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Two Essays on Labor Heterogeneity

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TWO ESSAYS ON LABOR HETEROGENEITY

by

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ABSTRACT

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Labor heterogeneity limits firm flexibility, subsequently affecting a firm's capacity to adapt and grow within a dynamic economic landscape and to formulate effective financial strategies. Firms with high labor heterogeneity tend to incur significant labor adjustment costs, making it costly and challenging to adjust their workforce in response to economic changes. While retaining skilled labor can be advantageous in preserving valuable human capital, it also incurs considerable economic costs that significantly influence firms' financial strategy and decision-making processes. This dissertation comprises two essays that explore the implications of firms' dependence on skilled labor.

The first essay empirically investigates how labor adjustment costs affect capital allocation efficiency. Using data from US-listed firms between 1999 and 2021, the findings reveal a negative relationship, indicating that retaining skilled labor reduces the responsiveness of investment to value-added growth. This effect is attributed to ineffective monitoring, as labor adjustment costs increase agency costs. Notably, this negative relationship became insignificant during the 2001-2003 period, following the dotcom crisis, when there were widespread layoffs of skilled workers.

The second essay investigates how labor adjustment costs affect a firm’s externally financed growth. Using a sample of US firms between 1999 and 2022, we find a positive relationship between labor adjustment costs and externally financed firm growth. For firms with high labor adjustment costs, external financing becomes important for growth because firms hoard precautionary cash in the face of higher firm risks. Further analysis shows that equity is the more important source of external funds for firms with high labor adjustment costs. The retention of skilled workers elevates conflicts between financial and non-financial stakeholders of the firm. Ineffective monitoring is the channel connecting labor adjustment costs and externally financed growth. The results remain unchanged after a battery of robustness checks.

DEDICATION

In honor of the memory of my late grandfather, Shangjun An,

and my late grandmother, Guifu Zhao.

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Earning my Ph.D. from Old Dominion University has been a transformative journey of self-discovery. This path presented numerous challenges and uncertainties, yet it was simultaneously filled with joyful moments and the invaluable support of many incredible people. Their generosity and the time we shared have profoundly enriched my life, nourishing my soul. I am deeply grateful to everyone who has been with me in the process.

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ESSAY 1: LABOR HETEROGENEITY, LABOR ADJUSTMENT COSTS, AND CAPITAL ALLOCATION EFFICIENCY

As our revenue accelerated through the pandemic, we hired too many people leading into this economic downturn we are now facing, and I take responsibility for that.

-- Salesforce CEO Marc Benioff (January 4, 2023)

I. Introduction

In 2022, the world economy experienced an unprecedented economic shock caused by a sharp rise in inflation worldwide. Since the third quarter of 2022, mass layoffs have been announced by major US corporations, including Amazon, Meta, Cisco, Salesforce, Goldman Sachs, Morgan Stanley, Snapchat, Alphabet, and Hewlett Packard, among others. These layoffs suggest that resources have not been allocated in an efficient manner that would have enabled the firms to respond effectively to rapid changes in economic conditions.

It is important for firms to allocate capital resources efficiently to remain sustainable, profitable, and achieve growth. Inefficient capital allocation has been associated with low productivity (Andrews and Cingano, 2014), poor response to growth opportunities (Mortal and Reisel, 2013), investment myopia (Thakor, 1990), and over- and underinvestment (Arrfelt et al., 2013), among others. Prior studies have attributed low capital allocation efficiency to underdeveloped financial markets (Wurgler, 2000), poor-quality financial accounting information (Sun, 2014), public policy restrictions (Andrews and Cingano, 2014; Epstein and Shapiro, 2017), strong creditor protection (Ersahin et al., 2021), and stakeholder conflicts (Xing et el. 2017), among others.

In this study, we posit that labor heterogeneity is a determinant of capital allocation efficiency (CAE) of the firm. Labor heterogeneity refers to the fact that firms differ in their dependence on skilled labor. Firms that rely more on high-skill workers face higher levels of labor adjustment costs (LACs) because it is costly to dismiss and hire high-skill workers (Shapiro, 1986; Belo et al., 2017; Ghaly et al., 2017). Hence, these firms tend to retain their high-skill workers and, consequently, are less flexible in responding to external shocks (Hamermesh, 2002; Ochoa, 2013; Belo et al., 2017; Ghaly et al., 2017; Qui, 2019). For example, Ghaly et al. (2017) find that firms with a higher share of skilled workers are less flexible in adjusting their labor demand in response to cash flow shocks, and thus must hold more precautionary cash.

Recent evidence of the harmful effects of inflexible inputs on business operations can be found by examining the supply chain disruptions experienced by US firms in the last several years. For example, in 2021 and 2022, automobile manufacturers, such as Ford and General Motors, had to cut back production because of the restricted supply of car-specific microchips. When production inputs, including labor, are difficult to adjust or replace, firm investment becomes suboptimal, and productivity suffers. Researchers have documented that labor inflexibility induced by employment protection regulations leads to firm-level and economy-wide declines in productivity (Okudaira et al., 2013; Bassanini et al., 2009) because labor resources cannot be allocated efficiently and effectively. Based on evidence from Japan, Okudaira et al. (2013) find that employment protection obstructs capital deployment. Andrews and Cingano (2014) examine firms in OECD countries and find that regulations that impede labor flexibility adversely affect the allocative efficiency of investment resources, particularly in more innovative sectors. Bena et al. (2022) report results suggesting that firms need to make innovative changes to production processes to mitigate value losses associated with labor inflexibility. Collectively, the literature suggests that inflexible labor resources have a negative impact on businesses.

Unlike the labor inflexibility caused by employment protection regulations, inflexibility associated with labor heterogeneity is voluntary. That is, firms voluntarily expose themselves to labor inflexibility, as the hoarding of skilled workers is equivalent to offering workers employment protections. To the extent that firms make hiring and investment decisions to maximize firm value, the hoarding of skilled workers may be the result of rational decisions, and thus may not negatively affect firms' CAE. Nevertheless, many researchers have reported that labor inflexibility negatively impacts firm performance (Chen, et al., 2011; Andrews and Cingano, 2014; Mamatzakis et al., 2015). The literature has not yet examined the relationship between voluntary retention of skilled workers and CAE; we provide an empirical investigation of this relationship in this study.

Following the literature (Belo et al. 2017; Ghaly et al. 2017), we construct a labor skill index (LSI) to measure the degree of dependence on skilled labor. Essentially, LSI is a proxy for LACs such that a high LSI value implies high LACs. Consistent with prior studies (Wurgler, 2000; Sun, 2014; Faccio et al., 2016), we define the efficient allocation of capital as the movement of capital into projects with increasing profitability and away from projects with declining profitability. The change in profitability is measured by the growth rate of the value added to the firm.

Building on prior studies, we argue that LACs impose a cost burden on firms and hinder the optimal allocation of resources to investments. We hypothesize that LACs and CAE are negatively related. In addition, we hypothesize that ineffective monitoring is the channel through which LACs and CAE are negatively connected.

Employing a sample of US firms between 1999 and 2021 to examine the relationship between LACs and CAE, our baseline model results show that LACs are negatively related to CAE. These results indicate that LACs diminish the sensitivity of investment to value-added growth. We perform robustness checks and confirm that our results are not affected by unobserved firm or industry heterogeneities. In addition, using propensity score-matched firms, we confirm that our results are not biased by endogeneity issues. We obtain results that support the hypothesis that ineffective monitoring is the channel that relates LACs to negative CAE. We attribute ineffective monitoring to agency costs associated with the hoarding of skilled workers, which elevates stakeholder conflicts and/or reduces the quality of financial reporting. Firms that rely more on high-skill workers tend to have significant amounts of intangible capital that is informationally opaque. We perform an analysis and rule out the possibility that the ineffective monitoring channel between LACs and CAE is affected by the informational opacity of intangible capital. The literature provides evidence that product market competition affects firm efficiency, and that the employment of workers is affected by a firm's ability to refinance its debt. We perform an additional analysis and rule out the possibility that the negative relationship between LACs and CAE is associated with product market competition or refinancing risk. Finally, an examination of the intervals three years before and after the 2000 dotcom crisis provides supportive evidence consistent with the baseline results. Specifically, the negative relationship between LACs and CAE disappeared in the post-dotcom crisis interval, a period when many skilled workers were laid off.

This study contributes to the burgeoning literature on labor heterogeneity. To our knowledge, this is the first investigation of the relationship between LACs and CAE at the firm level. Firms in the US have frequently voiced concerns about the inadequate supply of skilled workers; our results add to the debate on whether hoarding skilled labor is beneficial to businesses.

Although skilled labor is a desirable form of organizational capital, hoarding it beyond the optimal level is likely to have a negative impact on the firm. These findings suggest that firms should consider the negative implications of labor inflexibility associated with the hoarding of skilled workers when making employment decisions.

The remainder of this paper is organized as follows. Section 2 reviews related literature and develops the hypotheses. Section 3 describes the sample and major variables. Section 4 presents the empirical results and robustness checks. Finally, Section 5 concludes the study.

II. Literature and Hypotheses

The demand for skilled labor in the US has increased considerably in recent decades, as competitive pressures faced by firms intensify in a progressively globalized world economy. However, the supply of skilled labor appears to lag. On September 9, 2021, Forbes.com reported a survey performed by Manpower Incorporated, showing that talent shortages in the U.S. had more than tripled between 2011 and 2021 and that 69% of employers struggled to fill positions. Similarly, CNN.com reported on October 25, 2021, that nearly half of American companies said they were short of skilled workers. The shortage of skilled workers contributes to firms' voluntary retention of the workers in the US. However, we contend that hoarding skilled workers negatively impacts firms' CAE. We present our arguments below.

First, LACs negatively affect firm productivity. According to an estimation performed by the ERI Economic Research Institute, a research firm specializing in compensation analysis, a dismissal typically costs between 50% and 60% of a dismissed person's annual salary to refill the position. Researchers have argued that high firing and hiring costs are major justifications for firms to retain skilled workers (Shapiro, 1986; Ghaly et al., 2017; Belo et al., 2017). However, Rotemberg et al. (1988) argue that in the face of costly labor input adjustments, firms hoard labor to the extent that output does not increase proportionally to changes in labor input. Similarly, Andrews and Cingano (2014) find evidence suggesting that when firms face costly workforce adjustments, dismissal costs are likely to induce firms not to hire workers even if their marginal product exceeds the market wage and/or to retain workers whose wages exceed their productivity. The findings of Rotemberg et al. (1988) and Andrews and Cingano (2014) imply that LACs impair productivity and labor flexibility. The economic effect of labor inflexibility on firm value is significant. Lee and Mas (2012) document a 10% decline in share prices over a two-year period following the formation of a labor union. Overall, the evidence presented in prior studies implies that firm-level productivity is negatively affected when firms hoard labor. In other words, hoarding skilled workers negatively affects a firm's CAE.

Second, LACs lead to sub-optimal investment decisions. The hoarding of skilled workers diminishes a firm's ability to respond swiftly to changes in economic conditions. Ochoa (2013) argues that firms with a high share of skilled workers are slower to adjust their labor demand reactions to changes in economic conditions because of high labor adjustment costs. Despite hoarding skilled workers provides convenience to a firm's management of labor employment in the face of high LACs, Ghaly et al. (2017) posit that the policy exposes firms to the risk of not being able to mitigate the impact of future cash flow shocks. Similarly, Qiu (2019) documents that high LACs lower firms' responses to economic conditions and lower the correlation between firms' internal funds and investment opportunities. Collectively, the above studies suggest that high LACs are associated with suboptimal CAE, as slow reactions to changes in economic conditions imply that costly inputs are stuck in suboptimal investment projects.

Third, LACs reduce corporate resources for profitable investment opportunities. Unemployment imposes a significant cost burden on the workers. In a review of the literature on labor supply, Mincer (1966) reports that a high probability of unemployment results in low labor force participation. That is, if a firm has a high unemployment risk, workers reduce the labor supply to the firm (Brown and Matsa, 2012). Consequently, firms that rely more on skilled workers are motivated to mitigate their workers' unemployment risk. One way to lower firm-specific unemployment risk is to reduce firm risk by reducing leverage. Agrawal and Matsa (2013) find that firms employ conservative financial policies to mitigate the unemployment risk faced by workers. Reducing leverage decreases the probability of a firm encountering financial distress and subjecting workers to costly layoffs. Firms can also lower the unemployment risk faced by workers by increasing liquidity. Ghaly et al. (2017) report evidence that firms that rely more on skilled workers hold more precautionary cash than firms that rely less on skilled workers. Ghaly et al. (2017) posit that firms hold precautionary cash to reduce risk because cash reserves function as a buffer that safeguards against future cash flow uncertainty. Thus, hoarding skilled workers is associated with low leverage and high idle cash. As a result, fewer resources are allocated to profitable investment opportunities, and capital allocation efficiency suffers.

Fourth, labor inflexibility elevates conflicts between non-financial and financial stakeholders; thus, reduces the effectiveness of firm monitoring. According to the U.S. Bureau of Labor Statistics, a considerable number of workers in the US are members of labor unions. In 2021, among the private-sector industries, union membership rates were highest in transportation and utilities (17.6 percent), construction (12.7 percent), and information (9.3 percent). Within the public sector, the union membership rate was highest in the local government (41.7 percent), which employs many workers in heavily unionized occupations, such as police officers, firefighters, and teachers. Unionized skilled workers can be a formidable group among the non-financial stakeholders of the firm. Xing et al. (2017) find that venture-backed firms in highly unionized industries have lower Tobin's Q and are less likely to survive. They attribute the poor firm performance to stakeholder conflicts between unionized workers and venture capital investors. Their results imply that firm monitoring is less effective if workers are protected, and firm-level CAE suffers as a result.

Collectively, the discussion in this section suggests that hoarding skilled workers negatively impacts CAE of the firm. Thus, we propose the following hypothesis:

H1: LACs and CAE are negatively related.

The internal monitoring of a firm becomes less effective when stakeholder conflicts exist between protected workers and managers (Xing et al., 2017). Evidence also suggests that external monitoring may be less effective among firms that have protected workers. Nguyen (2022) finds that firms with high LACs are associated with higher levels of tax avoidance. Chang et al. (2022) document that firms with more unionized workers are more likely to engage in real earnings management. They attribute the finding to managers' motivations for upward earnings management to mitigate the costs of employee management in competitive labor markets. The results of Nguyen (2022) and Chang et al. (2022) provide direct evidence that labor inflexibility reduces the quality of firms' financial information, which renders external monitoring less successful. Overall, the above suggests that firm monitoring becomes less effective when firms experience labor inflexibility, and CAE suffers as a result. Thus, we formulate the second hypothesis as follows:

H2: Ineffective monitoring serves as the channel through which LACs and CAE are negatively related.

III. Sample Selection and Major Variables

3.1. Sample

Our initial sample includes all firm-year observations from the Compustat North America dataset for the period 1999-2021. We exclude financial firms (SIC codes 6000–6999) and utility firms (SIC codes 4900–4999). All continuous variables are winsorized at the 1st and 99th percentiles to mitigate potential outlier issues. The final sample consists of 12,338 firms, totaling 91,639 firm-year observations. Table 1 presents the descriptive statistics for the sample, while Table 2 shows the correlation coefficients among the major variables.

[Insert Tables 1.1 and 1.2 here]

3.2. Major Variables

3.2.1. Labor Skill Index and LAC

Following Belo et al. (2017) and Ghaly et al. (2017), we construct a labor skill index (LSI) using data available from the Bureau of Labor Statistics and the U.S. Department of Labor to measure the degree of dependence on skilled labor. Essentially, LSI is a proxy for LACs, such that a high LSI value implies an elevated level of LACs.

We compute the industry-specific labor skill index (LSI) score as follows:

$$LSI_{it} = \sum_{j=1}^{0}\left(\frac{E_{jit}}{E_{it}} \times Z_{jt}\right) \quad (1)$$

where E_{jit} indicates the number of employees in occupation *j* of industry *i* in year t, E_{it} is the total number of employees in industry *i* in year t, and Z_{jt} refers to the job zone score based on the skill level of job occupations per US Department of Labor. Job zone scores, which indicate similar employee characteristics (education, experience, training, etc.), range from one to five. A higher job zone score indicates a higher skill level. Thus, LSI is an industry-level index that measures the weighted-average skill level of occupations within an industry.

To compute the LSI, we merged the Occupational Employment Statistics (OES) data of the U.S. Bureau of Labor Statistics (BLS)[1] and job zone (occupational) skill level classification data of the O*Net program.[2] The industry LSI estimates are presented in the Appendix. As expected, scientific research and development and legal services have high LSI scores because these industries are most reliant on skilled labor, while coral mining and restaurant services have low average LSI scores.

3.2.2. Capital Allocation Efficiency

In line with the literature (Wurgler, 2000; Sun, 2014; Faccio et al., 2016), we define efficient allocation of capital as the movement of capital into projects with increasing profitability and away from projects with declining profitability. Accordingly, value added growth is an indication of allocative efficiency. Value added is equal to earnings before interest and taxes plus the cost of employees. We compute its growth rate as the value added in year t scaled by the value added in year $t - 1$. Value-added growth (VAG) is a (0,1) dummy variable that equals one if the growth rate is greater than one, and zero otherwise. Investments associated with a positive VAG imply efficient allocation of capital.

[1] https://www.bls.gov/

[2] https://www.onetonline.org/

IV. Results

4.1. The Baseline Model

We modify the models used in previous studies (Wurgler, 2000; Sun, 2014; Faccio et al., 2016) to investigate the relationship between CAE and LACs. Our baseline model has the following specifications.

$$\Delta INVT_{i,t} = \beta_0 + \beta_1 \ (LACs_{i,t} \times VAG_{i,t}) + \beta_2 LACs_{i,t} + \beta_3 VAG_{i,t} + \beta_4 Cashflow_{i,t} + \beta_5 CONTROLs_{i,t-1} + Year_t + \varepsilon_{i,t} \quad (2)$$

where ΔINVT is the change in investment computed as ΔGross PPE_t /Net fixed $assets_{t-1}$. Cash flow is the operating cash $flow_t$ scaled by total $assets_{t-1}$. Controls include firm age, firm leverage, Tobin's Q, firm size, R&D to sales ratio, return on assets, and sales growth. We control for year fixed effects in the regression. Heteroskedasticity-adjusted standard errors are clustered at the firm-level. The variable of interest is LACs*VAG. Following prior studies, a positive β_1 means that in the face of LACs, the firm invests more in projects with positive value-added growth and withdraws investments from projects with negative value-added growth. A negative β_1 means that, in the face of LACs, firm investment does not follow the growth of value-added. Thus, a positive (negative) β_1 indicates efficient (inefficient) capital allocation.

The regression results using Equation (2) are presented in Table 3. In Model 1, we perform pooled ordinary least squares (OLS) estimations and regress ΔINVT on the control variables only. The coefficients of the control variables are consistent with prior evidence reported in the literature.

In Model 2, we include LACs, VAG, and LACs*VAG as additional explanatory variables. As expected, the coefficient of LACs*VAG is negative and significant at the one percent level.

Since LACs are always positive, the negative coefficient of LACs*VAG implies that LACs diminish the sensitivity of investment to value-added growth. More importantly, the result implies that the firms may have retained skilled labor to a level beyond the optimal. The economic impact of LACs on reducing the sensitivity of investment to VAG is considerable. Considering the effect of VAG alone, the sensitivity of ΔINVT to VAG is positive given that the coefficient of VAG is 0.1255. That is, the average firm in the sample allocates capital efficiently in investment activity. The result shows that a one standard deviation increase in VAG increases ΔINVT by 30.6% relative to its sample mean. Since the coefficient of LACs*VAG is -0.0224, it can be estimated that a one standard deviation increase in LACs*VAG reduces ΔINVT by 13.8% relative to its sample mean. In other words, ΔINVT is considerably reduced when LACs exert influence on VAG, the result confirms that LACs diminish the sensitivity of ΔINVT to VAG. That is, LACs lower CAE. The coefficients of the control variables remain comparable to those in Model 1. In short, the negative association between LACs and CAE is not driven by the correlations of the two variables with the control variables in the baseline model.

In Model 3, we perform a cross-sectional regression using the time-series means of the firm variables. Consistent with the results in Model 2, the coefficient of LACs*VAG is negative and statistically significant. However, the value of the coefficient is 134% larger than that in Model 2. This finding suggests a strong cross-sectional relationship between LACs and investment-to-value-added growth sensitivity.

In Model 4, we examine whether the sensitivity of investment to value-added growth is affected by differences in LACs across industries. We perform a cross-sectional regression using the industry time-series means of the firm variables. 3-digit SIC codes are used to classify the industries. The coefficient of LACs*VAG remains negative and significant, suggesting that the negative relationship between LACs and CAE varies across industries.

[Insert Table 1.3 here]

4.2. Robustness Checks

4.2.1. Unobserved Firm and Industry Heterogeneity

To ascertain that the negative relationship between LACs and CAE is not driven by unobserved firm or industry heterogeneity, we apply our baseline model to subsamples that exhibit similar firm or industry characteristics.

The subsample regression results are presented in Table 4. In Model 1, the subsample is firms in high-skill industries. That is, we focus on firms in the top quartile of LSI. For this subsample, we expect the effect of labor heterogeneity on firm investment activity to be significant. As expected, the coefficient of LACs*VAG remains negative and significant. By focusing on firms in high-skill industries, our results are less affected by firm heterogeneity. In Model 2, we focus on firms in manufacturing industries (defined according to the Fama-French classification). Manufacturing firms are expected to rely significantly on skilled workers and have high LACs. Consistent with our expectation, the coefficient of LACs*VAG remains negative and significant at the one percent level. By focusing on firms in the manufacturing sector alone, our results are less affected by industry heterogeneity. In Model 3, the subsample is industries with positive R&D expenses. A priori, firms with R&D expenses tend to rely more on skilled labor; thus, the influence of LACs is expected to be significant. The result of Model 3 shows that the coefficient of LACs*VAG remains negative and significant at the one-percent level in Model 3. In Model 4, the subsample is firms in young industries (bottom quartile of age). Younger industries are more likely related to advanced technologies and therefore rely more on skilled workers. As expected, the coefficient of LACs*VAG remains negative and significant at the one percent level in Model 4.

Overall, the results in Models 1 to 4 suggest that the negative relationship between LACs and CAE is robust to the use of subsamples of relatively similar firms, and thus is conceivably unaffected by heterogeneity bias.

[Insert Table 1.4 here]

4.2.2. Propensity-Score-Matched Firms

Next, we use propensity score matching to control for endogeneity issues caused by observable differences in firm and industry characteristics. We begin by creating a treatment group (firms with above-median LSI) and a control group (firms with below-median LSI). We match the two groups by year, industry (2-digit SIC codes), and all control variables in the baseline model. This propensity score matching is applied to the whole sample, manufacturing firms, positive-R&D firms, zero-R&D firms, and young firms, respectively. After that, we apply the baseline probit regression to the propensity-score-matched firms in the whole sample and each subsample.

The results are presented in Table 5. The coefficients of LACs×VAG are negative and significant across all models. That is, LACs diminish the sensitivity of investment to value-added growth. As expected, Model 2 shows that the effect of LACs is pronounced in manufacturing firms relative to firms in the whole sample. Note that even when we hold the R&D constant at zero in Model 4, the differences in LACs still exhibit significant negative impacts on CAE. Model 5 shows that young firms experience stronger effects of LACs on CAE than other subsamples, likely because young firms use more advanced technologies and rely more on skilled workers. Overall, the results in Table 5 are consistent with those in the baseline model reported in Table 3. In other words, the results of the baseline model are robust.

[Insert Table 1.5 here]

4.3. The Monitoring Channel

In developing Hypothesis 2, we argue that LACs diminish CAE by reducing monitoring effectiveness. Ineffective monitoring occurs when LACs heighten conflicts between financial and non-financial stakeholders (Xing et al. 2017) and/or reduce the quality of financial reporting (Chang et al. 2022; Nguyen 2022). In other words, ineffective monitoring arises when agency costs increase. To confirm that the negative relationship between LACs and CAE is stronger when ineffective monitoring is elevated, we estimate the following equation:

$$\Delta INVT_{i,t} = \beta_0 + \beta_1 (AC_{i,t} \times LACs_{i,t} \times VAG_{i,t}) + \beta_2 LACs_{i,t} + \beta_3 VAG_{i,t} + \beta_4 AC_{i,t} + \beta_5 Cashflow_{i,t} + \beta_6 CONTROLs_{i,t-1} + Year_t + \varepsilon_{i,t} \quad (3)$$

where AC represents agency costs. We use five measures to proxy for agency costs: free cash flow (Faulkender et al., 2012), excess cash (Opler et al., 1999), book tax differences (BTD), permanent book tax differences (PBTD), and Manzon and Plesko book tax differences (MPBT) (Manzon and Plesko, 2002). Jensen (1986) argues that higher free cash flows lead to greater agency problems because managers are given more capital to engage in negative-NPV investment projects. Firms with excess cash are associated with entrenched managers (Jiang and Lie, 2016). Book tax differences are signs of tax avoidance. Firms that avoid taxes have unrestrained managers (Desai et al., 2007). Agency costs are generally viewed as an indicator of ineffective monitoring. If LACs diminish CAE by undermining monitoring, we predict a negative coefficient of AC*LACs*VAG (i.e., $\beta_1 < 0$).

Table 6 presents the results of estimating equation (3). As predicted, the coefficients of the interaction term AC*LACs*VAG are negative and significant at the one percent level across all models. The results show that higher agency costs amplify the impact of LACs on diminishing the sensitivity of investment to value-added growth. Thus, the results in Table 6 suggest that ineffective monitoring serves as the channel through which the LACs and CAE are negatively related. Note that the effect of LACs is stronger among firms with high agency costs, particularly those with free cash flows and those that avoid taxes.

[Insert Table 1.6 here]

4.4. Intangible Capital

In the previous section, we argue that an avenue for LACs to diminish the effectiveness of monitoring is to make information less accessible to investors (i.e., by decreasing the quality of financial reporting). However, firms that rely more on high-skill labor tend to have significant amounts of intangible assets such as R&D and organizational capital. Intangible assets are, in general, informationally opaque, which weakens external monitoring. Thus, the channel through which LACs negatively affect CAE may be confounded by the opacity of intangible capital. To confirm that LACs are responsible for the negative effect on CAE, we control for the effect of intangible capital in our regression.

Table 7 presents the results of the regressions that control for the effect of intangible capital. We follow Peters and Taylor (2017) in measuring intangible capital as the sum of external and internal intangible assets, scaled by total assets. Internal intangible assets are proxied by the sum of knowledge and organizational capital. For the entire sample in Model 1, the coefficient of LACs*VAG remains negative and significant at the one percent level, which is consistent with the baseline model results reported in Table 3. The coefficients of LACs*VAG are also negative in Models 2 and 3 for the zero-R&D and positive-R&D sub-samples. That is, the ineffective monitoring channel between the LACs and the CAE is not caused by intangible capital. It is worth mentioning that after controlling for the effect of intangible capital, the coefficient of LACs*VAG in Model 3 for the positive-R&D subsample (-0.0246) is even more negative than that of the whole sample in the baseline model (-0.0224) in Table 3. This finding provides strong evidence that intangible capital does not confound the ineffective monitoring channel between LACs and allocative efficiency.

[Insert Table 1.7 here]

4.5. Additional Analysis

4.5.1. Pre- and post-dotcom crisis

Thus far, our finding of a negative association between LACs and CAE among the sampled firms implies that skilled workers are retained beyond the optimal level. To seek additional evidence supporting our argument, we compare the intervals three years before and after the dotcom crisis of 2000. According to the Silicon Valley Business Journal, two million people were laid off because of the dotcom crisis (https://www.bizjournals.com/). These layoffs included many skilled workers in the high-tech industries.

Table 8 presents the results. We follow Grullon and Michaely (2004) in allowing for a systemic change in each regression variable in the baseline model after the dotcom crisis. Specifically, we apply the baseline model to propensity-score-matched firms and estimate the regression coefficients for the pre-dotcom crisis (1998-2000) and post-dotcom crisis (2001-2003) intervals simultaneously. We then compare the regression coefficients for the three years before and after the dotcom crisis. For the entire sample, the coefficient of LACs*VAG is -0.0487 and it is significant at the one-percent level for the three-year interval before the dotcom crisis. The coefficient of LACs*VAG is insignificant for the three-year interval after the crisis. A similar result is observed for firms in the positive R&D subsample. Since our variable of interest is LACs*VAG, we perform an F-test comparing the coefficients of LACs*VAG before and after the dotcom crisis. Results of the F-test shown at the bottom of Table 8 confirm that LAG*VAG is significantly more negative in the three-year interval before the dotcom crisis for firms in the whole sample and the positive R&D subsample, respectively. For firms in the zero R&D expenses subsample, the coefficient of LACs*VAG remains insignificant before and after the dotcom crisis. Firms with zero R&D expenses are likely to have lower levels of skilled labor; thus, it is not unexpected to see LACs*VAG experience no significant changes from the pre-dotcom crisis interval to the post-dotcom crisis interval. The results in Table 8 imply that the negative effect of LACs on diminishing the sensitivity of investment to value-added growth is likely driven by firms' excessive employment of skilled workers in the pre-dotcom crisis years. In untabulated results, we obtain similar and consistent findings by comparing the intervals of two or four years before and after the dotcom crisis.

[Insert Table 1.8 here]

4.5.2. Other Explanations

To further control for potential omitted variable bias and rule out alternative explanations for the negative relationship between LACs and CAE, we add several explanatory variables that may be relevant for determining CAE or related to the employment of skilled workers.

Product market competition may be related to firm efficiency and worker retention. Competition in the product market incentivizes firms to improve efficiency so that they can survive or gain a larger market share. However, empirical evidence on the relationship between product market competition and firm performance is mixed (Babar and Habib, 2021). Some researchers have related product market competition to a firm's labor force. Guadalupe (2007) finds that product market competition increases returns on skills. She finds little evidence that this causal effect is related to technology and unionization and argues that the effect of competition on returns to skill may be a direct effect through a change in the sensitivity of revenues to cost reductions. Guadalupe 's finding implies that product market competition intensifies skilled workers' retention. The opposite view is expressed by Aparicio-Fenoll (2015). Without differentiating between high- and low-skill workers, she finds evidence that product market competition lowers job security. Taken together, the literature provides mixed evidence that product market competition is related to firm efficiency and worker retention. To rule out the possibility that LACs capture the effect of product market characteristics on allocative efficiency, we control for industry concentration (Herfindahl index) and product market fluidity (Hoberg et al. 2014) in our exploration of alternative explanations of the relationship between LACs and CAE.

Refinancing risk is another variable that impacts a firm's CAE. A firm that may be denied refinancing is unlikely to commit capital to long-term projects. In addition, refinancing risk reduces firms' flexibility to respond to changes in their economic conditions. Benmelech, Bergman, and Seru (2011) find that firms manage their refinancing needs by changing the size of the labor force. For firms that rely heavily on high-skill labor, the burden of refinancing risk may cause them to retain high-skill workers and dismiss low-skill workers. To rule out the possibility that refinancing risk may be a determinant of the negative relationship between LACs and CAE, we control for refinancing risk in our regression. Following Harford, Klasa, and Maxwell (2014), we use the fraction of a firm's short-term debt to total debt for the next three years as a proxy for refinancing risk.

Table 9 presents the results of the analysis of the effects of product market competition and refinancing risk on the relationship between LACs and CAE. In Model 1, although the coefficients of the two product market competition measures are significant at the one percent level, the coefficient of LACs*VAG remains negative and significant at the one percent level. As expected, the coefficient of short-term debt is negative and significant in Model 2; however, the coefficient of LACs*VAG remains negative and significant at the one percent level. The results of Models 1 and 2 rule out the possibility that product market competition or refinancing risk can change the statistical or economic significance of the effects of LACs on allocative efficiency. This is further confirmed by the results of Model 3, in which the effects of product market competition and refinancing risk are controlled for simultaneously in the regression. In other words, our finding of a negative relationship between LACs and CAE is robust.

[Insert Table 1.9 here]

V. Conclusion

Labor heterogeneity refers to the fact that firms differ in their dependence on skilled labor. Skilled workers incur high labor adjustment costs because they are expensive to dismiss and hire. Thus, firms that rely on skilled workers tend to retain them. In this study, we investigate the effect of firms' hoarding of skilled labor on capital allocation efficiency. By defining capital allocation efficiency as the movement of capital into profitable investments and away from non-profitable projects, our results show that labor adjustment costs are negatively related to the allocative efficiency of capital. In other words, labor adjustment costs diminish the sensitivity of investment to value-added growth. We perform robustness checks and confirm that our results are not affected by unobserved firm or industry heterogeneities. In addition, using propensity-score-matched firms, we confirm that our results are not biased by endogeneity issues. We find results suggesting that ineffective monitoring is the channel that connects labor adjustment costs and negative allocative efficiency. We attribute ineffective monitoring to agency costs associated with the hoarding of skilled workers, which elevates stakeholder conflicts and/or reduces the quality of financial reporting. We rule out the possibility that this channel is affected by the informational opaqueness of intangible assets of firms. By comparing the intervals three years before (1998-2000) and after (2001-2003) the dotcom crisis, we find additional evidence supporting the baseline results. Specifically, during the three-year interval when mass layoffs of tech workers occurred after the dotcom crisis, the negative relationship between labor adjustment costs and allocative efficiency became insignificant. In an additional analysis, we rule out the possibility that the negative relationship between labor adjustment costs and capital allocation efficiency is associated with product market competition or refinancing risk.

This study contributes to the literature on labor heterogeneity. To our knowledge, this is the first investigation of the relationship between labor adjustment costs and the allocative efficiency of capital at the firm level. Firms in the US have frequently voiced concerns about the inadequate supply of skilled workers; our results add to the debate on whether the hoarding of skilled labor is beneficial to businesses. These findings suggest that firms should consider the negative implications of labor inflexibility associated with the hoarding of skilled workers when making employment decisions.

References

Agrawal, Ashwini K., and David A. Matsa. 2013. "Labor Unemployment Risk and Corporate Financing Decisions." *Journal of Financial Economics* 108 (2): 449–70.

Andrews, Dan, and Federico Cingano. 2014. "Public Policy and Resource Allocation: Evidence from Firms in OECD Countries." *Economic Policy* 29 (78): 253–96.

Aparicio-Fenoll, Ainhoa. 2015. "The Effect of Product Market Competition on Job Security." *Labour Economics* 35 (August): 145–59.

Arrfelt, Mathias, Robert M. Wiseman, and G. Tomas M. Hult. 2013. "Looking Backward Instead of Forward: Aspiration-Driven Influences on the Efficiency of the Capital Allocation Process." *Academy of Management Journal* 56 (4): 1081–1103.

Babar, Md., and Ahsan Habib. 2021. "Product Market Competition in Accounting, Finance, and Corporate Governance: A Review of the Literature." *International Review of Financial Analysis* 73 (January): 101607.

Bassanini, Andrea, Luca Nunziata, and Danielle Venn. 2009. "Job Protection Legislation and Productivity Growth in OECD Countries." *Economic Policy* 24 (58): 349–402.

Belo, Frederico, Jun Li, Xiaoji Lin, and Xiaofei Zhao. 2017. "Labor-Force Heterogeneity and Asset Prices: The Importance of Skilled Labor." *The Review of Financial Studies* 30 (10): 3669–3709.

Bena, Jan, Hernán Ortiz-Molina, and Elena Simintzi. 2022. "Shielding Firm Value: Employment Protection and Process Innovation." *Journal of Financial Economics* 146 (2): 637–64.

Benmelech, Efraim, Nittai K. Bergman, and Amit Seru. 2011. "Financing Labor." Working Paper. *Working Paper Series. National Bureau of Economic Research*.

Brown, Jennifer, and David A. Matsa. 2012. "Boarding a Sinking Ship? An Investigation of Job Applications to Distressed Firms," *National Bureau of Economic Research*, July.

Chang, Kiyoung, Young Sang Kim, Ying Li, and Jong Chool Park. 2022. "Labor Unions and Real Earnings Management." *Journal of Corporate Finance* 75 (August): 102242.

Chen, Huafeng Jason, Marcin Kacperczyk, and Hernán Ortiz-Molina. 2011. "Labor Unions, Operating Flexibility, and the Cost of Equity." *Journal of Financial and Quantitative Analysis* 46 (1): 25–58.

Desai, Mihir A., Alexander Dyck, and Luigi Zingales. 2007. "Theft and Taxes." *Journal of Financial Economics* 84 (3): 591–623.

Epstein, Neil, and Jay Shapiro. 2017. "Employment and firm heterogeneity, capital allocation, and countercyclical labor market policies." *Journal of Development Economics* 127: 25-14.

Ersahin, Nuri, Rustom M Irani, and Katherine Waldock. 2021. "Can Strong Creditors Inhibit Entrepreneurial Activity?" *The Review of Financial Studies* 34 (4): 1661–98.

Faccio, Mara, Maria-Teresa Marchica, and Roberto Mura. 2016. "CEO Gender, Corporate Risk-Taking, and the Efficiency of Capital Allocation." *Journal of Corporate Finance* 39 (August): 193–209.

Faulkender, M., M. Flannery, K. Hankins, K., and Smith, J. 2012. "Cash flows and leverage adjustments." *Journal of Financial Economics*, 103, 632–646.

Ghaly, Mohamed, Viet Anh Dang, and Konstantinos Stathopoulos. 2017. "Cash Holdings and Labor Heterogeneity: The Role of Skilled Labor." *The Review of Financial Studies* 30 (10): 3636–68.

Grullon, G., and Michaley, R. 2004. "The Information Content of Share Repurchase Programs." *Journal of Finance*, 59(2): 651-680.

Guadalupe, Maria. 2007. "Product Market Competition, Returns to Skill, and Wage Inequality." *Journal of Labor Economics* 25 (3): 439–74.

Hamermesh, Daniel S. 2002. "International Labor Economics." *Journal of Labor Economics* 20 (4): 709–32.

Harford, Jarrad, Sandy Klasa, and William F. Maxwell. 2014. "Refinancing Risk and Cash Holdings." *The Journal of Finance* 69 (3): 975–1012.

Hoberg, Gerard, Gordon Phillips, and Nagpurnanand Prabhala. 2014. "Product Market Threats, Payouts, and Financial Flexibility." *The Journal of Finance* 69 (1): 293–324.

Jensen, Michael C. 1986. "Agency Costs of Free Cash Flow, Corporate Finance, and Takeovers." *The American Economic Review* 76 (2): 323–29.

Jiang, Zhan, and Erik Lie. 2016. "Cash Holding Adjustments and Managerial Entrenchment." *Journal of Corporate Finance* 36 (February): 190–205.

Lee, David S., and Alexandre Mas. 2012. "Long-Run Impacts of Unions on Firms: New Evidence from Financial Markets, 1961–1999." *The Quarterly Journal of Economics* 127 (1): 333–78.

Mamatzakis, Emmanuel, Mike G. Tsionas, Subal C. Kumbhakar, and Anastasia Koutsomanoli-Filippaki. 2015. "Does Labour Regulation Affect Technical and Allocative Efficiency? Evidence from the Banking Industry." *Journal of Banking & Finance, Global Trends in Banking, Regulations, and Financial Markets*, 61 (December): S84–98.

Manzon Jr, G., and G. Plesko. 2002. "The Relation Between Financial and Tax Reporting Measures of Income." *Tax Law Review*, 55, 175-214.

Mincer, Jacob. 1966. "Labor Force Participation and Unemployment: A Review of Recent Evidence." In R.A. Gordon and M.S. Gordon, eds., *Prosperity and Unemploymen*t, New York: Wiley, 73-112.

Mortal, Sandra, and Natalia Reisel. 2013. "Capital Allocation by Public and Private Firms." *Journal of Financial and Quantitative Analysis* 48 (1): 77–103.

Nguyen, Justin Hung. 2022. "How Do Labor Adjustment Costs Affect Corporate Tax Planning? Evidence from Labor Skills." *International Review of Financial Analysis* 83 (October): 102293.

Ochoa, Marcelo. 2013. "Volatility, Labor Heterogeneity and Asset Prices." *SSRN Scholarly Paper*. Rochester, NY.

Okudaira, H., M. Takizawa, and K. Tsuru. 2013. "Employment Protection and Productivity: Evidence from Firm-Level Panel Data in Japan." *Applied Economics* 45 (15): 2091–2105.

Opler, T., Pinkowitz, L., Stulz, R., and Williamson, R. 1999. "The determinants and implications of corporate cash holdings." *Journal of Financial Economics* 52 (1999) 3-46.

Qiu, Yue. 2019. "Labor Adjustment Costs and Risk Management." *Journal of Financial and Quantitative Analysis* 54 (3): 1447–68.

Peters, R., and L. Taylor. 2017. "Intangible capital and the investment-q relation." *Journal of Financial Economics* 123:251–72.

Rotemberg, Julio J., and Lawrence H. Summers. 1988. "Labor Hoarding, Inflexible Prices, and Procyclical Productivity." Working Paper. *Working Paper Series. National Bureau of Economic Research*.

Shapiro, Matthew D. 1986. "The Dynamic Demand for Capital and Labor." *The Quarterly Journal of Economic*s 101 (3): 513–42.

Sun, Kevin. 2014. "The Relationship Between Capital Allocation Efficiency and Financial Reporting Quality: International Evidence." *International Journal of Business, Accounting & Finance* 8 (2): 1–11.

Thakor, Anjan V. 1990. "Investment Myopia and the Internal Organization of Capital Allocation Decisions." *Journal of Law, Economics, and Organization* 6: 129.

Wurgler, Jeffrey. 2000. "Financial Markets and the Allocation of Capital." *Journal of Financial Economics, Special Issue on International Corporate Governance*, 58 (1): 187–214.

Xing, Xuejing, John S. Howe, Randy I. Anderson, and Shan Yan. 2017. "Labor Rights, Venture Capital, and Firm Performance." *Financial Management* 46 (1): 129–54.

Appendix 1: Labor Skill levels across industries (1999-2021)

Industry	Labor skill index (LSI)
Full Sample	6383
Least Reliance on Skilled Labor:	
Coal Mining Services	1.137
Restaurants and Other Eating Places	1.482
Laundry, Cleaning, and Garment Services	1.564
Retail Bakeries	1.626
Seafood Product Preparation and Packaging	1.702
Taxi and Limousine Service	1.856
Grocery Stores	1.993
Most Reliance on Skilled Labor:	
Scientific Research and Development Services	3.469
Legal Services	3.415
Management, Scientific, and Technical Consulting Services	3.212
Advertising, Public Relations, and Related Services	3.161
Accounting, Tax Preparation, Bookkeeping, and Payroll Services	3.069
Accounting, Tax Preparation, Bookkeeping, and Payroll Services	3.069
Elementary and Secondary Schools	3.005
Offices of Physicians	2.974
Advertising and Related Services	2.851

Table 1.1 Summary Statistics

Variable	N	Mean	P25	Median	P75	SD
ΔINVT	91,639	0.2050	0.0440	0.1018	0.2213	0.0013
LACs*VAG	91,639	1.1628	0.0000	0.0000	2.3487	1.2340
LACs	91,639	2.3768	2.0660	2.3537	2.7265	0.4971
VAG	91,639	0.4897	0	0	1	0.4999
Cash flow/PPENT	91,639	-3.1958	-0.3273	0.1917	0.6019	21.3419
ln(1+firm age)	91,639	2.1057	1.6094	2.1972	2.6391	0.7092
Leverage	91,639	0.2816	0.0270	0.1984	0.3834	0.4382
Tobin's Q	91,639	2.4238	1.0598	1.4817	2.3684	4.5040
Size: ln(Total Assets in 1998 dollars)	91,639	5.3193	3.6864	5.3660	6.9934	2.3601
R&D/Sale	91,639	0.3144	0	0	0.0857	1.7082
ROA	91,639	-0.0818	-0.0639	0.0470	0.1023	0.5847
Sales growth	91,639	0.2098	-0.0410	0.0635	0.2384	0.7496

Note: this table presents summary statistics for the sample of US firms between 1999 and 2021. Financial firms and utilities are excluded. LACs stand for labor adjustment costs. Value added is equal to earnings before interest and taxes plus the cost of employees. We compute its growth rate as the value added in year t scaled by the value added in year $t - 1$. VAG, value-added growth, is a (0,1) dummy variable that equals one if the growth rate of value added to the firm is greater than one and zero otherwise. Investment associated with a positive VAG implies efficient allocation of capital.

Table 1.2 Correlation Matrix

	ΔINVT	LACs	VAG	Cash flow/net fixed assets	ln(1+firm age)	Leverage	Tobin's Q	Size	R&D/ sale	ROA	Sales growth
ΔINVT	1										
LACs	-0.0083**	1									
VAG	0.1230***	0.001	1								
Cash flow/PPENT	0.0027	-0.0573***	0.1611***	1							
ln(1+firm age)	-0.1650***	0.1483***	0.0016	0.0335***	1						
Leverage	-0.0382***	-0.0108***	0.003	-0.1589***	-0.0109***	1					
Tobin's Q	0.1520***	0.0181***	0.1031***	-0.2289***	-0.0439***	0.2750***	1				
Size	-0.1670***	-0.0071**	0.1117***	0.2446***	0.1538***	-0.0800***	-0.2627***	1			
R&D/Sale	0.0598***	0.1116***	-0.0297***	-0.1905***	-0.0563***	-0.0028	0.1206***	-0.1417***	1		
ROA	-0.0934***	-0.0390***	0.1264***	0.3744***	0.0698***	-0.3542***	-0.5014***	0.4163***	-0.2388***	1	
Sales growth	0.1517***	0.0098***	0.0927***	-0.0550***	-0.1820***	-0.0223***	0.0977***	-0.0742***	0.0450***	-0.0611***	1

Note: this table presents the correlation coefficients among the major variables used in this study. *, **, and *** indicate statistical significance at 10%, 5%, and 1% levels, respectively.

Table 1.3 LAC Effect on Capital Allocation Efficiency (CAE)

The baseline model:

$$\Delta INVT_{i,t} = \beta_0 + \beta_1 (LACs_{i,t} \times VAG_{i,t}) + \beta_2 LACs_{i,t} + \beta_3 VAG_{i,t} + \beta_4 Cashflow_{i,t} + \beta_5 CONTROLs_{i,t-1} + Year_t + \varepsilon_{i,t}$$

	OLS		Across firm	Across Industry
Variables	(1)	(2)	(3)	(4)
LACs*VAG		-0.0224***	-0.0525*	-0.1449*
		(0.000)	(0.091)	(0.099)
LACs		0.0115***	0.0214	0.0680
		(0.001)	(0.113)	(0.131)
VAG		0.1255***	0.2873***	0.3489*
		(0.001)	(0.000)	(0.076)
Cash flow/PPENT	0.0014***	0.0014***	0.0015***	-0.0361**
	(0.000)	(0.000)	(0.000)	(0.050)
ln(1+firm age)	-0.0799***	-0.0784***	-0.0925***	0.0015
	(0.000)	(0.000)	(0.000)	(0.548)
Leverage	-0.0699***	-0.0698***	-0.0796***	-0.1068***
	(0.000)	(0.000)	(0.000)	(0.001)
Tobin's Q	0.0115***	0.0108***	0.0061***	0.0229**
	(0.000)	(0.000)	(0.000)	(0.013)
Size	-0.0219***	-0.0235***	-0.0231***	-0.0083**
	(0.000)	(0.000)	(0.000)	(0.039)
R&D/sale	0.0054***	0.0048***	0.0064**	0.0116
	(0.000)	(0.000)	(0.041)	(0.791)
ROA	-0.0070	-0.0136	-0.0232*	-0.0515
	(0.353)	(0.068)	(0.095)	(0.336)
Sales growth	0.0562***	0.0543***	0.0878***	0.1235***
	(0.000)	(0.000)	(0.000)	(0.005)
Intercept	0.4492***	0.4024***	0.3760***	0.0935
	(0.000)	(0.000)	(0.000)	(0.391)
Year fixed effects	Yes	Yes	No	No
Observations	91,639	91,639	12,338	576
Adjusted R^2	9.79%	10.57%	14.40%	23.47%

Note: this table presents regression results on the relationship between LACs and CAE. P-values are given in parentheses. *, **, and *** indicate statistical significance at 10%, 5%, and 1% levels, respectively.

Table 1.4 LAC Effect on Capital Allocation Efficiency by Industry Characteristics

Variables	High-skill Industries (top 25% of LSI) (1)	Manufacturing Industries (2)	Positive R&D Industries (3)	Young Industries (bottom 25% of firm age) (4)
LACs*VAG	-0.0420*	-0.0259***	-0.0237***	-0.0478***
	(0.060)	(0.000)	(0.003)	(0.003)
LACs	-0.0435***	0.0146***	-0.0022	0.0233**
	(0.002)	(0.003)	(0.673)	(0.025)
VAG	0.1942***	0.1424***	0.1374***	0.2362***
	(0.005)	(0.000)	(0.000)	(0.000)
Cash flow/PPENT	0.0013***	0.0015***	0.0015***	0.0019***
	(0.000)	(0.000)	(0.000)	(0.000)
ln(1+firm age)	-0.0960***	-0.0893***	-0.0936***	-0.2016***
	(0.000)	(0.000)	(0.000)	(0.000)
Leverage	-0.0478***	-0.0626***	-0.0658***	-0.1408***
	(0.000)	(0.000)	(0.000)	(0.000)
Tobin's Q	0.0059***	0.0113***	0.0127***	0.0116***
	(0.000)	(0.000)	(0.000)	(0.000)
Size	-0.0227***	-0.0250***	-0.0280***	-0.0375***
	(0.000)	(0.000)	(0.000)	(0.000)
R&D/sale	0.0030*	0.0039***	0.0047***	0.0114***
	(0.079)	(0.005)	(0.001)	(0.000)
ROA	-0.0343***	-0.0067	0.0028	0.0139
	(0.006)	(0.419)	(0.731)	(0.209)
Sales growth	0.0417***	0.0534***	0.0501***	0.0729***
	(0.000)	(0.000)	(0.000)	(0.000)
Intercept	0.5730***	0.4211***	0.4953***	0.5273***
	(0.000)	(0.000)	(0.000)	(0.000)
Year fixed effects	Yes	Yes	Yes	Yes
Observations	22,917	58,712	45,069	18,199
Adjusted R^2	13.43%	11.05%	13.72%	14.59%

Note: this table presents regression results on the relationship between LACs and CAE by industry characteristics. P-values are given in parentheses. *, **, and *** indicate statistical significance at 10%, 5%, and 1% levels, respectively.

Table 1.5 LAC Effect on Capital Allocation Efficiency Using Propensity-Score-Matched Firms

Variables	Whole Sample (1)	Manufacturing firms (2)	Positive-R&D firms (3)	Zero-R&D firms (4)	Young Firms (bottom 25%) (5)
LACs*VAG	-0.0231***	-0.0266***	-0.0328***	-0.0232***	-0.0465***
	(0.000)	(0.000)	(0.000)	(0.001)	(0.004)
LACs	0.0175***	0.0294***	0.0096*	0.0276***	0.0211**
	(0.000)	(0.000)	(0.075)	(0.000)	(0.032)
VAG	0.0853***	0.0926***	0.0973***	0.0763***	0.1563***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Cash flow/PPENT	0.0014***	0.0015***	0.0015***	0.0012***	0.0019***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ln(1+firm age)	-0.0803***	-0.0886***	-0.0944***	-0.0587***	-0.2069***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Leverage	-0.0665***	-0.0622***	-0.0628***	-0.0675***	-0.1358***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Tobin's Q	0.0107***	0.0113***	0.0129***	0.0073***	0.0114***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Size	-0.0237***	-0.0250***	-0.0278***	-0.0198***	-0.0380***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
R&D/sale	0.0046***	0.0036**	0.0046***	0.0074	0.0107***
	(0.000)	(0.000)	(0.001)	(0.710)	(0.000)
ROA	-0.0136	-0.0068	0.0035	-0.0313**	0.0142
	(0.071)	(0.415)	(0.679)	(0.020)	(0.207)
Sales growth	0.0546***	0.0524***	0.0494***	0.0591***	0.0724***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Intercept	0.4247***	0.4481***	0.4903***	0.3560***	0.5714***

	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	87,861	57,734	43,620	44,195	16,818
Adjusted R^2	10.67%	11.08%	13.73%	7.63%	14.71%

Note: this table presents regression results on the relationship between LACs and CAE using propensity-score-matched firms. P-values are given in parentheses. *, **, and *** indicate statistical significance at 10%, 5%, and 1% levels, respectively.

Table 1.6 The Channel between LACs and Capital Allocation Efficiency

$$\Delta INVT_{i,t} = \beta_0 + \beta_1 (AC_{i,t} \times LACs_{i,t} \times VAG_{i,t}) + \beta_2 LACs_{i,t} + \beta_3 VAG_{i,t} + \beta_4 AC_{i,t} + \beta_5 Cashflow_{i,t} + \beta_6 CONTROLs_{i,t-1} + Year_t + \varepsilon_{i,t}$$

	AC=Excess cash	AC=free cash flow	AC=TAX Avoidance (BTD)	AC=TAX Avoidance (PBTD)	AC=TAX Avoidance (MPBT)
	(1)	(2)	(3)	(4)	(5)
AC*LACs*VAG	-0.0001***	-0.0387***	-0.0206***	-0.0230***	-0.0312**
	(0.000)	(0.000)	(0.001)	(0.000)	(0.035)
AC	0.0001***	-0.0359*	-0.0963***	-0.0950***	-0.0477*
	(0.000)	(0.057)	(0.000)	(0.000)	(0.056)
LACs	0.0033	-0.0023	-0.0014	-0.0055*	0.0012
	(0.274)	(0.416)	(0.612)	(0.089)	(0.707)
VAG	0.0705***	0.0512***	0.0522***	0.0474***	0.0685***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Cash flow/PPENT	0.0013***	0.0015***	0.0017***	0.0017***	0.0014***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ln(1+firm age)	-0.0800***	-0.0754***	-0.0750***	-0.0742***	-0.0749***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Leverage	-0.0768***	-0.0890***	-0.0924***	-0.0887***	-0.0679***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Tobin's Q	0.0180***	0.0136***	0.0125***	0.0115***	0.0104***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Size	-0.0265***	-0.0203***	-0.0201***	-0.0206***	-0.0221***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
R&D/sale	0.0039***	0.0042***	0.0049***	0.0055***	0.0042***
	(0.007)	(0.002)	(0.000)	(0.000)	(0.004)
ROA	-0.0056	0.0555***	0.0775***	0.0783***	-0.0168**
	(0.507)	(0.000)	(0.000)	(0.000)	(0.036)
Sales growth	0.0522***	0.0508***	0.0503***	0.0464***	0.0547***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Intercept	0.5207***	0.4102***	0.4087***	0.4255***	0.4187***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	86,068	89,807	89,885	66,946	78,242
Pseudo R^2	11.88%	10.82%	10.88%	11.33%	10.46%

Note: this table presents regression results examining ineffective monitoring as the channel that relates LACs to negative CAE. AC is agency costs. BTD is book-tax differences. PBTD is permanent book-tax differences. MPBT is the book tax differences measured using the method of

Manzon and Plesko (2002). P-values are given in parentheses. *, **, and *** indicate statistical significance at 10%, 5%, and 1% levels, respectively.

Table 1.7 Control for the Effect of Intangible Capital

Variables	Whole Sample (1)	Zero-R&D (2)	Positive R&D (3)
LACs*VAG	-0.0209***	-0.0189**	-0.0246***
	(0.000)	(0.013)	(0.002)
Intangible Capital	-0.0437***	-0.0748***	-0.0400***
	(0.000)	(0.000)	(0.000)
LACs	0.0129***	0.0253***	-0.0032
	(0.000)	(0.000)	(0.554)
VAG	0.1181***	0.10742***	0.1331***
	(0.000)	(0.000)	(0.000)
Cash flow/PPENT	0.0013***	0.0011***	0.0014***
	(0.000)	(0.000)	(0.000)
ln(1+firm age)	-0.0708***	-0.0512***	-0.0837***
	(0.000)	(0.000)	(0.000)
Leverage	-0.0786***	-0.0668***	-0.0755***
	(0.000)	(0.000)	(0.000)
Tobin's Q	0.0122***	0.0091***	0.0140***
	(0.000)	(0.000)	(0.000)
Size	-0.0268***	-0.0229***	-0.0320***
	(0.000)	(0.000)	(0.000)
R&D/sale	0.0067***	0.0155	0.0052***
	(0.000)	(0.523)	(0.000)
ROA	-0.0304***	-0.0389***	-0.0195*
	(0.001)	(0.009)	(0.0081)
Sales growth	0.0528***	0.0557***	0.0485***
	(0.000)	(0.000)	(0.000)
Intercept	0.4155***	0.3290***	0.5112***
	(0.000)	(0.000)	(0.000)
Year fixed effects	Yes	Yes	Yes
Observations	89,664	45,872	43,784
Adjusted R^2	11.36%	8.37%	14.68%

Note: this table presents regression results on the relationship between LACs and CAE while controlling for the effect of intangible capital. P-values are given in parentheses. *, **, and *** indicate statistical significance at 10%, 5%, and 1% levels, respectively.

Table 1.8 Pre- and Post-Dotcom Crisis (3 years before and after)

	Whole sample		Positive R&D		Zero R&D	
Variables	Pre-dotcom crisis	Post-dotcom crisis	Pre-dotcom crisis	Post-dotcom crisis	Pre-dotcom crisis	Post-dotcom crisis
LACs*VAG	-0.0487***	-0.0023	-0.0615**	0.027	-0.0311	-0.0373
	(0.005)	(0.893)	(0.018)	(0.229)	(0.160)	(0.152)
LACs	-0.0226*	0.0166*	-0.0732***	0.0086	0.0399**	0.0354**
	(0.088)	(0.079)	(0.000)	(0.456)	(0.036)	(0.023)
VAG	0.2212***	0.0800**	0.2596***	0.0245	0.1666***	0.1477***
	(0.000)	(0.029)	(0.000)	(0.609)	(0.001)	(0.009)
Cash flow/PPENT	0.0040***	0.0016***	0.0044***	0.0013***	0.0035***	0.0019***
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)
ln(1+firm age)	-0.1797***	-0.0614***	-0.2275***	-0.0802***	-0.1171***	-0.0372***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Leverage	-0.1257***	-0.0794***	-0.1305***	-0.1091***	-0.1023***	-0.0466**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.021)
Tobin's Q	0.0223***	0.0108***	0.0195***	0.0120***	0.0295***	0.0082**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.021)
Size	-0.0343***	-0.0217***	-0.0420***	-0.0234***	-0.0269***	-0.0206***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
R&D/sale	0.0079	0.003	0.0068	0.0017	-0.1454	0.0452
	(0.102)	(0.265)	(0.160)	(0.540)	(0.188)	(0.335)
ROA	0.0024	0.0193	-0.0025	0.0251	0.0335	0.0127
	(0.891)	(0.127)	(0.913)	90.143)	(0.142)	(0.520)
Sales growth	0.0857***	0.0353***	0.0843***	0.0250***	0.0817***	0.0491***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Intercept	0.6941***	0.3544***	0.9342***	0.4303***	0.3899***	0.2439***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	16,425	16,892	7,799	8,368	8,626	8,522
Adjusted R^2	15.56%	6.84%	19.70%	8.92%	10.28%	5.17%
p-value (F-test of equal coefficient estimates on LACs*VAG)	(0.0587)		(0.0117)		(0.8835)	

Note: this table compares the relationship between LACs and CAE of propensity-score-matched firms over the intervals 3 years before and after the dotcom crisis of 2000. P-values are given in parentheses. *, **, and *** indicate statistical significance at 10%, 5%, and 1% levels, respectively.

Table 1.9 Control for Alternative Explanations

Variables	(1)	(2)	(3)
LACs*VAG	-0.0215***	-0.0280***	-0.0174**
	(0.005)	(0.000)	(0.037)
LACs	-0.0105**	0.0152***	-0.0096*
	(0.020)	(0.000)	(0.052)
VAG	0.1080***	0.1368***	0.0988***
	(0.000)	(0.000)	(0.000)
Industry Concentration	0.7208***		0.8569***
	(0.000)		(0.000)
Product Market fluidity	0.0072***		0.0077***
	(0.000)		(0.000)
Short-term debt		-0.0003***	-0.0003**
		(0.001)	(0.019)
Cash flow/PPENT	0.0019***	0.0014***	0.0020***
	(0.000)	(0.000)	(0.000)
ln(1+firm age)	-0.0659***	-0.0687***	-0.0550***
	(0.000)	(0.000)	(0.000)
Leverage	-0.1013***	-0.0836***	-0.1236***
	(0.000)	(0.000)	(0.000)
Tobin's Q	0.0223***	0.0125***	0.0240***
	(0.000)	(0.000)	(0.000)
Size	-0.0246***	-0.0248***	-0.0251***
	(0.000)	(0.000)	(0.000)
R&D/sale	0.0038	0.0066***	0.0037
	(0.105)	(0.000)	(0.252)
ROA	0.0225*	-0.0203**	0.0081
	(0.075)	(0.032)	(0.630)
Sales growth	0.0522***	0.0550***	0.0413***
	(0.000)	(0.000)	(0.000)
Intercept	0.3274***	0.3878***	0.3129***
	(0.000)	(0.000)	(0.000)
Year fixed effects	Yes	Yes	Yes
Observations	36,348	73,024	28,725
Adjusted R^2	14.63%	10.93%	14.27%

Note: this table presents regression results on the relationship between LACs and CAE while controlling for other possible explanatory variables including product market competition (product market concentration and product market fluidity) and refinancing risk. P-values are given in parentheses. *, **, and *** indicate statistical significance at 10%, 5%, and 1% levels, respectively.

ESSAY 2: LABOR HETEROGENEITY, LABOR ADJUSTMENT COSTS, AND EXTERNALLY FINANCED FIRM GROWTH

I. Introduction

Financing is crucial for firms to ensure smooth business operations and to achieve growth. Without adequate access to financing, a business's sustainability becomes jeopardized, and the firm's growth potential is put at risk. An important decision regarding financing is the choice between using internal and external funds to finance growth. Earlier studies based on asymmetric information arguments emphasize the preference for internal over external sources of funds (Myers and Majluf, 1984). Some recent research suggests that the choice between internal and external funds is influenced by firm characteristics, such as managerial optimism (Heaton, 2005), financial constraints (Almeida and Campello, 2010), profitability (Rajan and Zingales, 1995; Frank and Goyal, 2009), the trade-off between firm autonomy and the cost of capital (Boot et al., 2006), managerial social capital (Javakhadze et al., 2016), national culture (Boubakri and Saffar, 2016), and the nature of cash needs (Huang and Ritter, 2021), among others.

In this study, we contribute to the literature by proposing that the choice between internal and external financing for funding firm growth is affected by labor heterogeneity. Labor heterogeneity refers to firms' varying levels of reliance on skilled labor. Because skilled workers entail higher hiring and firing expenses, firms tend to retain skilled workers in the face of high labor adjustment costs (LACs). This retention of skilled workers imposes inflexibility on business operations and affects firms' financial decisions. For instance, Ghaly et al. (2017) demonstrate that firms with high LACs hoard cash for precautionary purposes because labor inflexibility slows down the firms' ability to respond to changes in the business environment promptly. Nguyen and

Qiu (2022) observe that firms that rely more on skilled workers exhibit higher levels of cash flow volatility. Building upon the results of prior studies, we argue that LACs reduce internal funds for firm growth since firms with high LACs tend to hoard cash for precautionary needs. Additionally, LACs render the firm inflexible, undermining the optimal deployment of resources, which in turn affects firm productivity and profitability. The lower supply of internal funds for investment due to cash hoarding and the reduced profitability of firms with high LACs motivate the firms to seek financing from external sources. Therefore, our first hypothesis posits that LACs are positively related to externally financed growth. We further contend that when external financing becomes essential, equity is the preferred choice for firms with high LACs. This preference arises because firms with high LACs suffer higher levels of cash flow volatility as the firms are less flexible in responding to economic changes; equity financing is used when cash flows are riskier (Brown, Fazzari, and Petersen, 2009; Keefe and Yaghoubi, 2016; Grundy and Verwijmeren, 2020). Moreover, LACs elevate the fixed costs and irreversibility of investments; these lead to increases in operating leverage and, consequently, the crowding out of financial leverage (Simintzi, Vig, and Volpin 2015; Serfling 2016). Furthermore, firms with a greater reliance on skilled workers reduce unemployment risks for these employees by lowering leverage levels (Agrawal and Matsa, 2013). Thus, our second hypothesis asserts that equity is the preferred choice of external funds for financing firm growth among firms with high LACs.

Following the methodologies of prior studies (Ghaly et al. 2017; Belo et al., 2017), we devise a labor skill index (LSI) to measure the degree of dependence on skilled labor. Essentially, LSI serves as a proxy for LACs, where a high LSI value implies high LACs. To measure a firm's externally funded growth, we adopt the approach of Boubakri and Saffar (2016) and Demirgüç-Kunt and Maksimovic (1998), constructing three indicator variables: XR_IG represents firm growth financed by external funds, XR_SFG represents firm growth financed by external long-term capital, and XR_SG represents firm growth financed by external equity. We then relate these growth metrics to LACs in examining the relationship between LACs and externally financed firm growth.

Our baseline model results support Hypothesis 1, indicating that LACs are positively related to externally financed firm growth. We find evidence that a one standard deviation increase in LACs increases XR_IG by 7.75%, XR_SFG by 5.58%, and XR_SG by 5.53%, respectively, each relative to their sample means. The dominance of external equity in financing firm growth in the face of LACs is clearly shown in the results. For example, for firms in high skill industries, the results show that the positive association between LACs and external equity financed firm growth (XR_SG) is more than two times larger than the association between LACs and external long-term capital financed firm growth (XR_SFG). Specifically, a one standard deviation increase in LACs increases XR_SG by 21.4% and XR_SFG by 10.2%, respectively, relative to their sample means, for firms in high-skill industries. Similar results are observed for firms in manufacturing industries and high-skill manufacturing industries. The results provide robust support for Hypothesis 2. To address potential endogeneity concerns within the regression analysis, we divide the sample into low- and high-LAC firms and apply the baseline model to propensity-score-matched firms from the two groups; the results remain consistent. We also find evidence suggesting that agency costs serve as the channel between LACs and externally financed growth. Protected skilled workers elevate conflicts between financial and non-financial stakeholders, impeding the firm's ability to fund investment projects, thereby causing firms to require external funds to finance growth (Demirgüç-Kunt and Maksimovic, 1998). Further analysis confirms that the baseline results are robust against variations in access to external financing, internal fund availability, and firm-level cash flow volatility. Lastly, an examination of the different stages of the firm life cycle finds that the link between LACs and externally financed growth is modulated by the firm's growth orientation.

This study contributes to the literature in two ways. First, our results highlight the significance of human capital in affecting the decision to finance of firm growth. Specifically, the results point out that labor heterogeneity and labor adjustment costs require firms to seek external funds to finance firm growth. While prior cross-country investigations find that externally financed firm growth is dependent on formal and informal institutional factors such as financial system maturity, legal system, and national culture, our study adds to the understanding of the determinants of differences in externally financed growth. Second, this investigation is related to the literature on the choice between external and internal funds in financing firm investment. Our study adds to this strand of research by providing evidence that labor market frictions in the form of reliance on skilled workers affect real outcomes such as the financing of firm growth. While our paper is not the first to examine the effect of labor market frictions on firm investment activity, it is the first to show that labor retention impacts externally financed firm growth. Prior evidence suggests that labor retention is positively related to the operating performance of the firm; our investigation adds that the influence of labor retention extends to the financing decisions of the firm.

The remainder of this paper is organized as follows. Section 2 provides a brief review of the related literature and develops the hypotheses. Section 3 describes the major variables and sample. Section 4 presents the main results of the study and discusses the supplementary analyses. Section 5 concludes the paper.

II. Related Literature and Hypothesis Development

In a perfect capital market, firms' financing choices are irrelevant in financing firm growth because external and internal funds are perfect substitutes. However, due to factors like agency costs, asymmetric information, and transaction costs, this is not the case in reality. Although internal funds are often preferred over external funds according to the pecking order theory of Myers and Majluf (1984), the limited supply of internal funds restrains firm growth in most situations (Ayyagari, Demirgüç-Kunt, and Maksimovic, 2008). Fazzari, Hubbard, and Petersen (1988) posit that firms are financially constrained if they have a strong correlation between long-term investment and internal financing. Access to external financing is thus crucial because it removes financial constraints that negatively impact a firm's ability to invest optimally. Rahaman (2011) finds that access to external capital has a significant positive effect on firm growth, and the impact is more pronounced among firms that are financially constrained. In a cross-country investigation, Demirgüç-Kunt and Maksimovic (1998) posit that market imperfections, caused by agency problems and information asymmetries, limit firms' ability to fund investment opportunities, consequently making external financing important for firm growth. They find that the use of external financing is positively related to the development of a country's capital markets.

As internal funds are not unlimited in supply, not seeking external financing can be costly to the firm. In an increasingly competitive global economy, external financing is important for firms to maintain their competitiveness and to continually identify new opportunities that generate revenue streams. If no external financing is obtained in the face of cash shortfalls, firms suffer significant opportunity costs that include the costs of forgoing value-increasing investments, the costs of liquidating assets to raise cash, and the costs of experiencing disruptions to daily operations (Huang and Ritter, 2021). Understanding the determinants of external financing of firm growth is thus an important topic that can provide insights into strategic firm behaviors (Carpenter and Petersen, 2002).

Following Demirgüç-Kunt and Maksimovic (1998), we do not delve into arguments about whether reliance on internal funds implies financial constraints (Fazzari et al., 1988; Kaplan and Zingales, 1995). Instead, we directly identify firms whose internal funds are unable to satisfy investment needs by assessing the excess growth made possible by external financing. We then examine the relationship between the excess growth and LACs.

2.1. LACs and Externally Financed Firm Growth

There are several reasons why LACs increase the use of external financing for firm growth. First, firms with a heavy reliance on skilled labor tend to be less flexible to adjust their labor resources in response to rapid economic changes. Thus, firms with high LACs tend to hoard cash for precautionary needs in the face of cash flow shocks (Ghaly et al., 2017). According to Ghaly et al., a one standard deviation increase in LACs increases cash holdings by 21.2%, compared to the sample mean of 68,057 firm-year observations of US firms between 1999 and 2012. Increases in precautionary cash mean that less cash is available for pursuing firm growth. Thus, firms with high LACs likely need to raise external funds for firm growth.

Second, even if precautionary cash is not a primary concern, firms still need to secure external financing to cover cash shortfalls. In the face of cash shortfalls, 53% of firms in the US raise external financing (Huang and Ritter, 2021). According to the funding-horizon model of Huang and Ritter (2021), firms raise external funds that match the characteristics of their cash shortfalls. For example, firms with long-lived cash needs tend to raise long-term external funds. On average, firms that rely more on skilled labor invest more in intangible assets such as research and development; these assets have long-lived cash needs as they require a longer time to generate positive cash flows. Thus, firms with high LACs are motivated to raise long-term external funds to meet their long-lived cash needs. That is, seeking for external funds may be a financing decision for meeting the future cash needs of high-LAC firms rather than cash hoarding.

Third, high LACs imply that labor resources cannot be changed or replaced quickly in response to rapid economic changes. The inflexibility associated with labor heterogeneity suggests that resources can be stuck in suboptimal investment projects, and firm productivity and profitability suffer consequently. Bassanini et al. (2009) find evidence that labor inflexibility is associated with declines in the productivity of firms in OCED countries. Okudaira et al. (2013) report that labor inflexibility hinders effective allocations of capital among firms in Japan. Andrew and Cingano (2014) find evidence suggesting that firms with high LACs retain workers to the extent that their marginal costs exceed productivity. Lower productivity implies reduced profitability and, consequently, a lower supply of internal funds. External funds are thus needed to finance firm growth.

Based on the above discussion, we stipulate our first hypothesis as follows:

H1: LACs and externally financed firm growth are positively related.

2.2. LACs and External Equity

Several reasons motivate us to argue that firms with high LACs prefer using external equity to finance their growth. First, firms burdened by high LACs often face labor inflexibility, diminishing their ability to adapt to economic changes; thus, they are more exposed to cash flow shocks and are prone to experiencing higher levels of cash flow volatility (Nguyen and Qiu, 2022). Cash flow volatility is a major concern for firm managers because low cash flows may disrupt the functioning of budgets, postpone capital expenditure, or interrupt debt repayments. Thus, high cash flow volatility is undesirable for firms. In essence, volatile cash flows imply higher firm risk. There is evidence that riskier cash flows are associated with equity financing, as lenders do not want to extend credit when repayments are uncertain (Keefe and Yaghoubi, 2016; Friend and Lang, 1988).

Second, LACs impose fixed costs on the firm as skilled workers are protected and become an inflexible input. Following the rise of fixed costs, this condition escalates operating leverage and consequently displaces financial leverage. Prior studies show that labor protection increases operating leverage and crowds out the financial leverage of the firm (Simintzi, Vig, and Volpin 2015; Serfling 2016). According to Serfling (2016), labor protection crowds out financial leverage via increases in financial distress costs. These studies imply that external equity is required for financing firm growth of firms with high LACs. In addition, as LACs become fixed costs, the irreversibility of investment increases. Researchers have long argued that firms are reluctant to invest in projects that have high irreversibility (Bernanke, 1983; Pindyck, 1990; Dixit & Pindyck, 1994). Equity financing can mitigate this reluctance by reducing the pressure to underinvest (Mayers and Smith, 1987).

Third, unemployment is a significant risk faced by workers as the cost burden of being unemployed is substantial. Human capital is frequently firm-specific; thus, skilled workers are exposed to significant unemployment risk (Lazear, 2009; Coff and Raffiee, 2015). There is evidence that workers reduce labor supply to firms that have high unemployment risk (Mincer, 1976; Brown and Matsa, 2012). Consequently, firms that rely more on skilled workers are motivated to mitigate the unemployment risk faced by the workers. One strategy is to reduce firm bankruptcy risk by lowering firm leverage. Agrawal and Matsa (2013) find that the conservative firm leverage associated with employee protection has a positive effect on firm value, and the effect is more pronounced for firms in industries that have higher labor turnover ratios. The inclination of firms to employ less debt financing in providing protection to employees implies that firms with high LACs are obliged to use equity for financing firm growth.

Fourth, firms that rely more on skilled labor invest more in intangible assets such as research and development. Intangible assets are frequently long-term investments that do not generate quick payoffs. These assets tend to have a lower pledgeable value and are thus not useful in securing long-term debt financing (Frank and Sanati, 2021; Huang and Ritter, 2021). As a result, for firms with high LACs, the viable external financing choice is equity. Frank and Sanati (2021) find evidence showing that, in general, firms issue equity first, use the fund to acquire real assets, then use the real assets as pledges to issue debt while buying back equity. Their view supports our conjecture that firms with high LACs rely more on equity for financing growth.

Based on the above discussion, our second hypothesis is:

H2: Equity is the preferred choice of external funds for financing firm growth among firms that have high LACs.

III. Major Variables

3.1. Externally Financed Growth

In alignment with the financial planning model employed in prior studies (Demirgüç-Kunt and Maksimovic, 1998; Boubakri and Saffar 2016), we use three indicator variables to measure firm growth financed by external funds. The model presupposes that the requisite investment increase is directly proportional to the firm's sales growth. We start by assuming three potential scenarios for firm growth. First, firm growth is expected to rely solely on internal funds. Second, firm growth is financed by internal funds and short-term debt. Third, firm growth is financed by internal funds and short-term and long-term debts.

First, we compute a firm's external financing need (EFN) using the equation below:

$$EFN_{i,t} = Asset_{i,t} \times Sales\ growth_{i,t} - Earnings_{i,t} \times b_{i,t} \times (1 + Sales\ growth_{i,t})$$

(1)

$EFN_{i,t}$: Firm *i's* external financing need in year *t*.

$Asset_{i,t}$: Firm *i*'s book assets in year *t*.

$Sales\ growth_{i,t}$: Firm *i*'s inflation-adjusted (in 1998 dollars) sales growth rate in year *t*.

$Earnings_{i,t}$: Firm *i*'s earnings after interest and tax in year *t*.

$b_{i,t}$: Firm *i*'s plowback ratio in year *t*.

A firm's maximum internally financed growth rate (IG), if the firm has retained 100% of earnings ($b_{i,t}$=1) and there is no external financing ($EFN_{i,t} = 0$), is computed as:

$$IG_{i,t} = \frac{ROA_{i,t}}{1 - ROA_{i,t}}$$

Thus, inflation-adjusted sales growth minus IG is firm growth financed by external funds. XR_IG is a (0,1) dummy variable that equals 1 if inflation-adjusted sales growth is greater than the internal growth rate (IG), and 0 otherwise. That is, XR_IG equals 1 if firm growth is financed by external funds.

Next, a firm's maximum short-term debt financed growth rate (SFG), assuming the firm is financed by internal funds and short-term debt, is computed as:

$$SFG_{i,t} = \frac{ROLTC_{i,t}}{1 - ROLTC_{i,t}}$$

where $ROLTC = \frac{EBIT - interest\ (XINT) - tax(TXT)}{Total\ Assets\ (AT) \times [1 - \frac{Total\ debt(DT) - long-term\ debt\ (DLTT)}{AT}]}$

The estimate of SFG is obtained by setting b = 1 and by using the value of assets that are not financed by new short-term credit in place of total assets in the EFN equation above. Inflation-adjusted sales growth minus SFG is, thus, firm growth financed by external long-term capital (Demirgüç-Kunt and Maksimovic, 2002). XR_SFG is a (0,1) dummy variable that has a value of 1 if inflation-adjusted sales growth is larger than SFG, and 0 otherwise. If XR_SFG is 1, it means the firm grows faster than its maximum growth rate achievable by internal funds and short-term funds, indicating that the firm has access to external long-term financing.

Lastly, a firm's maximum sustainable growth rate (SG), if the firm is financed by both internal funds and corporate borrowing (short-term and long-term debts), is computed as:

$$SG_{i,t} = \frac{ROE_{i,t}}{1 - ROE_{i,t}}$$

Inflation-adjusted sales growth minus SG is, therefore, firm growth financed by external equity. XR_SG is a (0,1) dummy variable that has a value of 1 if inflation-adjusted sales growth is larger than SG, and 0 otherwise. If XR_SG is 1, it means the firm grows faster than its maximum growth rate achievable by long-term and short-term debt, implying that the firm has access to external equity.

3.2. Labor Skill Index

We measure a firm's dependence on skilled labor by creating an industry-specific labor skill index (LSI) (Ghaly et al., 2017; Belo et al., 2017). We collect Occupational Employment

Statistics (OES) from the website of the U.S. Bureau of Labor Statistics (BLS; https://www.bls.gov/). Additionally, we get job-zone (occupational) skill level classification from the O*NET program (https://www.onetonline.org/). 4-digit codes of the North American Industry Classification System (NAICS) are used in assigning firms to the relevant industry. Because NAICS codes are not available before 2001, we use 3-digit Standard Industrial Classification (SIC) codes for the interval between 1999 and 2000.

Then, we construct the LSI scores following Ghaly et al., (2017).

$$LSI_{it} = \sum_{j=1}^{0} \left(\frac{E_{jit}}{E_{it}} \times Z_{jt}\right)$$

E_{jit} indicates the employee numbers at *j* occupation of industry *i* in year t

E_{it} implies the total employee numbers in an industry *i* in year t

Z_{jt} refers job zone scores based on the skill level of job occupations by the analyst of the US Department of Labor. Job zone scores are in the range of 1 to 5. The higher score job implicates a higher skill level.

In sum, LSI is an index that captures the occupations' skill levels in an industry. A high LSI indicates a high share of skilled occupations in the industry and proxies for elevated LACs.

3.3. Sample

Our sample includes all firm-year observations included in the Compustat North America dataset between 1999 and 2022. We exclude financial firms (SIC codes between 6000 and 6999) and utility firms (SIC codes between 4900 and 4999). All continuous variables are winsorized at the 1% and 99% percentiles to mitigate potential problems associated with outliers. The final sample has 15,815 firms, totaling 118,290 firm-year observations. Descriptive statistics, including the mean, standard deviation, 25th, 50th, and 75th percentiles, are reported in Table 1. Our major variables have statistics comparable to prior studies. For example, XR_SFG has a mean, median, and standard deviation of 0.60, 1, and 0.49, respectively; they are comparable to the values reported by Demirgüç-Kunt and Maksimovic (1998) and Boubakri and Saffar (2016).

[Insert Table 2.1 here]

IV. Results

4.1. Baseline Regression Results

We modify the models used in previous studies ((Demirgüç-Kunt and Maksimovic, 1998; Boubakri and Saffar, 2016) to investigate the relationship between externally financed growth and LACs. Our baseline model is as follows:

$$\text{Externally financed growth}_{i,t} = \beta_0 + \beta_1 \text{LACs}_{i,t} + \beta_2 \text{Controls}_{i,t} + \text{Year}_t + \varepsilon_{i,t} \quad (2)$$

where externally financed growth is measured by XR_IG, XR_SFG, and XR_SG, respectively. Following Boubakri and Saffar (2016), control variables include the ratio of net fixed assets to total assets (NFA=PPENT/AT), leverage (LEVERAGE=(DLTT+DLC)/AT), size (SIZE= ln (AT)), profitability (PROFIT=ln((EBIT/AT) +1)), and firm age (ln(age+1)). Book assets are inflation-adjusted. All the firm variables are obtained from the COMPUSTAT North America dataset. Missing values are set to zero.

The probit regression results using Equation (2) are presented in Table 2. The coefficients of LACs are positive and significant at the one percent level across all models. That is, LACs increase the probability of relying on external funds for firm growth. The results support the prediction of Hypothesis 1. In Model (1), a one standard deviation increase in LACs increases externally financed firm growth (XR_IG) by 8.17%, relative to the sample mean. When firm-specific time-series means of firm variables are used in a cross-sectional regression in Model (4), the results show that a one standard deviation increase in LACs increases XR_IG by 34.18%. This result implies a strong cross-sectional relation between LACs and externally financed firm growth. In Models (2) and (3), the results show that a one standard deviation increase in LACs increases XR_SFG by 6.33% and XR_SG by 5.39%, respectively, compared to their sample means. That is, equity represents a considerable portion of the firm growth financed by external funds in the face of LACs. The results are consistent with the prediction of Hypothesis 2. In Models (5) and (6), when firm-specific time-series means of firm variables are used in regression, the results show that a one standard deviation increase in LACs increases XR_SFG by 32.61% and XR_SG by 29.02%, respectively. The results of Models (5) and (6) confirm that external equity plays a significant role in financing firm growth as LACs increase. Note that when we measure all the control variables in time period t-1, the results remain similar and consistent.

[Insert Table 2.2 here]

4.2. Subsamples of Industries with Similar Characteristics

The results presented in Table 2 are based on the whole sample. The mean LSI for the whole sample is 2.4067 and it applies to the rail transportation industry. To highlight the effect of LACs on firms that rely more on skilled labor, we focus on high-skill, manufacturing, and high-skill manufacturing industries and present the regression results in Table 3.

As shown in Table 3, for firms in high-skill industries, the coefficients of LACs are positive and significant at the one percent level across all models. The economic impact of LACs on externally financed firm growth is considerable. For firms in high-skill industries, a one standard deviation increase in LACs increases XR_IG by 15.38%, XR_SFG by 12.21%, and XR_SG by 20.88%, respectively, relative to their sample means. For firms in high-skill manufacturing industries, the results of Models (7)- (9) show that a one standard deviation increase in LACs increases XR_IG by 46.49%, XR_SFG by 39.35%, and XR_SG by 46.09%, respectively. Similar to the result in Table 2, external equity funds play an important role in financing the growth of firms affected by high LACs.

[Insert Table 2.3 here]

4.3. Control for Endogeneity Issues Using Propensity-Score-Matched Firms

To mitigate potential endogeneity issues that arise from differences in firm and industry characteristics, our analysis differentiates the sample into two distinct groups: a treatment group comprising firms with an above-median labor skilled index (LSI) and a control group consisting of firms with a below-median LSI. We then match the two groups by year, industry (2-digit SIC codes), and all control variables in the baseline model. This propensity score matching is applied to the whole sample, high-skill industries, manufacturing industries, high-skill manufacturing industries, positive-R&D firms, and zero-R&D firms, respectively. Then, we apply the baseline probit regression to the propensity-score-matched firms.

In Panel A of Table 4, we report the differences in externally financed growth between firms with above-median LSI and firms with below-median LSI. We expect firms with higher LSIs to have significantly higher levels of externally financed growth. The results for the whole sample and across all the propensity-score-matched subsamples support our expectations and are consistent with those reported in Tables 2 and 3. Specifically, in Panel A of Table 4, the results show that firms with above-median LACs have significantly larger XR_IG, XR_SFG, and XR_SG compared to firms with below-median LACs for the whole sample and across all the subsamples. The results in Panel A also indicate that equity is an important source of financing for externally financed growth. Using the whole sample to illustrate, XR_SFG is associated with 0.6158 of the externally financed growth of firms with high LACs, but XR_SG is associated with 0.5142 of the externally financed growth of firms with high LACs; thus, equity finances a large portion of the externally financed growth of the firms. Similar observations can be made for other subsamples in Panel A.

In Panel B of Table 4, we report the results of the probit model in equation (2) applied to the propensity-score-matched firms. The coefficients of LACs are positive and significant at the one percent or five percent levels in Panel B for the whole sample and across all the subsamples. The results, being consistent with those reported in Tables 2 and 3, imply that the baseline regression results are not affected by endogeneity issues associated with firm or industry characteristics. In addition, it can be observed in Panel B that the coefficient on LACs is frequently higher when XR_SG is the dependent variable compared to when XR_SFG is the dependent variable; the observation implies that the reliance on external equity is more pronounced in financing firm growth when LACs increase. The results in Table 4 support the predictions of Hypotheses 1 and 2.

[Insert Table 2.4 here]

4.4. Agency Costs as the Channel between LACs and Externally Financed Growth

Protected skilled workers elevate conflicts with other stakeholders of the firm and accentuate agency problems faced by the company. Prior research indicates that unionization can negatively impact firm value (Clark, 1984; Hirsch, 1991). However, the effect of agency problems on the relationship between LACs and externally financed growth may be two-sided. On the one hand, agency costs increase, squandering resources for private benefits and, therefore, causing firms to need more external resources to finance growth. Consistent with this view, Demirgüç-Kunt and Maksimovic (1998) posit that agency problems hinder the ability of firms to fund investment opportunities, consequently making external financing important for firm growth. On the other hand, agency problems may weaken a firm's willingness to seek growth if the CEO is more interested in enjoying a quiet life (Bertrand and Mullainathan, 2003).

To examine the role of agency problems in the relationship between LACs and externally financed growth, we add agency costs and agency costs*LACs as two additional independent variables to the baseline probit model. We proxy agency costs by free cash flow. The proxy is commonly used in the literature as an indicator of possible agency problems, as free cash flow encourages managers to promote private benefits.

Table 5 reports the results of the analysis on the role of agency costs in the relationship between LACs and externally financed growth. Our variable of interest is the interaction variable LACs*agency costs. For the whole sample, the coefficients of LACs*agency costs remain positive and significant at the one percent level across all models. The results are consistent with the view of Demirgüç-Kunt and Maksimovic (1998) that agency problems heighten the need for external financing for firm growth. The positive coefficients of LACs*agency costs imply that agency costs increase the sensitivity of externally financed growth to LACs. To illustrate, in the model (1), where XR_IG is the dependent variable, agency costs increase the sensitivity of XR_IG to LACs by 69% (0.0628/0.0911 =0.6894). Similar observations can be made in models (2) and (3). Positive and significant coefficients of LACs*agency costs are also observed in the three subsamples (manufacturing industries, high-skill industries, and high-skill manufacturing industries) in Table 5. The results in Table 5 suggest that agency problems induced by labor heterogeneity impede firms' ability to fund investment opportunities, thus requiring firms to seek external financing for growth.

[Insert Table 2.5 here]

4.5. Additional Analysis

4.5.1. Control for Access To External Finance

In the literature, access to external finance has been linked to firm growth (Beck and Demirgüç-Kunt, 2006; Rahaman, 2011). According to Rahaman (2011), firms rely less on internal funds and switch to external financing as the primary source of financing for their growth when external financing constraints are moderated. Similarly, Beck and Demirgüç-Kunt (2006) report that access to external finance enables small and medium-sized enterprises in developing and developed economies to have more significant growth. Consequently, the positive relationship between LACs and externally financed growth may be confounded by a firm's access to external finance. To rule out this potential confounding effect, we add access to external finance as an additional control variable in the probit model and re-examine the relationship between LACs and externally financed growth. We proxy access to external finance by the firm's bond rating. Access to finance is a (0,1) dummy variable that has a value of 1 if a bond rating exists and zero otherwise. In cases where the bond rating is unavailable, we employ Standard & Poor's long-term issuer credit rating as an alternative indicator.

Results of the probit model with access to external finance added as an additional control variable are reported in Table 6. As observed in Table 6, the coefficients of LACs remain positive and significant at the one percent level across all three models. That is, access to external finance does not affect the positive relationship between LACs and externally financed growth observed in the baseline model.

[Insert Table 2.6 here]

4.5.2. Control for the Availability of Internal Funds

Firms that have a lot of internal funds may not need to rely heavily on external funds to finance growth. In addition, internal funds mitigate the effect of financial constraints on firm growth. Traditional models based on asymmetric information arguments posit that firms prefer internal funds over external funds in financing decisions (Myers and Majluf, 1984). Thus, the availability of internal funds may dampen the relationship between LACs and externally financed growth. To validate the baseline results of a positive relationship between LACs and externally financed firm growth, we add internal funds as an additional control variable in the probit model. Following Rahaman (2021), we measure internal funds by the change in the logarithmic value of owner's equity. The results are documented in Table 7. It can be observed in Table 7 that the coefficients of LACs remain positive and significant at the one percent level across all three models. The results validate the finding in the baseline model of a positive relationship between LACs and externally financed growth. That is, the availability of internal funds does not influence the impact of LACs on externally financed growth.

[Insert Table 2.7 here]

4.5.3. Control for Cash Flow Volatility

Firms that rely more on skilled workers are less flexible in responding to external shocks; thus, firms with high LACs experience higher levels of cash flow volatility (Ghaly et al., 2017; Nguyen and Qiu, 2022). Nguyen and Qiu (2022) find that firms that rely more on skilled workers have lower dividend payouts as LACs heighten cash flow volatility. Accordingly, firms with high LACs may be less enthusiastic in seeking growth in the face of the elevated cash flow volatility. To ascertain that our baseline result on the positive relationship between LACs and externally financed growth is not affected by concerns of cash flow volatility, we control for firm-level cash flow volatility in the probit model and re-examine the relationship.

Table 8 reports the results of the probit model with cash flow volatility added as an additional control variable. As shown in Table 8, the coefficients of LACs remain positive and significant at the one percent level for the whole sample across all three models. That is, cash flow volatility does not dampen the positive relationship between LACs and externally financed growth. The positive and significant coefficients of cash flow volatility imply that firm-level cash flow volatility encourages firms to seek external funds to finance growth. Consistent with the finding, Minton and Schrand (1999) document that cash flow volatility increases the likelihood that a firm will need to access capital markets in making investment decisions.

Riskier investment projects are more likely to be axed relative to other investment opportunities when a firm faces uncertain cash flows (Beladi, Deng, and Hu, 2021). Hence, we re-examine the relationship between LACs and externally financed growth by focusing on firms that have positive R&D expenditures. We report the probit regression results in the right panel of Table 8. The coefficients of LACs remain positive and significant at the one percent level across all three models for firms with positive R&D expenses despite cash flow volatility being added as an additional control variable. In short, cash flow volatility does not affect the fundamental findings of a positive relationship between LACs and externally financed growth.

[Insert Table 2.8 here]

4.5.4. The Role of the Firm Life Cycle

A firm experiences different levels of growth during its life cycle. Younger firms are typically more growth-oriented, whereas older and mature firms are less likely to seek growth. When firms are eager to grow, they are inclined to seek external financing to maximize firm growth. Consequently, the relationship between LACs and externally financed growth may be influenced by the firm life cycle. To assess the influence of the firm life cycle on the relationship between LACs and externally financed growth, we divide the sampled firms into subsamples according to their respective stages of life cycle and apply the baseline probit model to firms in each subsample. We adopt Dickinson's (2011) widely used classification method to identify four stages of a firm's life cycle: introduction, growth, maturity, and decline. This classification methodology relies on the following cash flow pattern:

1. Introduction: OANCF<0, IVNCF<0 and FINCF>0,
2. Growth: OANCF>0, IVNCF<0 and FINCF>0,
3. Mature: OANCF>0, IVNCF<0 and FINCF<0,
4. Decline: OANCF<0, IVNCF>0 and FINCF ≤ or ≥ 0,

where OANCF, IVNCF, and FINCF represent cash flow from operations, cash flow from investment activities, and cash flow from finance activities, respectively.

Results of the influence of the firm life cycle on the relationship between LACs and externally financed growth are reported in Table 9. It is observed in Table 9 that when firms are in the introduction stage of their life cycles, LACs reduce externally financed growth. The coefficients LACs are negative and significant at the one percent level in models (1) – (3). The results imply that the effect of the firm life cycle dominates and turns the effect of LACs on external finance growth negative. During the growth and mature stages of the firm life cycle, LACs have a positive and significant relationship with externally financed growth. When firms are in the declining stage of the firm life cycle, LACs have no significant effect on externally financed growth. The results in Table 9 highlight the significance of the firm's growth orientation in influencing the relationship between LACs and externally financed growth.

[Insert Table 2.9 here]

V. Conclusion

Growth enables firms to overcome competition and enhance their performance results. The traditional view is that firm growth is limited by the size of internal resources and the firm's access to external finance. However, this study reveals that human capital is a critical factor in financing growth decisions. Specifically, the results of this investigation find that labor heterogeneity and labor adjustment costs require firms to seek external funds to finance firm growth. We attribute this observation to the inflexibility imposed by labor adjustment costs on firms' abilities to redeploy assets rapidly in response to economic fluctuations. Furthermore, the results also provide evidence that equity financing is the more important source of external funds for firms to finance growth in the face of labor adjustment costs. Our results remain unchanged after a battery of robustness tests and controlling for potential endogeneity issues that may arise from industry or firm characteristics. The retention of skilled workers may elevate conflicts between financial and non-financial stakeholders of the firm. We find evidence suggesting that agency costs associated with reliance on skilled labor serve as the channel between labor adjustment costs and externally financed growth. Additional analyses show that the core findings of the study are not affected by access to external finance, availability of internal funds, and firm cash flow volatility. This investigation is the first to show that labor market frictions in the form of reliance on skilled labor produce significant impacts on the decision to finance growth.

REFERENCES

Agrawal, Ashwini K., and David A. Matsa. 2013. "Labor Unemployment Risk and Corporate Financing Decisions." *Journal of Financial Economics* 108 (2): 449–70.

Almeida, Heitor, and Murillo Campello. 2010. "Financing Frictions and the Substitution between Internal and External Funds." *Journal of Financial and Quantitative Analysis* 45 (3): 589–622.

Andrews, Dan, and Federico Cingano. 2014. "Public Policy and Resource Allocation: Evidence from Firms in Oecd Countries." *Economic Policy* 29 (78): 253–96.

Ayyagari, M., Demirgüç-Kunt, A. and Maksimovic, V., 2008. "How well do institutional theories explain firms' perceptions of property rights?" *The review of financial studies*, *21*(4), pp.1833-1871.

Bassanini, Andrea, Luca Nunziata, and Danielle Venn. 2009. "Job Protection Legislation and Productivity Growth in OECD Countries." *Economic Policy* 24 (58): 349–402.

Beck, Thorsten, and Asli Demirgüç-Kunt. 2006. "Small and Medium-Size Enterprises: Access to Finance as a Growth Constraint." *Journal of Banking & Finance* 30 (11): 2931–43.

Beladi, Hamid, Jie Deng, and May Hu. 2021. "Cash Flow Uncertainty, Financial Constraints and R&D Investment." *International Review of Financial Analysis* 76 (July): 101785.

Belo, Frederico, Jun Li, Xiaoji Lin, and Xiaofei Zhao. 2017. "Labor-Force Heterogeneity and Asset Prices: The Importance of Skilled Labor." *The Review of Financial Studies* 30 (10): 3669–3709.

Bernanke, Ben S. 1983. “Irreversibility, Uncertainty, and Cyclical Investment.” *The Quarterly Journal of Economics* 98 (1): 85–106.

Bertrand, Marianne, and Sendhil Mullainathan. 2003. “Enjoying the Quiet Life? Corporate Governance and Managerial Preferences.” *Journal of Political Economy* 111 (5): 1043–75.

Boot, Arnoud W. A., Radhakrishnan Gopalan, and Anjan V. Thakor. 2006. “The Entrepreneur’s Choice between Private and Public Ownership.” *The Journal of Finance* 61 (2): 803–36.

Boubakri, Narjess, and Walid Saffar. 2016. “Culture and Externally Financed Firm Growth.” *Journal of Corporate Finance* 41 (December): 502–20.

Brown, James R., Steven M. Fazzari, and Bruce C. Petersen. 2009. “Financing Innovation and Growth: Cash Flow, External Equity, and the 1990s R&D Boom.” *The Journal of Finance* 64 (1): 151–85.

Brown, Jennifer, and David A. Matsa. 2012. “Boarding a Sinking Ship? An Investigation of Job Applications to Distressed Firms,” July. https://policycommons.net/artifacts/1391542/boarding-a-sinking-ship-an-investigation-of-job-applications-to-distressed-firms/2005807/.

Carpenter, Robert E., and Bruce C. Petersen. 2002. “Capital Market Imperfections, High-Tech Investment, and New Equity Financing.” *The Economic Journal* 112 (477): F54–72.

Clark, Kim B. 1984. “Unionization and Firm Performance: The Impact on Profits, Growth, and Productivity.” *The American Economic Review* 74 (5): 893–919.

Coff, Russell, and Joseph Raffiee. 2015. "Toward a Theory of Perceived Firm-Specific Human Capital." *Academy of Management Perspectives* 29 (3): 326–41.

Demirgüç-Kunt, Asli, and Vojislav Maksimovic. 1998. "Law, Finance, and Firm Growth." *The Journal of Finance* 53 (6): 2107–37.

Demirgüç-Kunt, Asli, and Vojislav Maksimovic. 2002. "Funding Growth in Bank-Based and Market-Based Financial Systems: Evidence from Firm-Level Data." *Journal of Financial Economics* 65 (3): 337–63.

Dickinson, Victoria. 2011. "Cash Flow Patterns as a Proxy for Firm Life Cycle." *The Accounting Review* 86 (6): 1969–94.

Dixit, Avinash K., and Robert S. Pindyck. 1994. *Investment Under Uncertainty*. Princeton University Press.

Fazzari, Steven, R. Glenn Hubbard, and Bruce Petersen. 1988. "Investment, Financing Decisions, and Tax Policy." *The American Economic Review* 78 (2): 200–205.

Frank, Murray Z., and Vidhan K. Goyal. 2009. "Capital Structure Decisions: Which Factors Are Reliably Important?" *Financial Management* 38 (1): 1–37.

Frank, Murray Z, and Ali Sanati. 2021. "Financing Corporate Growth." *The Review of Financial Studies* 34 (10): 4926–98.

Friend, Irwin, and Larry H. P. Lang. 1988. "An Empirical Test of the Impact of Managerial Self-Interest on Corporate Capital Structure." *The Journal of Finance* 43 (2): 271–81.

Ghaly, Mohamed, Viet Anh Dang, and Konstantinos Stathopoulos. 2017. “Cash Holdings and Labor Heterogeneity: The Role of Skilled Labor.” *The Review of Financial Studies* 30 (10): 3636–68.

Grundy, Bruce D., and Patrick Verwijmeren. 2020. “The External Financing of Investment.” *Journal of Corporate Finance* 65 (December): 101745.

Heaton, J. B. 2005. “Chapter 19. Managerial Optimism and Corporate Finance.” In *Chapter 19. Managerial Optimism and Corporate Finance*, 667–84. Princeton University Press.

Hirsch, Barry. 1991. “Labor Unions and the Economic Performance of Firms.” *Upjohn Press*, January.

Huang, Rongbing, and Jay R Ritter. 2021. “Corporate Cash Shortfalls and Financing Decisions.” *The Review of Financial Studies* 34 (4): 1789–1833.

Javakhadze, David, Stephen P. Ferris, and Dan W. French. 2016. “Social Capital, Investments, and External Financing.” *Journal of Corporate Finance* 37 (April): 38–55.

Kaplan, Steven N., and Luigi Zingales. 1995. “Do Financing Constraints Explain Why Investment Is Correlated with Cash Flow?” Working Paper. Working Paper Series. National Bureau of Economic Research.

Keefe, Michael O’Connor, and Mona Yaghoubi. 2016. “The Influence of Cash Flow Volatility on Capital Structure and the Use of Debt of Different Maturities.” *Journal of Corporate Finance* 38 (June): 18–36.

Lazear, Edward P. 2009. “Firm-Specific Human Capital: A Skill-Weights Approach.” *Journal of Political Economy* 117 (5): 914–40.

Mayers, David, and Clifford W. Smith. 1987. “Corporate Insurance and the Underinvestment Problem.” *The Journal of Risk and Insurance* 54 (1): 45–54.

Mincer, Jacob. 1976. “Unemployment Effects of Minimum Wages.” *Journal of Political Economy* 84 (4, Part 2): S87–104.

Minton, Bernadette A., and Catherine Schrand. 1999. “The Impact of Cash Flow Volatility on Discretionary Investment and the Costs of Debt and Equity Financing.” *Journal of Financial Economics* 54 (3): 423–60.

Myers, Stewart C., and Nicholas S. Majluf. 1984. “Corporate Financing and Investment Decisions When Firms Have Information That Investors Do Not Have.” *Journal of Financial Economics* 13 (2): 187–221.

Nguyen, Justin Hung, and Buhui Qiu. 2022. “The Effect of Skilled Labor Intensity on Corporate Dividend Payouts.” *Journal of Business Finance & Accounting* 49 (5–6): 963–1010.

Okudaira, H., M. Takizawa, and K. Tsuru. 2013. “Employment Protection and Productivity: Evidence from Firm-Level Panel Data in Japan.” *Applied Economics* 45 (15): 2091–2105.

Pindyck, Robert S. 1990. “Irreversibility, Uncertainty, and Investment.” Working Paper. Working Paper Series. National Bureau of Economic Research.

Rahaman, Mohammad M. 2011. “Access to Financing and Firm Growth.” *Journal of Banking & Finance*, Australasian Finance Conference: Global financial crisis, international financial architecture and regulation, 35 (3): 709–23.

Rajan, Raghuram G., and Luigi Zingales. 1995. “What Do We Know about Capital Structure? Some Evidence from International Data.” *The Journal of Finance* 50 (5): 1421–60.

Serfling, Matthew. 2016. “Firing Costs and Capital Structure Decisions.” *The Journal of Finance* 71 (5): 2239–86.

Simintzi, Elena, Vikrant Vig, and Paolo Volpin. 2015. “Labor Protection and Leverage.” *The Review of Financial Studies* 28 (2): 561–91.

Appendix 2: Variable Definitions

IG	A firm's maximum internally financed growth rate
SFG	A firm's maximum growth rate if firm growth is financed by internal funds and short-term debt
SG	A firm's maximum sustainable growth rate, if firm growth is financed by both internal funds and corporate borrowing (short-term and long-term debts)
XR_IG	XR_IG is a (0,1) dummy variable that equals 1 if inflation-adjusted sales growth is greater than the internal growth rate (IG), and 0 otherwise. That is, XR_IG equals 1 if firm growth is financed by external funds.
XR_SFG	XR_SFG is a (0,1) dummy variable that has a value of 1 if inflation-adjusted sales growth is larger than SFG, and 0 otherwise. If XR_SFG is 1, it means the firm grows faster than its maximum growth rate achievable by internal funds and short-term funds, indicating that the firm has access to external long-term financing.
XR_SG	XR_SG is a (0,1) dummy variable that has a value of 1 if inflation-adjusted sales growth is larger than SG, and 0 otherwise. If XR_SFG is 1, it means the firm grows faster than its maximum growth rate achievable by long-term and short-term debt, implying that the firm has access to external equity.
NFA	Net fixed assets. NFA = PPENT/AT
Leverage	Total debt divided by total assets
Firm size	The logarithmic value of total assets at the end of fiscal year
Size	Ln (AT)
Cash flow volatility	The standard deviation of cash flow from operations scaled by average total assets from year t − 5 to t – 1.

Table 2.1 Summary Statistics

Variable	N	Mean	P25	Median	P75	SD
Dependent Variable						
XR_IG	118,290	0.5309	0	1	1	0.4990
XR_SFG	118,290	0.6015	0	1	1	0.4896
XR_SG	118,290	0.4908	0	0	1	0.4999
Interest Variables						
LACs(t)	118,290	2.4067	2.0948	2.3611	2.7699	0.5038
Control Variables (t)						
NFA	118,290	0.2760	0.0627	0.1757	0.4306	0.2644
LEVERAGE	118,290	0.2578	0.0134	0.1809	0.3733	0.3595
Size	118,290	5.1871	3.5612	5.1787	6.8164	2.3041
PROFIT	118,290	-0.0801	-0.1052	0.0348	0.0917	0.3340
ln(1+firm age)	118,290	1.9617	1.3863	2.0794	2.6391	0.8103

Note: this table presents summary statistics for the sample of US firms between 1999 and 2021. Financial and utility firms are excluded. LACs stand for labor adjustment costs. All financial variables are winsorized at the 1^{st} and 99^{th} percentiles. Variable definitions are given in the Appendix.

Table 2.2 Baseline Model

$$Externally\ financed\ growth_{i,t} = \alpha + \beta_1 LSI_{i,t} + \beta_2 NFT_{i,t} + \beta_3 LEV_{i,t} + \beta_4 SIZE_{i,t} + \beta_5 PROFIT_{i,t} + \beta_6 Firm\ Age_{i,t} + Year\ Effects + \varepsilon$$

	Whole Sample			Across firm		
	(1)	(2)	(3)	(4)	(5)	(6)
Variables	XR_IG	XR_SFG	XR_SG	XR_IG	XR_SFG	XR_SG
LAC(t)	0.0817***	0.0633***	0.0539***	0.3418***	0.3261***	0.2990***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
NFA(t)	0.2833***	0.2649***	0.2372***	0.2061***	0.2081***	0.1650***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)
LEVERAGE(t)	-0.1617***	0.0413***	-0.0573***	-0.2701***	-0.1374***	-0.2593***
	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
Size (t)	-0.0703***	-0.0534***	-0.1008***	-0.0286***	-0.0116	-0.0706***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.198)	(0.000)
PROFIT (t)	-0.9160***	-0.7146***	-1.1590***	-0.9770***	-0.6778***	-1.0372***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ln(1+firm age)(t)	-0.3672***	-0.3421***	-0.3563***	0.2248***	0.2842***	0.1520***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Intercept	0.3144***	0.5253***	0.2700***	0.2216**	0.2887***	0.4912***
	(0.000)	(0.000)	(0.000)	(0.013)	(0.003)	(0.000)
Year fixed effects	Yes	Yes	Yes	No	No	No
Observations	118,290	118,290	118,290	15,815	15,815	15,815
Pseudo R^2	11.78%	9.03%	14.64%	7.36%	5.48%	8.47%

Note: this table presents Probit regression results on the relationship between LACs and externally financed growth. P-values are given in parentheses. *, **, and *** indicate statistical significance at 10%, 5%, and 1% levels, respectively.

Table 2.3 Subsamples of Similar Industries

	High-skill Industries			Manufacturing Industries			High-skill Manufacturing Industries		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Variables	XR_IG	XR_SFG	XR_SG	XR_IG	XR_SFG	XR_SG	XR_IG	XR_SFG	XR_SG
LAC(t)	0.1538***	0.1221***	0.2088***	0.1083***	0.0916***	0.0904***	0.4649***	0.3935***	0.4609***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
NFA(t)	0.3585***	0.2862***	0.3853***	0.1650***	0.1413***	0.1152***	0.3445***	0.2813***	0.3482***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
LEVERAGE(t)	-0.1262***	0.0410**	-0.0574***	-0.1226***	0.0554***	-0.1235***	-0.0706***	0.0694***	-0.0980***
	(0.000)	(0.019)	(0.002)	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)	(0.000)
Size (t)	-0.0688***	-0.0494***	-0.0986***	-0.0651***	-0.0468***	-0.0925***	-0.0683***	-0.0520***	-0.0960***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
PROFIT (t)	-0.7600***	-0.5878***	-1.0010***	-0.7507***	-0.6049***	-1.0003***	-0.6387***	-0.5001***	-0.8686***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ln(1+firm age)(t)	-0.3660***	-0.3460***	-0.3546***	-0.3643***	-0.3449***	-0.3564***	-0.3428***	-0.3274***	-0.3338***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Intercept	0.0664	0.3627***	-0.2389***	0.1324*	0.2503***	0.1019	-0.9607***	-0.6374***	-1.0883***
	(0.411)	(0.000)	(0.004)	(0.075)	(0.001)	(0.186)	(0.000)	(0.000)	(0.000)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	59,177	59,177	59,177	75,051	75,051	75,051	42,777	42,777	42,777
Pseudo R^2	11.91%	9.17%	15.18%	11.38%	9.17%	14.29%	12.42%	10.09%	15.55%

Note: this table presents Probit regression results on the relationship between LACs and externally financed growth using subsamples that have similar industry characteristics. P-values are given in parentheses. *, **, and *** indicate statistical significance at 10%, 5%, and 1% levels, respectively.

Table 2.4 Propensity-Score-Matched Subsamples

	Matched firms with high (above median) LSI	Matched firms with low (below median) LSI	Difference
Whole Sample			
XR_IG	0.5537	0.5119	0.0418***
Observations	59,122	57,978	
XR_SFG	0.6158	0.5902	0.0256***
Observations	59,122	57,978	
XR_SG	0.5142	0.4717	0.0425***
Observations	59,122	57,978	
Manufacturing Industries			
XR_IG	0.5939	0.5214	0.0725***
Observations	37,944	37,107	
XR_SFG	0.6426	0.5888	0.0538***
Observations	37,944	37,107	
XR_SG	0.5641	0.4842	0.0799***
Observations	37,944	37,107	
High-Skill Industries:			
XR_IG	0.5948	0.5173	0.0775***
Observations	29,565	28,583	
XR_SFG	0.6444	0.5913	0.0532***
Observations	29,565	28,583	
XR_SG	0.5685	0.4642	0.1043***
Observations	29,565	28,583	
High-Skill Manufacturing Industries:			
XR_IG	0.6336	0.5347	0.0989***
Observations	21,403	18,885	
XR_SFG	0.6724	0.5977	0.0748***
Observations	21,403	18,885	
XR_SG	0.6128	0.4903	0.1225***
Observations	21,403	18,885	
Positive-R&D Firms:			

XR_IG	0.6099	0.5957	0.0142***
Observations	31,731	30,802	
XR_SFG	0.6538	0.6484	0.0054***
Observations	31,731	30,802	
XR_SG	0.5872	0.5733	0.0139***
Observations	31,731	30,802	
Zero-R&D Firms:			
XR_IG	0.4719	0.4230	0.0489***
Observations	27,362	26,884	
XR_SFG	0.5592	0.5288	0.0304***
Observations	27,362	26,884	
XR_SG	0.4067	0.3661	0.0406***
Observations	27,362	26,884	

Note: this table presents results comparing externally financed growth of high and low LSI firms that are propensity-score matched. P-values are given in parentheses. *, **, and *** indicate statistical significance at 10%, 5%, and 1% levels, respectively.

Table 2.4 Panel B: Baseline Regressions for Propensity-Score-Matched Samples

	Whole Sample			Manufacturing Industries		
	(1)	(2)	(3)	(4)	(5)	(6)
Variables	XR_IG	XR_SFG	XR_SG	XR_IG	XR_SFG	XR_SG
LAC(t)	0.0484***	0.0441***	0.0499***	0.0503***	0.0445***	0.0246*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.002)	(0.085)
NFA(t)	0.2924***	0.2655***	0.2477***	0.1675***	0.1437***	0.1174***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
LEVERAGE(t)	-0.1632***	0.0401***	-0.0637***	-0.1139***	0.0627***	-0.1134***
	(0.000)	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)
Size (t)	-0.0703***	-0.0531***	-0.1012***	-0.0640***	-0.0460***	-0.0913***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
PROFIT (t)	-0.9019***	-0.7051***	-1.1530***	-0.7254***	-0.5845***	-0.9703***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ln(1+firm age)(t)	-0.3671***	-0.3430***	-0.3549***	-0.3618***	-0.3428***	-0.3536***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Intercept	0.3483***	0.5496***	0.2763***	0.1329*	0.2513***	0.1012
	(0.000)	(0.000)	(0.000)	(0.074)	(0.001)	(0.189)

Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	117,100	117,100	117,100	75,051	75,051	75,051
Pseudo R^2	11.74%	8.98%	14.61%	11.44%	9.21%	14.37%

	High-Skill Industries			High-Skill Manufacturing Industries		
	(7)	(8)	(9)	(10)	(11)	(12)
Variables	XR_IG	XR_SFG	XR_SG	XR_IG	XR_SFG	XR_SG
LAC(t)	0.0864***	0.0719***	0.1057***	0.3032***	0.2578***	0.3142***
	(0.001)	(0.005)	(0.000)	(0.000)	(0.000)	(0.000)
NFA(t)	0.3803***	0.3101***	0.4166***	0.3344***	0.2722***	0.3497***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
LEVERAGE(t)	-0.1191***	0.0444**	-0.0538***	-0.0587***	0.0726***	-0.0938***
	(0.000)	(0.012)	(0.004)	(0.001)	(0.001)	(0.000)
Size (t)	-0.0680***	-0.0484***	-0.0973***	-0.0665***	-0.0501***	-0.0933***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
PROFIT (t)	-0.7475***	-0.5816***	-0.9809***	-0.6010***	-0.4685***	-0.8314***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ln(1+firm age)(t)	-0.3632***	-0.3438***	-0.3506***	-0.3372***	-0.3239***	-0.3311***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Intercept	0.2053**	0.4491***	-0.0544	-0.7093***	-0.4225***	-0.8963***
	(0.018)	(0.000)	(0.538)	(0.000)	(0.000)	(0.000)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	58,148	58,148	58,148	40,288	40,288	40,288
Pseudo R^2	11.88%	9.16%	15.22%	12.55%	10.18%	15.79%

	Positive R&D Firms			Zero R&D Firms		
	(13)	(14)	(15)	(16)	(17)	(18)
Variables	XR_IG	XR_SFG	XR_SG	XR_IG	XR_SFG	XR_SG
LAC(t)	0.0779***	0.0726***	0.0431**	0.0315*	0.0290*	0.0867***
	(0.000)	(0.000)	(0.012)	(0.064)	(0.084)	(0.000)
NFA(t)	0.3351***	0.3853***	0.3625***	0.4442***	0.3333***	0.4296***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
LEVERAGE(t)	-0.1092***	0.0280	-0.1320***	-0.1172***	0.1452***	0.1441***
	(0.000)	(0.117)	(0.000)	(0.000)	(0.000)	(0.000)

Size (t)	-0.1123***	-0.0936***	-0.1390***	-0.0225***	-0.0094***	-0.0604***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)
PROFIT (t)	-0.7385***	-0.6100***	-0.9535***	-1.0046***	-0.6585***	-1.2193***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ln(1+firm age)(t)	-0.4083***	-0.3861***	-0.4105***	-0.3081***	-0.2784***	-0.2748***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Intercept	0.7458***	0.7786***	0.8473***	-0.1717**	0.1635**	-0.4337***
	(0.000)	(0.000)	(0.000)	(0.020)	(0.026)	(0.000)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	62,533	62,533	62,533	54,246	54,246	54,246
Pseudo R^2	14.85%	12.09%	18.39%	7.86%	6.23%	8.74%

Note: this table presents Probit regression results on the relationship between LACs and externally financed growth using propensity-scored matched firms. P-values are given in parentheses. *, **, and *** indicate statistical significance at 10%, 5%, and 1% levels, respectively.

Table 2.5 Agency Costs as the Channel between LACs and Externally Financed Growth

	Whole sample			Manufacturing industries		
	(1)	(2)	(3)	(4)	(5)	(6)
Variables	XR_IG	XR_SFG	XR_SG	XR_IG	XR_SFG	XR_SG
LAC(t)	0.0911***	0.0753***	0.0670***	0.1007***	0.0880***	0.0945***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Agency Costs(t)	-0.3268***	-0.3060***	-0.3445***	-0.2575***	-0.2600***	-0.2675***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
LACs*AgencyCosts	0.0628***	0.0567***	0.0770***	0.0352**	0.0362**	0.0541***
	(0.000)	(0.000)	(0.000)	(0.048)	(0.041)	(0.002)
NFA(t)	0.2556***	0.2332***	0.2082***	0.1400***	0.1105***	0.0829***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
LEVERAGE(t)	-0.1878***	0.0344***	-0.0785***	-0.1465***	0.0459***	-0.1474***
	(0.000)	(0.007)	(0.000)	(0.000)	(0.005)	(0.000)
Size (t)	-0.0641***	-0.0485***	-0.0965***	-0.0589***	-0.0420***	-0.0876***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
PROFIT (t)	-0.7969***	-0.5797***	-1.0631***	-0.6468***	-0.4814***	-0.9335***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ln(1+firm age)(t)	-0.3188***	-0.2963***	-0.3094***	-0.3129***	-0.2948***	-0.3097***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Intercept	0.1704**	0.3867***	0.1312**	0.0291	0.1452*	-0.0166
	(0.000)	(0.000)	(0.023)	(0.705)	(0.056)	(0.836)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	111,333	111,333	111,333	70,374	70,374	70,374
Pseudo R^2	11.62%	8.78%	14.57%	11.19%	8.95%	14.11%

	High-skill Industries			High-skill Manufacturing Industries		
	(7)	(8)	(9)	(10)	(11)	(12)
Variables	XR_IG	XR_SFG	XR_SG	XR_IG	XR_SFG	XR_SG
LAC(t)	0.1585***	0.1267***	0.2382***	0.4721***	0.4143***	0.4784***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Agency Costs(t)	-0.3105***	-0.2087**	-0.5337***	-0.4263***	-0.4327***	-0.3891***
	(0.002)	(0.037)	(0.000)	(0.002)	(0.002)	(0.007)
LACs*AgencyCosts	0.0405	0.0066	0.1328***	0.0834*	0.0841*	0.0901*
	(0.254)	(0.852)	(0.000)	(0.082)	(0.082)	(0.066)
NFA(t)	0.3185***	0.2451***	0.3457***	0.3338***	0.2799***	0.3625***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
LEVERAGE(t)	-0.1521***	0.0327*	-0.0796***	-0.0873***	0.0623***	-0.1350***
	(0.000)	(0.067)	(0.000)	(0.000)	(0.008)	(0.000)
Size (t)	-0.0613***	-0.0438***	-0.0933***	-0.0637***	-0.0494***	-0.0904***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
PROFIT (t)	-0.6159***	-0.4250***	-0.9062***	-0.4779***	-0.3199***	-0.7746***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ln(1+firm age)(t)	-0.3170***	-0.2967***	-0.3108***	-0.3058***	-0.2871***	-0.3016***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Intercept	-0.0731	0.2360***	-0.4292***	-1.1021***	-0.8089***	-1.2836***
	(0.389)	(0.005)	(0.000)	(0.000)	(0.000)	(0.000)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	55,106	55,106	55,106	34,931	34,931	34,931
Pseudo R^2	11.67%	8.84%	15.09%	12.36%	9.98%	15.62%

Note: this table presents Probit regression results examining agency problems as the channel between LACs and externally financed growth. P-values are given in parentheses. *, **, and *** indicate statistical significance at 10%, 5%, and 1% levels, respectively.

Table 2.6 Access to External Finance

	(1)	(2)	(3)
Variables	XR_IG	XR_SFG	XR_SG
LAC(t)	0.1209***	0.0987***	0.0579***
	(0.000)	(0.000)	(0.000)
Access to finance (01) (t)	-0.2424***	-0.1527***	-0.0805***
	(0.000)	(0.000)	(0.000)
NFA(t)	0.3358***	0.3150***	0.2674***
	(0.000)	(0.000)	(0.000)
LEVERAGE(t)	-0.0823***	0.1453***	0.0677***
	(0.000)	(0.000)	(0.000)
Size (t)	-0.0317***	-0.0256***	-0.0878***
	(0.000)	(0.000)	(0.000)
PROFIT (t)	-1.0284***	-0.7641***	-1.2633***
	(0.000)	(0.000)	(0.000)
ln(1+firm age)(t)	-0.2551***	-0.2305***	-0.2476***
	(0.000)	(0.000)	(0.000)
Intercept	-0.1297*	0.1361*	0.0495
	(0.028)	(0.019)	(0.416)
Year fixed effects	Yes	Yes	Yes
Observations	88,265	88,265	88,265
Pseudo R^2	8.98%	6.66%	11.19%

Note: this table presents Probit regression results on the relationship between LACs and externally financed growth while controlling for the effect of access to external finance. P-values are given in parentheses. *, **, and *** indicate statistical significance at 10%, 5%, and 1% levels, respectively.

Table 2.7 Availability of Internal Funds

	(1)	(2)	(3)
Variables	XR_IG	XR_SFG	XR_SG
LAC(t)	0.1080***	0.0760***	0.1323***
	(0.000)	(0.000)	(0.000)
Internal Funds (t)	0.5150***	0.4734***	0.2672***
	(0.000)	(0.000)	(0.000)
NFA(t)	0.4580***	0.3768***	0.5360***
	(0.000)	(0.000)	(0.000)
LEVERAGE(t)	0.0499	0.3210***	-0.0393
	(0.118)	(0.000)	(0.234)
Size (t)	-0.0819***	-0.0689***	-0.1233***
	(0.000)	(0.000)	(0.000)
PROFIT (t)	-1.1438***	-0.9359***	-1.7147***
	(0.000)	(0.000)	(0.000)
ln(1+firm age)(t)	-0.3044***	-0.2873***	-0.3036***
	(0.000)	(0.000)	(0.000)
Intercept	0.0406	0.5531*	-0.1702
	(0.882)	(0.041)	(0.578)
Year fixed effects	Yes	Yes	Yes
Observations	62,862	62,862	62,862
Pseudo R^2	15.01%	11.87%	20.86%

Note: this table presents Probit regression results on the relationship between LACs and externally financed growth while controlling for the availability of internal funds. P-values are given in parentheses. *, **, and *** indicate statistical significance at 10%, 5%, and 1% levels, respectively.

Table 2.8 Control for Cash Flow Volatility

	Whole Sample			Positive R& D Firms		
	(1)	(2)	(3)	(4)	(5)	(6)
Variables	XR_IG	XR_SFG	XR_SG	XR_IG	XR_SFG	XR_SG
LAC(t)	0.0588***	0.0470***	0.0224**	0.0720***	0.0715***	0.0430***
	(0.000)	(0.000)	(0.022)	(0.000)	(0.000)	(0.004)
Cashflow Volatility(t)	1.3347***	0.9320***	1.7920***	0.7344***	0.5694***	0.9214***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
NFA(t)	0.3343***	0.2992***	0.3013***	-0.1175***	-0.0407	-0.0787**
	(0.000)	(0.000)	(0.000)	(0.001)	(0.251)	(0.032)
LEVERAGE(t)	-0.1326***	0.0640***	-0.0197	-0.0522***	0.1000***	-0.0897***
	(0.000)	(0.000)	(0.178)	(0.004)	(0.000)	(0.000)
Size (t)	-0.0647***	-0.0489***	-0.0941***	-0.0764***	-0.0601***	-0.1047***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
PROFIT (t)	-0.8611***	-0.6816***	-1.0779***	-0.9392***	-0.8020***	-1.1896***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ln(1+firm age)(t)	-0.3655***	-0.3430***	-0.3514***	-0.4034***	-0.3782***	-0.4073***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
(R&D/Sale)(t)				-0.0247***	-0.0242***	-0.0233***
				(0.000)	(0.000)	(0.000)
Intercept	0.3279***	0.5422***	0.2501***	0.6316***	0.7103***	0.6587***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	113,027	113,027	113,027	53,800	53,800	53,800
Pseudo R^2	12.08%	9.26%	15.05%	13.14%	10.73%	16.59%

Note: this table presents Probit regression results on the relationship between LACs and externally financed growth while controlling for the effect of firm-level cashflow volatility. P-values are given in parentheses. *, **, and *** indicate statistical significance at 10%, 5%, and 1% levels, respectively.

Table 2.9 Firm Life Cycle

	Introduction			Growth		
	(1)	(2)	(3)	(4)	(5)	(6)
Variables	XR_IG	XR_SFG	XR_SG	XR_IG	XR_SFG	XR_SG
LAC(t)	-0.0666***	-0.1001***	-0.0957***	0.1292***	0.0988***	0.1378***
	(0.004)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
NFA(t)	0.3258***	0.2944***	0.4908***	0.1189***	0.044	0.1524***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.121)	(0.000)
LEVERAGE(t)	-0.1775***	-0.0202	-0.4596***	-0.2418***	0.1646***	-0.1088***
	(0.000)	(0.373)	(0.000)	(0.000)	(0.000)	(0.006)
Size (t)	-0.0552***	-0.0415***	-0.0493***	-0.0326***	-0.0222***	-0.0852***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
PROFIT (t)	-0.3405***	-0.2588***	-0.5183***	-1.1694***	-0.3992***	-2.6679***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ln(1+firm age)(t)	-0.2943***	-0.2755***	-0.2379***	-0.3410***	-0.3163***	-0.3552***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Intercept	1.0767***	1.2123***	1.0962***	0.4380***	0.6845***	0.2836***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.007)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	24,708	24,708	24,708	29,033	29,033	29,033
Pseudo R^2	6.36%	4.92%	8.06%	6.64%	5.70%	10.10%

	Mature			Decline		
	(7)	(8)	(9)	(10)	(11)	(12)
Variables	XR_IG	XR_SFG	XR_SG	XR_IG	XR_SFG	XR_SG
LAC(t)	0.1295***	0.1176***	0.0852***	-0.00770	-0.042	-0.0484
	(0.000)	(0.000)	(0.000)	(0.811)	(0.198)	(0.144)
NFA(t)	0.3524***	0.2906***	0.0969***	0.1339**	0.1582**	0.2209***
	(0.000)	(0.000)	(0.000)	(0.030)	(0.012)	(0.001)
LEVERAGE(t)	-0.2951***	0.0699***	0.8927***	-0.1308***	-0.0207	-0.3728***
	(0.000)	(0.009)	(0.000)	(0.000)	(0.524)	(0.000)
Size (t)	-0.0355***	-0.0275***	-0.0809***	-0.0661***	-0.0536***	-0.0498***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
PROFIT (t)	-2.3761***	-1.7112***	-2.2286***	-0.3872***	-0.3430***	-0.4851***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ln(1+firm age)(t)	-0.3020***	-0.2560***	-0.2783***	-0.2864***	-0.2717***	-0.2286***

	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Intercept	-0.4649***	-0.1559	-0.6337***	0.5399**	0.6995***	0.7677***
	(0.000)	(0.104)	(0.000)	(0.000)	(0.000)	(0.000)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	40,561	40,561	40,561	10,183	10,183	10,183
Pseudo R^2	7.66%	5.78%	9.92%	5.60%	4.46%	6.00%

Note: this table presents Probit regression results on the relationship between LACs and externally financed growth during different stages of the firm life cycle. P-values are given in parentheses. *, **, and *** indicate statistical significance at 10%, 5%, and 1% levels, respectively.

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RESEARCH

RESEARCH INTERESTS	Corporate Finance; International Finance; Financial Accounting; Financial Econometrics; and Investor Behavior.
PUBLISHED PAPERS	"Life Satisfaction and Stock Market Participation", with Xiaohui Yang and Bing Chen, ***Journal of Applied Business and Economics,*** 23 (5), 2021.
	"The effect of online search volume on financial performance: Marketing insight from Google trends data of the top five US technology firms", with Ran Liu and Wenkai Zhou, ***Journal of Marketing Theory and Practice***, 29 (4), 2021.

TEACHING

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- FIN323: Introductory Financial Management, Spring 2024
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- FIN323: Introductory Financial Management, Spring 2021