns. There is an additional productivity gain in aggregate wave years but this additional gain is concentrated in low return acquirers, suggesting that high return acquirers consistently do better, while low return acquirers have

additional gains on the wave.[18]

In sum, adding unexplained valuation (potential misvaluation) and stock returns to our specifications provides new insights, but does not change any of our previous results. Unexplained valuation predicts higher participation in acquisition activity for public firms. Changes of TFP for transacted plants remain positive, both on and off the wave and are particularly high for public buyers with high stock market valuation in aggregate wave years. The evidence is consistent with public buyers paying for synergies as they are more likely to buy with highly valued stock but still make productivity improvements ex post. This result is consistent with high valuations facilitating productive mergers, even if potentially at the wrong price.

VII Conclusions

We examine the participation of public and private firms in merger waves. We find that public firms participate more in the market for assets than private firms, in both purchases and sales, and especially so during merger waves. Acquisitions by public firms are more likely to lead to increases in the productivity of acquired assets, especially in transactions between public firms and when public acquirers have higher valuations and stock market liquidity.

Our paper provides several implications for our understanding of mergers and acquisitions across different organization forms and over the business cycle. First, we find evidence that both efficiency and financial access affect acquisition decisions. Firms with higher productivity are more likely to buy assets and firms with lower productivity are more likely to sell assets, and plants transacted improve productivity. Financial access does matter. We document that the higher participation of public firms is partly due to their favorable access to financial markets. Among all public firms, those with better credit rating and more liquid stock are more likely to buy and sell assets. We show that public firms with intermediate access to capital market (low-rating and medium-liquidity firms) are most sensitive to credit spreads and aggregate merger activity in their acquisition decisions. Public firms that do not have credit ratings, on the other hand, behave like private firms.

Second, differences in participation between public and private firms are not just driven by contemporaneous efficiency and valuation. Firms with higher productivity and greater anticipation of future growth choose to become public and later participate more in acquisitions when opportunities rise. Using initial conditions at birth, we show that initial quality explains a significant portion of variation in public status five or ten years later and the subsequent acquisition behavior. Productive firms select to become public and later participate more in the market for corporate assets as both buyers and sellers in ways that in-

[18] For robustness checks, we repeat this analysis using several alternative grouping methods such as (1) using industry-adjusted unexplained valuation and (2) defining high unexplained valuation group based on the 75th percentile rather than the median. The results are qualitatively the same.

crease the productivity of the acquired assets. These findings are related to the recent study by Lemmon, Roberts and Zender (2006) who show that a firm's later financial policies are predictable from its early characteristics before becoming public. Together, these studies suggest that there are differences between firms that persist over many years and affect their behavior and value creation. Purchases and sales of assets are in part driven by firm characteristics which are set when a firm is created by its entrepreneur

Third, consistent with neoclassical theories, Maksimovic and Phillips (2001, 2002) and Yang (2008), we find that mergers that occur on the waves are associated with greater efficiency improvements. In particular, acquisitions by public firms during wave years realize bigger productivity gains. We find little evidence that merger waves are causing economic inefficiency. We do find that public firms with high unexplained valuation and high stock-market liquidity are more likely to engage in acquisitions However, those transactions also result in greater productivity gains, although we do not know whether the efficiency gain from those reallocations create sufficient value to the acquiring firms' shareholders to cover the premiums usually paid. The finding that highly valued acquirers do better in terms of productivity improvement suggests that there might be some economic rationale for high unexplained valuation - such as public firms with high valuations paying for future synergy or productivity gains.

Our results also have implications for corporate governance. We find that public firms make better acquisition decisions than private firms judged by efficiency gains despite of the potential conflicts due to separation of ownership and control in public firms. These finding thus suggest that gains from access to capital for productive firms may outweigh potential costs from the separation of ownership and control.

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Figure I Transactions Over Time

This figure plots the time series for the rate of acquisitions among U.S. manufacturing firms in the period of 1977 to 2004. The two lines present percentage of transactions made by public firms (diamond) and private firms (square), respectively. The bars show the number of industries having industry-wide merger waves. Industry merger waves are defined as years when the rate of transactions within an industry is at least one standard deviation above it sample mean rate.

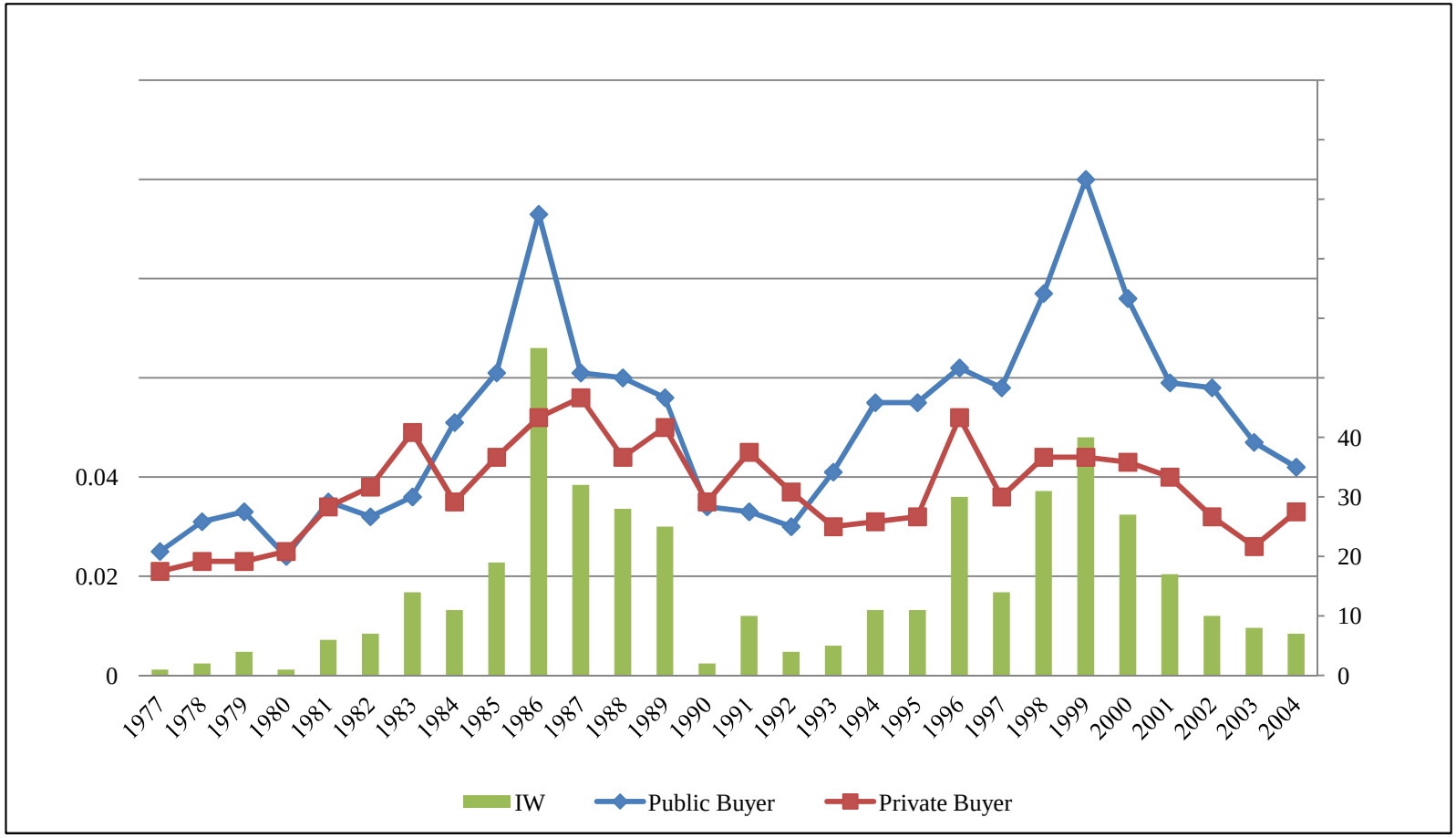

Table I: Summary Statistics - Public and Private Merger Waves

This table presents summary statistics on participation over the merger waves. Panel A presents the percentage of plants in transaction by the public status. We use the number of plants owned by public (private) firms as denominator to calculate the rate for public (private) buyers and sellers. Panel B shows the composition of all transactions and Panel C presents the summary statistics on the size and type of the transactions. D_Wave is an indicator variable that equals to 1 for aggregate merger wave years and zero otherwise. Aggregate wave years are years in which the percentage of plants traded is greater than one standard deviation above the aggregate mean. We classify all transactions into two categories: asset acquistion and mergers.

Panel A: Percentage of Plants in Transaction

D_Wave	Public Firms		Private Firms	
	Buyers	Sellers	Buyers	Sellers
0	4.16%	3.39%	3.74%	4.21%
1	7.41%	5.94%	5.06%	6.27%
Average	4.88%	3.95%	4.03%	4.66%

Panel B: Number of Transactions

Buyer	D_Wave = 0		D_Wave = 1	
Private	22,470	(65%)	8,374	(58%)
Public	11,892	(35%)	6,179	(42%)
Total	34,362		14,553	

Seller	D_Wave = 0		D_Wave = 1	
Private	24,127	(70%)	8,787	(60%)
Public	10,235	(30%)	5,766	(40%)
Total	34,362		14,553	

Transaction	D_Wave = 0		D_Wave = 1	
Public Buyer Public Seller	4,129	(12%)	2,726	(19%)
Public Buyer Private Seller	7,763	(23%)	3,453	(24%)
Private Buyer Public Seller	6,106	(18%)	3,040	(21%)
Private Buyer Private Seller	16,364	(48%)	5,334	(37%)
Total	34,362		14,553	

Panel C: Size and Type of Transactions

	Number of Plants Bought		Percent of Mergers	
Transaction	D_Wave=0	D_Wave=1	D_Wave=0	D_Wave=1
Public Buyer Public Seller	2.48	3.19	18%	26%
Public Buyer Private Seller	2.01	2.13	72%	78%
Private Buyer Public Seller	1.74	1.94	8%	11%
Private Buyer Private Seller	1.42	1.38	74%	74%
Average	1.67	1.84	58%	57%

Table IIA: Decision to Buy or Sell Assets

This table reports the estimated marginal effects(in %) from logit models. In Panel A, the dependent variable, D_Buy, equals to 1 if a firm buys at least one plant and zero otherwise. In Panel B, the dependent variable, D_Sell, equals to 1 if a firm sells at least one plant and 0 otherwise. Size is the log of total value of shipments (in 1987 dollars), and TFP is the total factor productivity. I_Tobinq is the industry Tobin's q and HERF measures the industry Herfindahl Index based on sales. Ind_UV is the average unexplained valuation based on all public firms in that industry. We calculate unexplained valuation (UV) using the procedure of Rhodes-Kropf, Robinson and Viswanathan (2004) as updated by Hoberg and Phillips (2010). Credit Spread is the spread between C&I loan rate and Fed Funds rate. S&P is the return of S&P Industrial Index. D_Wave is an indicator variable which equals 1 for wave years and zero for non-wave years. Column 2 and 5 are estimated using public firms and Column 3 and 6 are estimated using private firms. Column 4 and 7 reports the p-value for the difference between public and private firms which we estimate using the combined sample with interaction between the public status dummy and all other explanatory variables. We control for firm random effects. Robust standard errors allow clustering at the industry-year level and are reported in parentheses. *, ** and *** represent significance at 10%, 5%, and 1% level, respectively.

Panel A: Decision to Buy (Dependent Variable = D_Buy)

Variable	Public	Private	P-value for Difference	Public	Private	P-value for Difference
Size	0.425 ***	0.338 ***	<0.001	0.436 ***	0.335 ***	<0.001
	(0.040)	(0.010)		(0.040)	(0.010)	
TFP	0.300 ***	0.023 **	0.294	0.307 ***	0.024 **	0.308
	(0.080)	(0.010)		(0.080)	(0.010)	
I_Tobinq	-0.361 ***	-0.096 ***	0.037	-0.177	-0.072 ***	0.039
	(0.130)	(0.020)		(0.130)	(0.020)	
Ind_UV	0.022	0.049 **	0.223	-0.520 **	0.003	0.079
	(0.210)	(0.020)		(0.220)	(0.020)	
HERF	1.083	0.612 ***	0.143	2.131	0.701 ***	0.185
	(1.790)	(0.210)		(1.800)	(0.210)	
D_Wave	2.454 ***	0.182 ***	<0.001			
	(0.18)	(0.020)				
Credit Spread				-1.941 ***	-0.020	<0.001
				(0.220)	(0.030)	
S&P				3.096 ***	0.383 ***	0.978
				(0.510)	(0.060)	
Pr(D_Buy)	7.36%	1.75%		7.36%	1.75%	
Chi Square	385	6716		291	6600	
Number of Obs	99,121	420,944	520,065	99,121	420,944	520,065

Panel B: Decision to Sell (Dependent Variable = D_Sell)

Variable	Public	Private	P-value for Difference	Public	Private	P-value for Difference
Size	0.969 ***	1.091 ***	<0.001	0.963 ***	1.101 ***	<0.001
	(0.050)	(0.020)		(0.050)	(0.020)	
TFP	-0.813 ***	-0.169 ***	<0.001	-0.810 ***	-0.169 ***	<0.001
	(0.090)	(0.020)		(0.090)	(0.020)	
I_Tobinq	-0.602 ***	-0.105 ***	0.185	-0.445 ***	-0.083 **	0.478
	(0.130)	(0.030)		(0.130)	(0.030)	
Ind_UV	1.688 ***	0.330 ***	<0.001	1.349 ***	0.221 ***	0.001
	(0.230)	(0.050)		(0.240)	(0.050)	
HERF	-6.150 ***	1.973 ***	<0.001	-5.656 ***	2.005 ***	<0.001
	(2.050)	(0.470)		(2.050)	(0.470)	
D_Wave	3.64 ***	0.4410 ***	<0.001			
	(0.20)	(0.040)				
Credit Spread				-3.905 ***	-0.350 ***	<0.001
				(0.250)	(0.050)	
S&P				0.294	0.834 ***	<0.001
				(0.560)	(0.120)	
Pr(D_Sell)	7.91%	4.08%		7.91%	4.08%	
Chi Square	821	5191		663	5279	
Number of Obs	107,645	557,470	665,115	107,645	557,470	665,115

Table IIB: Decision to Buy or Sell Assets (OLS)

This table reports the estimated coefficients from OLS (multiplied by 100). In Panel A, the dependent variable, D_Buy, equals to 1 if a firm buys at least one plant and zero otherwise. In Panel B, the dependent variable, D_Sell, equals to 1 if a firm sells at least one plant and 0 otherwise. Size is the log of total value of shipments (in 1987 dollars), and TFP is the total factor productivity. I_Tobinq is the industry Tobin's q and HERF measures the industry Herfindahl Index based on sales. Credit Spread is the spread between C&I loan rate and Fed Funds rate. S&P is the return of S&P Industrial Index. D_Wave is an indicator variable which equals 1 for wave years and zero for non-wave years. Column 2 and 5 are estimated using public firms and Column 3 and 6 are estimated using private firms. Column 4 and 7 reports the p-value for the difference between public and private firms which we estimate using the combined sample with interaction between the public status dummy and all other explanatory variables. We control for firm random effects. Robust standard errors allow clustering at the industry-year level and are reported in parentheses. *, ** and *** represent significance at 10%, 5%, and 1% level, respectively.

Panel A: Decision to Buy (Dependent Variable = D_Buy)

Variable	Public	Private	P-value for Difference	Public	Private	P-value for Difference
Size	0.050	1.080 ***	<0.001	0.070	1.090 ***	<0.001
	(0.100)	(0.000)		(0.100)	(0.000)	
TFP	0.420 ***	-0.010	<0.001	0.430 ***	-0.010	<0.001
	(0.100)	(0.000)		(0.100)	(0.000)	
I_Tobinq	-0.790 ***	-0.310 ***	0.163	-0.470 **	-0.250 ***	0.985
	(0.200)	(0.000)		(0.200)	(0.000)	
Ind_UV	0.050	0.050	0.806	-0.740 ***	-0.070	0.017
	(0.300)	(0.100)		(0.300)	(0.100)	
HERF	7.500 **	3.070 ***	0.891	9.570 ***	3.170 ***	0.669
	(3.200)	(0.700)		(3.200)	(0.700)	
D_Wave	2.730 ***	0.390 ***	<0.001			
	(0.20)	(0.100)				
Credit Spread				-1.520 ***	0.060	<0.001
				(0.200)	(0.100)	
S&P				5.180 ***	1.120 ***	<0.001
				(0.600)	(0.100)	
Pr(D_Buy)				7.36%	1.75%	
R-Square	0.3%	2.9%		0.2%	2.9%	
Number of Obs	99,121	420,944	520,065	99,121	420,944	520,065

Panel B: Decision to Sell (Dependent Variable = D_Sell)

Variable	Public	Private	P-value for	Public	Private	P-value for
Size	1.230 ***	2.440 ***	<0.001	1.210 ***	2.440 ***	<0.001
	(0.100)	(0.000)		(0.100)	(0.000)	
TFP	-0.900 ***	-0.510 ***	<0.001	-0.890 ***	-0.510 ***	<0.001
	(0.100)	(0.000)		(0.100)	(0.000)	
I_Tobinq	0.110	0.340 ***	0.441	0.400 **	0.450 ***	0.079
	(0.200)	(0.100)		(0.200)	(0.100)	
Ind_UV	2.010 ***	0.980 ***	0.002	1.630 ***	0.890 ***	0.022
	(0.300)	(0.100)		(0.300)	(0.100)	
HERF	-2.520	6.630 ***	0.327	-1.550	6.720 ***	0.466
	(2.700)	(1.200)		(2.700)	(1.200)	
D_Wave	4.28 ***	1.2300 ***	<0.001			
	(0.20)	(0.100)				
Credit Spread				-4.750 ***	-1.130 ***	<0.001
				(0.200)	(0.100)	
S&P				-1.560 ***	-0.620 ***	0.003
				(0.600)	(0.200)	
Pr(D_Sell)				7.91%	4.08%	
R-Square	0.8%	1.3%		0.6%	1.3%	
Number of Obs	107,645	557,470	665115	107,645	557,470	665,115

Table III: Economic Significance: Decision to Buy or Sell and Credit Spreads

This table shows the estimated probabilities of purchases and sales for public and private firms at the 10th, 25th, 50th, 75th, and 90th percentile for credit spread and on- and off-the-wave. We compute the estimated probabilities using coefficients from the logit regression reported in Table 2A. Throughout, all other variables are held at the sample median for respective sample (public and private firms).

Panel A: Probability of Purchases

	Credit Spread					D_Wave	
	p10	p25	p50	p75	p90	0	1
(1) Public firms	6.23%	5.80%	5.42%	5.22%	4.84%	4.81%	7.29%
(2) Private firms	0.50%	0.49%	0.49%	0.49%	0.48%	0.45%	0.59%
(3) Private firms using medians of data from public firms	4.05%	4.02%	4.00%	3.99%	3.96%	3.68%	4.74%
Ratio (unadjusted): (2)/(1)	0.08	0.08	0.09	0.09	0.10	0.09	0.08
Ratio (adjusted for size): (3)/(1)	0.65	0.69	0.74	0.76	0.82	0.77	0.65

Panel B: Probability of Sales

	Credit Spread					D_Wave	
	p10	p25	p50	p75	p90	0	1
(1) Public firms	8.34%	7.40%	6.62%	6.23%	5.49%	5.80%	9.48%
(2) Private firms	2.34%	2.27%	2.20%	2.17%	2.10%	2.04%	2.45%
(3) Private firms using medians of data from public firms	5.26%	5.11%	4.97%	4.90%	4.75%	4.63%	5.52%
Ratio (unadjusted): (2)/(1)	0.28	0.31	0.33	0.35	0.38	0.35	0.26
Ratio (adjusted for size): (3)/(1)	0.63	0.69	0.75	0.79	0.87	0.80	0.58

Table IV: Public Firms' Decisions to Buy or Sell Assets

This table reports the estimated marginal effects(in %) from logit models using public firms only. In Panel A, the dependent variable, D_Buy, equals to 1 if a firm buys at least one plant and zero otherwise. In Panel B, the dependent variable, D_Sell, equals to 1 if a firm sells at least one plant and 0 otherwise. Size is the log of total value of shipments (in 1987 dollars), and TFP is the total factor productivity. I_Tobinq is the industry Tobin's q and HERF measures the industry Herfindahl Index based on sales. Credit Spread is the spread between C&I loan rate and Fed Funds rate. S&P is the return of S&P Industrial Index. D_Wave is an indicator variable which equals 1 for wave years and zero for non-wave years. We calculate unexplained valuation (UV) using the procedure of Rhodes-Kropf, Robinson and Viswanathan (2004) as updated by Hoberg and Phillips (2010). Ret measures the annualized equity return and Illiq measures the Amihud Liquidity. For all three variables (UV, Ret and Illiq), we compute industry average (based on 3-digit SIC codes) and the firm-level de-meaned variable. We control for firm random effects. Robust standard errors allow clustering at the industry-year level and are reported in parentheses. *, ** and *** represent significance at 10%, 5%, and 1% level, respectively.

	Panel A: D_Buy				Panel B: D_Sell			
Variable	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Size	0.422 ***	0.131 **	0.435 ***	0.128 **	0.872 ***	0.703 ***	0.867 ***	0.690 ***
	(0.050)	(0.060)	(0.050)	(0.060)	(0.060)	(0.070)	(0.060)	(0.070)
TFP	0.255 **	0.208 **	0.275 ***	0.220 **	-0.844 ***	-0.854 ***	-0.829 ***	-0.842 ***
	(0.100)	(0.100)	(0.100)	(0.100)	(0.110)	(0.110)	(0.110)	(0.110)
I_Tobinq	-0.276 *	-0.346 **	-0.091	-0.197	-0.592 ***	-0.619 ***	-0.492 ***	-0.548 ***
	(0.160)	(0.160)	(0.160)	(0.160)	(0.160)	(0.160)	(0.160)	(0.160)
HERF	3.668	3.243	4.350 *	3.599	-6.926 ***	-6.273 **	-6.485 **	-6.195 **
	(2.300)	(2.290)	(2.300)	(2.290)	(2.570)	(2.550)	(2.570)	(2.560)
D_Wave	2.316 ***	2.107 ***			3.060 ***	2.787 ***		
	(0.220)	(0.230)			(0.240)	(0.250)		
Credit Spread			-1.619 ***	-1.580 ***			-3.575 ***	-3.251 ***
			(0.280)	(0.290)			(0.310)	(0.330)
S&P			2.805 ***	3.335 ***			1.431 **	1.337 *
			(0.630)	(0.650)			(0.690)	(0.750)
Firm UV	1.251 ***	0.659 ***	1.091 ***	2.699 ***	0.481 ***	0.276	0.264	0.150
	(0.170)	(0.210)	(0.170)	(0.970)	(0.160)	(0.200)	(0.160)	(1.000)
Ind_UV	0.602 **	0.315	-0.009	-0.336	1.528 ***	1.540 ***	0.997 ***	1.067 ***
	(0.280)	(0.280)	(0.290)	(0.300)	(0.290)	(0.290)	(0.300)	(0.300)
Firm Ret		0.212		0.459 **		-0.988 ***		-0.804 ***
		(0.210)		(0.210)		(0.240)		(0.240)
Ind. Ret		0.195		0.191		-1.282 ***		-1.223 ***
		(0.370)		(0.370)		(0.400)		(0.420)
Firm Illiq		-2.133 ***		-2.201 ***		-2.300 ***		-2.320 ***
		(0.280)		(0.280)		(0.240)		(0.240)
Ind Illiq		-2.615 ***		-2.867 ***		-2.358 ***		-2.556 ***
		(0.340)		(0.340)		(0.320)		(0.320)
Chi Square	291	333	220	295	425	515	373	470
N	61,252	61,252	61,252	61,252	66,501	66,501	66,501	66,501

Table V: Decisions by Credit Rating and Liquidity Groups

This table reports the estimated marginal effects (in %) from logit models on decision to buy (Panel A) or sell assets (Panel B) by credit rating status and liquidity groups. The dependent variable, D_Buy (D_Sell), equals to 1 if a firm buys (sells) at least one plant and 0 otherwise. "No Rating" refers to public firms that are not rated, "Low Rating" refers to public firms that have BBB or below credit ratings, and "High Rating" refers to public firms that have above BBB ratings. For illiquidity, we separate firms into three equal-sized group based on Amihud Illiquidity measure. Size is the log of total value of shipments (in 1987 dollars). TFP is the total factor productivity. We calculate Unexplained Valuation (Firm UV) using the procedure in Rhodes-Kropf, Robinson and Viswanathan (2004) as updated by Hoberg and Phillips (2010). I_Tobinq is the industry Tobin's q and HERF measures the industry Herfindahl Index based on sales. Credit Spread is the spread between C&I loan rate and Fed Funds rate. S&P is the return of S&P Industrial Index. All explanatory variables are lagged. We control for firm random effects. Robust standard errors are computed allowing clustering at the industry-year level and reported in parentheses. *, ** and *** represent significance at 10%, 5%, and 1% level, respectively. a, b, c represent significance level at 1%, 5% and 10%, repectively for testing the difference between the Low or High Rating group and the No Rating group or between the Medium or High Liquidity Group and Low Liquidity Group.

Panel A: Decisions to Buy Assets

	Credit Rating Groups			Liquidity Groups		
Variable	No Rating	Low Rating	High Rating	Low Liquidity	Medium Liquidity	High Liquidity
Size	0.460 ***	-0.538 ***[a]	-0.405 **[a]	0.558 ***	-0.374 ***[a]	-0.310 **[a]
	(0.06)	(0.16)	(0.16)	(0.09)	(0.12)	(0.15)
TFP	0.072	0.251	0.482 **	0.069	-0.035	0.352 *
	(0.11)	(0.27)	(0.21)	(0.13)	(0.18)	(0.20)
Firm UV	0.843 ***	1.259 ***	0.115 [b]	0.898 ***	0.040 [a]	0.365 [b]
	(0.16)	(0.38)	(0.42)	(0.20)	(0.30)	(0.37)
I_Tobinq	-0.692 ***	-0.121 [b]	0.545 *[a]	-0.702 ***	-0.901 ***	0.132 [b]
	(0.17)	(0.37)	(0.29)	(0.23)	(0.28)	(0.25)
HERF	-2.982	17.264 ***[a]	8.229 *[b]	-1.583	-0.950	12.978 ***[b]
	(2.36)	(5.36)	(4.91)	(2.79)	(3.78)	(4.55)
Credit Spread	-1.218 ***	-4.213 ***[a]	-1.742 ***	-0.847 **	-2.619 ***[c]	-1.063 **
	(0.28)	(0.76)	(0.52)	(0.35)	(0.48)	(0.57)
S&P	2.499 ***	1.962	1.990 *	1.483	2.039 *	4.655 ***
	(0.75)	(1.49)	(1.19)	(0.95)	(1.11)	(1.12)
Pr (D_Buy)	6.10%	8.89%	9.37%	5.07%	7.75%	9.30%
Chi Square	152	79	40	82	55	46
Number of Obs	43,230	12,240	22,424	19,796	21,220	22,257

Panel B: Decisions to Sell Assets

	Credit Rating Groups			Liquidity Groups		
Variable	No Rating	Low Rating	High Rating	Low Liquidity	Medium Liquidity	High Liquidity
Size	0.936 ***	0.723 ***[b]	0.686 ***[a]	0.443 ***	0.453 ***	0.722 ***
	(0.07)	(0.14)	(0.12)	(0.09)	(0.10)	(0.12)
TFP	-0.638 ***	-0.899 ***	-1.160 ***[b]	-0.381 ***	-1.046 ***	-1.199 ***
	(0.11)	(0.25)	(0.21)	(0.13)	(0.17)	(0.22)
Firm UV	0.647 ***	0.948 ***	0.383	-0.142	-0.444	0.510
	(0.16)	(0.36)	(0.42)	(0.18)	(0.29)	(0.43)
I_Tobinq	-0.139	-0.082	0.194	-0.001	-0.307	-0.791 ***
	(0.16)	(0.35)	(0.28)	(0.18)	(0.25)	(0.30)
HERF	-5.989 **	-4.197	-2.174	-1.480	-5.554	-8.307
	(2.59)	(5.45)	(5.06)	(2.67)	(3.73)	(5.73)
Credit Spread	-2.837 ***	-5.016 ***[b]	-4.021 ***	-1.426 ***	-2.607 ***	-4.865 ***
	(0.30)	(0.72)	(0.58)	(0.35)	(0.46)	(0.72)
S&P	0.463	-0.393	2.899 **	0.401	1.308	6.050 ***[b]
	(0.77)	(1.44)	(1.25)	(0.85)	(1.11)	(1.34)
Pr (D_Sell)	7.47%	8.05%	8.87%	4.63%	7.08%	10.35%
Chi Square	284	92	128	49	84	133
Number of Obs	50,337	13,606	24,139	23,058	23,552	23,375

Table VI: Predicting Public Status

This table reports the estimated marginal effects(in %) of probit models predicting the public status. The dependent variable, D_Pub, is equal to 1 for public firms and 0 for private firms. TFP0 and TFP02 represent the linear and square terms of initial TFP, respectively, and Size0 and Size02 measure the linear and square terms of initial size, respectively. CDTVS25 measures the change in long-run shipments in the industry (in 25 years). I_CapEx, I_Tobinq and HERF represent the industry capital expenditure, Tobin's q, and Herfindahl Index (based on sales), respectively. Small Firms measures the percentage of small firms(with less than 50 employees) in the industry. Persistence measures the persistence of TFP within the industry based on rank correlation. Ln(N_IPO) is the log number of annual IPOs. Q2(Size0) - Q5(Size0) are indicators for the second to fifth quintile based on Size0, respectively. For column (1) to (3), we only include firms that are at least five years after their birth, and for column (4) to (6), we only include firms that are ten years after their birth. All time-varying variables are lagged. Robust standard errors are computed allowing clustering at the industry level. *, ** and *** represent significance at 10%, 5%, and 1% level, respectively.

Dependent Variable:	Five Years after Birth			Ten Years after Birth		
D_Pub	(1)	(2)	(3)	(4)	(5)	(6)
TFP0	0.29	1.98 ***	-0.89	0.52	2.90 ***	1.00
	(0.20)	(0.30)	(0.90)	(0.40)	(0.50)	(1.50)
TFP02	11.48 ***	10.04 ***		17.16 ***	15.58 ***	
	(0.60)	(0.60)		(1.00)	(1.00)	
SIZE0	1.80 ***	1.25 ***		1.90 **	1.46 *	
	(0.50)	(0.50)		(0.80)	(0.80)	
SIZE02	0.18 ***	0.19 ***		0.22 ***	0.22 ***	
	(0.00)	(0.00)		(0.00)	(0.00)	
CDTVS25	0.31 ***	0.21 ***	0.22 ***	0.42 ***	0.28 ***	0.28 ***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
I_CapEx		12.08 ***	11.72 ***		19.91 ***	19.95 ***
		(0.70)	(0.70)		(1.30)	(1.30)
I_Tobinq		9.56 ***	10.92 ***		14.23 ***	14.94 ***
		(1.40)	(1.40)		(2.30)	(2.30)
HERF		7.20 ***	7.78 ***		4.13 ***	4.37 ***
		(0.70)	(0.70)		(1.10)	(1.20)
Small Firms		-12.41 ***	-14.80 ***		-16.79 ***	-19.41 ***
		(0.60)	(0.60)		(1.00)	(1.00)
Persistence		1.70 ***	1.83 ***		1.94 ***	2.09 ***
		(0.10)	(0.10)		(0.10)	(0.10)
Ln(N_IPO)		0.24 ***	0.06		0.42 ***	0.36 ***
		(0.10)	(0.10)		(0.10)	(0.10)
Q2(Size0)			1.43 ***			1.42 ***
			(0.30)			(0.50)
Q3(Size0)			5.70 ***			6.72 ***
			(0.40)			(0.60)
Q4(Size0)			10.86 ***			11.95 ***
			(0.40)			(0.60)
Q5(Size0)			30.05 ***			30.51 ***
			(0.60)			(0.80)
Q2(Size0)*TFP			-2.99 **			-6.12 ***
			(1.20)			(2.00)
Q3(Size0)*TFP			-0.75			-3.24 *
			(1.10)			(1.80)
Q4(Size0)*TFP			1.45			0.21
			(1.00)			(1.70)
Q5(Size0)*TFP			5.62 ***			4.83 ***
			(1.00)			(1.60)
R-square	0.180	0.191	0.169	0.165	0.178	0.167
Number of Obs	187,581	187,581	187,581	88,934	88,934	88,934

Table VII : Decisions to Buy or Sell Assets - Propensity Score Matching

This table shows the difference in estimated probabilities in purchases (Panle A) and sales(Panel B) between public and private firms before and after matching. We match firms based on the predicted probability of being public using the specification in Table VI column 1. The Treatment group includes all firm-year observations for public firms and the Control group includes all firm-year observations for private firms.

Panel A: Probability of Purchases

	All	Off-the-Wave (D_Wave = 0)	On-the-Wave (D_Wave = 1)
Public firms	5.37%	4.83%	6.47%
Private firms	1.11%	1.03%	1.28%
Difference (w/o matching)	4.27%	3.80%	5.19%
Difference (w/ matching)	3.10%	2.56%	4.00%
% Explained by matching	0.27	0.33	0.23
# of Treatment	16,656	11,138	5,518
# of Control	143,576	99,735	43,841
T-stat (from bootstrap)	(16.36)	(13.31)	(9.64)

Panel B: Probability of Sales

	All	Off-the-Wave (GW = 0)	On-the-Wave (GW = 1)
Public firms	6.63%	5.88%	8.16%
Private firms	3.42%	3.21%	3.90%
Difference (w/o matching)	3.22%	2.68%	4.26%
Difference (w/ matching)	0.30%	0.03%	0.85%
% Explained by matching	0.91	0.99	0.80
# Treatment	16,656	11,138	5,518
# Control	143,576	99,735	43,841
T-stat (from bootstrap)	(1.07)	(0.13)	(1.91)

Table VIII: Changes in Productivity

This table reports regression estimates on changes of Total Factor Productivity (TFP) on the plant level. D_Sale is an indicator variable that equals to 1 if the plant is sold and 0 otherwise. D_Wave is an indicator variable which equals to 1 for aggregate merger wave years and 0 otherwise. PrvtoPrv indicates transactions between private firms, and PubtoPub indicates transactions between public firms. PrvtoPub indicates transactions between private sellers and public buyers, and PubtoPrv indicates transactions between public buyers and private sellers. Lambda is estimated as the inverse Mills Ratio based on a first-stage selection model in which we predict the probability of being sold (based on Table IIA Panel B). TFP and Ln(output) measure the total factor productivity and the log of output level for the plant, respectively. TFP(-1, 1) is the change of TFP from t-1 to t+1 with t being the current year. Similarly, TFP(-1,2) and TFP(-1,3) measure change of TFP from t-1 to t+2 and t+3, respectively.Industry (based on 3-digit SIC) fixed effects are included. The robust standard errors allow clustering at the industry-year level and are reported in parentheses. *, ** and *** represent significance at 10%, 5%, and 1% level, respectively.

Panel A

Dependent Variable	TFP (-1,1)		TFP(-1,2)		TFP(-1,3)	
Variable Name	(1)	(2)	(3)	(4)	(5)	(6)
D_Sale	0.020 ***	0.014 ***	0.034 ***	0.028 ***	0.028 ***	0.021 ***
	(0.00)	(0.01)	(0.01)	(0.01)	(0.00)	(0.01)
D_Wave		-0.005 *		-0.009 ***		-0.003
		(0.00)		(0.00)		(0.00)
D_Sale * D_Wave		0.021 ***		0.020 **		0.024 **
		(0.01)		(0.01)		(0.01)
Lamda	-0.065 ***	-0.066 ***	-0.074 ***	-0.078 ***	-0.056 **	-0.057 *
	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)
TFP	-0.019 ***	-0.019 ***	-0.032 ***	-0.032 ***	-0.036 ***	-0.036 ***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Ln(Output)	0.054 ***	0.054 ***	0.064 ***	0.064 ***	0.066 ***	0.066 ***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Constant	-0.389 ***	-0.384 ***	-0.475 ***	-0.467 ***	-0.543 ***	-0.541 ***
	(0.05)	(0.05)	(0.06)	(0.06)	(0.07)	(0.07)
Number of Obs	745,940	745,940	624,899	624,899	513,743	513,743
R-Square	1.46%	1.46%	1.70%	1.70%	1.61%	1.61%

Panel B

Dependent Variable	TFP (-1,1)		TFP(-1,2)		TFP(-1,3)	
Variable Name	(1)	(2)	(3)	(4)	(5)	(6)
PrvtoPrv	0.004	0.002	0.013 **	0.006	0.003	-0.001
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
PrvtoPub	0.020 **	0.010	0.023 **	0.020 *	0.028 ***	0.026 **
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
PubtoPrv	0.046 ***	0.043 ***	0.067 ***	0.072 ***	0.043 ***	0.037 **
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
PubtoPub	0.034 ***	0.023	0.066 ***	0.058 ***	0.071 ***	0.055 ***
	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)
D_Wave		-0.005 *		-0.009 ***		-0.003
		(0.00)		(0.00)		(0.00)
PrvtoPrv * D_Wave		0.008		0.029		0.014
		(0.02)		(0.02)		(0.01)
PrvtoPub * D_Wave		0.032 *		0.009		0.007
		(0.02)		(0.02)		(0.02)
PubtoPrv * D_Wave		0.009		-0.012		0.017
		(0.02)		(0.02)		(0.02)
PubtoPub * D_Wave		0.028 *		0.024		0.039 *
		(0.02)		(0.02)		(0.02)
Lambda	-0.064 ***	-0.066 ***	-0.075 ***	-0.078 ***	-0.056 **	-0.057 *
	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)
TFP	-0.019 ***	-0.019 ***	-0.032 ***	-0.032 ***	-0.036 ***	-0.036 ***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Ln(Output)	0.054 ***	0.054 ***	0.064 ***	0.064 ***	0.066 ***	0.066 ***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Constant	-0.389 ***	-0.384 ***	-0.474 ***	-0.465 ***	-0.542 ***	-0.540 ***
	(0.05)	(0.05)	(0.06)	(0.06)	(0.07)	(0.07)
Number of Obs	745,940	745,940	624,899	624,899	513,743	513,743
R-Square	1.46%	1.46%	1.70%	1.71%	1.62%	1.62%

Table IX: Change in Productivity and Market Valuation

This table reports the changes in productivity for transacted plants based on buyer's valuation. Prv Buyer and Pub Buyer are indicator variables for private and public acquirer, respectively. D_UV is an indicator variable that equals 1 if the acquirer has higher than average unexplained valuation (based on all public firms in that year) and 0 otherwise. We calculate unexplained valuation (UV) using the procedure of Rhodes-Kropf, Robinson and Viswanathan (2004) as updated by Hoberg and Phillips (2010). D_Sale is an indicator variable that equals to 1 if a plant is sold and 0 otherwise. D_Wave is an indicator variable that equals to 1 for aggregate wave years and 0 otherwise. Lambda is the estimated inverse Mills Ratio based on a first-stage selection model in which we predict the probability of being sold (based on Table IIA Panel B). TFP and Ln(output) measure the total factor productivity and the log of output level for the plant, respectively. Industry (based on 3-digit SIC) fixed effects are included. The robust standard errors allow clustering at the industry-year level and are reported in parentheses. *, ** and *** represent significance at 10%, 5%, and 1% level, respectively.

Dependent Variable	TFP (-1,1)		TFP(-1,2)		TFP(-1,3)	
Variable Name	(1)	(2)	(3)	(4)	(5)	(6)
D_Sale * Prv Buyer	0.020 ***	0.016 ***	0.031 ***	0.027 ***	0.021 ***	0.014 **
	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
D_Sale * Pub Buyer * (D_UV=0)	0.015	0.004	0.036 ***	0.035 **	0.041 ***	0.039 **
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
D_Sale * Pub Buyer * (D_UV=1)	0.028 ***	0.013	0.048 ***	0.029 **	0.050 ***	0.038 **
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
D_Wave		-0.005 ***		-0.009 ***		-0.003
		(0.00)		(0.00)		(0.00)
D_Sale * Prv Buyer * D_Wave		0.013		0.015		0.023 *
		(0.01)		(0.01)		(0.01)
D_Sale * Pub Buyer * (D_UV=0)* D_Wave		0.035		0.005		0.008
		(0.02)		(0.03)		(0.03)
D_Sale * Pub Buyer * (D_UV=1) * D_Wave		0.038 **		0.048 **		0.029
		(0.02)		(0.02)		(0.03)
Lambda	-0.065 ***	-0.066 ***	-0.074 ***	-0.078 ***	-0.056 ***	-0.056 ***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
TFP	-0.019 ***	-0.019 ***	-0.032 ***	-0.032 ***	-0.036 ***	-0.036 ***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Ln(Output)	0.054 ***	0.054 ***	0.064 ***	0.064 ***	0.066 ***	0.066 ***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Constant	-0.389 ***	-0.384 ***	-0.475 ***	-0.467 ***	-0.544 ***	-0.542 ***
	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)
Number of Obs	745,940	745,940	624,899	624,899	513,743	513,743
Numer of Clustering	1,915	1,915	1,872	1,872	1,799	1,799
R-Square	1.46%	1.46%	1.70%	1.70%	1.61%	1.61%

Internet Appendix to "Private and Public Merger Waves"*

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*Citation format: Vojislav Maksimovic, Gordon Phillips, and Liu Yang XXXX, Internet Appendix to "Private and Public Merger Waves", *Journal of Finance XX*, XXX-XXX, http://www.afajof.org/IA/2012asp. Please note: Wiley-Blackwell is not responsible for the content or functionality of any supporting information supplied by the authors. Any queries (other than missing material) should be directed to the authors of the article.

Appendix Table I: Decision to Buy Assets - Robustness Checks (Public Firms Only)

This table reports the estimated odds ratio from logit models using public firms only. In (1) and (2), the dependent variable equals to 1 if a firm buys at least one plant and the seller continues to exist after the acquisition, 2 if the seller exits completely (i.e. mergers), and 0 otherwise. In (3) and (4), the dependent variable equals to 1(2) if a firm buys at least one plant in the existing (new) industry, and zero otherwise. Size is the log of total value of shipments (in 1987 dollars), and TFP is the total factor productivity. I_Tobinq is the industry Tobin's q and HERF measures the industry Herfindahl Index based on sales. Credit Spread is the spread between C&I loan rate and Fed Funds rate. S&P is the return of S&P Industrial Index. D_Wave is an indicator variable which equals 1 for wave years and 0 for non-wave years. We calculate unexplained valuation (misvaluation) using the procedure of Rhodes-Kropf, Robinson and Viswanathan (2004) as updated by Hoberg and Phillips (2010). Ret measures the annualized equity return and Illiq measures the Amihud Liquidity. For all three variables (MISV, Ret and Illiq), we compute industry average (based on 3-digit SIC codes) and the firm-level de-meaned variable. We control for firm random effects. Robust standard errors allow clustering at the industry-year level and are reported in parentheses. *, ** and *** represent significance at 10%, 5%, and 1% level, respectively. a, b, c represent significance tests of Partial Firm (Within industry) purchases versus Full Firm (Diversifying) group at the 1%, 5%, and 10% level, respectively.

Variable	(1)		(2)		(3)		(4)	
	Partial	Full	Partial	Full	Within	Divers	Within	Divers
Size	1.052 ***	1.008	1.052 ***	1.008	1.112 ***	0.900 ***, [a]	1.113 ***	0.898 ***, [a]
	(0.018)	(0.016)	(0.018)	(0.016)	(0.017)	(0.016)	(0.018)	(0.016)
TFP	1.028	1.062 **	1.030	1.066 **	1.044 *	1.052	1.047 *	1.054 *
	(0.029)	(0.029)	(0.029)	(0.029)	(0.026)	(0.033)	(0.026)	(0.033)
I_Tobinq	0.863 ***	0.972 [b]	0.885 ***	1.012 [a]	0.992	0.781 ***, [a]	1.025	0.808 ***, [a]
	(0.038)	(0.039)	(0.039)	(0.041)	(0.037)	(0.041)	(0.038)	(0.043)
HERF	3.205 *	1.251	3.427 **	1.348	0.300 **	17.882 ***	0.326 *	18.829 ***
	(1.911)	(0.757)	(2.047)	(0.817)	(0.184)	(10.599)	(0.200)	(11.191)
D_Wave	1.311 ***	1.630 ***, [a]			1.459 ***	1.495 ***		
	(0.070)	(0.080)			(0.067)	(0.089)		
Credit Spread			0.832 **	0.676 ***			0.724 ***	0.791 ***
			(0.065)	(0.053)			(0.051)	(0.071)
S&P			2.210 ***	1.629 ***			1.619 ***	2.489 ***
			(0.413)	(0.283)			(0.260)	(0.527)
Firm UV	1.173 ***	1.243 ***	1.117 **	1.185 ***	1.243 ***	1.145 **	1.188 ***	1.084
	(0.059)	(0.059)	(0.058)	(0.058)	(0.056)	(0.064)	(0.054)	(0.062)
Ind UV	1.129	1.024	0.985	0.890	1.191 **	0.887 [b]	1.051	0.751 ***, [a]
	(0.091)	(0.080)	(0.083)	(0.072)	(0.085)	(0.082)	(0.078)	(0.072)
Firm Ret	0.984	1.108 *	1.044	1.164 ***	1.046	1.067	1.100 *	1.133 *
	(0.062)	(0.061)	(0.066)	(0.064)	(0.056)	(0.070)	(0.059)	(0.073)
Ind. Ret	1.137	0.956	1.189	0.920	1.155	0.859	1.156 ***	0.862
	(0.122)	(0.097)	(0.129)	(0.095)	(0.107)	(0.106)	(0.109)	(0.107)
Firm Illiq	0.605 ***	0.664 ***	0.597 ***	0.655 ***	0.619 ***	0.630 ***	0.614 ***	0.616 ***
	(0.053)	(0.050)	(0.053)	(0.049)	(0.050)	(0.051)	(0.050)	(0.050)
Ind Illiq	0.514 ***	0.637 ***	0.494 ***	0.596 ***	0.517 ***	0.645 ***	0.493 ***	0.605 ***
	(0.053)	(0.058)	(0.051)	(0.054)	(0.049)	(0.065)	(0.047)	(0.061)
Pr(D_Buy)	3.47%	3.88%	3.47%	3.88%	4.73%	2.62%	4.73%	2.62%
LL	-18,506		-18,528		-18,230		-18,506	
N	61,252		61,252		61,252		61,252	

Appendix Table IIA: Decision to Buy or Sell Assets w/ Endogenous Selection

This table reports the estimated marginal effects (in %) of logit models on decisions to buy (Panel A) or to sell assets (Panel B) by quartiles in predicted probability of being public. Q1 includes firms with the lowest probability of being public and Q4 includes firms with the highest probability of being public. In (5) and (6), we further break firms in Q4 based on their actual public status. Q4Pub includes public firms in the highest quartile and Q4Prv includes private firms in the highest quartile. The predicted probability of being public is estimated based on column 1 in Table 2. In Panel A, the dependent variable, D_Buy, equals to 1 if a firm sells at least one plant in the next year and 0 otherwise, and in Panel B, the depependent variable, D_Sell, equals to 1 if a firm buys at least one plant in the next year and 0 otherwise.We control for firm random effects. Robust standard errors allow clustering at the industry-year level and are reported in parentheses. *, ** and *** represent significance at 10%, 5%, and 1% level, respectively. a, b, c represent significance level of comparing coefficient between other quartiles and Quartile 1 at the 1%, 5%, and 10% level, respectively which we estimate using the combined sample with interaction between the quartile dummy and all other explanatory variables.

Panel A: Decision to Buy Assets

	(1)	(2)	(3)	(4)	(5)	(6)
Variable	Q1	Q2	Q3	Q4	Q4Pub	Q4Prv
Firm Size	0.078 ***	0.143 ***,a	0.431 ***,a	0.580 ***,a	0.697 ***	0.440 ***
	(0.020)	(0.020)	(0.040)	(0.040)	(0.110)	(0.040)
TFP	0.000	-0.005	-0.022	-0.026	0.057	-0.062
	(0.010)	(0.010)	(0.030)	(0.050)	(0.160)	(0.050)
I_Tobinq	-0.016	0.006	-0.144 ***	-0.139 *	-0.128	-0.172 **
	(0.010)	(0.020)	(0.050)	(0.070)	(0.210)	(0.070)
Ind_UV	-0.001	0.039	0.023	0.030	-0.415	0.164
	(0.020)	(0.030)	(0.080)	(0.150)	(0.490)	(0.130)
HERF	-0.157	0.071	-1.068	-2.852 **	-10.994 **	-0.906
	(0.210)	(0.310)	(0.800)	(1.290)	(4.440)	(1.080)
Credit Spread	0.014	-0.042	0.112	-0.568 ***,c	-2.213 ***	-0.161
	(0.020)	(0.050)	(0.110)	(0.200)	(0.690)	(0.180)
S&P	0.078 *	0.234 ***	0.623 ***	0.786 ***	1.537 *	0.430
	(0.040)	(0.080)	(0.180)	(0.280)	(0.900)	(0.260)
Chi Square	255	366	354	339	74	185
Number of Obs	36,216	37,111	38,304	39,288	10718	28570

Panel B: Decision to Sell Assets

	(1)	(2)	(3)	(4)	(5)	(6)
Variable	Q1	Q2	Q3	Q4	Q4Pub	Q4Prv
Firm Size	0.520 ***	1.054 ***	0.922 ***,a	0.768 ***,a	0.436 ***	0.996 ***
	(0.070)	(0.080)	(0.090)	(0.090)	(0.150)	(0.110)
TFP	-0.145 ***	-0.191 ***	-0.258 ***	-0.364 ***	-0.477 **	-0.304 **
	(0.050)	(0.070)	(0.090)	(0.130)	(0.240)	(0.150)
I_Tobinq	-0.117	-0.034	-0.047	-0.082	-0.182	0.047
	(0.080)	(0.110)	(0.130)	(0.170)	(0.300)	(0.190)
Ind_UV	0.139	-0.040	-0.178	-0.390 c	0.238	-0.607
	(0.110)	(0.180)	(0.220)	(0.360)	(0.720)	(0.400)
HERF	2.474 **	0.861	0.384 a	-10.205 ***,a	-10.610 *	-9.091 ***
	(1.000)	(1.580)	(2.040)	(2.970)	(5.940)	(3.290)
Credit Spread	-0.023	-0.228	-0.946 ***	-3.384 ***,a	-3.836 ***	-3.122 ***
	(0.160)	(0.260)	(0.310)	(0.490)	(0.990)	(0.530)
S&P	0.228	0.571	0.249	-0.148	0.138	-0.415
	(0.240)	(0.380)	(0.460)	(0.680)	(1.290)	(0.750)
Chi Square	190	270	130	134	28	122
Number of Obs	40,071	40,074	40,075	40,064	10836	29228

Appendix Table IIB: Decision to Buy or Sell Assets w/ Endogenous Selection (OLS)

This table reports the estimated coefficent from OLS regressions (multiplied by 100) on decisions to buy (Panel A) or to sell assets (Panel B) by quartiles in predicted probability of being public. Q1 includes firms with the lowest probability of being public and Q4 includes firms with the highest probability of being public. In (5) and (6), we further break firms in Q4 based on their actual public status. Q4Pub includes public firms in the highest quartile and Q4Prv includes private firms in the highest quartile. The predicted probability of being public is estimated based on column 1 in Table 2. In Panel A, the dependent variable, D_Buy, equals to 1 if a firm sells at least one plant in the next year and 0 otherwise, and in Panel B, the depependent variable, D_Sell, equals to 1 if a firm buys at least one plant in the next year and 0 otherwise.We control for firm random effects. Robust standard errors allow clustering at the industry-year level and are reported in parentheses. *, ** and *** represent significance at 10%, 5%, and 1% level, respectively. a, b, c represent significance level of comparing coefficient between other quartiles and Quartile 1 at the 1%, 5%, and 10% level, respectively which we estimate using the combined sample with interaction between the quartile dummy and all other explanatory variables.

Panel A: Decision to Buy Assets

	(1)	(2)	(3)	(4)	(5)	(6)
Variable	Q1	Q2	Q3	Q4	Q4Pub	Q4Prv
Firm Size	0.810 ***	1.150 ***,a	1.370 ***,a	1.340 ***,a	1.370 ***	1.030 ***
	(0.000)	(0.000)	(0.100)	(0.100)	(0.100)	(0.100)
TFP	-0.070 *	-0.060	-0.080	-0.080	0.020	-0.170
	(0.000)	(0.000)	(0.100)	(0.100)	(0.200)	(0.100)
I_Tobinq	-0.070	0.090	-0.300 ***	-0.070	0.030	-0.260 *
	(0.100)	(0.100)	(0.100)	(0.100)	(0.300)	(0.100)
Ind_UV	-0.020	0.080	0.000	-0.200	-1.100	0.260
	(0.100)	(0.100)	(0.200)	(0.300)	(0.800)	(0.300)
HERF	-0.750	-0.050	-2.920 *	-4.450 **	-17.660 ***	-0.480
	(1.000)	(1.200)	(1.600)	(2.100)	(5.600)	(2.100)
Credit Spread	0.190 *	0.080	0.240	-1.000 ***,a	-3.460 ***	-0.330
	(0.100)	(0.200)	(0.200)	(0.400)	(1.000)	(0.400)
S&P	0.420 **	0.840 ***	1.240 ***	1.380 **,a	2.730 *	0.650
	(0.200)	(0.300)	(0.400)	(0.600)	(1.400)	(0.600)
R-Square	1.50%	2.25%	1.51%	1.47%	1.21%	0.97%
Number of Obs	36,216	37,111	38,304	39,288	10718	28570

Panel B: Decision to Sell Assets

	(1)	(2)	(3)	(4)	(5)	(6)
Variable	Q1	Q2	Q3	Q4	Q4Pub	Q4Prv
Firm Size	1.300 ***	2.050 ***,a	1.720 ***,c	1.420 ***	0.730 ***	1.910 ***
	(0.100)	(0.100)	(0.200)	(0.100)	(0.300)	(0.200)
TFP	-0.310 ***	-0.380 ***	-0.550 ***	-0.670 ***,a	-0.680 **	-0.630 ***
	(0.100)	(0.100)	(0.100)	(0.200)	(0.300)	(0.200)
I_Tobinq	-0.140	0.260	0.560 **	0.880 ***,c	0.640	1.190 ***
	(0.200)	(0.200)	(0.200)	(0.200)	(0.400)	(0.300)
Ind_UV	0.100	-0.490 *	-1.080 ***	-1.630 ***,c	-0.700	-1.820 ***
	(0.200)	(0.300)	(0.300)	(0.400)	(0.900)	(0.500)
HERF	6.000 **	2.490	1.080	-3.720	0.000	-4.050
	(2.400)	(3.000)	(4.300)	(4.500)	(9.100)	(5.400)
Credit Spread	-0.250	-0.700 *	-1.820 ***	-4.300 ***,a	-4.090 ***	-4.220 ***
	(0.300)	(0.400)	(0.400)	(0.500)	(1.100)	(0.600)
S&P	-0.180	-0.790	-1.360 **	-2.080 ***	-1.390	-2.490 ***
	(0.400)	(0.500)	(0.600)	(0.700)	(1.500)	(0.900)
R-Square	0.63%	0.85%	0.28%	0.23%	0.13%	0.28%
Number of Obs	40,071	40,074	40,075	40,064	10836	29228

Appendix Table III: Change in Productivity and Market Valuation (Robustness)

This table reports the changes in productivity for transacted plants based on buyer's valuation. Prv Buyer and Pub Buyer are indicator variables for private and public acquirer, respectively. D_HRet is an indicator variable that equals 1 if the firm's stock return is above the median for the previous year. D_Sale is an indicator variable that equals to 1 if a plant is sold and 0 otherwise. D_Wave is an indicator variable that equals to 1 for aggregate wave years and 0 otherwise. Lambda is the estimated inverse Mills Ratio based on a first-stage selection model in which we predict the probability of being sold (based on Table 3 Panel B). TFP and Ln(output) measure the total factor productivity and the log of output level for the plant, respectively. Industry (based on 3-digit SIC) fixed effects are included. The robust standard errors allow clustering at the industry-year level and are reported in parentheses. *, ** and *** represent significance at 10%, 5%, and 1% level, respectively.

Dependent Variable	TFP (-1,1)		TFP(-1,2)		TFP(-1,3)	
Variable Name	(1)	(2)	(3)	(4)	(5)	(6)
D_Sale * Prv Buyer	0.020 ***	0.015 ***	0.032 ***	0.028 ***	0.020 ***	0.015 **
	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
D_Sale * Pub Buyer * (D_HRet=0)	0.000	-0.018	0.029 **	0.008	0.026 *	0.000
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
D_Sale * Pub Buyer * (D_HRet=1)	0.044 ***	0.039 ***	0.050 ***	0.050 ***	0.074 ***	0.078 ***
	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.02)
D_Wave		-0.005 ***		-0.009 ***		-0.003
		(0.00)		(0.00)		(0.00)
D_Sale * Prv Buyer * D_Wave		0.017 *		0.017		0.020
		(0.01)		(0.01)		(0.01)
D_Sale * Pub Buyer * (D_HRet=0) * D_Wave		0.047 **		0.053 *		0.061 **
		(0.02)		(0.03)		(0.03)
D_Sale * Pub Buyer * (D_HRet=1) * D_Wave		0.016		0.002		-0.010
		(0.02)		(0.03)		(0.03)
Lambda	-0.065 ***	-0.066 ***	-0.074 ***	-0.078 ***	-0.056 ***	-0.056 ***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
TFP	-0.019 ***	-0.019 ***	-0.032 ***	-0.032 ***	-0.036 ***	-0.036 ***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Ln(Output)	0.054 ***	0.054 ***	0.064 ***	0.064 ***	0.066 ***	0.066 ***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Constant	-0.389 ***	-0.384 ***	-0.475 ***	-0.467 ***	-0.543 ***	-0.542 ***
	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)
Number of Obs	745,940	745,940	624,899	624,899	513,743	513,743
R-Square	1.46%	1.46%	1.70%	1.70%	1.61%	1.62%