The Cyclical Growth of Public Firms and the COVID Crisis

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June 2021

We document a significant but declining size effect and cyclicality in sales growth within U.S. public firms, including the COVID crisis. The patterns differ significantly from those documented in prior studies, which focus on samples dominated by private firms. Small public firms grow faster than large public firms since the start of our sample period in 1974, especially during expansions, but the gap declines significantly starting in early 2000s and closes entirely during the 2020 recession. Contrary to the prevailing view in the literature, financing constraints do not explain the size effect, and the effect is stronger in 2020 than in the Great Recession during which constraints were, arguably, more severe. We examine alternative explanations for the size effect, including differences in diversification, productivity, and investment opportunities. Preliminary analysis shows evidence inconsistent with the first two hypotheses. The size effect increases market shares of large firms in recessions, but this is counteracted by new entry, thus, mitigating the effects on industry structures across business cycles.

1 Introduction

We document a substantial size effect in sales growth of public firms during the COVID-19 induced recession of 2020. Large firms grew faster during the first three quarters of 2020 than in the previous quarters compared to small firms within the same industry. The effect is stronger than in the Great Recession, it is present in each of the quarters we examine and is robust to standard controls. A comparison to previous business cycles reveals a significant decline in the relative performance of small vs. large public firms over the past two decades, particularly during expansionary periods. This paper aims at a better understanding of the causes and consequences of the size effect within U.S. public firms during the 2020 pandemic and across business cycles more broadly.

While numerous studies in finance and economics have noted that large firms perform relatively better during bad times, the reasons for this "size effect" are not well understood. The leading explanation in the literature is that larger firms have easier access to external financing and are, thus, more resilient to negative economic shocks. Following this reasoning, many corporate finance studies use firm size as a proxy for financing constraints. However, direct evidence for the financing hypothesis is difficult to come by, and much of the literature in this area does not explore other dimensions of firm heterogeneity that might be linked to size[1]. Nevertheless, a few studies question the financial explanation. Crouzet and Mehrotra (2020) examine Census data on public and private firms and conclude that the "differences in cyclicality are not simply explained by financing, and in fact appear largely unrelated to proxies for financial strength." (p. 1). Earlier asset pricing literature also suggests that other factors might be at play. For example, Chan and Chen (1991) argue that smaller firms might be less productive as inefficiency leads to smaller size. Such marginal firms would be less able to deal with economic downturns, independent of financing constraints. In contrast to our paper, the focus of Chan and Chen and related literature is on asset pricing anomalies rather than the firms' real choices and outcomes.

Given the relevance of the topic for key areas of finance and economics, a more thorough examination of the size effect seems warranted. It also seems useful to shift the focus towards public firms (most prior studies examine samples dominated by small private firms) which might be less financially constrained but have more potential to influence aggregate outcomes. The 2020 downturn offers an especially useful setting to study the size effect due to both its magnitude and origin. First,

[1] Exceptions include Fort, Haltiwanger, Jarnim, and Miranda (2013) who consider firm age and Crouzet and Mehrotra (2000) who consider diversification.

the COVID shock was sudden and unexpected, allowing a clean break between the recession and non-recession quarters. Importantly, the shock was exogenous to the broader economy, so economic activity prior to 2020 was unaffected by its precursors or causes. Second, in contrast to the Great Recession, the COVID crisis was not accompanied by a collapse of the banking sector, and the strong stock market performance in the second half of 2020 might have further eased financing constraints. These features offer an interesting contrast to the earlier recessions, which we exploit to shed light on the role of firm size in the transmission of economic shocks.

We begin by documenting the existence and the magnitude of the size effect for the 2020 downturn, comparing it to previous recessions. To do so, we estimate regressions of quarterly sales growth (and other outcomes) on measures of firm size, interactions of size with recession indicators, and industry-year-quarter fixed effects. We find that during the nine years leading up to the COVID crisis, since the Great Recession, public firms in the bottom tercile of the size distribution grew their sales 1% faster per quarter (as a percentage of assets) than firms in the top tercile. This gap was eliminated entirely during the pandemic. Strikingly, during 2020, small and large firms grew at the same pace for the first time since the start of our sample in 1974. This stands in contrast to the Great Recession: while small firms entered the recession growing faster than large firms, the wedge of approximately 1.3% per quarter did not change significantly during the recession (a finding we discuss in more detail below).

The comparison to the earlier recessions is similarly striking, and it is illustrated in Figure 1. The figure highlights three notable patterns: (1) Small public firms grow faster and are significantly more cyclical throughout our sample period. (2) The cyclicality of small firms declined substantially over time, and in particular their "excess" growth during expansions has become much more modest. (3) During the most recent decade, large firms' growth rates increased steadily relative to small firms (controlling for industry effects). Consequently, the historical "size gap" in sales growth narrowed over time and closed entirely during the 2020 recession (consistently with the regression results described above). These longer-term trends are of interest in their own right and are relevant when interpreting the effects of the more recent recessions vs. those in the 1980s through early 2000s.

The evidence in Figure 1 contrasts with that in prior studies of the size effect in economics (summarized in Section 2), which typically examine much larger samples of private and public, often manufacturing, firms. For example, a recent study by Crouzet and Mehrorta (2020) finds either no significant size effect or a much more muted size effect driven entirely by the 0.5% largest firm in their sample. Our analysis focuses instead on heterogeneity within public firms that fall roughly within the top 1% of their size distribution. Looking more closely at firms in this size bucket is important as they

account for an outsized fraction of the overall economy. Moreover, their public status means that their exposure to financial shocks might be quite different than that of small private firms.

Having established the significant size effect in sales growth for public firms, we turn next to other outcomes. We find that, as expected, the patterns in sales growth are mirrored in firms' investment and financing choices across all recessions. A notable difference is in how small and large firms financed themselves during the COVID crisis. Historically, small firms raised relatively more external funds (both debt and equity) and accumulated more cash during expansionary periods compared to large firms. This difference was typically reversed in the subsequent recessions during which large firms "had the upper hand". The 2020 recession was different. While the pre-recession period resembled the earlier events in that smaller firms issued more debt and equity and accumulated more cash, this gap did not diminish during the 2020 downturn for either equity or cash. This suggests that small firms might have been less constrained in 2020 compared to earlier recessions, possibly because they were able to access capital markets at more attractive terms[2]. Yet, mirroring previous downturns, small firms reduced their sales growth in 2020 relative to large firms, and in fact, the slow-down was stronger than in 2008-2009 during which credit supply was, arguably, much tighter. This points to factors other than financing constraints as explanations for the size effect.

To investigate this more directly, we test whether measures of financing constraints, such as lagged leverage, cash balances, and profitability, affect the magnitude of the size effect, and whether they are directly related to growth rates in good vs. bad times. We find that this is not the case in any of the recessions we examine, casting further doubt at financing constraints as the first-order explanation for the size effect.

We turn next towards exploring alternative explanations. We group them into three broad and somewhat overlapping categories related to (1) productivity and managerial talent, (2) diversification, and (3) investment opportunities. We find little support for the hypothesis that small firms do worse during downturns because they are less productive or more poorly managed. First, we find that it is the better performing firms – those with higher lagged profitability and higher sales growth – that tend to do worse during recessions. Second, including measures of executive pay in the regressions has no effect on the size effect, and higher pay is not related to higher performance during recessions. CEO

[2] Acharya and Steffen (2020) and Halling, Yu, and Zechner (2020) document a sharp increase in credit line drawdowns, cash holdings, and bond issues during the first few weeks of the pandemic. Zechner show that while credit spreads on bonds issued during this period increased relative to 2019, the coupon rates did not, reflecting the downward shift in the U.S. Treasury yield curve. Li, Strahan, and Zhang (2020) show that in spite of the massive increase in firms' fund drawdowns during 2020, banks had enough liquidity to accommodate the spike in demand.

pay is often interpreted a measure of managerial quality.[3] Our finding suggests that either managerial talent does not help explain the size effect or that pay is not a good proxy for talent. Combined with the results on the firms' pre-recession profitability and growth, we are inclined to conclude that the size effect is not caused by lower ex-ante productivity of small firms.

Diversification could contribute to the size effect through multiple channels. An obvious mechanism is related to financing constraints: diversified firms might be more resilient to industry-specific shocks because they can reallocate financial resources from their more profitable to less profitable segments (Stein (1997)). This flexibility could be especially valuable during downturns when access to external capital is more constrained.[4] An analogous mechanism operates via internal labor markets (Tate and Yang (2015)). To explore the effects of diversification on the size effect, we include measures of diversifications and their interactions with recession dummies in the sales growth regressions. We find that while doing so does not reduce the size effect, diversified firms grow significantly faster during downturns relative to normal times.

Finally, we consider the possibility that the size effect is caused by differences in the small vs. large firms' investment opportunities. The hypothesis is simple: firms that operate below their optimal long-run scale would grow faster on average and especially during times of economic expansions when investment opportunities are generally more valuable. If small size correlates with less-than-optimal scale, such firms would be more strongly represented at the lower end of the size spectrum. The combined evidence is consistent with this hypothesis. We argue that differences in growth options should be considered as a potentially important explanation for the size effect, alongside the more standard explanations such as financing constraints.

The analysis summarized thus far focuses on documenting the size effect for public firms and understanding its causes. In Section 4, we examine the consequences of the size effect, focusing on industry structure. If larger firms grow relatively faster in recessions, their market power and, thus, industry concentration might also increase during these periods. We find that the size effect is indeed reflected in greater market shares of large firms during downturns, but this is the case only when surviving firms (i.e., those present in the current and the previous year) are counted when computing

[3]The traditional theories of CEO labor markets predict that larger firms should match with more skilled CEOs and should pay them more, and the link between firm size and CEO pay is empirically well established. See Lucas (1978), Rosen (1982) and more recently Gabaix and Landier (2008) and Terviö (2008).

[4] On the dark side, internal capital markets can help finance operations that should be scaled down (Scharfstein and Stein. (2000).

market shares. The effect disappears after new entrants are included. These preliminary results suggest that entry by small firms counteracts shifts in industry structures caused by the size effect.

To summarize, we document a strong but declining size effect within public firms during recent recessions, including the COVID pandemic. These patterns differ significantly from those in prior studies, which focus on samples dominated by small private firms. The size effect in public firms is unlikely caused by the small firms' greater exposure to financing constraints or their persistent inefficiency. The evidence points instead towards differences investment opportunities as a potential explanation. Finally, we find that the size effect increases market shares of large public firms during recessions, but that the effect is counteracted by entry.

2 Relation to prior literature

The effect of size on firm outcomes across business cycles has been of interest to researchers in multiple areas of economics and finance. In economics, the seminal paper by Gertler and Gilchrist (1994) shows that sales and investments of small firms respond more strongly to monetary shocks. This finding offered strong support for the "financial accelerator" theories by Bernanke and Gertler (1989) and Bernanke, Gertler, and Gilchrist (1999). At the core of the argument was the assumption that small firms are more financially constrained and, thus, should grow more slowly when credit is tight. Finding that this is the case lent credence to the idea that financial frictions amplify aggregate shocks. Subsequent studies complement the evidence in Gertler and Gilchrist (1994) by examining other outcomes, such as employment or financing choices. Recent papers extend this research to include the period through the Great Recession but differ from our paper in important ways. In addition to Crouzet and Mehrorta (2020), which we discuss earlier, Kudlyak and Sanchez (2017) examine the 2007-2009 downturn using aggregate data on private and public firms split on size. They find that large firms performed better during this episode than in earlier recessions, which is broadly consistent with one of our findings. Moscarini and Postel-Vinay (2012) examine employment of small and large firms across business cycles through the Great Recession. They find that, contrary to the findings on growth and investment, large firms destroy relatively more jobs when unemployment is high, which coincides with periods at the end of or shortly after recessions.[5] While employment patterns are not the focus of this paper, we discuss potential labor-market explanations for the size effect in Section 4.4.

[5] They argue that this is because smaller employers, which tend to be less productive and thus pay workers less, are more dependent on hiring unemployed workers.

In addition to the economics literature, a large stream of research in corporate finance investigates the effects of financing constraints on firms' choices. The focus in these studies is on testing how exogenous shocks to firms' cash flows (or financial health) affect their investment, employment, or product market decisions. Firm size if often used as a proxy for financing constraints, so that a stronger sensitivity of small firms to cash flow shocks is interpreted as supportive of the financial channels. While the literature has struggled to identify causal effects of financing constraints, several papers suggest that they are significant and stronger among small firms. Recent examples include Chaney, Sraer, Thesmar (2012), Chodorow-Reich (2014), Mian and Sufi (2014), Zwick and Mahon (2017), Duygan-Bump, Levkov, and Montoriol-Garriga (2015), Giroud and Mueller (2015), and Siemer (2019)[6]. These findings are generally interpreted as supportive of the financial explanations for the size effect and, indirectly, of the financial accelerator theories of business cycles.[7] In this paper, we question this interpretation: even if small firms are more financially constrained, other differences linked to size (e.g., in the firms' production functions, growth options, or investor base) could contribute to their differential outcomes across booms and busts. A more thorough understanding of the channels through which size affects these outcomes seems important. Moreover, depending on the channels, the effects may have different implications for the aggregate economy, including competition, innovation, and business cycles.

Our paper also contributes to the growing literature on the effects of recessions and especially the COVID pandemic on financing of public firms. Erel, Julio, Kim, and Weisbach (2011) examine capital raising across business cycles and show that it tends to be procyclical for lower-quality borrowers. A few papers examine the role of financing constraints during the COVID recession but do not focus on the size effect. Acharya and Steffen (2020) document the widespread corporate credit line drawdowns in the early stages of the pandemic. Halling, Yu, and Zechner (2020) investigate bond issues during the first eight weeks of the pandemic and find increased issuance across credit ratings, and increased maturities and credit spreads. Li, Strahan, and Zhang (2020) examine banks' response to the COVID crisis and show that banks' liquidity was sufficient to accommodate the increased demand. Fahlenbrach, Rageth, and Stulz (2020) show that firms that appear less financially constrained before

[6] Earlier studies on the effects of financial constraints include, among many other, Fazzari, Hubbard, and Petersen (1988), Hubbard (1997), Whited (1992), Kaplan and Zingales (1997), Cleary (1999), Baker, Stein, and Wurgler (2003), Rauh (2006), Hennessy, Almeida and Campello (2007), Hennessy, Levy, and Whited (2007), Erickson and Whited (2012), and Lewellen and Lewellen (2013).

[7] One exception is Crouzet and Mehorta (2020). They suggests that the size effect could be due to large and diversified firms investing more in customer loyalty, which pays off more during economic downturns. We explore the effects of diversification in Section 4.4.

the pandemic experience a lower stock price drop during the first quarter of 2020 (see also Ding, Levine, Lin, and Xie (2020). We confirm this finding in our data but find that the effect reverses in the second quarter 2020 and is not present for sales growth or investment. This suggests that the stock market might have overestimated the importance of financing constraints.

3 Data

Our main source of quarterly financial data is Compustat, and stock return data comes from The Center for Research in Security Prices (CRSP). Starting in 2019, public firms were required to record their operating leases as assets and liabilities on their balance sheets (see the Financial Accounting Standards Board (FASB) Accounting Standards Update No. 2016-02, Leases (Topic 842)). To make assets and liabilities comparable across time, we adjust the affected accounts for this change using information on operating assets and liabilities from the firms' quarterly reports. This data comes from the financial data platform Calbench.[8] Information on US NBER recessions is from the Federal Reserve Bank of St. Louis.

We begin the sample construction with 871,311 firm-quarters from 1974 to the third calendar quarter of 2020 with available total assets on Compustat in the current quarter and the same quarter of the prior year, and SIC code available on CRSP. We define calendar quarters based on the month of the fiscal quarter end, so that fiscal quarters ending in the first three months of a calendar year are denoted as the first calendar quarter. The sample period spans 7 recessions (we consider a quarter to be a recession quarter if at least one of the three months of the quarter falls into a recession period). In most tests, we exclude the smallest Compustat firms by requiring that the firm's total assets must be at least 50 million in the 2020 Dollars.[9] Because our focus is on the most recent recession, which in our sample period corresponds to the first three quarters of 2020, we drop the fourth calendar quarter from the sample for consistency. After requiring that sales growth and lagged assets are non-missing, we obtain the final regression sample consisting of 16,533 firms and 472,734 firm-quarters.

Descriptive statistics for our sample are in Table 1. Based on Panel A, the average firm in the overall sample has $11,417 million in assets and $1,050 million in sales (the medians are $793 million and $124 million). The average quarterly sales growth is 2.9% of assets (the median is 0.9%). Panels

[8] For companies with missing Calcbench data (approximately 10% of the sample), we use the change in the Compustat variable "Property, Plant, and Equipment Leases at Cost" in the year of the rule adoption from as a proxy for operating leases.

[9] We do this to reduce the influence of firms that represent a negligible fraction of the total economic activity. In our data, firms below 50 million in assets (in 2020 Dollars) make up 19% of the sample but only 0.1% of the overall sales and 0.05% of overall assets.

B and C show these statistics for firms split into terciles based on prior-year assets, and for three periods associated with the recessions during 1980s-2001, 2008-2009, and 2020. Based on Panel B, small and large firms differ along many dimensions, including profitability, growth, and capital structure.

4 Firm sales and sales growth over the business cycles

4.1 Baseline results

Table 2 shows our baseline regressions describing the relationship between firm size and sales growth across business cycles. The regressions are estimated on a firm-year-quarter panel from the first quarter of 1974 through the third quarter of 2020, as described in Section 3. In most tests, we exclude the fourth quarter for consistency with the COVID recession. The baseline specification is as follows:

$$\Delta y_{it-4,t} = \mathrm{B} \times Size_{it-4} + \Gamma \times Size_{it-4} \times Recession + \eta_{j,t} + \varepsilon_{it}, \quad (1)$$

where $\Delta y_{it-4,t}$ is the growth in sales relative to quarter *t-4*, scaled by total assets in quarter *t-4*. We measure firm size, $Size_{it-4}$, as the log of total assets in quarter *t-4* (Panel A) or as indicators for the second and the third size tercile formed each quarter (Panel B). In the second column, we interact the size measure with the $Recession$ indicator set to one if at least one month in the quarter falls within an NBER recession period. In column 3, we use instead two non-overlapping recession dummies, one for the COVID recession of 2020 ($COVID\ Recession$), and one for all other recessions ($Non\text{-}COVID\ Recession$). Finally, each regression includes industry-year-quarter fixed effects, where industry is defined based on four-digit SIC codes. The regressions are clustered at the two-digit SIC industry level.

The first two columns in Table 2 show that small firms grow significantly faster than large firms on average and outside of recessions, but that this size gap shrinks considerably during recessions. Focusing on Panel A, a one standard deviation increase in firm size is associated with a 1.2% slower quarterly sales growth outside of recessions (as a percent of assets), and this difference declines by a significant 0.5% during recessions[10]. Based on Panel B, firms in the top size tercile grow sales approximately 2% more slowly each quarter during non-recessions relative to firms in the bottom size tercile, and the gap declines by 1% during recessions. This pattern is consistent with the greater cyclicality of small firms documented in prior literature (summarized in Section 2). Interestingly, the

[10] The standard deviation of $\log(\text{Size})_{t-4}$ for this sample is 2.02.

relatively faster growth of large firms during recessions was especially strong during the COVID pandemic compared to all prior recessions combined. For example, based on Panel B, the coefficient on *Size Tercile 3 x Covid Recession* is 0.02 compared to the coefficient on *Size Tercile 3 x Non-Covid Recession* of 0.008. This suggests that the relative advantage of large firms during downturns was especially important during the most recent event.

Table 3 explores this finding in more detail. In this table, we split the sample into five recessionary periods: 1980 and 1981-82, 1990-1991, 2001, 2008-2009, and 2020. Each regression compares sales growth during a recession to sales growth during the preceding period since the previous recession (for example, in the 2020 column, we compare year 2020 to years 2010-2019). Otherwise, the specification in Table 3 matches that in Table 2. Limiting the benchmark years to the pre-recession period (rather than all non-recession quarters in the sample) helps control for longer-term trends that may have affected small and large firms differentially over time, independent of recessions.

Table 3 reveals a more nuanced picture of the link between firm size and growth. The first important pattern to note is that the "excess" growth of small firms in expansionary periods shrank considerably over the past decades. Based on Panel B, the wedge in sales growth between the bottom and the top tercile firms was 3.3% during the pre-1991 expansion, and it dropped to 1.3% pre-2009 and to 1% pre-2020. Each of the early recessions eliminated approximately 2/3 of the pre-recession gap, so that even during recessions, small firms grew somewhat faster than large firms. In this respect, the recent recessions were different. On the onset of the COVID pandemic, the sales growth gap between small and large firms was narrower compared to historic levels, and the COVID recession erased it completely. Thus, in 2020, small and large firms grew sales at roughly the same rate for the first time since the start of our sample in 1974. The 2009 recession shows a similarly narrow size gap at the onset, but, interestingly, no significant decline during the downturn.

These patterns are illustrated in Figure 1. Panel A of Figure 1 shows average sales growth per quarter for firms sorted into terciles based their total assets in the prior quarter. The lines represent a median spline of the scatter points, and the grey areas mark the recession quarters. Panel B is similar except that instead of raw growth rates, we plot the average residuals from a regression of sales growth on industry-quarter-year fixed effects. The most striking observation from both panels is that the cyclicality of small firms over business cycles declined considerably over time, particularly after the 2001 recession, consistent with the results in Table 3.

The figure also illustrates a few notable features of the COVID recession. First, in contrast to earlier recessions, the expansion that preceded it was marked by a relatively sluggish growth for all size terciles. This is especially striking for the smallest firms, which historically performed much better during good times. Second, based on Panel B (i.e., controlling for industry effects), the relative performance of large vs. small firms increased steadily during the ten years leading up to the pandemic, so that large firms entered the recession in a position of relative strength. The pandemic accelerated this trend, so that the historically positive size gap closed almost entirely in 2020 (consistently with the results in Table 3). Finally, the figure shows that, in contrast to the previous downturns, all three groups of firms show no obvious signs of a slowdown leading up to the recession year.

4.2 Other outcomes

The previous section focuses on sales growth; this section extends the analysis to other outcomes. Table 4, Panel A, reports regressions similar to those in Table 3 except that, instead of sales growth, we use as dependent variables measures of investment: change in property plant and equipment (PPE), capital expenditures, R&D, change in inventory, and change in accounts receivables (all changes are scaled by lagged assets). The regressions also include a set of lagged firm-specific controls and their interactions with the recession dummy (details are in Appendix A). Table 4, Panel B is similar except that it examines financing choices. It includes as dependent variables net equity issues, net debt issues, and changes in cash balances, each scaled by assets. Panels A through C in each table investigate separately the recessions of 2020, 2008-2009, and the 1980-2001 recessions combined.

As expected, the differential effects of recessions on large vs. small firms' sales growth are mirrored in their investment patterns. All panels show that large firms invest less in physical capital than small firms outside of recessions (the effects for growth in PPE range from -0.16% to -0.25% of total assets per quarter for a one-standard deviation increase in size), and recessions tend to reduce or even eliminate this gap (e.g. by 0.36% in 2020 or 0.11% for 1980-2001 events). This reversal is absent for the 2008-2009 recession, which is consistent with the lack of size effect during this episode. Similar patterns are present for investments in short-term operating assets (inventory and accounts receivables) and investments in R&D and SG&A. It is perhaps not surprising that the effects on R&D are more pronounced for recent recessions while the effects on investments in physical assets, such as inventory, appear more pronounced in the earlier recessions. Overall, the combined evidence in Tables 3 and 4 (Panel A) paints a consistent picture of the size effect reflected in the firms' sales growth as well as their investment choices.

Shifting the focus to financing, Panel B of Table 4 explores how large and small firms finance themselves across business cycles. All panels show that smaller firms raise more external capital (both debt and equity) and accumulate more cash outside of recessions. This difference typically shrinks during recessions, consistent with smaller firms growing more slowly and having more limited access to financing during bad times. The one exception is the COVID pandemic: during this episode, small firms did not scale down their equity issues or their cash accumulation (relative to large firms), and in fact, might have increased both (though the effects are not statistically significant). There is also less evidence of reduced borrowings compared to the evidence from other recessions. These results suggest that small firms might have been able to access external capital more easily during the COVID pandemic than during the earlier downturns.[11] It is noteworthy that the size effect was present in 2020 (and was not weaker than in 2008-2009), in spite of the fact that small firms' access to capital was likely less constrained. This suggests that non-financial factors might have contributed to the size effect, which is what we explore below.

4.3 The importance of financing constraints

In Table 5, we test whether basic firm characteristics, in particular those reflecting the firms' financial health, help explain the size effect. The regressions in Table 5 are similar to those in Table 3, except that they include firm-specific controls and their interactions with the recession indicators (columns 1, 3, and 5), or with year-quarter fixed effects (columns 2, 4, and 6). To save space, we group the earlier recessions, so that Table 5 shows recessions during 1980s through 2001 (columns 1 and 2), the 2008-2009 recession (columns 3 and 4), and the 2020 recession (columns 5 and 6). The controls include prior-year book-to-market, profitability, financial leverage, cash balances, and sales growth.

The striking observation from this table is that including these controls has almost no effect on the size effect in any of the recession periods. The coefficients on firm size and the interactions of size with recession dummies in Table 4 remain statistically significant and have similar magnitudes to those in Table 3. This suggests that the effect of firm size on growth across business cycles is highly robust and cannot be easily explained by observable differences between large and small firms, including those related to financing constraints.

[11] This is consistent with the evidence in Acharya and Steffen (2020) and Halling, Yu, and Zechner (2020), and Li, Strahan, and Zhang (2020) who document sharp increases in bank borrowing, bond issues and equity issues during 2020 across a range of borrower categories.

To explore the effects of financing constraints more directly, we ask whether common proxies for constraints, such as financial leverage and cash balances, themselves predict differential firm growth during downturns vs. expansions. We find that this is not the case: the coefficients on the interactions of recession dummies with lagged leverage or cash-to-assets ratio are not statistically significant in any of the regressions in columns 1, 3, and 5. Interestingly, for the pre-2020 recessions, higher past profitability and sales growth are followed by relatively larger declines in sales growth during recessions, suggesting that firms that are more successful in good times are hit harder by the subsequent downturns. Interestingly, this pattern is not present for the COVID recession: based on column 5, firms that grew faster during the 2010s, continued to grow faster during 2020, suggesting that they were less affected by the COVID shock.

To summarize, we find no evidence that financing constraints help explain the size effect, or that they directly predict firms' growth during recessions vs. expansions. Our results do not imply that financing constraints are unimportant, but only that they are not a first-order explanation for the size effect within public firms.

4.4 Alternative explanations for the size effect

The differential performance of small and large firms across business cycles could be caused by several factors correlated with size. In this section we consider explanations related to firm (and management) quality, diversification, and investment opportunities.

4.4.1 Fallen angels

Firms differ in their productivity levels, and it is reasonable to assume that productivity is correlated with size. A common argument in the literature is that smaller firms are less productive as inefficiency leads to smaller size (though small size may also indicate young age and high future growth). Consistently with this view, Chen and Chan (1991) find that smaller public firms are more likely to have experienced recent stock price declines.[12] Formal models of firm dynamics that consider firm size include Cooley and Quadrini (2001) and Mehrorta and Sergeyev (2020). It is conceivable that inefficient firms find it more difficult to compete during downturns when demand is low. This might be because their high-quality competitors have more skilled managers who are better able to adapt to negative demand shocks, for example, by shifting their firms' product mix, adjusting

[12] They show that about 66% of firms in the bottom size quintile (formed based on market value) fell from the higher quintiles compared to only 14% that entered that quintile at the time of their listing during the preceding 10 years.

production process, or offering more competitive prices. If so, less efficient firms would experience larger sales declines and more frequent exit during bad times even in the absence of financing constraints.

To explore this possibility, we include measures of lagged profitability and sales growth in the regressions in Table 5 as well as their interactions with the recession dummy. Contrary to the "fallen angels" hypothesis, we find that the inclusion of these variables has no significant effect on the coefficients on the interaction of size with *Recession*. Thus, the size effect does not seem to be caused by the correlation of size with poor past performance. Moreover, there is no evidence that firms that experience the largest declines during downturns resemble "fallen angels" as described in Chan and Chen (1991). In fact, it is the more profitable and faster growing firms that experience the strongest declines in sales growth during recessions vs. normal times. Based on column (1) a one standard deviation increase in the lagged ROA is associated with -0.3% lower sales growth per quarter (as a fraction of assets) during recessions vs. normal times. The effects are generally consistent across recessions, except for the coefficient on lagged sales growth for the COVID recession.

As an additional test, we investigate whether firms with higher CEO pay do better during recessions. The classic labor markets theories predict that higher-quality CEOs should be paid more and should match with larger firms in which they are relatively more productive (Lucas (1978), Rosen (1982) and more recently Gabaix and Landier (2008) and Terviö (2008)). Empirically, size and CEO pay are strongly positively linked (see Table 1, Panel B), so it seems natural to ask whether the size effect can be at least partially explained by measures of CEO pay. In Table 6, we include the log of CEO total pay along with the log of CEO age and tenure as explanatory variables and interact all three measures with the recession dummy. The regressions are estimated on a smaller sample for which CEO compensation data is available. The sample includes S&P 1500 firms from 1993 to 2020, which are covered by the Execucomp database. (We verify that the size effect is present within this sample and find that this is the case in Table 6, columns 1, 4, 7.) The results from this analysis support the earlier conclusions: the inclusion of CEO pay has no significant impact on the size effect. There is also no evidence that firms with more highly paid CEOs do relatively better during recessions. In fact, with the exception of the COVID recession, high pay translated to larger declines in sales growth during recessions (vs. other) quarters. This implies that either CEO quality is not an explanation for the size effect or that CEO pay is a poor proxy for quality. The combination of these results with the findings in Table 5 on past profitability and growth rates makes it unlikely that the size effect is caused by lower productivity of small firms.

4.4.2 Diversification

Large firms tend to be more diversified (see Table 1, Panel B), and it is reasonable to argue that diversification is more valuable during downturns. Diversified firms can re-allocate internal cash from their more profitable to less profitable segments, and thus, mitigate credit constraints (Stein (1997)). Similarly, diversified firms may reallocate labor across segments in ways that boost their overall sales more during downturns. To explore these possibilities, Table 7 repeats the earlier tests after including diversification measures in the regressions along with their interactions with the recession dummy. We measure diversification as the Inverse Herfindahl-Hirschman Index (*IHHI*), defined using information on sales by industry segments from Compustat.

We find evidence that the more diversified firms grow faster during downturns vs. expansions. This result is stronger in Panel B, in which we use tercile dummies to control for size (rather than the log of size). Based on column 5, a one standard deviation increase *IHHI* increases a firm's growth by 0.21% of assets per quarter during recessions vs. expansions. These results are consistent with the internal capital (or labor) markets contributing to the faster growth. However, the effect of diversification on growth is orthogonal to that of size: the coefficient on the interactions of size with the recession dummy in Table 7 remain significant and have similar magnitude to those in Table 3.

4.4.3 Investment opportunities

The hypotheses discussed thus far focus on small firms' inability to deal with hard times, e.g., because of limited access to financing or persistent inefficiency. In this section, we consider instead the possibility that small firms respond more strongly to positive shocks to investment opportunities, such as increases in demand or declines in costs, which tend to occur in good times. There are many reasons to expect such differential responses, and our goal here is not to pinpoint a specific mechanism but rather to highlight this type of firm heterogeneity as a potential explanation for the size effect.

To provide a simple example, suppose that a small firm operates below its desired long-run scale, either because of its young age or some external factor that caused its size to shrink in the past. During times of low demand, expansion is more difficult because it requires more investment in marketing and sales to lure away customers from competitors. In contrast, during expansionary periods, growth is immediately profitable as new customers can be more easily attracted. As a consequence, the small firm grows faster than the large firm overall and especially during expansions, consistently with what we see in the data.

In a related scenario, the small firm has more opportunities to grow in the long run than the large firm, but growth requires investment in physical capital. Once the investment is made, the small firm can expand sales and, possibly, also lower its future marginal costs. When demand is high, any capital investment is more valuable as it is followed by a more immediate increase in revenue. Thus, both firms choose to invest more during good times, but the effect is stronger for the small firm which, by assumption, has more growth options to begin with.

The evidence in Table 5 is broadly consistent with the growth-options based explanations. The regressions show that, controlling for size, firms that experience larger fluctuations in sales growth across business cycles (that is, firms that grow relatively faster in expansions vs. recessions) exhibit significantly higher lagged profitability, lagged sales growth (for all but the 2020 recessions, for which the effect is opposite), lagged growth in PPE (only for the 2020 recession), and lagged market-to-book ratios (for the 1980-2001 recessions). Taken together, this points to firms with more valuable growth opportunities rather than firms that are financially constrained or inefficient. It is interesting, however, that controlling for measures of growth opportunities in Table 5 does not diminish the size effect. It may be that size itself is a strong proxy for growth opportunities (e.g., if being small indicates less-than-optimal scale), or that it captures additional unrelated factors behind the size effect.

Table 8 offers related evidence: it shows that small-firms' growth responds more strongly not only to aggregate business cycles but also to firm-level cashflow news, after the business cycles effects are controlled for. Thus, the higher sensitivity of small firms to business conditions appears to be a more general phenomenon, not necessarily tied to business cycles. To illustrate this, we estimate the sales growth regressions similar to our main tests in Table 3, except that we include the firm-level stock return and its interaction with size as explanatory variables (the firm-level stock return is measured in excess of the market return; the details are in Appendix A). Stock returns reflect investors' updates about the firm's expected future cash flows, and the regressions in Panel A, columns (1) and (4) show that small firms' sales growth responds more strongly to these cash-flow news. Based on on column Panel A, column (1), an increase in the monthly stock return by 10 percentage points is associated with a 1.1 percentage point increase in the quarterly sales growth for firms in the bottom size tercile, and this effect declines by 0.6 percentage points for firms in the top size tercile. The remaining columns in Panel A show similar effects for growth rates in physical assets and for R&D.

Panel B of Table 8 shows how these effects change over time. To match the analysis in Table 3, we split the sample into the five sub-periods, each ending with a recession. The regressions show that the gap between the small vs. large firms' sensitivities of sales growth to stock returns declined over

time. For example, during the period ending with the 1990-1991 recession, the gap was 1.5 percentage points and it declined steadily reaching 0.3 percentage points during the most recent period.[13] This pattern is analogous to the declining gap in the small vs. large firms' sensitivity to business cycles documented in Table 3. This reinforces our conjecture that the two types of sensitivities are related and both reflect a more fundamental firm attribute linked to size.

To summarize, we find that the sensitivity of sales growth and investment to cash-flow news is stronger for smaller firms. This could be because small firms face tighter financing constraints. However, it is just as likely that, independently of these frictions, small firms tend to benefit more from growth and choose to grow faster especially when growth opportunities are more valuable. Such times coincide with periods of macroeconomic expansions. Our evidence points to this mechanism as an (at least partial) explanation for the size effect.

4.5 Implications for industry structure

The persistence and the magnitude of the size effect throughout our sample period suggests that it may be reflected in the dynamics of the industry structures across business cycles. In the absence of entry and exit, the relatively high growth of large firms (within industry) should increase their market shares during downturns, and the reverse is true for expansions. However, entry and exit could mitigate or even reverse the effects of sales growth of existing firms. Moreover, the size effect operates on the firm level, and it is not obvious how it translates into industry-level measures such as the HHI. We plan to explore these questions in this section.

As a starting point, Table 9 shows regressions similar to those in Table 3 but instead of sales growth, we use the firm's market share in the 4-digit SIC industry (the results are generally similar when we use 3-digit industries instead). To isolate the effect of sales growth from that of entry and exit (as well as industry re-classifications), the market shares used in columns 2, 5, and 8 are computed using only the subset of firms that are part of the industry in the current quarter and in the same quarter of the prior year. As expected, these regressions mirror those with sales growth as the dependent variable. Based on Panel B, column 2, firms in the top tercile of the size distribution increase their market shares by 0.3% per quarter (relative to firms in the bottom tercile) during recessions vs.

[13] As before, we consider the effect of a 10 percentage point increase in the firm-level stock return. Thus, the 1.5 percentage point gap is estimated from the coefficient of 0.153 on *Size Tercile 3 x Firm Return* in column 2 of Panel B.

expansions. Thus, growth on the intensive margin, shifts market power towards larger firms during recessionary periods.

In columns 3, 6, and 9, we re-estimate the regressions without imposing the requirement that a firm must be part of the SIC code in the current and previous year. Thus, these regressions reflect the combined effect of sales growth of existing firms as well as that of entry. It appears that the overall effect is much more muted and not statistically significant. Based on Panel B, column 3, large firms did not increase their market shares more during the earlier downturn, and based on column 9, the same is true for the COVID recession. Thus, it appears that while growth of large public firms is countercyclical, potentially increasing market concentration during downturns, this effect is reversed by entry and exit.

5 Conclusions

We document strong but declining size effect within public firms during recent recessions, including the COVID pandemic. These patterns differ significantly from those in prior studies, which focus on samples dominated by small private firms. The size effect in public firms is unlikely caused by the presence of financing constraints. The preliminary analysis also rules out diversification and the "fallen angels" hypotheses as potential explanations (though diversification itself is related to business cycles in expected ways). The evidence points to the heterogeneity in how small and large firms' respond to investment opportunities as a potential explanation for the size effect. The size effect increases market shares of large public firms during recessions, but the effect is counteracted by entry and exit.

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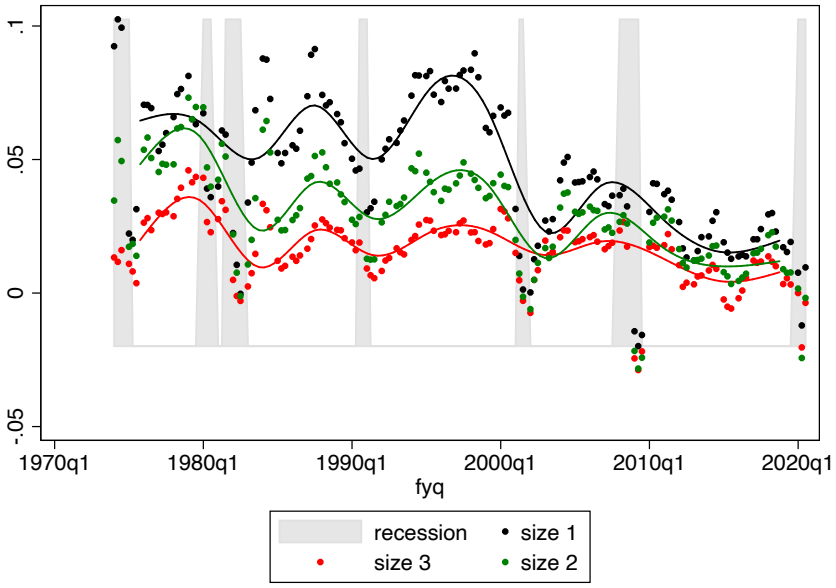
Figure 1. Sales growth over business cycles. Panel A shows average sales growth per quarter for firms sorted into size terciles. The terciles are formed each quarter (*t*) based on total assets in quarter *t-4*. Sales growth in quarter *t* is measured as the change in quarterly sales for firm *i* from quarter *t-4* to *t* over total assets in quarter *t-4*. The lines represent the median spline estimation of the scatter points. The gray areas mark the NBER recession quarters. The sample period is from 1974q1 to 2020q3. Panel B is similar but plots the average residuals from the following regression:

$$\Delta y_{it-4,t} = \eta_{j,t} + \varepsilon_{it}$$

where $\Delta y_{it-4,t}$ is sales growth and $\eta_{j,t}$ are industry-year-quarter fixed effects, with industries at the 4-digit SIC level.

Panel A. Average sales growth by quarter



Panel B. Residual sales growth per quarter

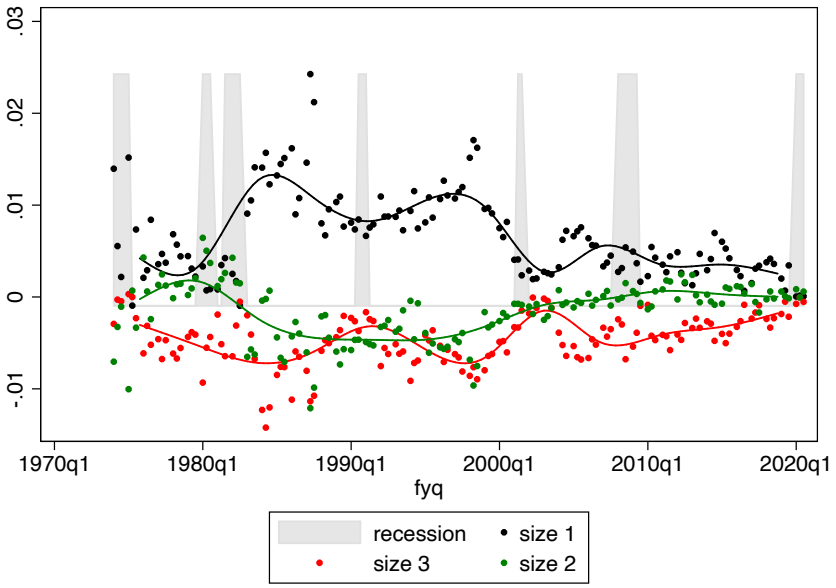


Table 1. Descriptive statistics. This table shows descriptive statistics for the 472,734 firm-quarters from 1974q1 to 2020q3; the fourth quarters are omitted for consistency with the 2020 recession. Panel A shows the full sample. Panel B shows subsamples split into size terciles based on total assets lagged by four quarters. Panel C shows subsamples split into three periods associated with recessions of 1980s-2001, 2009, and 2020. Each period includes the recession quarters and the pre-recession quarters starting from the first quarter after the previous recession. *Total assets*, *Sales* and *Compensation* are in 2020 Dollars. Variables definitions are in Appendix A.

Panel A: Full Sample

	Mean	Stdev	P1	P50	P99	N
Total assets (millions)	11,417	87,876	54	793	173,076	472,734
Sales (millions)	1,050	4,659	0	124	17,007	472,734
Sales growth	0.029	0.091	-0.170	0.009	0.410	472,734
ΔPPE	0.011	0.039	-0.072	0.003	0.202	336,319
CAPX	0.014	0.020	0.000	0.007	0.100	373,253
R&D	0.006	0.019	0.000	0.000	0.095	472,732
ΔInventory	0.003	0.026	-0.083	0.000	0.101	450,401
ΔAR	0.003	0.028	-0.087	0.001	0.116	142,219
Equity issuance	0.008	0.051	0.000	0.000	0.206	472,732
Debt issuance	0.023	0.070	0.000	0.000	0.402	472,732
ΔCash	0.003	0.067	-0.155	0.000	0.258	467,513
B/M_{t-4}	0.793	0.653	0.055	0.638	3.347	451,176
ROA_{t-4}	0.026	0.041	-0.120	0.027	0.132	399,401
Book $Leverage_{t-4}$	0.344	0.255	0.000	0.338	0.917	415,468
$Cash_{t-4}$	0.140	0.187	0.000	0.062	0.856	467,184
Sales $growth_{t-4}$	0.032	0.093	-0.162	0.010	0.430	431,862
Compensation (thousands)	6,782	13,211	294	3,933	42,978	128,003
Tenure	7.4	7.3	0.0	5.0	34.0	120,911
CEO age	56	7	39	56	76	127,931
N of Segments	1.95	1.33	1.00	1.00	6.00	374,164
IHHI	1.49	0.79	1.00	1.00	4.42	374,164
ΔMarket Share (Surviving)	-0.004	0.031	-0.158	0.000	0.088	472,672
ΔMarket Share (All)	-0.004	0.066	-0.390	0.000	0.196	472,002

Panel B: Subsamples split into size terciles

	Size Tercile 1 (N=151712)		Size Tercile 2 (N=157956)		Size Tercile 3 (N=163069)	
	Mean	SD	Mean	SD	Mean	SD
Total assets (millions)	184	213	974	834	31,984	147,445
Sales (millions)	48	64	211	290	2,794	7,628
Sales growth	0.046	0.122	0.027	0.083	0.015	0.058
ΔPPE	0.014	0.044	0.011	0.037	0.008	0.032
CAPX	0.015	0.023	0.014	0.020	0.012	0.016
R&D	0.013	0.028	0.004	0.013	0.002	0.008
ΔInventory	0.004	0.031	0.002	0.027	0.001	0.019
ΔAR	0.004	0.034	0.003	0.027	0.002	0.021
Equity issuance	0.016	0.082	0.005	0.031	0.002	0.015
Debt issuance	0.023	0.077	0.025	0.074	0.020	0.058
ΔCash	0.006	0.098	0.002	0.054	0.001	0.036
B/M_{t-4}	0.785	0.711	0.806	0.656	0.786	0.591
ROA_{t-4}	0.019	0.058	0.031	0.033	0.029	0.025
Book $Leverage_{t-4}$	0.229	0.242	0.354	0.248	0.445	0.228
$Cash_{t-4}$	0.221	0.247	0.119	0.155	0.085	0.106
Sales $growth_{t-4}$	0.043	0.116	0.035	0.094	0.021	0.067
Compensation (thousands)	2647	8494	4183	7046	9295	16072
Tenure	8.2	7.7	7.9	7.9	6.9	6.9
CEO age	55	8	56	8	57	7
N of Segments	1.50	0.89	1.82	1.17	2.59	1.63
IHHI	1.26	0.52	1.42	0.70	1.81	1.01
ΔMarket Share (Surviving)	-0.003	0.027	-0.004	0.032	-0.005	0.032
ΔMarket Share (All)	-0.002	0.055	-0.004	0.066	-0.007	0.074

Panel C: Subsamples split by recessions

	Recessions 1980s-2001 (N=114,599)		Recession in 2008-2009 (N=100,374)		Recession in 2020 (N=255,627)	
	Mean	SD	Mean	SD	Mean	SD
Total assets (millions)	5,517	28,375	14,302	106,376	22,094	141,199
Sales (millions)	765	3,557	1,175	5,004	1,583	6,236
Sales growth	0.040	0.108	0.020	0.072	0.012	0.056

Table 2. Firm size and sales growth over business cycles. This table shows results from the following regression:

$$\Delta y_{it-4,t} = \mathrm{B} \times Size_{it-4} + \Gamma \times Size_{it-4} \times Recession + \eta_{j,t} + \varepsilon_{it,}$$

where $\Delta y_{it-4,t}$ is sales growth measured as the change in quarterly sales for firm *i* from quarter *t-4* to *t* over total assets in quarter *t-4*, $\eta_{j,t}$ are industry-year-quarter fixed effects, with industries at the 4-digit SIC level, $Size_{it-4}$ is either log of total assets in quarter *t-4* or tercile dummies formed based on assets in *t-4*, and $Recession$ is an indicator for NBER recession quarters. *COVID* and *No COVID* denote indictors for the 2020 recession and all other recessions. The sample period is from 1974q1 to 2020q3; the fourth quarters are omitted for consistency with the 2020 recession. Standard errors in parentheses are clustered at the two-digit industry level, and *, **, *** indicate p values of less than 1%, 5%, and 10%.

Panel A. Firm size measured using total assets in previous year

	(1)	(2)	(3)	(4)
Log (Size)$_{t-4}$	-0.006	-0.006	-0.006	-0.006
	(0.001)***	(0.001)***	(0.001)***	(0.001)***
Log (Size)$_{t-4}$ x Recession		0.003		0.002
		(0.000)***		(0.000)***
Log (Size)$_{t-4}$ x No COVID Recession			0.002	
			(0.000)***	
Log (Size)$_{t-4}$ x COVID Recession			0.005	0.003
			(0.001)***	(0.001)***
N of observations	427,734	427,734	427,734	427,734
N of clusters	73	73	73	73

Panel B. Firm size measured using tercile indicators based on total assets in previous year

	(1)	(2)	(3)	(4)
Size Tercile 2	-0.014	-0.015	-0.015	-0.015
	(0.001)***	(0.001)***	(0.001)***	(0.001)***
Size Tercile 3	-0.019	-0.021	-0.021	-0.021
	(0.002)***	(0.002)***	(0.002)***	(0.002)***
Size Tercile 2 x Recession		0.010		0.009
		(0.001)***		(0.001)***
Size Tercile 3 x Recession		0.010		0.008
		(0.001)***		(0.002)***
Size Tercile 2 x No COVID Recession			0.009	
			(0.001)***	
Size Tercile 3 x No COVID Recession			0.008	
			(0.002)***	
Size Tercile 2 x COVID Recession			0.015	0.006
			(0.003)***	(0.003)*
Size Tercile 3 x COVID Recession			0.020	0.012
			(0.003)***	(0.004)***
N of observations	427931	427931	427931	427931
N of clusters	73	73	73	73

Table 3. Firm size and sales growth by recession. This table shows results from regressions similar to those in Table 2, except that we split the sample into periods that include a recession and the pre-recession quarters starting after the end of the previous recession. The 1980s period combines two recessions. The results are from the regression:

$$\Delta y_{it-4,t} = \mathrm{B} \times Size_{it-4} + \Gamma \times Size_{it-4} \times Recession + \eta_{j,t} + \varepsilon_{it},$$

where $\Delta y_{it-4,t}$ is sales growth measured as the change in quarterly sales for firm *i* from quarter *t-4* to *t* over total assets in quarter *t-4*, $\eta_{j,t}$ are industry-year-quarter fixed effects, with industries at the 4-digit SIC level, $Size_{it-4}$ is either log of total assets in quarter *t-4* or tercile dummies formed based on assets in *t-4*, and $Recession$ is an indicator for NBER recession quarters. The sample period is from 1974q1 to 2020q3; the fourth quarters are omitted for consistency with the 2020 recession. Standard errors in parentheses are clustered at the two-digit industry level, and *, **, *** indicate p values of less than 1%, 5%, and 10%.

Panel A. Firm size measured using total assets in previous year

	1980s	1990-1991	2001	2008-2009	2020
Log (Size)$_{t-4}$	-0.005	-0.010	-0.009	-0.004	-0.002
	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.000)***
Log (Size)$_{t-4}$ x Recession	0.001	0.004	0.006	0.001	0.001
	(0.001)	(0.001)***	(0.001)***	(0.001)	(0.001)**
N of observations	40455	73632	141540	100374	114599
N of clusters	63	70	70	66	66

Panel B. Firm size measured using tercile indicators based on total assets in previous year

	1980s	1990-1991	2001	2008-2009	2020
Size Tercile 2	-0.011	-0.026	-0.024	-0.008	-0.005
	(0.004)***	(0.003)***	(0.003)***	(0.001)***	(0.001)***
Size Tercile 3	-0.023	-0.033	-0.031	-0.013	-0.010
	(0.005)***	(0.003)***	(0.004)***	(0.002)***	(0.001)***
Size Tercile 2 x Recession	0.013	0.011	0.017	0.001	0.005
	(0.003)***	(0.004)**	(0.004)***	(0.002)	(0.004)
Size Tercile 3 x Recession	0.009	0.020	0.020	0.000	0.009
	(0.003)***	(0.005)***	(0.004)***	(0.002)	(0.003)**
N of observations	32261	58061	125860	96560	113505
N of clusters	63	68	70	65	66

Table 4. Firm size and other outcomes across business cycles. This table shows results from regressions of firms investment and financing choices on measures of size interacted with a recession dummy and controls:

$$\Delta y_{it-4,t} = \mathrm{B} \times Size_{it-4} + \Gamma \times Size_{it-4} \times Recession + \Phi \times X_{i,t-4} + \Omega \times X_{i,t-4} \times Recession + \eta_{j,t} + \varepsilon_{it}.$$

where $\Delta y_{it-4,t}$ are measures of investment (Panel A) or financing (Panels B) shown in the table heading and defined in Appendix A, $X_{i,t-4}$ are lagged firm-specific controls described in Appendix A, $Size_{it-4}$ is the log of total assets in quarter *t-4*, and $Recession$ is an indicator for NBER recession quarters, $\eta_{j,t}$ are industry-year-quarter fixed effects, with industries at the 4-digit SIC level. The sample period is from 1974q1 to 2020q3; the fourth quarters are omitted for consistency with the 2020 recession. Each panels shows separate regressions for recessions during 1980-2001, 2009, and 2020. Each regression is estimated on the period including the recession quarters and the quarters prior to the recession and starting after the previous recession. Standard errors in parentheses are clustered at the two-digit industry level, and *, **, *** indicate p values of less than 1%, 5%, and 10%.

Panel A. Dependent variables are measures of investment

	ΔPPE	CAPX	R&D	ΔInventory	ΔAR*	ΔSGA
Panel A1: Recessions during 1980s - 2001						
Log (Size)$_{t-4}$	-0.0014	-0.0006	0.0000	-0.0007		-0.0003
	(0.000)***	(0.000)**	(0.000)	(0.000)***		(0.000)***
Log (Size)$_{t-4}$ x Recession	0.0020	0.0002	-0.0002	0.0005		0.0003
	(0.001)***	(0.000)**	(0.000)	(0.000)***		(0.000)***
N of observations	146908	170203	257904	242391		191174
N of clusters	69	71	71	71		71
Panel A2: Recession of 2009						
Log (Size)$_{t-4}$	-0.0009	-0.0006	-0.0005	-0.0003	-0.0011	-0.0003
	(0.000)**	(0.000)**	(0.000)**	(0.000)**	(0.000)***	(0.000)***
Log (Size)$_{t-4}$ x Recession	-0.0004	0.0003	0.0002	0.0002	0.0004	0.0002
	(0.000)	(0.000)	(0.000)*	(0.000)	(0.000)*	(0.000)**
N of observations	85499	93039	101159	97428	53153	80628
N of clusters	66	66	66	66	66	66
Panel A3: Recession of 2020						
Log (Size)$_{t-4}$	-0.0011	-0.0003	-0.0003	-0.0002	-0.0005	-0.0001
	(0.000)***	(0.000)**	(0.000)**	(0.000)***	(0.000)***	(0.000)*
Log (Size)$_{t-4}$ x Recession	0.0005	0.0002	0.0005	0.0003	0.0004	0.0001
	(0.000)**	(0.000)**	(0.000)***	(0.000)*	(0.000)**	(0.000)
N of observations	102138	110472	115299	111127	87843	95117
N of clusters	66	66	66	66	65	64

*Data on Accounts Receivables are not available for the earlier recessions.

Panel B. Dependent variables are measures of financing

	Net Equity Issues	Net Debt Issues	ΔCash
Panel B1: Recessions during 1980s - 2001			
Log (Size)$_{t-4}$	-0.0022	-0.0027	-0.0013
	(0.000)***	(0.000)***	(0.000)***
Log (Size)$_{t-4}$ x Recession	0.0014	0.0018	0.0009
	(0.000)***	(0.000)***	(0.000)***
N of observations	146908	170203	257904
N of clusters	69	71	71
Panel B2: Recession of 2008-2009			
Log (Size)$_{t-4}$	-0.0023	-0.0025	-0.0017
	(0.000)***	(0.001)***	(0.000)***
Log (Size)$_{t-4}$ x Recession	0.0021	0.0011	0.0016
	(0.000)***	(0.001)**	(0.001)***
N of observations	85499	93039	101159
N of clusters	66	66	66
Panel B3: Recession of 2020			
Log (Size)$_{t-4}$	-0.0017	-0.0027	-0.0010
	(0.000)***	(0.001)***	(0.000)**
Log (Size)$_{t-4}$ x Recession	-0.0012	0.0011	-0.0008
	(0.001)	(0.001)	(0.001)
N of observations	102138	110472	115299
N of clusters	66	66	66

Table 5. Explanations for the size effect: financing constraints. This table shows results from regressions similar to those in Table 4, except that we include lagged firm attributes and their interactions with the recession dummy as independent variables. The results in columns (1), (3), and (5) are from the following regression:

$$\Delta y_{it-4,t} = \mathrm{B} \times Size_{it-4} + \Gamma \times Size_{it-4} \times Recession + \Phi \times X_{i,t-4} + \Omega \times X_{i,t-4} \times Recession + \eta_{j,t} + \varepsilon_{it.}$$

In columns (2), (4), and (6), $X_{i,t-4} \times Recession$ is replaced with interactions of $X_{i,t-4}$ with year-quarter fixed effects. We define $\Delta y_{it-4,t}$ as sales growth measured as the change in quarterly sales for firm *i* from quarter *t-4* to *t* over total assets in quarter *t-4*; $\eta_{j,t}$ are industry-year-quarter fixed effects, with industries at the 4-digit SIC level; $Size_{it-4}$ is either log of total assets in quarter *t-4* or tercile dummies formed based on assets in *t-4*; $Recession$ is an indicator for NBER recession quarters, and *X* are lagged firm attributes defined in Appendix A. The sample period is from 1974q1 to 2020q3; the fourth quarters are omitted for consistency with the 2020 recession. Standard errors in parentheses are clustered at the two-digit industry level, and *, **, *** indicate p values of less than 1%, 5%, and 10%.

Panel A. Firm size measured using total assets in previous year

	2001-1980		2008-2009		2020	
	(1)	(2)	(3)	(4)	(5)	(6)
Log (Size)$_{t-4}$	-0.008	-0.008	-0.004	-0.004	-0.002	-0.002
	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.000)***	(0.000)***
Log (Size)$_{t-4}$ x Recession	0.004	0.004	0.001	0.001	0.002	0.002
	(0.001)***	(0.001)***	(0.001)*	(0.001)*	(0.001)***	(0.001)***
Sales Growth$_{t-4}$ x Recession	-0.089		-0.105		0.070	
	(0.017)***		(0.031)***		(0.036)*	
ΔPPE$_{t-4}$ x Recession	-0.032		0.024		-0.062	
	(0.027)		(0.033)		(0.022)***	
Book Leverage$_{t-4}$ x Recession	0.004		0.001		-0.003	
	(0.004)		(0.003)		(0.003)	
B/M$_{t-4}$ x Recession	0.006		-0.006		0.001	
	(0.002)***		(0.003)		(0.002)	
Cash$_{t-4}$ x Recession	-0.008		-0.005		0.003	
	(0.009)		(0.007)		(0.008)	
ROA$_{t-4}$ x Recession	-0.075		-0.097		-0.096	
	(0.040)*		(0.026)***		(0.055)*	
$X_{i,t-4}$ x Year-quarter FE	No	Yes	No	Yes	No	Yes
N of observations	255627	255627	100374	100374	114599	114592
N of clusters	71	71	66	66	66	66

Panel B. Firm size measured using tercile indicators based on total assets in previous year

	Recessions 1980s to 2001		Recession in 2009		Recession in 2020	
	(1)	(2)	(3)	(4)	(5)	(6)
Size Tercile 2	-0.021	-0.021	-0.008	-0.008	-0.003	-0.003
	(0.002)***	(0.002)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***
Size Tercile 3	-0.026	-0.027	-0.012	-0.012	-0.007	-0.007
	(0.002)***	(0.002)***	(0.002)***	(0.002)***	(0.001)***	(0.001)***
Size Tercile 2 x Recession	0.015	0.016	0.004	0.004	0.008	0.009
	(0.002)***	(0.002)***	(0.002)*	(0.002)*	(0.004)**	(0.004)**
Size Tercile 3 x Recession	0.013	0.015	0.003	0.003	0.013	0.014
	(0.003)***	(0.003)***	(0.002)	(0.002)	(0.004)***	(0.004)***
Sales Growth$_{t-4}$ x Recession	-0.119		-0.112		0.069	
	(0.020)***		(0.030)***		(0.035)*	
ΔPPE$_{t-4}$ x Recession	-0.040		0.030		-0.064	
	(0.030)		(0.032)		(0.023)***	
Book Leverage$_{t-4}$ x Recession	0.006		0.001		-0.004	
	(0.004)		(0.003)		(0.003)	
B/M$_{t-4}$ x Recession	0.005		-0.006		0.001	
	(0.002)**		(0.003)		(0.002)	
Cash$_{t-4}$ x Recession	-0.013		-0.003		0.003	
	(0.010)		(0.006)		(0.008)	
ROA$_{t-4}$ x Recession	-0.070		-0.092		-0.107	
	(0.045)		(0.025)***		(0.055)*	
$X_{i,t-4}$ x Year-quarter FE	No	Yes	No	Yes	No	Yes
N of observations	216182	216182	96560	96560	113505	113498
N of clusters	71	71	65	65	66	66

Table 6. Explanations for the size effect: CEO skill. This table shows results from regressions similar to those in Table 4, except that we include lagged measures of CEO compensation, age, and tenure, and their interactions with the recession dummy as independent variables. The regressions are estimated on a sample with available CEO data, and columns (1), (4), and (7) shows regressions without the CEO controls as a benchmark. The results in columns (2), (5), and (8) are from the following regression:

$$\Delta y_{it-4,t} = \mathrm{B} \times Size_{it-4} + \Gamma \times Size_{it-4} \times Recession + \Phi \times Z_{i,t-4} + \Omega \times Z_{i,t-4} \times Recession + \eta_{j,t} + \varepsilon_{it}.$$

In columns (3), (6), and (9), $Z_{i,t-4} \times Recession$ is replaced with interactions of $Z_{i,t-4}$ with year-quarter fixed effects. We define $\Delta y_{it-4,t}$ as sales growth measured as the change in quarterly sales for firm *i* from quarter *t-4* to *t* over total assets in quarter *t-4*; $\eta_{j,t}$ are industry-year-quarter fixed effects, with industries at the 4-digit SIC level; $Size_{it-4}$ is either log of total assets in quarter *t-4* or tercile dummies formed based on assets in *t-4*; $Recession$ is an indicator for NBER recession quarters, and Z are lagged CEO variables defined in Appendix A. The sample period is from 1993q1 to 2020q3; the fourth quarters are omitted for consistency with the 2020 recession. Standard errors in parentheses are clustered at the two-digit industry level, and *, **, *** indicate p values of less than 1%, 5%, and 10%.

Panel A. Firm size measured using total assets in previous year

	Recessions during 1993 to 2001			Recession in 2009			Recession in 2020		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Log (Size)$_{t-4}$	-0.007	-0.011	-0.011	-0.004	-0.005	-0.005	-0.004	-0.004	-0.004
	(0.002)***	(0.002)***	(0.002)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***
Log (Size)$_{t-4}$ x Recession	0.005	0.006	0.005	-0.001	0.001	0.000	0.004	0.0039	0.004
	(0.003)*	(0.003)**	(0.004)	(0.001)	(0.001)	(0.001)	(0.001)***	(0.001)***	(0.001)***
Log(Compensation)$_{t-4}$ x Recession		-0.005			-0.003			0.000	
		(0.002)**			(0.001)**			(0.001)	
CEO Age$_{t-4}$ x Recession		0.002			0.000			-0.001	
		(0.004)			(0.002)			(0.002)	
CEO Age$^2_{t-4}$ x Recession		0.000			0.000			0.000	
		(0.000)			(0.000)			(0.000)	
Tenure$_{t-4}$ x Recession		0.001			0.000			0.000	
		(0.001)			(0.000)			(0.000)	
Tenure$^2_{t-4}$ x Recession		0.000			0.000			0.000	
		(0.000)			(0.000)			(0.000)	
$Z_{i,t-4}$ x Year-quarter FE	No	No	Yes	No	No	Yes	No	No	Yes
N of observations	26497	26497	26550	31822	31822	31857	50432	50432	50544
N of clusters	60	60	60	58	58	58	61	61	61

Panel B. Firm size measured using tercile indicators based on total assets in previous year

	Recessions during 1993-2001			Recession in 2009			Recession in 2020		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Size Tercile 2	-0.034	-0.037	-0.036	-0.007	-0.008	-0.008	-0.009	-0.009	-0.010
	(0.011)***	(0.010)***	(0.011)***	(0.003)**	(0.003)**	(0.003)**	(0.002)***	(0.002)***	(0.002)***
Size Tercile 3	-0.046	-0.054	-0.052	-0.013	-0.015	-0.015	-0.015	-0.015	-0.016
	(0.013)***	(0.013)***	(0.014)***	(0.003)***	(0.003)***	(0.003)***	(0.003)***	(0.003)***	(0.003)***
Size Tercile 2 x Recession	0.024	0.025	0.024	-0.008	-0.006	-0.007	0.015	0.014	0.014
	(0.016)	(0.016)	(0.017)	(0.004)*	(0.004)	(0.004)	(0.006)**	(0.006)**	(0.006)**
Size Tercile 3 x Recession	0.035	0.037	0.034	-0.006	-0.002	-0.005	0.020	0.019	0.020
	(0.020)*	(0.021)*	(0.022)	(0.004)	(0.005)	(0.005)	(0.006)***	(0.006)***	(0.006)***
$Log(Compensation)_{t-4}$ x Recession		-0.003			-0.002			0.001	
		(0.002)			(0.001)**			(0.001)	
$CEO\ Age_{t-4}$ x Recession		0.002			0.000			-0.001	
		(0.004)			(0.002)			(0.003)	
$CEO\ Age^2_{t-4}$ x Recession		0.000			0.000			0.000	
		(0.000)			(0.000)			(0.000)	
$Tenure_{t-4}$ x Recession		0.001			0.000			0.000	
		(0.001)			(0.000)			(0.000)	
$Tenure^2_{t-4}$ x Recession		0.000			0.000			0.000	
		(0.000)			(0.000)			(0.000)	
$Z_{i,t-4}$ x Year-quarter FE	No	No	Yes	No	No	Yes	No	No	Yes
N of observations	26497	26497	26550	31822	31822	31857	50432	50432	50544
N of clusters	60	60	60	58	58	58	61	61	61

Table 7. Explanations for the size effect: diversification. This table shows results from regressions similar to those in Table 4, except that we include a lagged measure of firm diversification and its interaction with the recession dummy as independent variables. Diversification is measured using the inverse of the firm's HHI computed using segment sales (details are in Appendix A). The regressions are estimated on a sample with available diversification data, and columns (1), (4), and (7) shows regressions without diversification as a benchmark. The results in columns (2), (5), and (8) are from the following regression:

$$\Delta y_{it-4,t} = \mathrm{B} \times Size_{it-4} + \Gamma \times Size_{it-4} \times Recession + \Phi \times InvHHI_{i,t-4} + \Omega \times IHHI_{i,t-4} \times Recession + \eta_{j,t} + \varepsilon_{it}.$$

In columns (3), (6), and (9), $InvHHI_{i,t-4} \times Recession$ is replaced with interactions of $InvHHI_{i,t-4}$ with year-quarter fixed effects. We define $\Delta y_{it-4,t}$ as sales growth measured as the change in quarterly sales for firm *i* from quarter *t-4* to *t* over total assets in quarter *t-4*; $\eta_{j,t}$ are industry-year-quarter fixed effects, with industries at the 4-digit SIC level; $Size_{it-4}$ is either log of total assets in quarter *t-4* or tercile dummies formed based on assets in *t-4*; $Recession$ is an indicator for NBER recession quarters, and *Z* are lagged CEO variables defined in Appendix A. The sample period is from 1993q1 to 2020q3; the fourth quarters are omitted for consistency with the 2020 recession. Standard errors in parentheses are clustered at the two-digit industry level, and *, **, *** indicate p values of less than 1%, 5%, and 10%.

Panel A. Firm size measured using total assets in previous year

	Recessions during 1980s-2001			Recession in 2009			Recession in 2020		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Log (Size)$_{t-4}$	-0.010	-0.009	-0.009	-0.005	-0.004	-0.004	-0.003	-0.003	-0.002
	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.000)***	(0.001)***	(0.000)***	(0.000)***	(0.000)***
Log (Size)$_{t-4}$ x Recession	0.006	0.006	0.005	0.000	0.000	0.001	0.002	0.002	0.003
	(0.001)***	(0.001)***	(0.001)***	(0.001)	(0.001)	(0.001)	(0.001)*	(0.001)*	(0.001)***
IHHI$_{t-4}$ x Recession		0.000			0.003			0.000	
		(0.001)			(0.001)**			(0.001)	
IHHI$_{t-4}$ x Year-quarter FE	N	N	Y	N	N	Y	N	N	Y
N of observations	220631	220631	220631	77740	77740	77739	87001	87001	86992
N of clusters	71	71	71	66	66	66	65	65	65

Panel B. Firm size measured using size terciles in previous year

	Recessions during 1980s-2001			Recession in 2009			Recession in 2020		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Size Tercile 2	-0.005	-0.004	-0.002	-0.008	-0.008	-0.008	-0.021	-0.020	-0.018
	(0.001)***	(0.001)***	(0.001)*	(0.001)***	(0.001)***	(0.001)***	(0.002)***	(0.002)***	(0.002)***
Size Tercile 3	-0.010	-0.009	-0.006	-0.014	-0.012	-0.012	-0.029	-0.026	-0.025
	(0.001)***	(0.001)***	(0.001)***	(0.002)***	(0.002)***	(0.002)***	(0.003)***	(0.003)***	(0.002)***
Size Tercile 2 x Recession	0.004	0.004	0.008	0.002	0.001	0.005	0.016	0.016	0.014
	(0.004)	(0.004)	(0.004)*	(0.002)	(0.003)	(0.003)*	(0.003)***	(0.003)***	(0.002)***
Size Tercile 3 x Recession	0.009	0.009	0.015	0.000	-0.002	0.002	0.017	0.017	0.014
	(0.004)**	(0.004)**	(0.004)***	(0.003)	(0.003)	(0.003)	(0.004)***	(0.004)***	(0.003)***
$IHHI_{t-4}$ x Recession		0.000			0.003			0.003	
		(0.001)			(0.001)**			(0.001)**	
$IHHI_{t-4}$ x Year-quarter FE	N	N	Y	N	N	Y	N	N	Y
N of observations	87001	87001	86992	77740	77740	77739	220631	220631	220631
N of clusters	65	65	65	66	66	66	71	71	71

Table 8. Firm size and the relation between growth and stock returns. This table shows results from regressions of firms sales growth and investment on measures of size interacted with a firm-level stock returns and controls:

$$\Delta y_{it-4,t} = \alpha \times Firm\ return_{i,t} + \Gamma \times Size_{it-4} \times Firm\ return_{i,t} + B \times Size_{it-4} + \Gamma \times Size_{it-4} \times Recession + \eta_{j,t} + \varepsilon_{it},$$

where $\Delta y_{it-4,t}$ are measures of sales growth and investment defined in Appendix A, $Size_{it-4}$ is the log of total assets in quarter *t-4*, $Firm\ return_{i,t}$ is the average monthly return in excess of the market return of firm i in quarter t (details are in Appendix A). $Recession$ is an indicator for NBER recession quarters, $\eta_{j,t}$ are industry-year-quarter fixed effects, with industries at the 4-digit SIC level. The sample period is from 1974q1 to 2020q3. Standard errors in parentheses are clustered at the two-digit industry level, and *, **, *** indicate p values of less than 1%, 5%, and 10%.

Panel A. Full sample with dependent variables in the table headings

	Sales Growth	ΔPPE	R&D	Sales Growth	ΔPPE	R&D
Firm return	0.105***	0.003	0.006***	0.177***	0.012	0.009***
	(0.011)	(0.005)	(0.002)	(0.018)	(0.007)	(0.003)
Size Tercile 2 x Firm Return	-0.035***	-0.010**	-0.004***			
	(0.008)	(0.004)	(0.001)			
Size Tercile 3 x Firm Return	-0.059***	-0.018***	-0.005***			
	(0.009)	(0.004)	(0.002)			
				-0.017***	-0.003***	-0.001***
Log (Size)t-4 x Firm Return				(0.002)	(0.001)	(0.000)
N of observations	562395	400112	566473	545069	386440	549029
N of clusters	72	70	72	72	70	72

Panel B. By recession period with sales growth as the dependent variable

	1980s	1990-1991	2001	2008-2009	2020	1980s	1990-1991	2001	2008-2009	2020
Firm return	0.190***	0.224***	0.120***	0.080***	0.066***	0.297***	0.330***	0.187***	0.118***	0.110***
	(0.031)	(0.021)	(0.013)	(0.007)	(0.012)	(0.049)	(0.035)	(0.027)	(0.013)	(0.021)
Size Tercile 2 x Firm Return	-0.066**	-0.081***	-0.040***	-0.039***	-0.018*					
	(0.029)	(0.017)	(0.010)	(0.007)	(0.009)					
Size Tercile 3 x Firm Return	-0.126***	-0.153***	-0.061***	-0.047***	-0.032***					
	(0.030)	(0.022)	(0.013)	(0.007)	(0.010)					
Log (Size)t-4 x Firm Return						-0.030***	-0.033***	-0.018***	-0.010***	-0.008***
						(0.007)	(0.005)	(0.004)	(0.002)	(0.002)
N of observations	46474	75074	165458	122713	150358	44964	71247	157556	120312	148691
N of clusters	63	66	70	65	66	63	66	70	65	66

Table 9. Market shares across business cycles. This table shows results from regressions of firms market shares on measures of size interacted with a recession dummy and controls:

$$\Delta y_{it-4,t} = \mathrm{B} \times Size_{it-4} + \Gamma \times Size_{it-4} \times Recession + \Phi \times X_{i,t-4} + \Omega \times X_{i,t-4} \times Recession + \eta_{j,t} + \varepsilon_{it}.$$

where $\Delta y_{it-4,t}$ is either sales growth (defined in previous tables) or market shares defined in Appendix A. *Market Share (Surviving)* in quarter *t* is computed only using firms that are part of the industry in quarter *t* and *t-4*. Market Shares (All) are computed using all firms in the industry in quarter *t*. Variables $X_{i,t-4}$ are lagged firm-specific controls described in Appendix A, $Size_{it-4}$ is the log of total assets in quarter *t-4*, and $Recession$ is an indicator for NBER recession quarters, $\eta_{j,t}$ are industry-year-quarter fixed effects, with industries at the 4-digit SIC level. The sample period is from 1974q1 to 2020q3; the fourth quarters are omitted for consistency with the 2020 recession. Each panel shows separate regressions for recessions during 1980-2001, 2009, and 2020. Each regression is estimated on the period including the recession quarters and the quarters prior to the recession and starting after the previous recession. Standard errors in parentheses are clustered at the two-digit industry level, and *, **, *** indicate p values of less than 1%, 5%, and 10%.

Panel A. Firm size measured using total assets in previous year

	Recessions 1980s-2001			Recession in 2009			Recession in 2020		
	Sales Growth	Market Share (Surviving)	Market Share (All)	Sales Growth	Market Share (Surviving)	Market Share (All)	Sales Growth	Market Share (Surviving)	Market Share (All)
Log (Size)$_{t-4}$	-0.010	-0.003	-0.002	-0.005	-0.002	-0.002	-0.003	-0.001	-0.001
	(0.001)***	(0.000)***	(0.000)***	(0.001)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)**
Log (Size)$_{t-4}$ x Recession	0.005	0.001	0.000	0.001	0.001	0.003	0.002	0.001	0.000
	(0.001)***	(0.000)***	(0.000)	(0.001)	(0.000)***	(0.001)***	(0.001)**	(0.000)***	(0.001)
N of observations	243655	243655	243261	83502	83501	83425	94793	94785	94646
N of clusters	71	71	71	66	66	66	66	66	66

Panel B. Firm size measured using size terciles in previous year

	Recessions 1980s-2001			Recession in 2009			Recession in 2020		
	Sales Growth	Market Share (Surviving)	Market Share (All)	Sales Growth	Market Share (Surviving)	Market Share (All)	Sales Growth	Market Share (Surviving)	Market Share (All)
Size Tercile 2	-0.021	-0.005	-0.003	-0.010	-0.002	0.001	-0.007	0.000	0.001
	(0.002)***	(0.001)***	(0.000)***	(0.002)***	(0.000)***	(0.001)	(0.001)***	(0.000)	(0.001)**
Size Tercile 3	-0.030	-0.011	-0.007	-0.017	-0.005	-0.004	-0.013	-0.003	-0.002
	(0.003)***	(0.001)***	(0.001)***	(0.002)***	(0.001)***	(0.001)**	(0.002)***	(0.000)***	(0.001)*
Size Tercile 2 x Recession	0.016	0.002	0.002	0.003	0.002	0.003	0.005	0.002	0.003
	(0.003)***	(0.001)***	(0.001)	(0.002)	(0.001)**	(0.002)	(0.004)	(0.001)*	(0.002)
Size Tercile 3 x Recession	0.017	0.003	0.000	0.001	0.003	0.010	0.010	0.004	0.002
	(0.003)***	(0.001)***	(0.002)	(0.003)	(0.001)**	(0.003)***	(0.004)**	(0.001)***	(0.003)
N of observations	243655	243655	243261	83502	83503	83427	94793	94785	94646
N of clusters	71	71	71	66	66	66	66	66	66

Appendix A: Variables Definitions

Sales growth	Change in sales from qtr t-4 to qtr t / Total assets in qtr t-4
ΔPPE	Change in property, plant and equipment (PPE) from qtr t-1 to t) / Total assets in qtr t-1. PPE is adjusted for asset impairments using as an approximation the Compustat quarterly statement of cash flow variable Funds From Operations-Other (FOPO; see Dechow, Larson, and Resutek (2020)).
CAPX	Capital expenditure in qtr t / Total assets in qtr t-1
R&D	R&D in qtr t / Total assets in qtr t-1 / Total assets in qtr t-1
ΔInventory	Change in Inventory from qtr t-1 to t / Total assets in qtr t-1
ΔAR	Change in Accounts Receivables from qtr t-1 to t / Total assets in qtr t-1
Equity issuance	Net equity issue in qtr t from statement of cashflows / Total assets in qtr t
Debt issuance	Net debt issue in qtr t from statement of cashflows / Total assets in qtr t
ΔCash	Change in Cash from qtr t-1 to t / Total assets in qtr t-1
B/M_{t-4}	Book value of equity / Market value of equity
ROA_{t-4}	Operating income before depreciation in qtr t / Total assets in qtr t-1
Book $Leverage_{t-4}$	Total Debt / (Total debt + Book value of equity)
$Cash_{t-4}$	Cash and short-term investments in qtr t / Total assets in qtr t
Sales $growth_{t-4}$	Sales growth lagged by four quarters
Compensation	Total CEO compensation ($ thousands)
CEO age	CEO age
Tenure	CEO tenure measured as the number of years since taking office
Firm $return_t$	Average monthly return in quarter t minus the average monthly return on the value-weighted NYSE, Nasdaq, Amex index in quarter t
N of Segments	Number of Segments defined on the
IHHI	Inverse HHI formed based on the firm's segment sales
ΔMarket Share (Surviving)	Change in the firm's market share on the 4-digit industry from qtr t-4 to t computed using only firms that are part of the industry in quarter t and t-4
ΔMarket Share (All)	Change in the firm's market share on the 4-digit industry from qtr t-4 to t computed using all firms that are part of the industry in quarter t