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The unintended consequence of collateral-based financing: Evidence from corporate cost behavior ☆

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A B S T R A C T

This paper examines how real estate appreciation correspondingly changes collateral value, which affects debt structure choices and consequent operating decisions. Specifically, we explore whether collateral-based financing provides a link between real estate values and corporate cost behavior. Our baseline results show that an appreciation of a firm's real estate assets alleviates its cost stickiness. A further analysis shows that this influence is stronger for firms with less prior bank debt, less dependence on external financing, and a lower leverage ratio. We also observe that the impact of collateral shocks on cost stickiness is more pronounced when selling, general and administrative (SG&A) costs create less future value for mature firms and for firms with weaker external governance. Collectively, our results support the argument that an increase in bank debt arising from collateral value appreciation mitigates agency problems and thus lessens cost stickiness.

Introduction

The existing literature points out that collateralizable assets, such as real estate, can enhance firms' financing capacity and allow them to borrow more (e.g., Barro, 1976; Stiglitz and Weiss, 1981; Hart and Moore, 1994; Rampini and Viswanathan, 2013). Empirical research is consistent with this argument and shows that firms with higher collateral values can easily access external finance at a relatively lower cost (e.g., Gan, 2007; Berger et al., 2011; Cvijanović, 2014; Alimov, 2016; Lin, 2016). Especially when the value of real estate assets rises, firms are likely to borrow more in the form of bank debt than public debt (Lin, 2016). Prior empirical studies also document that such collateral-based financing plays important roles in corporate investment (Chaney et al., 2012; Balakrishnan et al., 2014), competitive performance (Alimov, 2016), cash policy (Chen et al., 2017), payout policy (Kumar and Vergara-Alert, 2020), employment (Ersahin and Irani, 2020), and innovation (Mao, 2021). However, the implication of collateral-based financing on a firm's cost behavior has remained largely unex-

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plored. In this study, we attempt to fill this gap by investigating whether and how collateral-based financing provides a link between real estate values and firms' asymmetric cost reaction to sales changes (i.e., cost stickiness).

Explaining cost stickiness has long been a research question in cost accounting. Since the analysis of Anderson et al. (2003) that documented that costs were sticky or asymmetrically adjusted, i.e., costs increased more rapidly when sales increased than they declined when sales decreased, studies have extensively investigated the pervasive phenomenon of asymmetric cost adjustment. Recent research has proposed two main theories underlying the observed cost stickiness, namely, adjustment cost theory and agency theory (Anderson et al., 2003; Chen et al., 2012; Banker et al., 2013; Banker and Byzalov, 2014; Liu et al., 2019). Adjustment cost theory argues that firms incur adjustment costs (e.g., severance pay to dismissed employees, costs of training new hires, loss of employee morale, and reduced employee efforts) when making resource capacity adjustments (Anderson et al., 2003; Trevor and Nyberg, 2008; Banker et al., 2013; Liu et al., 2019). If sales rise, managers expand the required resources, whereas if sales decline, managers prefer to retain some unused resources to avoid adjustment costs associated with cutting resources, which results in cost stickiness (Banker et al., 2013; Liu et al., 2019).[1] Agency theory argues that due to a self-interest motivation to build an "empire" or pursue a "quiet life", managers often increase costs rapidly when market demand increases, and are reluctant to reduce costs when demand declines (Datta et al., 2009; Chen et al., 2012). This again leads to cost stickiness.

We hypothesize that higher real estate collateral values lead to lesser cost stickiness. Lin (2016) shows that an increase in a firm's collateral values makes the firm shift its debt structure toward bank debt. Specifically, firms are likely to start to use bank debt and repay public debt after a positive shock to collateral values. A related well-known aspect is that banks are engaged in governance activities such as monitoring and screening. Among these activities, monitoring is considered to be one of banks' most important activities (Freixas and Rochet, 1997). The main purpose of bank monitoring is to reduce the credit/default risk by preventing the moral hazard problems of corporate insiders. Compared to public debtholders, banks have significant comparative advantages in monitoring efficiency due to superior access to borrowers' private information, the alleviation of free-rider problems, and credible threats (Fama, 1985; Park, 2000; Lin et al., 2013). Consequently, corporate managers are less likely to be able to extract private benefits at the expense of shareholders and lenders under bank monitoring (Hoshi et al., 1993). Since retaining idle resources during a period of declining sales can lead to a greater decline in earnings and an increase in earnings volatility and thus higher default risk for lenders (Weiss, 2010), banks have more incentives to monitor borrowers' cost management practices. The comparative advantages will also make bank monitoring more efficient. Hence, managers are expected to reduce unused resources during such periods.

Moreover, after bank loans are obtained, borrowers continue to have incentives to manage earnings to avoid debt covenant violations. Consistently with this prediction, prior evidence in the literature shows that to avoid bank debt covenant violations, firms engage in more real earnings management activities (e.g., Bartov, 1993; Roychowdhury, 2006; Kim et al., 2010). Since asset sales and reduction of discretionary expenditures represent two main methods of such management (Roychowdhury, 2006; Gunny, 2010), firms with more bank loans are expected to curtail more unused resources during a sales decline period to avoid debt covenant violations. This again results in lower cost stickiness.

To test our hypothesis, we exploit variations in firms' real estate values caused by movements in local real estate prices (at the state or metropolitan statistical area (MSA) level). Considering a sample of U.S. public firms from 1993 to 2018, we observe that a positive shock to real estate collateral values has a significantly negative impact on cost stickiness. The results are consistent with the agency costs hypothesis that greater collateral values lead to more bank debt financing, which restrains managers from engaging in self-serving actions that could induce cost stickiness.

We perform several robustness tests to confirm our statistical inference. Our baseline results continue to hold if we use alternative samples, alternative measures of collateral value and cost stickiness, alternative clustering methods, and alternative model specifications that control for unobserved confounding geographic trends and industry shocks. Next, we perform several tests to address potential endogeneity issues, as in Chaney et al. (2012). First, we show that our results are robust by performing a propensity score-matched (PSM) sample analysis in which we match firms with zero collateral values to firms with higher collateral values based on firm-level characteristics. Second, we show that our results are robust to the instrumental variable (IV) model in which we instrument for MSA-level real estate prices using the interaction between the national mortgage rate and the local land supply elasticity. Third, our baseline results are proven to be robust if we control for the interactions between firms' initial characteristics and real estate price indices.

We perform additional analyses to substantiate the argument that collateral appreciation leads to more bank debt financing, which eventually results in a lower degree of cost stickiness. First, we observe that the effect of collateral values on cost stickiness is more pronounced if firms have fewer non-real-estate tangible assets, more redeployable assets, and bond ratings. Prior studies have shown that such firms are less likely to borrow from banks than to issue public debt (Denis and Mihov, 2003; Lin, 2016; Chen et al., 2020). Second, we establish that the collateral value effect is stronger for more profitable firms. In general, profitable firms are less likely to rely on external financing (Myers, 1984; Rajan and Zingales, 1995; Almeida and Campello, 2010). Third, we document that the association between collateral value and cost stickiness is more pro-

[1] Earlier studies have documented that although firms incur costs to adjust resources upward, such costs are relatively lower than costs' increase from cutting resources when sales decline (e.g., Bentolila and Bertola, 1990; Pfann and Palm, 1993; Cooper and Haltiwanger, 2006).

nounced in less-levered firms. Leverage helps reduce agency problems by limiting managers' ability to allocate corporate resources to unproductive uses (Jensen and Meckling, 1976).[2]

We next examine whether the effect of collateral values on cost stickiness is stronger for firms with more severe managerial agency problems. We observe that collateral values only negatively affect cost stickiness for firms with selling, general and administrative (SG&A) costs that create less future value, for mature firms, and for firms with weak external corporate governance. The results are thus consistent with the agency theory of cost stickiness. Moreover, we establish that the effect is more pronounced for firms with higher institutional ownership and greater board independence, indicating that institutional ownership (and internal corporate governance) and bank debt act as complements for monitoring managerial behavior.

Our study makes two contributions. First, our analyses add to the literature on the real effects of collateral-based financing. As mentioned above, prior studies have investigated the effects of collateral value on a series of corporate decisions. However, such studies have focused on the role of financial flexibility generated by collateral-based debt capacity. This paper documents a negative relationship between collateral values and cost stickiness, complementing the findings of Lin (2016) by showing that the increase in bank debt arising from a positive shock to a firm's real estate value could enhance the intensity of bank monitoring and thus restrain managers from acting on personal motives that could induce cost stickiness. Therefore, the paper provides the link between collateral value and a firm's financing decision and the consequent operating decisions. To the best of our knowledge, this is the first study that shows an important role that collateral finance plays in affecting corporate cost adjustment decisions.

Second, this study contributes to the literature on the determinants of cost stickiness. Specifically, we add to the literature on how access to external finance, a factor that was largely ignored before, affects corporate cost behavior. Considering a large sample of private Chinese firms, Cheng et al. (2018) note that firms in regions with lower financial development are associated with weak cost stickiness. Consistently with this, Lee et al. (2021) observe that an increase in credit supply due to enhanced banking competition leads to a higher degree of cost stickiness. Costa et al. (2021) show that financially constrained firms exhibit less cost asymmetry. However, these studies mainly focus on explaining asymmetric cost behavior in the framework of adjustment costs. The existing literature also emphasizes the role of external finance in mitigating managerial agency problems. In a relatively recent analysis, Habib and Costa (2021) note that short-maturity debt lessens opportunistic cost stickiness. Costa and Habib (2021) show that trade credit restrains the empire-building behavior of managers in firms with grave agency problems and thus restrains cost stickiness. Our study extends this stream of literature and demonstrates that exogenous shocks to a firm's real estate values play a significant role in influencing cost stickiness due to increasing reliance on bank debt and thus more intensive monitoring.

The paper proceeds as follows. Section 2 describes the related literature and develops our hypothesis. Section 3 describes the sample and the empirical design. Section 4 presents our main findings and performs additional analyses. We conclude the article in Section 5.

Literature review and hypothesis development

Cost stickiness

The traditional textbook view is that production costs can be split into fixed and variable costs. Fixed costs tend to be constant irrespective of the volume of output or activity. In contrast, variable costs change proportionately and symmetrically with changes in outputs or activity levels, regardless of the direction of activity change (Noreen, 1991). Recent research on cost management, however, has documented that costs are sticky; i.e., they increase more rapidly if sales increase than they decline if sales decrease (Noreen and Soderstrom, 1997; Anderson et al., 2003; Balakrishnan et al., 2014). Moreover, previous studies have proposed two main explanations underlying the observed cost stickiness, namely, adjustment cost theory and agency theory (Liu et al., 2019).

Adjustment cost theory argues that firms incur adjustment costs when making resource capacity adjustments, such as paying severance to dismissed employees, costs of training new hires, and installation and disposal costs of equipment. In addition to such out-of-pocket costs, adjustment costs include implicit costs such as the loss of employee morale and reduced employee efforts (Anderson et al., 2003; Trevor and Nyberg, 2008; Banker et al., 2013; Liu et al., 2019). When sales rise, managers expand required resources, whereas when sales decline, managers prefer to retain some unused resources to avoid high adjustment costs associated with cutting resources, which results in cost stickiness (Banker et al., 2013; Liu et al., 2019).

Managerial behavior can also be an important driver of cost asymmetry. Agency theory argues that the separation of ownership and control could lead to agency problems; i.e., managers are likely to pursue their own interests instead of those of shareholders (Jensen and Meckling, 1976; Fama and Jensen, 1983). A well-documented agency problem is managerial ''empire building'' or ''a preference for a quiet life'' (Bertrand and Mullainathan, 2003). Prior research has shown that managers engaged in ''empire building'' have a higher tendency to grow the firm beyond its optimal size or retain unutilized resources

[2] Lin (2016) observes that both financially constrained and unconstrained firms use more bank debt when the value of their real-state assets rises. Consequently, the effect of collateral values on cost stickiness should be more pronounced for firms with less prior bank debt.

to enhance personal utility from status, power, compensation and prestige (e.g., Jensen, 1986; Stulz, 1990; Masulis et al., 2007; Hope and Thomas, 2008). In terms of cost management, managers motivated by self-interest in building an ''empire'' or pursuing a ''quiet life'' often increase costs rapidly when market demand increases or are reluctant to reduce costs when demand declines (Datta et al., 2009; Chen et al., 2012). This again leads to cost stickiness.

Moreover, Anderson et al. (2003) note that firms have lower cost stickiness when they experience two periods of consecutive sales declines. Consistently with this, Banker and Byzalov (2014) show that cost anti-stickiness follows a prior sales decrease, whereas cost stickiness only follows a prior sales increase. The scholars' findings thus suggest that managerial expectations of future demand can influence firms' cost stickiness. Subsequent research has also established that economic incentives could affect cost stickiness. Kama and Weiss (2013) show that managers tend to accelerate resource cuts in periods of sales decline in the presence of earnings targets. Similarly, Dierynck et al. (2012) observe that earnings management via discretionary accruals induces higher cost stickiness.

Studies of real estate collateral value

U.S. firms hold a large amount of real estate assets, representing 37.2 % of their total assets on average in our sample. Firms can pledge real estate assets as collateral. In the Modigliani–Miller (MM) model, the amount and value of collateral assets can affect the firm's credit rating but should not create additional value (Cvijanović, 2014). However, several theoretical papers argue that in the presence of financial friction, collateralizable assets could mitigate inefficiency costs caused by moral hazard and adverse selection, which in turn increase the financing capacity of firms suffering from these costs and allow them to borrow more (Barro, 1976; Stiglitz and Weiss, 1981; Hart and Moore, 1994). Consistently with this theory, subsequent empirical studies have shown that firms that experience real estate appreciation can raise external financing at lower cost (e.g., Gan, 2007; Berger et al., 2011; Cvijanović, 2014; Alimov, 2016; Lin, 2016).

Building on the role of collateral assets in mitigating financing constraints and enhancing the firm's financing capacity, recent studies have investigated how collateral values affect firm-level outcomes. Chaney et al. (2012) note that an increase in a firm's collateral values leads to more investment, and this result is stronger for firms with tighter credit constraints. Similarly, Ersahin and Irani (2020) show that firms increase employment when the value of their real estate appreciates. Mao (2021) documents that real estate appreciation leads to an increase in quantity and quality of innovation. Extending this literature, Balakrishnan et al. (2014) show that financing and investment of firms with higher reporting quality are less sensitive to changes in collateral values than those of firms with lower reporting quality. The researchers further observe that firms improve reporting quality in response to decreases in the values of collateral assets. In addition, Alimov (2016) documents a positive relation between collateral value and product market performance. Chen et al. (2017) note that an increase in a firm's real estate values lowers its cash holdings and the marginal value of cash holdings. Kumar and Vergara-Alert (2020) argue that firms with higher collateral values may shift some of their income from investments and cash reserves to payouts. The scholars find strong evidence that a positive shock to a firm's collateral values leads to an increase in corporate payout and payout flexibility.

Although many studies have examined the role of collateral values in shaping corporate decisions, we still know little about whether and how collateral values affect firms' cost management.

Collateral value and cost stickiness

As mentioned above, an increase in collateral values improves firms' financing capacity and allows firms to borrow at a lower cost; however, its impact on debt choice is not uniform. Lin (2016) observes that when real estate assets appreciate, firms are likely to shift their debt structure toward bank debt; in particular, firms are likely to start to use bank debt and repay public debt. It is well known that banks engage in governance activities such as monitoring and screening. Among these activities, monitoring is considered to be one of banks' most important activities (Freixas and Rochet, 1997). The main purpose of bank monitoring is to reduce a bank's credit/default risk by preventing expropriation by or opportunistic activities of a borrower (i.e., moral hazard problems) that occur after a bank loan has been extended due to information asymmetries between banks and firms.

Previous studies have hypothesized that banks have significant comparative advantages over public debtholders in monitoring efficiency due to access to borrowers' private information. For example, Fama (1985) argues that banks, as insiders, have an advantage in accessing inside information because of their ongoing relationship with the borrowing firm. Diamond (1984, 1991) contends that banks have economies of scale and comparative cost advantages in obtaining information that enable them to undertake superior debt-related monitoring. Superior access to information enables banks to detect expropriation or opportunistic activities by corporate insiders such as C-suite members and, consequently, to punish offending borrowers either by liquidation or through renegotiation (Park, 2000; Lin et al., 2013). As a consequence, bank monitoring reduces borrowers' moral hazard problems and provides corporate managers with strong incentives to make appropriate decisions (Stiglitz and Weiss, 1983; Rajan, 1992).

In contrast, public debt is usually held by a diffuse set of owners that rely primarily on publicly available information after issuance. The diffuse ownership of public debt could lead to free-rider problems that weaken individual public lenders' incentives to engage in costly monitoring (Diamond, 1984, 1991). Furthermore, limited information access can reduce the efficiency of monitoring. In short, the combination of concentrated holdings and superior access to information makes banks much more effective monitors than public bondholders in constraining managerial discretion. Therefore, it should be less likely for corporate insiders to be able to extract private benefits at the expense of shareholders and lenders under bank monitoring (Hoshi et al., 1993). Consistently with this, Saunders and Song (2018) show that an increase in bank monitoring significantly reduces CEOs' risk-taking incentives and leads to corporate policy changes that are generally in favor of lenders, such as higher cash holdings, lower capital expenditures, and lower dividend payouts.

Prior studies have documented that managers engaged in "empire building" often increase costs rapidly when market demand increases or are reluctant to reduce costs when demand declines, resulting in cost stickiness (Datta et al., 2009; Chen et al., 2012). The findings are more pronounced in firms with weak corporate governance (Chen et al., 2012; Banker et al., 2013). Therefore, self-serving managers might be less likely to shed unused resources because downsizing by slashing resources reduces the managers' chance of maximizing private benefits. Although retaining idle resources during periods of sales declines could send a positive signal for future performance, the resulting cost stickiness can lead to a greater decline in earnings and increase earnings volatility (Weiss, 2010). The reason is that a smaller cost adjustment when sales decrease leads to lower cost savings, which ultimately result in a greater decline in earnings. The latter decline increases the variability of the earnings distribution and thus leads to higher earnings volatility. This, in turn, can increase the default risk for lenders (Homburg et al., 2019). In addition, due to superior access to firms' private information, banks can more accurately assess firms' overall operations, and thus such a positive signal might be meaningless. Since the self-serving actions of managers increase the default risk for lenders, banks should have more incentives to monitor borrowers' cost management practices. The advantages of accessing private information and alleviating free-rider problems will further make monitoring more efficient. Therefore, we expect that firms with more bank debt tend to shed unused assets during periods of sales declines, resulting in a lower level of cost stickiness.

Moreover, after bank loans have been extended, borrowers may have incentives to actively cut unused resources during a period of sales declines. The main reason for such ex post cost management is to avoid debt covenant violations. In loan contracts, covenants have traditionally been viewed as a mechanism of addressing agency problems by restricting managerial self-serving behavior (e.g., Jensen and Meckling, 1976; Smith and Warner, 1979; Smith, 1993). Debt covenant violations generally result in negative consequences for borrowers, including increases in interest costs and reductions in credit availability (Roberts and Sufi, 2009), declines in future investment (Chava and Roberts, 2008), requests for early debt repayment, and additional restrictions on borrowers' activities (Beneish and Eric, 1993). Hence, firm managers have more incentives to engage in earnings management to avoid disclosing such violations. In addition, the debt-equity hypothesis suggests a positive relation between a firm's debt-equity ratio and managers' choice of earnings-enhancing activities, indicating that firms with high leverage are more likely to engage in earnings management (Watts and Zimmerman, 1986; Bartov, 1993). Consistently with this argument, Roychowdhury (2006) observes that real earnings management is more pronounced for firms with debt than for firms without. Similarly, Bartov (1993) notes that income from asset sales is higher for firms with higher leverage, as the latter serves as a proxy for more restrictive debt covenants. Using debt covenant slack as a measure of debt covenant violations, Kim et al. (2010) show that the overall level of real earnings management is higher for smaller net worth covenant slack. Since asset sales and reduction of discretionary expenditures represent two main methods of real earnings management (Roychowdhury, 2006; Gunny, 2010), managers in firms with more bank loans are expected to shed more unused resources during periods of decline in sales to avoid debt covenant violations. This again results in lower cost stickiness.

In summary, more bank debt arising from collateral value appreciation can force managers to make efficient operational and investment decisions, and such decisions encompass downsizing resources in the event of an activity decline. Therefore, we state our hypothesis as follows:

Hypothesis: *A positive shock to a firm's real estate collateral values leads to a decrease in the degree of cost stickiness.*

Data and variable construction

Sample selection

To empirically examine the impact of collateral asset appreciation on cost stickiness, we use a sample of U.S. public firms during the period from 1993 to 2018. The financial and accounting information of all firms is obtained from Compustat. Following prior studies of real estate shocks (e.g., Chaney et al., 2012; Balakrishnan et al., 2014; Cvijanović, 2014; Lin, 2016; Chen et al., 2017; Ersahin and Irani, 2020; Kumar and Vergara-Alert, 2020), we start with a sample of active firms from 1993, as this was the last year that the accumulated depreciation of buildings was reported in Compustat. In the next section, we use accumulated depreciation to calculate the market value of a firm's real estate assets.

Table 1 describes the sample selection procedure. Following the conventional approach in cost stickiness studies, we exclude firms in financial and public utility industries (SIC 6,000–6,999 and SIC 4,900–4,999), as they operate in a different regulatory environment. We further require firms to have available figures of sales revenue, SG&A costs, and real estate values. Next, we remove observations with missing values of key measures of cost stickiness, including change in SG&A costs and change in sales revenue. Finally, we exclude observations if values of any control variables in the main regression model are missing. This reduces our sample to 24,398 firm-year observations for 2,421 unique firms over the sample period. To remove the effects of outliers, we winsorize all continuous variables at 1 % tails.

Table 1
Sample Selection.

Firm-year observations available in COMPUSTAT for the years 1993–2018	327,621
Less: firm-year observations without "GVKEY" or "FYEAR"	(875)
Less: firm-year observations in the financial services or utility industries	(126,408)
Less: firm-year observations with missing values of SG&A costs and sales revenue	(32,243)
Less: firm-year observations without real estate value's data	(134,435)
Less: firm-year observations without sufficient data to calculate the change in SG&A costs and the change in sales revenue	(3,988)
Less: firm-year observations with missing values of control variables	(5,275)
Final sample of firm-year observations	24,398

This table reports the sample selection procedure for the sample period of 1993–2018.

Value of corporate real estate assets

The key variable of interest in this study is the value of a firm's real estate assets. We closely follow the methodology used by Chaney et al. (2012) and Balakrishnan et al. (2014) to construct this variable. Specifically, we define a firm's real estate assets as the sum of three major categories of property, plant and equipment (PPE), namely, PPE land and improvements at cost, PPE buildings at cost or historical cost of buildings, and PPE construction-in-progress at cost. Since these assets are valued at historical cost rather than marked to market, we need to recover their market value. The procedure is as follows. First, we compute the average age and the purchase year of buildings for each firm. To this end, we calculate the ratio of buildings' accumulated depreciation to historical cost. This quantity measures the proportion of the original value of a building claimed to be depreciation. Next, we multiply the ratio by the assumed mean term of depreciation of 40 years (see Nelson et al., 1999). This calculation yields the average age of real estate assets. The purchase year is determined as 1993 less the average age of real estate assets.

Next, we use real estate price indices to compute the market value of firms' real estate assets in 1993 and then calculate the market value of these assets in each subsequent year during our sample period as a function of changes in real estate prices. We obtain the state- and MSA-level real estate price indices from the Federal Housing Finance Agency (FHFA) for the period starting in 1975, the year the index became available. For years before 1975, we use the consumer price index (CPI) to adjust real estate prices.

We match state-level real estate price indices with our financial and accounting data using the state identifier from Compustat. For MSA-level real estate price indices, we first use a table that maps ZIP codes to MSA codes maintained by the U.S. Department of Labor's Office of Workers' Compensation Programs (OWCP). Afterwards, we match MSA-level real estate price indices with financial and accounting data for each firm using the ZIP code as an identifier, which is also provided in Compustat.

We estimate the market value of real estate assets held in 1993 as the book value (i.e., the sum of the three major categories of PPE) at the time of purchase (acquisition) multiplied by the cumulative price increase from the purchase (acquisition) date to 1993. Afterwards, we estimate the market value of these assets in subsequent years during our sample period as the market value in 1993 multiplied by the cumulative price increase from 1993 to a given year.[3]

Estimation model

To measure cost stickiness, existing studies mainly use the approach of Anderson et al. (2003), which links the magnitude of variation in SG&A costs ($\Delta lnSG\&A$) to contemporaneous variations in sales revenue ($\Delta lnSALE$) and differentiates between sales increases and sales declines as follows:

$$\Delta lnSG\&A_{s,i,t} = \beta_0 + \beta_1 \Delta lnSALE_{s,i,t} + \beta_2 \Delta lnSALE_{s,i,t} \times DEC_{s,i,t} + \varepsilon_{s,i,t} \quad (1)$$

where $\Delta lnSG\&A_{s,i,t}$ is the logarithm of change in selling, general and administrative costs of firm *i* in location *s* in year *t*. The term $\Delta lnSALE_{s,i,t}$ denotes the logarithm of change in sales revenue, and $DEC_{s,i,t}$ is a dummy variable that equals 1 if a firm experiences a sales decrease in year *t* and zero otherwise. Coefficient β_1 measures the percentage change in *SG&A* costs for a 1 % increase in sales, β_2 measures the differential cost response to a sales decrease relative to a sales increase, and the sum of the coefficients ($\beta_1 + \beta_2$) measures the percentage change in *SG&A* costs for a 1 % decrease in sales. We expect β_1 to be positive, as *SG&A* costs normally change in the same direction as that of sales. In contrast, we predict β_2 to be negative since *SG&A* costs respond more to sales increases than to sales decreases, which we refer to as asymmetric cost behavior.

To test our hypothesis, we follow Banker et al. (2013), Lee et al. (2020), and Jin and Wu (2021) and extend the above standard Anderson et al. (2003) cost stickiness model (the Level 1 model) by adding the influence of collateral shocks and control variables. Specifically, we introduce the Level 2 model by specifying β_1 and β_2 in Eq. (1) as functions of explanatory and control variables. It follows that.

[3] Balakrishnan et al. (2014) illustrate the computation of the market value of real estate assets for IBM.

$$\beta_1 = \alpha_1 + \alpha_2 RE\_VALUE_{s,i,t} + \alpha_3 PRICE\_INDEX_{s,t} + \alpha_4 AI_{s,i,t} + \alpha_5 EI_{s,i,t} + \alpha_6 LAGDEC_{s,i,t} + \alpha_7 GDP_t + \alpha_8 FCF_{s,i,t} + \alpha_9 ROA_{s,i,t} + \alpha_{10} MTB_{s,i,t} + \alpha_{11} R\&D_{s,i,t} + \alpha_{12} SIZE_{s,i,t} + \alpha_{13} BLR_{s,i,t} \tag{2a}$$

$$\beta_2 = \alpha_{14} + \alpha_{15} RE\_VALUE_{s,i,t} + \alpha_{16} PRICE\_INDEX_{s,t} + \alpha_{17} AI_{s,i,t} + \alpha_{18} EI_{s,i,t} + \alpha_{19} LAGDEC_{s,i,t} + \alpha_{20} GDP_t + \alpha_{21} FCF_{s,i,t} + \alpha_{22} ROA_{s,i,t} + \alpha_{23} MTB_{s,i,t} + \alpha_{24} R\&D_{s,i,t} + \alpha_{25} SIZE_{s,i,t} + \alpha_{26} BLR_{s,i,t} \tag{2b}$$

where $RE\_VALUE_{s,i,t}$ is the market value of real estate assets of firm i in location s in year t scaled by total assets. $PRICE\_INDEX_{s,t}$ is a control for real estate prices in location s for fiscal year t. Following prior studies (e.g., Anderson et al., 2003; Chen et al., 2012; Banker et al., 2013; Kama and Weiss, 2013; Liu et al., 2019; Li and Lu, 2022), we use as control variables asset intensity (*AI*), employee intensity (*EI*), an indicator variable for sales decrease in the preceding year (*LAGDEC*), GDP growth rate (*GDP*), free cash flow (*FCF*), return on assets (*ROA*), market-to-book ratio (*MTB*), research and development expenses (*R&D*), firm size (*SIZE*), and firm leverage (*BLR*). The detailed definitions of all variables are provided in Appendix A. We also include firm fixed effects (ϑ_i) and year fixed effects (ω_t) to control for potential unobserved predictors of cost stickiness. We cluster standard errors at the state or MSA level, depending on the regression. Combining Eq. (1) with Eqs. (2a) and (2b), we obtain the following main regression model:

$$\begin{aligned}\Delta lnSG\&A_{s,i,t} = \beta_0 &+ (\alpha_1 + \alpha_2 RE\_VALUE_{s,i,t} + \alpha_3 PRICE\_INDEX_{s,t} + \alpha_4 AI_{s,i,t} + \alpha_5 EI_{s,i,t} + \alpha_6 LAGDEC_{s,i,t} + \alpha_7 GDP_t \\ &+ \alpha_8 FCF_{s,i,t} + \alpha_9 ROA_{s,i,t} + \alpha_{10} MTB_{s,i,t} + \alpha_{11} R\&D_{s,i,t} + \alpha_{12} SIZE_{s,i,t} + \alpha_{13} BLR_{s,i,t}) \times \Delta lnSALE_{s,i,t} + (\alpha_{14} \\ &+ \alpha_{15} RE\_VALUE_{s,i,t} + \alpha_{16} PRICE\_INDEX_{s,t} + \alpha_{17} AI_{s,i,t} + \alpha_{18} EI_{s,i,t} + \alpha_{19} LAGDEC_{s,i,t} + \alpha_{20} GDP_t + \alpha_{21} FCF_{s,i,t} \\ &+ \alpha_{22} ROA_{s,i,t} + \alpha_{23} MTB_{s,i,t} + \alpha_{24} R\&D_{s,i,t} + \alpha_{25} SIZE_{s,i,t} + \alpha_{26} BLR_{s,i,t}) \times \Delta lnSALE_{s,i,t} \times DEC_{s,i,t} + \vartheta_i + \omega_t \\ &+ \varepsilon_{s,i,t}\end{aligned} \tag{3}$$

The main parameter of interest is α_{15}, namely the coefficient of the three-way interaction term $RE\_VALUE_{s,i,t} \times \Delta lnSALE_{s,i,t} \times DEC_{s,i,t}$. It captures the relationship between collateral shocks and the degree of cost stickiness. A significantly positive (negative) coefficient would imply that an increase in collateral values leads to a lower (respectively, higher) degree of cost stickiness.

Empirical results

Summary statistics

Table 2 presents the summary statistics for the key variables used in our empirical analyses. The average (median) sales revenue is $3,014.64 (respectively, $309.41) million. *SG&A* has a mean (median) of $620.37 ($56.26) million. The mean (median) of *ΔlnSG&A* is 0.064 (0.054), indicating that the mean (median) percentage increase in *SG&A* costs is 6.4 (5.4). The mean (median) of *ΔlnSALE* is 0.062 (0.056), suggesting that the mean (median) percentage increase in sales revenue is 6.2 (5.6). However, the average *DEC* is 0.327, indicating that sales decreases were experienced in 32.7 % of firm-years in our sample.

The independent variable of interest is the market value of real estate assets (*RE_VALUE*), calculated using either state- or MSA-level real estate price indices. Both measures are scaled by the total book value of assets. Consistently with Chaney et al. (2012) and Chen et al. (2017), the two versions of *RE_VALUE* yield similar values. For example, *RE_VALUE_STATE* (using state-level real estate price indices) has a mean value of 0.37 and a standard deviation of 0.79, while *RE_VALUE_MSA* has a mean of 0.38 and a standard deviation of 0.82. The mean cumulative change in real estate prices at the state level (the MSA level) equals 59 % (respectively, 63 %), which is comparable to the values in Cvijanović (2014) and Balakrishnan et al. (2014). Table 2 also shows the descriptions of the control variables, which appear to be reasonable.

We report both Pearson and Spearman correlations between the key variables in Table 3. The results show that *ΔlnSG&A* is positively and significantly correlated with *ΔlnSALE*, suggesting that firms generally increase (reduce) SG&A expenditures when sales revenues increase (respectively, decrease). *DEC* is negatively and significantly correlated with *ΔlnSG&A*, indicating that firms reduce their SG&A expenditures when facing a sales decline. Correlations between other variables are also reasonable.

Real estate values and net debt issuance

Our underlying assumption relies on an important finding in prior research that firms are likely to borrow more when the market value of their real estate assets increases (e.g., Gan, 2007; Chaney et al., 2012; Cvijanović, 2014; Lin, 2016). Before proceeding to the main tests, it is necessary to confirm this finding using our own data. Table 4 shows the regression results.

The dependent variable is net debt issuance (*DEBT_ISSUE*), calculated as the net change in the firm's total outstanding debt between years *t* and *t*-1, scaled by the firm's total assets (Hovakimian et al., 2001; Hovakimian, 2004; Adhikari et al., 2021). In estimating the specification, we also control for a battery of firm-level characteristics, as in Table 3 of Lin (2016). Detailed definitions of variables are provided in Appendix A. Both Columns (1) and (2) show that *RE_VALUE* has a

Table 2
Summary Statistics.

	Mean	P25	Median	P75	S.D.	Obs.
SG&A ($mil)	620.371	12.993	56.257	248.930	2,968.619	24,398
SALE ($mil)	3,014.643	53.169	309.408	1,386.520	14,183.690	24,398
ΔlnSG&A	0.064	−0.031	0.054	0.147	0.238	24,398
ΔlnSALE	0.062	−0.035	0.056	0.157	0.279	24,398
DEC	0.327	0.000	0.000	1.000	0.469	24,398
RE_VALUE_STATE	0.372	0.000	0.135	0.393	0.786	24,398
RE_VALUE_MSA	0.377	0.000	0.129	0.391	0.820	23,205
PRICE_INDEX_STATE	1.592	1.167	1.517	1.909	0.484	24,398
PRICE_INDEX_MSA	1.634	1.171	1.510	1.991	0.558	23,205
ELASTICITY_SAIZ	1.533	0.760	1.241	2.243	0.895	22,545
AI	1.201	0.612	0.870	1.263	1.419	24,398
EI	0.008	0.004	0.006	0.009	0.008	24,398
LAGDEC	0.309	0.000	0.000	1.000	0.462	24,398
GDP	2.828	1.876	2.861	4.127	1.555	24,398
FCF	0.020	0.011	0.069	0.116	0.261	24,398
ROA	0.004	0.008	0.074	0.124	0.344	24,398
MTB	1.737	0.789	1.154	1.856	2.167	24,398
R&D	0.044	0.000	0.004	0.047	0.094	24,398
SIZE	5.492	3.817	5.546	7.162	2.377	24,398
BLR	0.263	0.051	0.212	0.362	0.309	24,398

This table presents descriptive statistics for key variables in a sample period of 1993–2018. All continuous variables are winsorized at the 1st and 99th percentiles.
Variable definitions are provided in Appendix A.

positive effect on net debt issuance. The results thus confirm the findings that firms are likely to increase debt after a positive shock to collateral values.

Moreover, the estimated results for control variables are reasonable and consistent with prior literature. Specifically, we observe that firms that are larger (*SIZE*) and have a credit rating (*RATING*) are more likely to issue debt. In contrast, firms with greater free cash flow (*FCF*) and non-real-estate collateralizable assets (*COL*) issue less debt.

Baseline results

The baseline regression results are presented in Table 5. Columns (1)–(3) use real estate price indices at the state level to construct the market value of real estate assets, while Columns (4)–(6) use real estate price indices at the MSA level. We first estimate the baseline cost stickiness Model (1). As shown in Column (1), the coefficient of *ΔlnSALE* is 0.519 and is highly significant (*t*-value = 26.89), indicating that a 1 % increase in sales revenue results in a 0.519 % increase in SG&A costs. The coefficient of *DEC* × *ΔlnSALE* is negative and statistically significant (−0.152 with *t*-value = −8.54), which is consistent with the generally sticky behavior of SG&A costs. In terms of magnitudes, a 1 % decrease in sales revenue only leads to a 0.367 % (0.519–0.152) decrease in SG&A costs. The unconditional degree of cost stickiness in this sample period is 1.414 (0.519/0.367). Column (4) shows results similar to those in Column (1), except that we use the observations without the missing value of *RE_VALUE_MSA*.

To examine our hypothesis, we add the key variable *RE_VALUE* (i.e., the market value of real estate assets) to the baseline model while controlling for local real estate price fluctuations (*PRICE_INDEX*). The results are reported in Columns (2) and (5) of Table 5. The coefficients of the three-way interaction term *RE_VALUE* × *DEC* × *ΔlnSALE* are positive and statistically significant (0.112 with *t*-value = 3.96, and 0.113 with *t*-value = 3.82). The results imply that higher collateral values are associated with lower cost stickiness, supporting our hypothesis. In addition, the main effect of cost stickiness persists, as shown by the negative coefficient of *DEC* × *ΔlnSALE* (−0.135 with *t*-value = −6.91, and −0.141 with *t*-value = −5.10). The coefficients of the two-way interaction term *RE_VALUE* × *ΔlnSALE* are negative and statistically significant (−0.039 with *t*-value = −2.13, and −0.040 with *t*-value = −2.12), implying that positive shocks to collateral values also lead to a smaller increase in SG&A expenditures if sales rise, which further reduces the extent of asymmetric costs. In terms of economic magnitude, for firms with higher real estate value, a 1 % increase in sales results in a 0.470 % (0.509–0.039) increase in SG&A cost, whereas the same decrease in sales leads to a 0.486 % (0.509–0.135 + 0.112) and 0.482 % (0.510–0.141 + 0.113) reduction in cost. Thus, the degree of cost stickiness is 0.967 (0.470/0.486) and 0.975 (0.470/0.482). Taken together, a 1 % increase in collateral values can mitigate the degree of cost stickiness from 1.414 to 0.967 and 1.434 to 0.975. Overall, these results strongly support our prediction that positive shocks to corporate collateral values reduce the degree of cost stickiness.

Columns (3) and (6) of Table 5 show the results of estimating Eq. (3), which includes all control variables. The coefficients of *RE_VALUE* × *DEC* × *ΔlnSALE* remain positive and significant (0.061 with *t*-value = 2.32, and 0.065 with *t*-value = 2.26) after the addition of these controls. The signs of control variables' coefficients are reasonable and consistent with the prior literature. For instance, the coefficients of *EI* × *DEC* × *ΔlnSALE* are negative and significant, which is consistent with the results of Anderson et al. (2003). The coefficients of *LAGDEC* × *DEC* × *ΔlnSALE* are positive and significant, suggesting that cost stick-

Table 3
Correlation Matrix.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
(1) *ΔlnSG&A*		0.65	−0.51	−0.15	−0.15	−0.12	−0.11	−0.03	0.05	0.02	−0.27	0.17	0.08	0.20	0.22	−0.00	0.04	−0.05
(2) *ΔlnSALE*	0.63		−0.81	−0.15	−0.15	−0.09	−0.09	−0.03	0.01	−0.02	−0.23	0.16	0.11	0.29	0.25	−0.00	0.03	−0.05
(3) *DEC*	−0.41	−0.62		0.04	0.04	0.04	0.04	0.01	0.03	0.03	0.23	−0.13	−0.17	−0.34	−0.21	0.03	−0.12	0.03
(4) *RE_STATE*	−0.12	−0.11	0.08		0.99	−**0.00**	−0.04	0.12	−0.09	−**0.01**	0.06	−0.02	0.12	0.17	−0.19	−0.13	0.26	0.15
(5) *RE_MSA*	−0.12	−0.11	0.08	0.98		**0.00**	−0.02	0.09	−0.08	−0.01	0.06	−0.02	0.12	0.17	−0.19	−0.12	0.27	0.15
(6) *INDEX_STATE*	−0.08	−0.06	0.02	0.06	0.06		0.96	−0.08	0.09	−0.28	0.07	−0.48	0.04	−0.02	0.02	0.08	0.22	−0.06
(7) *INDEX_MSA*	−0.07	−0.05	**0.01**	0.03	0.05	0.94		−0.16	0.11	−0.29	0.07	−0.46	0.04	−0.02	0.03	0.11	0.22	−0.07
(8) *ELASTICITY*	−0.02	−0.02	**0.01**	−0.04	−0.06	−0.15	−0.23		−0.10	0.05	**0.00**	−**0.00**	0.05	0.09	−0.09	−0.18	0.12	0.10
(9) *AI*	0.03	−0.08	0.07	−0.04	−0.04	0.05	0.05	−0.07		−0.07	0.03	−0.04	−0.14	−0.16	0.13	0.26	0.21	0.02
(10) *EI*	0.04	−0.03	0.03	0.03	0.03	−0.19	−0.18	0.03	0.27		0.02	0.19	−0.08	−0.16	−0.05	−0.16	−0.32	0.01
(11) *LAGDEC*	−0.22	−0.16	0.23	0.10	0.10	0.05	0.04	−**0.00**	0.06	0.01		−0.06	−0.17	−0.26	−0.15	0.04	−0.12	0.02
(12) *GDP*	0.16	0.15	−0.16	−0.02	−0.02	−0.39	−0.36	**0.01**	−0.02	0.11	−0.06		−0.05	0.02	0.07	−0.02	−0.16	0.04
(13) *FCF*	0.05	0.10	−0.14	−0.03	−0.03	0.02	0.02	0.06	−0.21	−0.20	−0.12	−0.03		0.64	0.12	−0.12	0.29	−0.12
(14) *ROA*	0.08	0.18	−0.20	−0.03	−0.03	**0.01**	**0.00**	0.07	−0.21	−0.22	−0.14	0.00	0.87		0.32	−0.13	0.40	−0.07
(15) *MTB*	0.09	0.09	−0.05	−0.01	−**0.01**	**0.01**	0.02	−0.08	0.12	0.12	−0.02	0.06	−0.47	−0.47		0.30	−0.01	−0.12
(16) *R&D*	−0.02	−0.04	0.09	−0.02	−0.01	0.03	0.05	−0.13	0.10	0.02	0.07	0.02	−0.48	−0.49	0.35		−0.13	−0.26
(17) *SIZE*	0.05	0.04	−0.12	−0.05	−0.04	0.19	0.18	0.09	−0.02	−0.26	−0.12	−0.14	0.39	0.44	−0.23	−0.31		0.19
(18) *BLR*	−0.07	−0.07	0.08	0.10	0.10	−0.03	−0.04	0.05	0.03	0.08	0.07	0.02	−0.33	−0.35	0.26	0.03	−0.08	

This table presents the correlation matrix for key variables. Spearman (Pearson) correlations are shown above (respectively, below) the diagonal. Values shown in bold indicate statistically insignificant relationships ($p > 0.10$) according to a two-tailed test.
Variable definitions are provided in Appendix A.

Table 4
Real Estate Collateral Value and Net Debt Issuance.

	RE_VALUE_STATE	*RE_VALUE_MSA*
	(1)	(2)
RE_VALUE	0.019**	0.018**
	(2.56)	(2.32)
PRICE_INDEX	−0.008	−0.011*
	(-1.34)	(-1.67)
FCF	−0.207***	−0.203***
	(-12.12)	(-11.71)
MTB	−0.001	−0.001
	(-0.66)	(-0.32)
SIZE	0.062***	0.061***
	(12.22)	(11.02)
COL	−0.079***	−0.076***
	(-5.21)	(-5.90)
RATING	0.027*	0.026
	(1.75)	(1.49)
INVRATING	−0.012	−0.012
	(-0.89)	(-0.84)
Intercept	0.063***	0.062***
	(6.83)	(7.97)
Year fixed effects	Yes	Yes
Firm fixed effects	Yes	Yes
Obs.	19,273	18,302
Adj. R^2	0.125	0.123

This table presents OLS regression results for the impact of collateral shocks on net debt issuance. All regressions include year and firm fixed effects. Robust standard errors are clustered at the state or MSA level. The *t*-statistics are reported in parentheses. For brevity, we do not show coefficient estimates for year dummy variables. Labels *, ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.
Variable definitions are provided in Appendix A.

iness is less pronounced if demand decreased in the previous period (Anderson et al., 2003). The coefficients of *FCF* × *DEC* × *ΔlnSALE* are negative and significant, indicating that the degree of cost stickiness increases with free cash flow, which is consistent with the argument that cost stickiness increases with managers' empire-building incentives due to agency issues (Chen et al., 2012). The significantly positive coefficients of *ROA* suggest that the degree of SG&A cost asymmetry is lower in better-performing firms, consistently with Liu et al. (2019). Furthermore, we document significantly negative coefficients of *SIZE* × *DEC* × *ΔlnSALE*, suggesting that it is difficult for larger firms to reduce their SG&A expenditures when demand declines.

Basic robustness checks

In this section, we perform several robustness checks on our main findings in Table 6. For brevity, we only report the results for the main variables. Panels A and B present the empirical results for the effects of collateral values on cost stickiness, obtained using *RE_VALUE_STATE* and *RE_VALUE_MSA*, respectively. First, we note that our sample consists of numerous firms with zero real estate holdings. To remove the concern that our main finding is driven by these specific firms, we eliminate observations with zero *RE_VALUE* and repeat the analysis using Eq. (3). The results are presented in Column (1), showing that all coefficients of *RE_VALUE* × *DEC* × *ΔlnSALE* remain positive and statistically significant, which is similar to the baseline results. We further construct a dummy variable (*RE_VALUE_DMY*) that equals 1 if the value of a firm's real estate is zero in year *t*, and 0 otherwise. Column (2) presents the estimations of Eq. (3) obtained using this alternative measure of real estate value. The negative and significant coefficients of *RE_VALUE_DMY* × *DEC* × *ΔlnSALE* suggest that firms with zero values of real estate holdings are associated with a higher degree of cost stickiness. The results are thus consistent with our main findings.

Second, we acknowledge that most firms (approximately 14 % of observations) in our sample are in California. To ensure that our results are not driven by the single large state, we remove these firms from the sample. The result reported in Column (3) of Table 6 suggests that our main findings remain unchanged.

Third, to ensure that our main results are not driven by a particular collateral value measure used in the above analyses, we show that the baseline findings are robust to alternative measures of collateral values. Specifically, following prior studies (e.g., Chaney et al., 2012; Ersahin and Irani, 2020; Kumar and Vergara-Alert, 2020), we divide the market value of a firm's real estate assets by PPE. The results are presented in Column (4). Unsurprisingly, the coefficients of *RE_VALUE* × *DEC* × *ΔlnSALE*

Table 5
Main Results.

	RE_VALUE_STATE			*RE_VALUE_MSA*		
	(1)	(2)	(3)	(4)	(5)	(6)
Basic Model						
Intercept	0.056***	0.056***	0.059***	0.056***	0.056***	0.059***
	(37.28)	(37.28)	(44.54)	(26.61)	(26.19)	(33.84)
ΔlnSALE	0.519***	0.509***	0.607***	0.519***	0.510***	0.609***
	(26.89)	(25.83)	(47.89)	(31.17)	(30.61)	(46.06)
DEC × *ΔlnSALE*	−0.152***	−0.135***	−0.124***	−0.157***	−0.141***	−0.130***
	(-8.54)	(-6.91)	(-4.71)	(-6.10)	(-5.10)	(-5.02)
Two-Way Interaction Terms: Variables × *ΔlnSALE*						
RE_VALUE		−0.039***	−0.029*		−0.040**	−0.030*
		(-2.13)	(-1.79)		(-2.12)	(-1.89)
PRICE_INDEX		−0.135***	−0.110***		−0.124***	−0.109***
		(-5.91)	(-5.65)		(-5.42)	(-5.64)
AI			−0.027***			−0.027***
			(-4.08)			(-4.79)
EI			3.607**			3.471**
			(2.47)			(2.12)
LAGDEC			−0.048*			−0.048*
			(-1.91)			(-1.95)
GDP			0.017***			0.015**
			(2.88)			(2.56)
FCF			0.162**			0.153**
			(2.48)			(2.17)
ROA			−0.120**			−0.115**
			(-2.04)			(-2.01)
MTB			−0.002			−0.002
			(-0.88)			(-0.57)
R&D			−0.206**			−0.162*
			(-2.19)			(-1.93)
SIZE			0.053***			0.054***
			(9.79)			(8.13)
BLR			0.014			0.018
			(0.48)			(0.59)
Three-Way Interaction Terms: Variables × *DEC* × *ΔlnSALE*						
RE_VALUE		0.112***	0.061**		0.113***	0.065**
		(3.96)	(2.32)		(3.82)	(2.26)
PRICE_INDEX		0.131**	0.102**		0.133***	0.114***
		(2.50)	(2.34)		(2.88)	(2.68)
AI			0.001			0.001
			(0.09)			(0.07)
EI			−9.880***			−9.882***
			(-3.52)			(-3.41)
LAGDEC			0.331***			0.344***
			(9.03)			(7.98)
GDP			−0.014			−0.010
			(-1.36)			(-1.03)
FCF			−0.310***			−0.341***
			(-3.32)			(-3.16)
ROA			0.399***			0.418***
			(5.18)			(5.02)
MTB			−0.004			−0.002
			(-0.52)			(-0.24)
R&D			−0.055			−0.070
			(-0.35)			(-0.58)
SIZE			−0.077***			−0.076***
			(-5.65)			(-5.81)
BLR			0.086			0.048
			(1.58)			(0.92)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	24,398	24,398	24,398	23,205	23,205	23,205
Adj. R^2	0.433	0.440	0.492	0.432	0.439	0.492

This table presents OLS regression results for the impact of collateral shocks on cost stickiness. All regressions include year and firm fixed effects. Robust standard errors are clustered at the state or MSA level. The *t*-statistics are reported in parentheses. For brevity, we do not show coefficient estimates for year dummy variables. Labels *, ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.
Variable definitions are provided in Appendix A.

Table 6
Basic Robustness Checks.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Without zero *RE_VALUE*	*RE_VALUE_DMY*	Drop California	Scaled by PPE	*Δln (SG&A-R&D-AD)*	Cluster at firm level	State × Year fixed effects	Industry × Year fixed effects
Panel A: *RE_VALUE_STATE* sample								
ΔlnSALE	0.596***	0.605***	0.615***	0.611***	0.619***	0.607***	0.609***	0.607***
	(58.02)	(54.53)	(44.15)	(47.75)	(47.54)	(51.11)	(49.25)	(49.74)
DEC × ΔlnSALE	−0.103***	−0.118***	−0.104***	−0.133***	−0.119***	−0.124***	−0.123***	−0.123***
	(-3.65)	(-4.28)	(-4.82)	(-4.97)	(-4.10)	(-5.30)	(-4.70)	(-4.72)
RE_VALUE_STATE × DEC × ΔlnSALE	0.079*	−0.105***	0.057*	0.011***	0.055**	0.061**	0.060**	0.059**
	(2.00)	(-2.75)	(1.79)	(4.20)	(2.10)	(2.04)	(2.25)	(2.27)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State × Year fixed effects	No	No	No	No	No	No	Yes	No
Industry × Year fixed effects	No	No	No	No	No	No	No	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	No	No
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	17,808	24,398	20,884	24,301	24,275	24,398	24,398	24,398
Adj. R^2	0.522	0.492	0.493	0.496	0.411	0.492	0.491	0.492
Panel B: *RE_VALUE_MSA* sample								
ΔlnSALE	0.594***	0.604***	0.615***	0.613***	0.620***	0.609***	0.609***	0.609***
	(40.93)	(49.75)	(42.54)	(47.19)	(45.31)	(50.21)	(45.89)	(46.39)
DEC × ΔlnSALE	−0.106***	−0.120***	−0.110***	−0.139***	−0.126***	−0.130***	−0.129***	−0.128***
	(-3.85)	(-4.97)	(-4.10)	(-5.18)	(-4.47)	(-5.40)	(-4.99)	(-5.02)
RE_VALUE_STATE × DEC × ΔlnSALE	0.081**	−0.126***	0.061*	0.011***	0.059**	0.065**	0.065**	0.064**
	(2.07)	(-2.72)	(1.82)	(3.60)	(2.04)	(2.17)	(2.25)	(2.21)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
MSA × Year fixed effects	No	No	No	No	No	No	Yes	No
Industry × Year fixed effects	No	No	No	No	No	No	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
Obs.	16,779	23,205	19,708	23,111	23,088	23,205	23,205	23,205
Adj. R^2	0.521	0.492	0.492	0.496	0.408	0.492	0.492	0.493

This table presents robustness checks' results for the impact of collateral shocks on cost stickiness. All regressions include year and firm fixed effects. Robust standard errors are clustered at the state or MSA level. The *t*-statistics are reported in parentheses. For brevity, we only show coefficient estimates for the key variables. Labels *, ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.
Variable definitions are provided in Appendix A.

remain negative and statistically significant, suggesting that the results above are not driven by a particular measure of collateral values.

We also use an alternative measure of SG&A costs. Previous studies of cost stickiness have argued that research and development expenses (R&D) and advertising expenses (AD) represent value-enhancing investments and thus have a positive impact on future operating income (Lev and Sougiannis, 1996; Chen et al., 2012; Ma et al., 2021). As a result, these two cost types might behave differently from the other components of SG&A costs. We therefore re-estimate Eq. (3) by replacing *ΔlnSG&A* with *Δln(SG&A-R&D-AD)*. The results are reported in Column (5). The estimated coefficients of *RE_VALUE × DEC × ΔlnSALE* are all positive and statistically significant, suggesting that our baseline results are unlikely to be driven by a particular measure of SG&A costs.

Fourth, following prior studies, throughout the paper we cluster standard errors at the state or MSA level depending on the specification. According to Chaney et al. (2012), this clustering method is conservative since the explanatory variable of interest *RE_VALUE* is measured at the firm level. Specifically, a small number of clusters may result in overestimating the precision of the coefficient of interest. To mitigate this concern, we rerun the analysis using Eq. (3), clustering at the firm level. As shown in Column (6), our main results are robust to this alternative clustering strategy.[4]

Finally, we estimate additional specifications to confirm the robustness of the main results. Specifically, to account for any unobserved confounding geographic trends and industry shocks, we include industry × year fixed effects and location × year fixed effects. The results are shown in Columns (7) and (8), respectively. The coefficients of *RE_VALUE × DEC × ΔlnSALE* are all positive and statistically significant, suggesting that the baseline results are not driven by state- level confounding factors or industry trends.

Addressing endogeneity problems

Our analysis thus far has documented a negative relationship between collateral asset values and cost stickiness. However, as Chaney et al. (2012) indicate, there is a concern that our estimates could be biased due to endogeneity issues. First,

[4] The primary findings are also robust to clustering standard errors at the location-by-year level as well as at both the state and year levels.

an unobserved local economic shock may affect both real estate prices and firms' cost management behavior. If this shock is not captured by firm and location × year fixed effects, then this omission would bias the estimates. Second, the decision to own or lease real estate assets could be correlated with firms' cost behavior. For example, it may be optimal for a firm with severe agency problems to use bank debt and to own real estate assets instead of leasing them (Lin, 2016). As a result, firms with a higher market value of real estate assets tend to be associated with a lower degree of cost stickiness. We address these endogeneity issues in several ways.

Propensity score matching analysis

First, we apply a propensity score matching (PSM) method to mitigate the concern of endogeneity and self-selection bias (Rosenbaum and Rubin, 1983; Roberts and Whited, 2013). To perform the propensity score-matched sample analysis, we match firms with zero market value of real estate assets to firms with a higher market value of real estate assets.[5] To this end, we estimate a logistic model and regress a dummy variable for whether the firm has a zero collateral value on a set of firm characteristics, including *AI*, *EI*, *FCF*, *ROA*, *MTB*, *R&D*, *SIZE* and *BLR*.

Next, we calculate a propensity score for each firm and match firms with zero collateral values and firms with higher collateral values. We adopt two criteria for the matching procedure. First, we match the observations without replacement. Second, we follow the nearest-neighbor approach and require that the difference in propensity scores for each matched pair not exceed 0.1 %. This matching procedure finally results in a new sample of 1,244 and 1,194 firm-year observations for *RE_VALUE_STATE* and *RE_VALUE_MSA*, respectively.

To evaluate the success of the matching procedure, we perform several diagnostic tests. First, we re-estimate the PSM logistic model for the postmatch sample. The untabulated results show that almost all coefficients are statistically insignificant, and the pseudo-R-squared measure declines to approximately 0.006, suggesting that the control variables do not explain much of the variation for a firm with a zero market value of real estate assets. Second, we examine the difference in propensity scores between matched firms with zero collateral values and high collateral values. The mean difference is less than 0.001, and is therefore trivial. Third, we verify whether firms in the matched pairs are indistinguishable in terms of observable characteristics. Panel A of Table 7 shows that the mean differences of control variables across the two groups are statistically insignificant. Overall, the diagnostic results suggest that the PSM procedure is successful.

Next, we re-estimate our baseline Eq. (3) using the matched samples and report the results in Panel B of Table 7. The PSM results are qualitatively identical to our main results, as reported in Table 5. The coefficients of *ΔlnSALE* are significantly positive, and the coefficients of *DEC* × *ΔlnSALE* are significantly negative. More importantly, the coefficients of *RE_VALUE* × *DEC* × *ΔlnSALE* remain positive and statistically significant, which is consistent with our earlier findings.

Instrumental variable estimation

Second, following Mian and Sufi (2011) and Chaney et al. (2012), we use an instrumental variable (IV) approach to address the endogeneity concern that real estate prices could be correlated with local shocks that may affect firms' operational decisions. Specifically, we instrument for MSA-level real estate prices as the interaction between the local real estate supply elasticity and the nationwide 30-year real mortgage interest rate (Himmelberg et al., 2005). The logic of this is that the mortgage interest rate affects real estate prices differently for MSA locations with different land supply elasticities. If mortgage interest rates decrease, the demand for real estate increases. If the local supply of land in a given MSA location is very elastic, the increased demand for real estate assets will translate mostly into more construction rather than higher land prices. In contrast, if the local supply of land is very inelastic, the increased demand will translate mostly into higher prices rather than more construction. In summary, the change in the mortgage interest rate should have a larger impact on real estate prices in MSA locations with lower land supply elasticity. Accordingly, we estimate the following equation to predict real estate prices:

$$PRICE\_INDEX_{s,t} = \gamma_1 \times Local\ housing\ supply\ elasticity_s \times Mortgage\ rate_t + \nu_s + \omega_t + \varepsilon_{s,t} \quad (4)$$

where $Local\ housing\ supply\ elasticity_s$ is the MSA-level local land supply elasticity, $Mortgage\ rate_t$ is the nationwide 30-year real estate mortgage interest rate at which banks refinance home loans, and ν_s and ω_t are MSA fixed effects and year fixed effects, respectively. Standard errors are clustered at the MSA level. We replicate Columns (1) and (2) of Table 3 in Chaney et al. (2012) and report the first-stage results in Appendix B.[6] Column (1) shows the results obtained by directly using the measure of local land supply elasticity, and Column (2) uses groups of MSAs by quartile of such elasticity. As expected, the interaction of MSA-level housing supply elasticity and the mortgage interest rate has a significantly positive effect on local real estate prices.

[5] We require the two subsamples to have the same number of observations. To construct the sample that includes only the firms with higher market values of real estate assets, we first remove the firms with a zero market value of real estate assets from the full sample. Next, we rank the remainder of observations according to the market value of real estate assets. Finally, we only keep the top-ranked firms.

[6] Saiz (2010) provided the local housing elasticity measure for 95 MSAs. We thank Prof. Albert Saiz for kindly providing us the supply elasticity data that covers 269 MSAs. We obtain the 30-year real estate mortgage interest rate data from the website of the Federal Reserve Bank of St. Louis (https://research.stlouisfed.org/fred2/series/MORTGAGE30US/).

Table 7
Results Based on the Propensity Score-Matching Technique.

Panel A: firm characteristics across subsamples

	RE_VALUE_STATE sample				*RE_VALUE_MSA* sample			
	Treated	Control	Diff.	*t*-value	Treated	Control	Diff.	*t*-value
AI	1.285	1.162	0.123	1.43	1.310	1.167	0.143	1.60
EI	0.008	0.008	0.000	0.06	0.009	0.009	0.000	0.04
FCF	−0.057	−0.034	−0.023	−1.05	−0.065	−0.035	−0.030	−1.29
ROA	−0.112	−0.081	−0.031	−1.08	−0.122	−0.082	−0.040	−1.33
MTB	2.024	2.216	−0.192	−0.99	2.081	2.230	−0.149	−0.74
R&D	0.074	0.069	0.005	0.68	0.075	0.067	0.008	1.09
SIZE	4.064	4.213	−0.149	−1.53	3.971	4.101	−0.130	−1.42
BLR	0.286	0.272	0.014	0.54	0.290	0.273	0.017	0.65

Panel B: regression results

	RE_VALUE_STATE	*RE_VALUE_MSA*
	(1)	(2)
ΔlnSALE	0.692***	0.669***
	(15.87)	(11.31)
DEC × *ΔlnSALE*	−0.260**	−0.200*
	(-2.43)	(-1.70)
RE_VALUE× *DEC* × *ΔlnSALE*	0.246***	0.237***
	(2.81)	(4.03)
Control	Yes	Yes
Year fixed effects	Yes	Yes
Firm fixed effects	Yes	Yes
Obs.	1,244	1,194
Adj. R^2	0.500	0.495

This table reports the impact of real estate value on cost stickiness using a propensity score-matched sample. The treated and control groups consist of firms with zero market value of real estate assets and higher market value of real estate assets, respectively. All regressions include year and firm fixed effects. Robust standard errors are clustered at the state or MSA level. The *t*-statistics are reported in parentheses. For brevity, we only show coefficient estimates for the key variables. Labels *, ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.
Variable definitions are provided in Appendix A.

To further address the second endogeneity problem, we control for interaction between firms' initial characteristics and real estate prices.[7] The intuition is that if these controls identify characteristics that make a firm more likely to own real estate and if those characteristics also make this firm more sensitive to fluctuations in real estate prices, then controlling for the interaction between these controls and contemporaneous real estate prices will allow us to separately identify the channels in which we are interested (Chaney et al., 2012).

In Columns (1) and (2) of Table 8, we include initial controls interacted with real estate prices. We observe that the coefficients of the three-way interaction term *RE_VALUE* × *DEC* × *ΔlnSALE* remain positive and statistically significant regardless of whether *RE_VALUE_STATE* or *RE_VALUE_MSA* is used. Column (3) implements the IV strategy, in which real estate prices are instrumented using the interaction of the national mortgage rate and local land supply elasticity. In Column (4), we further control for initial controls interacted with real estate prices in implementing the IV strategy. The coefficients of *RE_VALUE* × *DEC* × *ΔlnSALE* are positive and statistically significant, indicating that our main findings continue to hold.

Heterogeneous effects

In this section, we perform heterogeneity tests to refine our understanding of the impact of collateral shocks on SG&A cost asymmetry and further corroborate our interpretation. Specifically, we re-estimate our baseline model by partitioning the sample into "High" and "Low" groups based on several firm characteristics that arguably could affect firms' debt structure. Next, we perform a Wald test to compare the coefficients of *RE_VALUE* × *DEC* × *ΔlnSALE* between the two groups. Table 9 reports the resulting estimates obtained using the subsamples. Specifications (1) and (2) use state-level residential price indices to calculate the market value of real estate assets, and specifications (3) and (4) use MSA-level residential price indices.

First, if the negative relation between collateral value appreciation and cost stickiness is due to the increase in bank debt, we would expect this relationship to be more pronounced for the subsample of firms with less prior bank debt. To test this prediction, we split our sample according to non-real-estate tangibility (*COL*), asset redeployability (*REDEP*), and credit rating (*RATING*). Lin (2016) observes that firms with more non-real-estate fixed assets are likely to use bank debt rather than public debt. Chen et al. (2020) show that firms with less redeployable assets are more likely to obtain financing from banks than

[7] In our regressions, the interaction terms between firms' initial characteristics and real estate prices are thus interacted with *ΔlnSALE* and *DEC* × *ΔlnSALE* terms, respectively.

Table 8
Address Endogeneity.

	(1)	(2)	(3) IV	(4) IV
ΔlnSALE	0.596***	0.593***	0.606***	0.591***
	(33.54)	(35.18)	(42.95)	(36.01)
DEC × *ΔlnSALE*	−0.093***	−0.095***	−0.117***	−0.093***
	(-3.45)	(-3.46)	(-4.68)	(-3.59)
RE_VALUE_STATE × *DEC* × *ΔlnSALE*	0.070*			
	(1.95)			
RE_VALUE_MSA × *DEC* × *ΔlnSALE*		0.077**	0.089**	0.093*
		(2.03)	(2.15)	(1.84)
Controls	Yes	Yes	Yes	Yes
Initial controls × *PRICE_INDEX*	Yes	Yes	No	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes
Obs.	20,003	19,032	22,545	18,487
Adj. R^2	0.503	0.501	0.493	0.503

This table presents the results of the OLS and instrumental variables (IV) regressions. All regressions include year and firm fixed effects. Robust standard errors are clustered at the state or MSA level. The *t*-statistics are reported in parentheses. For brevity, we do not show coefficient estimates for year dummy variables and *Initial controls* × *PRICE_INDEX*. Labels *, ** and *** denote statistical significance at the 10 %, 5 % and 1 % levels, respectively.
Variable definitions are provided in Appendix A.

from public debt markets. Denis and Mihov (2003) document that credit ratings of public borrowers tend to be higher than those of firms borrowing from banks.[8]

Panel A of Table 9 reports the estimates resulting from using the subsamples created according to non-real-estate tangibility. Following Lin (2016), we define the latter as the sum of inventories, machinery and equipment, natural resources, and other PPE divided by the total book value of assets. We observe that the coefficients of *RE_VALUE* × *DEC* × *ΔlnSALE* are positive and statistically significant across all specifications. However, the magnitudes are statistically higher for firms with lower non-real-estate tangibility than for those with higher tangibility. The results thus imply that the negative relation between positive shocks to collateral values and cost stickiness is stronger for the subsample of firms with less bank debt.

In Panel B, we split our sample based on the median value of asset redeployability scores, obtained from Kim and Kung (2017). The authors construct the measure using the 1997 Bureau of Economic Analysis (BEA) capital flow table. For each asset category, a redeployability score is calculated as the proportion of industries or firms by which a given asset is used. The industry-level redeployability measure is the value-weighted average of each asset's redeployability score. The firm-level measure is the value-weighted average of industry-level redeployability indices across business segments in which the firm operates. More redeployable assets are less firm specific. The estimation results are similar to those in Panel A. The negative impact of collateral values on cost stickiness is only concentrated in firms with higher asset redeployability. Next, we sort the firms based on their bond ratings and report the estimation results in Panel C. We observe that the coefficients of *RE_VALUE* × *DEC* × *ΔlnSALE* are only positive and statistically significant for firms with credit ratings. Consequently, the effect of positive shocks to collateral values is much stronger for firms that tended to use less bank debt prior to the shocks.

Next, the sample is divided by corporate profitability (*ROA*). We expect that the impact of collateral values on cost stickiness is more pronounced for more profitable firms. Such firms in general are less likely to depend on external financing (Myers, 1984; Rajan and Zingales, 1995; Almeida and Campello, 2010). Consequently, the role of bank monitoring is less pronounced. As the increase in the market value of real estate assets raises the proportion of bank debt in a firm's debt structure,[9] the strength of bank monitoring should increase significantly, and thus the native relationship between collateral values and cost stickiness should be more pronounced in profitable firms. As shown in Panel D, the effect of collateral shocks on cost stickiness is more pronounced in more profitable firms, which is consistent with our conjecture.

Finally, we split the sample based on firm leverage (*BLR*). A higher leverage could reduce agency costs by limiting managers' ability to allocate corporate resources to unproductive uses (Jensen and Meckling, 1976). We predict that when the increase in collateral values leads to more bank debt financing, the less-levered firms should be influenced more in terms of bank monitoring. The results are shown in Panel E. We observe that the coefficients of *RE_VALUE* × *DEC* × *ΔlnSALE* are significantly positive in less-levered firms but are insignificant in more-levered firms across all specifications. The findings are thus consistent with our prediction.

Overall, the results in Table 9 suggest that the effect of collateral asset values on cost stickiness is stronger for firms with less prior bank debt, with less dependence on external financing, and with a lower leverage ratio. Analyzing the heterogeneous effects of variables further helps empirically clarify whether the impact of positive collateral shocks on cost stickiness indeed stems from the use of bank debt.

[8] Even though firms with credit ratings are likely to use public debt, Lin (2016) observes that firms are more likely to repay public debt and start to borrow from banks after a positive shock to collateral value.

[9] Lin (2016) observes that both financially constrained and unconstrained firms use more bank debt when the value of their real estate assets rises.

Table 9
Heterogeneous Treatment Effects.

	RE_VALUE_STATE		*RE_VALUE_MSA*	
	(1)	(2)	(3)	(4)
	High / With	Low / Without	High / With	Low / Without
Panel A: subsamples partitioned by non-real-estate tangibility				
ΔlnSALE	0.557***	0.614***	0.561***	0.616***
	(18.89)	(54.08)	(26.30)	(50.74)
DEC × *ΔlnSALE*	−0.098***	−0.044	−0.095***	−0.042
	(-2.76)	(-1.66)	(-3.04)	(-1.49)
RE_VALUE × *DEC* × *ΔlnSALE*	0.095***	0.192***	0.115***	0.200***
	(5.15)	(9.84)	(3.72)	(5.50)
Difference in coefficients	−0.097***			
			−0.085**	
Controls	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes
Obs.	10,561	10,560	10,022	10,021
Adj. R^2	0.480	0.552	0.485	0.551
Panel B: subsamples partitioned by asset redeployability				
ΔlnSALE	0.613***	0.583***	0.611***	0.587***
	(43.13)	(31.74)	(36.70)	(32.60)
DEC × *ΔlnSALE*	−0.037	−0.155***	−0.040	−0.161***
	(-1.15)	(-3.44)	(-1.16)	(-4.48)
RE_VALUE × *DEC* × *ΔlnSALE*	0.112*	0.078*	0.134***	0.079*
	(2.00)	(1.85)	(2.94)	(1.82)
Difference in coefficients	0.034			
			0.055**	
Controls	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes
Obs.	11,344	11,345	10,569	10,532
Adj. R^2	0.538	0.465	0.524	0.457
Panel C: subsamples partitioned by credit rating				
ΔlnSALE	0.518***	0.619***	0.522***	0.624***
	(9.45)	(40.01)	(8.87)	(39.21)
DEC × *ΔlnSALE*	−0.055	−0.215***	−0.069	−0.223***
	(-0.65)	(-5.31)	(-0.67)	(-7.07)
RE_VALUE × *DEC* × *ΔlnSALE*	0.237**	0.037	0.245**	0.044
	(2.26)	(1.08)	(2.15)	(1.31)
Difference in coefficients	0.200***			
			0.201***	
Controls	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes
Obs.	6,330	15,869	6,031	15,090
Adj. R^2	0.616	0.464	0.614	0.466
Panel D: subsamples partitioned by profitability				
ΔlnSALE	0.741***	0.602***	0.735***	0.607***
	(19.14)	(47.59)	(17.07)	(32.47)
DEC × *ΔlnSALE*	−0.023	−0.163***	−0.047	−0.169***
	(-0.17)	(-3.77)	(-0.43)	(-4.13)
RE_VALUE × *DEC* × *ΔlnSALE*	0.082***	0.054*	0.094***	0.053
	(2.79)	(1.75)	(3.40)	(1.59)
Difference in coefficients	0.028			
			0.041*	
Controls	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes
Obs.	12,199	12,199	11,586	11,586
Adj. R^2	0.643	0.433	0.643	0.434
Panel E: subsamples partitioned by leverage				
ΔlnSALE	0.666***	0.596***	0.666***	0.578***
	(30.28)	(21.53)	(33.57)	(16.45)
DEC × *ΔlnSALE*	−0.136**	−0.129	−0.121**	−0.116
	(-2.66)	(-1.44)	(-2.41)	(-1.27)
RE_VALUE × *DEC* × *ΔlnSALE*	0.060	0.120***	0.064	0.120***
	(1.55)	(3.37)	(1.64)	(3.59)

Table 9 (*continued*)

	RE_VALUE_STATE		*RE_VALUE_MSA*	
	(1)	(2)	(3)	(4)
	High / With	Low / Without	High / With	Low / Without
Difference in coefficients	−0.060*		−0.056**	
Controls	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes
Obs.	12,199	12,199	11,603	11,602
Adj. R^2	0.524	0.502	0.524	0.501

This table presents the effect of non-real-estate tangibility, asset redeployability, credit rating, profit, and leverage on the relation between collateral shocks and cost stickiness. All regressions include year and firm fixed effects. Robust standard errors are clustered at the state or MSA level. The *t*-statistics are reported in parentheses. For brevity, we do not show coefficient estimates for year dummy variables. Labels *, ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.
Variable definitions are provided in Appendix A.

Additional analyses of the agency costs mechanism

We perform additional analyses to provide further evidence for the agency argument. The results are shown in Table 10. The table layout is similar to that in Table 9 except for partitioning the sample based on different firm features.

First, we split our sample into "High" and "Low" subsamples according to the future value created by SG&A expenditures (*FV_SG&A*). The magnitude of such value varies significantly across firms and industries (Banker et al., 2011). Chen et al. (2012) document that SG&A expenditures are sticky if they create more future value but are not if they create less future value. In the former case, cutting SG&A costs too drastically in the short term would potentially lead to lower performance in the long term. In contrast, if SG&A costs create less future value, managers do not have a legitimate reason to retain slack resources when sales decrease. However, motivated by empire-building incentives, managers still prefer to retain slack resources. As a result, agency problems are likely aggravated if SG&A expenditures create low future value (Liu et al., 2019). Consistently with this conjecture, Chen et al. (2012) note that agency factors have a greater impact on asymmetric cost behaviors if SG&A costs create low future value. In the latter case, we therefore predict that the effect of positive shocks to collateral values on cost stickiness is stronger. To test this prediction, we partition our sample based on the industry-specific indices of the impact of SG&A costs on future value creation, as documented in Table 2 of Banker et al. (2011).

Panel A of Table 10 presents the results for the subsamples. We observe that the coefficients of $RE\_VALUE \times DEC \times \Delta lnSALE$ are only significantly positive for firms with low future SG&A value creation but are insignificant for firms with high future value creation across all specifications. A Wald test also rejects the equality of coefficients of $RE\_VALUE \times DEC \times \Delta lnSALE$ across the two subsamples. The findings are consistent with our prediction.

Second, we test whether the relationship between collateral shocks and cost stickiness varies with firms' growth opportunities. Chen et al. (2012) show that SG&A cost stickiness is more pronounced in mature firms than in growth firms, suggesting that agency problems are more severe in mature firms. Thus, we expect the effect of collateral value to be stronger in mature firms. To test this conjecture, we partition our sample based on the life cycle proxy by DeAngelo et al. (2006), i.e., the ratio of retained earnings to total equity (*RETE*). The researchers show that firms with low *RETE* tend to be young and growing; conversely, firms with high *RETE* are typically more mature with declining investments. Panel B of Table 10 summarizes the results. We observe that the coefficients of $RE\_VALUE \times DEC \times \Delta lnSALE$ are significantly positive for mature firms only, which is consistent with our prediction.

Third, the theoretical model of Hart (1983) shows that firms in a competitive product market have strong incentives to reduce costs if selling prices decline so that they can maximize profits. Baggs and De Bettignies (2007) note a positive effect of competition on cost reduction, and such an effect is more pronounced if firms are subject to more severe agency problems. Consequently, product market competition exerts an external pressure to increase efficiency and control agency problems (Kim and Lu, 2011). Such competition improves governance (Guadalupe and Wulf, 2010) and serves as an effective external governance mechanism (Giroud and Mueller, 2010). Accordingly, we expect the relation between positive shocks to real estate values and cost stickiness to be stronger for firms operating in a less-competitive product market.

We partition our sample into subsamples using a Herfindahl index for text-based network industry classification (TNIC), denoted by *THHI* and developed by Hoberg and Phillips (2010, 2016). Compared with the standardized industry classifications, such as SIC and NAICS, TNIC is more informative in explaining firm traits and is more likely to capture continuous measures of product market similarity and relatedness both within and across product markets. Panel C of Table 10 provides regression results for the partitioned sample. We observe that the effect of real estate values on cost stickiness is statistically insignificant across the two subsamples.

Finally, we test whether the relationship between positive shocks to collateral values and cost stickiness varies with analyst coverage (*ANALYST*). In a seminal paper, Jensen and Meckling (1976) emphasize the governance role of financial analysts in reducing the agency problems arising from the separation of ownership and control. Consistently with this, subsequent

Table 10
Agency Costs Mechanism.

	RE_VALUE_STATE		*RE_VALUE_MSA*	
	(1)	(2)	(3)	(4)
	High	Low	High	Low
Panel A: subsamples partitioned by future *SG&A* value creation				
ΔlnSALE	0.616***	0.614***	0.616***	0.610***
	(39.25)	(25.10)	(31.65)	(29.54)
DEC × *ΔlnSALE*	−0.169***	−0.130***	−0.171***	−0.130***
	(-3.00)	(-3.96)	(-4.03)	(-3.31)
RE_VALUE × *DEC* × *ΔlnSALE*	0.057	0.107**	0.069	0.111***
	(1.61)	(2.67)	(1.65)	(3.27)
Difference in coefficients	−0.050**			
			−0.042*	
Controls	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes
Obs.	10,011	9,464	9,644	8,887
Adj. R^2	0.519	0.519	0.519	0.517
Panel B: subsamples partitioned by growth opportunity				
ΔlnSALE	0.607***	0.630***	0.606***	0.640***
	(49.56)	(18.78)	(34.54)	(30.06)
DEC × *ΔlnSALE*	−0.171***	−0.107**	−0.178***	−0.118**
	(-6.08)	(-2.53)	(-5.66)	(-2.69)
RE_VALUE × *DEC* × *ΔlnSALE*	0.027	0.096***	0.028	0.101**
	(0.56)	(4.32)	(0.63)	(2.91)
Difference in coefficients	−0.069***			
			−0.073***	
Controls	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes
Obs.	12,140	12,141	11,567	11,567
Adj. R^2	0.511	0.522	0.506	0.528
Panel C: subsamples partitioned by product market competition				
ΔlnSALE	0.582***	0.609***	0.586***	0.619
	(28.81)	(33.93)	(28.34)	(26.27)
DEC × *ΔlnSALE*	−0.121***	−0.037	−0.119***	−0.061
	(-3.80)	(-1.09)	(-3.15)	(-1.57)
RE_VALUE × *DEC* × *ΔlnSALE*	0.049	0.073	0.047	0.053
	(0.57)	(1.53)	(0.60)	(1.22)
Difference in coefficients	−0.024			
			−0.006	
Controls	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes
Obs.	9,927	9,927	9,451	9,451
Adj. R^2	0.526	0.538	0.542	0.546
ΔlnSALE	0.538***	0.595***	0.530***	0.594***
	(12.18)	(26.32)	(10.23)	(23.24)
DEC × *ΔlnSALE*	−0.027	−0.148***	−0.029	−0.145**
	(-0.42)	(-3.14)	(-0.31)	(-2.59)
RE_VALUE × *DEC* × *ΔlnSALE*	−0.005	0.100	0.001	0.125**
	(-0.11)	(1.59)	(0.01)	(2.19)
Difference in coefficients	−0.105***			
			−0.124***	
Controls	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes
Obs.	7,308	6,630	6,932	6,290
Adj. R^2	0.627	0.564	0.626	0.562

This table presents the effect of future SG&A value creation, growth opportunity, product market competition, and analyst coverage on the relation between collateral shocks and cost stickiness. All regressions include year and firm fixed effects. Robust standard errors are clustered at the state or MSA level. The *t*-statistics are reported in parentheses. For brevity, we do not show the coefficient estimates for year dummy variables. Labels *, ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.
Variable definitions are provided in Appendix A.

empirical studies show that financial analysts play an important role in scrutinizing management behavior. For example, Yu (2008) notes that firms followed by more financial analysts engage in less opportunistic earnings management. Chen et al. (2015) show that if a firm experiences an exogenous decrease in analyst coverage, its managers receive excess compensation and are more likely to make value-destroying acquisitions. Hence, we expect the impact of collateral shocks on cost stickiness to be stronger for firms with less analyst coverage. We obtain the data on analyst coverage from the I/B/E/S database. The sample is partitioned by the median of this variable. As shown in Panel D of Table 10, the coefficients of $RE\_VALUE \times DEC \times \Delta lnSALE$ are significant only for firms with less analyst coverage if *RE_VALUE_MSA* is used. The Wald test's results also suggest that the difference in coefficient estimates across the two subsamples is statistically significant. The findings thus support our prediction.

Role of institutional ownership and internal corporate governance

Our evidence thus far has documented that the impact of collateral shocks on cost stickiness is stronger for firms with weak external governance (see Panel D of Table 10). In this section, we deepen our analysis by investigating whether this effect varies with institutional ownership and internal corporate governance mechanisms. On the one hand, strong corporate governance curbs self-serving actions of managers, thus mitigating agency problems. Chen et al. (2012) note that corporate governance mechanisms such as institutional shareholders and board independence are effective in reducing the impact of agency problems on SG&A cost stickiness. Accordingly, we expect the relationship between collateral shocks and cost stickiness to be less pronounced for firms with higher institutional ownership and stronger internal corporate governance (i.e., smaller boards and greater board independence).

On the other hand, prior studies have suggested that debt structure's choice is an effective way to mitigate agency problems (e.g., Grossman and Hart, 1982; Jensen, 1986; Hart and Moore, 1995). Even though this choice is often at the discretion of managers, strong boards may force managers to choose a debt structure that can facilitate more monitoring (Harford et al., 2008). Institutional investors have large ownership stakes and can exert influence through voting rights (Harris and Raviv, 1988; Aggarwal et al., 2015; Li and Ang, 2022). Consequently, in contrast to other external governance mechanisms such as analyst coverage, institutional shareholders can intervene more directly in a firm's financing decisions (Hirschman, 1970). Given the superior monitoring of banks, institutional investors may rely more on bank debt for curbing self-serving behavior of managers. Since an increase in the values of real estate assets significantly reduces firms' borrowing costs and enhances the liquidation value of such assets (Lin, 2016), large institutional owners and strong boards may force managers to use more bank debt.[10] As a result, the effect of collateral shocks on cost stickiness should be more pronounced for firms with higher institutional ownership and stronger internal corporate governance.

Collectively, these theoretical arguments indicate that the impact of institutional ownership and internal corporate governance on the association between real estate values and cost stickiness remains an empirical issue. To test these theories, we split our sample into "High" and "Low" groups based on the median value of institutional ownership (*IO*), board size (*BSIZE*), and board independence (*BINDP*), respectively. *IO* is measured as the number of shares held by institutional investors divided by the total shares outstanding. *BSIZE* is defined as the total number of directors on the board. *BINDP* is calculated as the number of outside directors divided by the total number of directors. Table 11 presents regression results for the partitioned sample. We observe that the coefficients of $RE\_VALUE \times DEC \times \Delta lnSALE$ are statistically significant only for firms with higher institutional ownership and higher board independence, suggesting that institutional ownership (board independence) and bank debt act as complements for monitoring managerial behavior.

Alternative explanation

While our findings are consistent with higher collateral values affecting cost stickiness by mitigating agency problems, one alternative explanation is possible. If real estate collateral values increase, firms may dispose of idle assets in a favorable market regardless of whether sales decrease or increase, which could lead to a sharp reduction in administrative operating expenses and ultimately appear as a lower degree of cost stickiness.[11]

To mitigate the concern that our main findings are driven by the abovementioned possibility, we perform the following two tests. First, we control for sales of PPE in the baseline specification. *PPE_SALE* is defined as sales of PPE divided by the total book value of assets. Column (1) of Table 12 presents the results obtained after controlling for sales of PPE. We still observe a significant negative association between real estate collateral values and cost stickiness. In addition, we note that the estimated coefficients of the three-way interaction term $PPE\_SALE \times DEC \times \Delta lnSALE$ are positive and statistically significant, indicating that the sales of PPE lead to a lower degree of cost stickiness.

Second, we conjecture that if our baseline results are driven by sales of PPE, then the main effect will be stronger for firms with more sales of idle assets. To test this conjecture, we split the sample based on the median value of *PPE_SALE*. Columns (2) and (3) present the results of the subsample analysis. We observe that the association between real estate collateral values and cost stickiness is largely unchanged between firms with increasing and decreasing sales of PPE, suggesting that sales of PPE are unlikely to drive our main findings.

[10] Our untabulated results show that institutional ownership and board independence magnify the relationship between collateral value and net debt issuance.

[11] We thank one anonymous referee for bringing this to our attention.

Table 11
Effect of Institutional Ownership and Internal Corporate Governance.

	RE_VALUE_STATE		*RE_VALUE_MSA*	
	(1)	(2)	(3)	(4)
	High	Low	High	Low
Panel A: subsamples partitioned by institutional ownership				
ΔlnSALE	0.542***	0.628***	0.550***	0.628***
	(20.74)	(29.83)	(16.47)	(29.70)
DEC × *ΔlnSALE*	−0.041***	−0.189***	−0.054	−0.193***
	(-0.80)	(-3.93)	(-0.89)	(-4.10)
RE_VALUE × *DEC* × *ΔlnSALE*	0.091**	0.023	0.084**	0.027
	(1.98)	(0.54)	(2.00)	(0.57)
Difference in coefficients	0.068*			
			0.057*	
Controls	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes
Obs.	9,128	9,128	8,650	8,649
Adj. R^2	0.609	0.510	0.610	0.506
Panel B: subsamples partitioned by board size				
ΔlnSALE	0.510***	0.605***	0.522***	0.621***
	(4.87)	(11.82)	(4.48)	(13.40)
DEC × *ΔlnSALE*	−0.086	−0.051	−0.132	−0.085
	(-0.48)	(-0.60)	(-0.72)	(-0.88)
RE_VALUE × *DEC* × *ΔlnSALE*	0.058	0.037	0.042	0.005
	(0.81)	(0.37)	(0.59)	(0.05)
Difference in coefficients	0.021			
			0.037	
Controls	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes
Obs.	3,652	4,622	3,417	4,448
Adj. R^2	0.648	0.573	0.652	0.574
Panel C: subsamples partitioned by board independence				
ΔlnSALE	0.526***	0.651***	0.575***	0.640***
	(7.86)	(8.57)	(7.96)	(10.53)
DEC × *ΔlnSALE*	−0.042	−0.117	−0.042	−0.090
	(-0.37)	(0.90)	(-0.44)	(-0.64)
RE_VALUE × *DEC* × *ΔlnSALE*	0.165*	0.012	0.098	0.028
	(1.84)	(0.17)	(1.16)	(0.39)
Difference in coefficients	0.153**			
			0.070	
Controls	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes
Obs.	3,950	4,324	3,770	4,095
Adj. R^2	0.623	0.600	0.624	0.602

This table presents the effect of institutional ownership and internal corporate governance on the relation between collateral shocks and cost stickiness. All regressions include year and firm fixed effects. Robust standard errors are clustered at the state or MSA level. The *t*-statistics are reported in parentheses. For brevity, we do not show coefficient estimates for the year dummy variables. Labels *, ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.
Variable definitions are provided in Appendix A.

Different cost categories

In the above analyses, we have explored the impact of collateral shocks on SG&A cost stickiness. In this final test, we investigate whether the results for SG&A costs can be extended to cost of goods sold (*COGS*) and total operating cost (*TOC*).

Table 13 presents the results of testing the impact of collateral shocks on the two types of cost stickiness. As shown in Columns (1) and (2), we are unable to identify any significant effect of collateral values on the stickiness of cost of goods sold. In contrast, the coefficients of *RE_VALUE* × *DEC* × *ΔlnSALE* are positive and statistically significant in Columns (3) and (4), suggesting that positive shocks to real estate values reduce the cost stickiness of total operating cost. Taken together, the results suggest that the negative impact of collateral shocks on cost stickiness identified using operating costs is mainly driven by SG&A costs. The findings appear reasonable since SG&A costs capture most of the costs incurred in the corporate office and thus are highly subject to managerial empire-building incentives and opportunism (Chen et al., 2012; Hartlieb et al., 2020).

Table 12
Alternative Explanation.

	(1)	(2)	(3)
		High	Low
Panel A: *RE_VALUE_STATE* sample			
ΔlnSALE	0.597***	0.596***	0.592***
	(43.84)	(36.21)	(38.59)
DEC × *ΔlnSALE*	−0.142***	−0.070	−0.203***
	(-3.76)	(-1.67)	(-4.16)
RE_VALUE × *DEC* × *ΔlnSALE*	0.077***	0.070**	0.064***
	(3.88)	(2.13)	(3.13)
PPE_SALE × *DEC* × *ΔlnSALE*	2.401*		
	(1.92)		
Difference in coefficients		0.006	
Controls	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes
Obs.	18,824	9,412	9,412
Adj. R^2	0.481	0.582	0.445
Panel B: *RE_VALUE_MSA* sample			
ΔlnSALE	0.600***	0.600***	0.595***
	(40.01)	(32.44)	(34.24)
DEC × *ΔlnSALE*	−0.149***	−0.076**	−0.201***
	(-5.32)	(-2.10)	(-5.39)
RE_VALUE × *DEC* × *ΔlnSALE*	0.086***	0.074*	0.076**
	(3.94)	(1.88)	(2.19)
PPE_SALE × *DEC* × *ΔlnSALE*	2.477*		
	(1.92)		
Difference in coefficients		−0.002	
Controls	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes
Obs.	17,845	8,923	8,922
Adj. R^2	0.481	0.584	0.443

This table presents OLS results for the impact of collateral shocks on cost stickiness after controlling for alternative explanations. All regressions include year and firm fixed effects. Robust standard errors are clustered at the state or MSA level. The *t*-statistics are reported in parentheses. For brevity, we do not show coefficient estimates for the year dummy variables. Labels *, ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively. Variable definitions are provided in Appendix A.

Table 13
Different Cost Categories.

	ΔlnCOGS		*ΔlnTOC*	
	(1)	(2)	(3)	(4)
ΔlnSALE	0.966***	0.969	0.841***	0.843***
	(95.78)	(110.78)	(122.42)	(96.18)
DEC × *ΔlnSALE*	0.009	0.013	−0.021	−0.022
	(0.44)	(0.61)	(-0.96)	(-1.29)
RE_VALUE_STATE × *DEC* × *ΔlnSALE*	0.044		0.058***	
	(1.38)		(2.68)	
RE_VALUE_MSA × *DEC* × *ΔlnSALE*		0.041		0.060***
		(1.25)		(2.68)
Controls	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes
Obs.	24,325	22,469	24,342	23,145
Adj. R^2	0.764	0.768	0.793	0.813

This table presents OLS regression results for the impact of collateral shocks on cost stickiness. All regressions include year and firm fixed effects. Robust standard errors are clustered at the state or MSA level. The *t*-statistics are reported in parentheses. For brevity, we do not show coefficient estimates for the year dummy variables. Labels *, ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.
Variable definitions are provided in Appendix A.

Conclusions

In this paper, we document a negative impact of positive shocks to collateral values on SG&A cost stickiness. The results are observed to hold in a series of robustness tests. Further studies show that this effect is stronger for firms with less prior bank debt, with less dependence on external financing, and with lower leverage ratios. The findings complement those of Lin (2016) by showing that the increase in bank debt arising from exogenous shocks to a firm's collateral values could reinforce bank monitoring, thus mitigating cost stickiness derived from agency issues and opportunistic managerial behavior. Consistently with this, we also observe that the effect of collateral shocks is more pronounced if SG&A costs create low future value for mature firms and for firms with weak external governance.

This paper contributes to the literature in two main ways. First, this study extends the literature on cost stickiness. Anderson et al. (2003) propose two theories underlying the observed asymmetric cost behavior, namely, adjustment cost theory and agency theory. Subsequent empirical studies have noted that many economic factors and managerial traits could affect cost stickiness. This paper contributes to the literature by documenting an association between collateral shocks and cost adjustment behavior. Second, this article enriches the literature on the real economic consequences of collateral finance. To the best of our knowledge, this is the first paper that shows an important role that collateral finance plays in influencing firms' cost management decisions.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A Variable Definitions

Variable	Definition
ΔlnSG&A	Natural logarithm of a firm's annual change in selling, general and administrative expenses.
ΔlnSALE	Natural logarithm of a firm's annual change in sales revenue.
DEC	Indicator variable that equals 1 if sales decrease between two fiscal years, and 0 otherwise.
RE_VALUE_STATE	Market value of the firm's real estate assets is scaled by the total book value of assets, using state-level real estate price indices.
RE_VALUE_MSA	Market value of the firm's real estate assets is scaled by the total book value of assets, using MSA-level real estate price indices.
PRICE_INDEX_STATE	Home Price Index (HPI) at the state level.
PRICE_INDEX_MSA	HPI at the MSA level.
AI	Asset intensity, calculated as the natural logarithm of total current assets divided by sales revenue.
EI	Employee intensity, calculated as the natural logarithm of the number of employees divided by sales revenue.
LAGDEC	Indicator variable that equals 1 if sales decreased in the preceding year, and 0 otherwise.
GDP	GDP growth rate.
FCF	Free cash flow, calculated as cash flow from operating activities less common and preferred dividends scaled by the total book value of assets.
ROA	Return on assets, calculated as earnings before interest and taxes scaled by the total book value of assets
MTB	The market value of assets is scaled by the total book value of assets.
R&D	Research and development expense, scaled by the total book value of assets. Missing R&D values are replaced with zeros.
SIZE	Natural logarithm of a firm's total book value of assets.
BLR	Total debt is scaled by the total book value of assets.
DEBT_ISSUE	The net change in the firm's total outstanding debt is scaled by the total book value of assets.
COL	The sum of inventories, machinery and equipment, natural resources, and other components of property, plant and equipment (PP&E) is scaled by the total book value of assets.
RATING	Indicator variable that equals 1 if a firm has an S&P long-term rating, and 0 otherwise.
INVRATING	Indicator variable that equals 1 if a firm's S&P long-term rating is BBB− or above, and 0 otherwise.
RE_VALUE_DMY	Indicator variable that equals 1 for firms with zero real estate value, and 0 otherwise.
Δln(SG&A-R&D-AD)	Natural logarithm of a firm's annual change in SG&A costs excluding R&D and advertising expenses.
REDEP	Redeployability score developed by Kim and Kung (2017).
FV_SG&A	Industry-specific indices of the impact of SG&A costs on future value creation developed by Banker et al. (2011).

Appendix A Variable Definitions (*continued*)

Variable	Definition
RETE	Ratio of retained earnings to total equity.
THHI	Similarity index based on the textual analysis of product descriptions in firms' 10-K statements, developed by Hoberg and Phillips (2010, 2016).
ANALYST	Number of analysts following the firm.
IO	The number of shares held by institutional investors is divided by the total shares outstanding.
BSIZE	The total number of directors on the board.
BINDP	The number of outside directors is divided by the total number of directors.
PPE_SALE	The sales of PPE are scaled by the total book value of assets.
ΔlnCOGS	Natural logarithm of a firm's annual change in the cost of goods sold.
ΔlnTOC	Natural logarithm of a firm's annual change in operating costs.

Appendix B First Stage

	(1)	(2)
Local housing supply elasticity × *Mortgage rate*	0.020***	
	(4.69)	
First quartile of elasticity × *Mortgage rate*		-0.077***
		(-5.28)
Second quartile of elasticity × *Mortgage rate*		-0.016
		(-1.44)
Third quartile of elasticity × *Mortgage rate*		-0.009
		(-0.83)
Year fixed effects	Yes	Yes
MSA fixed effects	Yes	Yes
Obs.	7,200	7,200
Adj. R^2	0.790	0.797

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