Strategic Liability Management: Lessons from Past Inflation

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Abstract

I study firm liability decisions through the learning-from-experience channel, where a manager who experienced high inflation in her lifetime strategically decreases the real value of firm liabilities. During periods of high inflation, the real value of fixed-rate liabilities is lower than that of floating-rate liabilities. A manager that learned from past inflation, acknowledging this fact, converts floating-rate to fixed-rate debts using interest rate swaps. This liability management mitigates unexpected inflation shocks and demands high returns sorted by inflation beta. Consistent with findings from survey data, a manager draws lessons from inflation experience, stretching her experience back to the distant past.

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1 Introduction

Does a firm manager learn from inflation experience and use this experience to shape corporate decisions? Standard economic theories assume that individuals use complete information available, resulting in homogeneous beliefs regardless of prior experience (Lucas Jr, 1972; Sargent and Wallace, 1976). However, there is recent but already influential literature showing that experience channel is important and it affects individual's expectation (D'Acunto et al., 2021; Kuchler and Zafar, 2019; Koudijs and Voth, 2016; Malmendier and Nagel, 2011, 2016). This personal experience affects individual's risk preference, debt financing, and portfolio investment (Bernile et al., 2017; Carvalho et al., 2023; Cronqvist et al., 2012; Dittmar and Duchin, 2016; Duchin et al., 2021). A common thread underlying these studies is that a firm manager's decisions are shaped by personal experience, which spans from early childhood trauma to individual portfolio management.

In this study, I examine the extent to which a manager uses corporate debt strategies to buffer against unexpected inflation shocks. Does a firm manager learn from inflation experience she had over her lifetime? I find that a manager who experienced high inflation is likely to harbor concerns about future inflation, as evidenced by an increase in future inflation expectation. If a manager expects high inflation, she is likely to borrow less from floating-rate debts and more from fixed-rate liabilities. In high inflation times, the real value of floating rate debt is expected to be higher than the real value of fixed rate debt (Bretscher et al., 2018). A manager who learned from the past inflation experience acknowledges this fact and converts the floating-rate debts to fixed-rate debts as an attempt to reduce the real burden of liabilities. That is, the manager pays debts at fixed rates and receives debts with floating rates using interest rate swaps (IRS). This action would convert the liabilities into fixed-rates, which imposes less burden than floating-rates during high inflation times. This liability management mitigates unexpected inflation shock, as evidenced by an increase in the inflation beta-sorted returns. Based on the experience, a manager forms expectations on future inflation and strategically manages firm liabilities. I measure the learning-from-experience channel with a non-Bayesian learning approach by incorporating a learning parameter depending on the manager's age, in the spirit of Malmendier and Nagel (2011) and Malmendier and Nagel (2016).[1]

In conventional psychological theories, time's arrow is straight, and unidirectionality of time is one of the nature's most fundamental laws (Benedek et al., 2023; Tulving, 2002). This wisdom implies that individuals remember recent events and forgets those that occured in the distant past. Given that the most recent high inflation prior to the 2020s stretches back to the early 1980s, with moderate rates in the mid-1990s, one might believe that managers have forgotten about inflation, rendering the learning-from-experience channel ineffective. In fact, Malmendier and Nagel (2011) and Malmendier and Nagel (2016) show that individuals place more weight on recent than past economic conditions and inflation. In this study, however, I show that a learning parameter is concave compared to Malmendier and Nagel (2011) and Malmendier and Nagel (2016)'s findings when I estimate manager's inflation expectation instead of household expectation. That is, managers remember inflation shocks from the past to a certain extent and learn from those past events.

In the literature, further research documents what experience shapes expectation, which leads to changes in individual decisions. Kuchler and Zafar (2019) show that a household's experience in unemployment and housing prices shape their expectations on unemployment and inflation, respectively. Building on this work, Carvalho et al. (2023) use the local housing prices as the economic experience of loan officers, and show that these experience affect the officers' loan pricing decisions. D'Acunto et al. (2021) use novel data on grocery purchases of households and find that price of purchased groceries shape household expectation on inflation. Experience shapes investment decisions and portfolio management of not only retail investors (Andersen et al., 2024; Greenwood

[1] John Graham has survey data for CFOs from 2020 to 2024 asking the expected level of prices of products and units for production. Source: CFO outlook. Fed of Cleveland has proprietary data on manager's inflation expectation from 2018, which (Candia et al., 2024) uses to show that managers are ignorant on inflation rates and incorrect in expectation, as in households are.

and Nagel, 2009) but also professionals such as central bankers (Malmendier et al., 2021) and bank branch managers (Gao et al., 2023). Experience channel affects home purchases for out-of-town home buyers (Favilukis and Van Nieuwerburgh, 2021; Li, 2024).

A firm manager makes corporate decisions based on learning-from-experience channel, where the experience ranges from economic recessions to natural hazards (Bernile et al., 2017; Dittmar and Duchin, 2016; Graham and Narasimhan, 2004; Schoar and Zuo, 2017). Cronqvist et al. (2012) find that firm financing is influenced by a manager's personal financial matters, such as home mortgage debt, blending their personal and professional financial approaches. Coibion et al. (2020) use a survey in Italy and study that inflation expectations of firms affect corporate policies, such as price, credit, and employment. Savignac et al. (2021) do a new survey to firms in France and find that wage is less correlated with inflation expectations. Coibion et al. (2018) conduct a new survey in New Zealand and suggest that firms update their beliefs on inflation in a Bayesian learning manner. On the other hand, Candia et al. (2021) find an inattention-based explanation suggesting that firm managers in the U.S. are not paying attention to inflation and monetary policies. Ropele et al. (2022) document the causal effects of inflation expectation on firm financing.

Consumption-based models incorporate inflation shocks in the real economy. For instance, in the U.S., higher inflation expectations correlate with increased future consumption growth, while in Japan, it relates to lower consumption growth (Bachmann et al., 2015; Ichiue and Nishiguchi, 2015). Boons et al. (2020) highlight that the relationship between inflation and consumption growth has changed since the early 2000s. Inflation disagreement affects nominal interest rates and yield volatility (Ehling et al., 2018). Lastly, a number of studies measure the effects of inflation on asset prices. Fama and Schwert (1977) find that assets like bonds and real estate hedge against inflation. Recently, Chava et al. (2022) provide a new measure of a firm's inflation exposure using textual analysis of earnings call transcripts. They study the effects of the firm-level inflation exposure on the stock returns. Inflation expectation also influences corporate yields (Bhamra et al., 2023; Kang and Pflueger, 2015).

My focus is on inflation instead of other economic outlooks. Indeed, inflation expectations and unforeseen inflation shocks drive shifts in the real economy. For instance, inflation expectation induces aggregate consumption growth (Bachmann et al., 2015; Ichiue and Nishiguchi, 2015), changes returns of portfolio sorting strategy on inflation beta (Boons et al., 2020), and acts as a mechanism for inflation disagreement (Ehling et al., 2018). These would in turn decide aggregate investment choice of households (D'Acunto et al., 2021; Kuchler and Zafar, 2019; Malmendier and Nagel, 2016). This behavior is not only confined to households, but also to professional managers (Coibion et al., 2018, 2020), and bank officers (Carvalho et al., 2023; Gao et al., 2023; Malmendier et al., 2021).

Furthermore, inflation allows for more distinct cohort identification due to its long cyclical nature. Data reveals inflation spikes in the early 1980s and 2020s, along with a moderate rise in the early 1990s. I view this long cycle of inflation as the strength of my research: The long cycle of inflation delineates clean cohorts based on age group. Old cohorts are exposed to the high inflation of the early 1980s. They have prior experience with high inflation rates before the 2020s. Mid cohorts lack these experience, being more familiar with extended low inflation in the 1990s. Young cohorts are dominated with high rates in the 2020s. This delineation does not happen in recessions due to its short cycle and that all age groups would have experienced a recession.

2 Data

I examine a learning-from-experience channel that focuses on how a manager strategically manages corporate decisions based on her past experiences. In this paper, I find that the personal experience of a manager influences firm financing and bond issuance, subsequently boosting the firms' excess returns sorted on inflation beta.

The key variable in this study is measuring inflation experience of managers. This analysis requires inflation rates far back to the birth date for each manager. Inflation experience is measured by weighting inflation in her lifetime using a learning parameter that determines the weight placed in each piece of lifetime of a manager. Monthly inflation rate is defined as headline CPI change from a year ago, where CPI is compiled by BLS and obtained from FRED. Monthly stock return data are obtained from the Center for Research in Security Prices (CRSP). Firm-level accounting variables are obtained from Compustat. To mitigate the effects of outliers, I require stocks to have at least 24 returns out of the last 60 months of returns available. Furthermore, I collect the age of managers from Compustat's Execucomp database, which covers firms from 1992 to 2022. manager age is defined as the current month minus her date of birth.

Using common firms and months across these data sources, a sample results in a panel dataset with 230,926 firm-month observations. This sample includes 1,828 firms from January 1992 to December 2022. Notably, headline inflation rate is available from January 1948. Specification in this study stretches inflation rates as far back as a firm's founding date and a manager's birth date. For example, consider a manager born in April 1960 whose company is listed in the CRSP-Compustat-Execucomp universe in December 2022. When I aggregate the manager's inflation experience, the data on the inflation rate spans from April 1960 to December 2022.

I augment this sample with detailed data on firms' debt structure from S&P Capital IQ. S&P Capital IQ is an annual dataset that goes from 2001 to 2022, providing information on whether debt is fixed or floating rate. Specifically, I use firm-year data on fixed- and floating-rate debts and total debt. Bank debt ratio is the bank debt divided by the total debt, where total debt is the sum of principal outstanding, unamortized premium or discount, minus total adjustment. I also use firm's bond issuance data from S&P Capital IQ. I require the sum of fixed- and floating-rate debts to be greater than zero. As in Kirti (2020), I drop firms from the sample when the sum of fixed and variable-rate debts deviates by more than 10% from the total debt for more than half of the available years. The number of common firms reduces to 896. As a result, the augmented dataset, presented in Section 4.2, is a firm-year panel dataset that has 12,095 observations spanning from 2001 to 2022.

I use IRS data from Bretscher et al. (2018) and extend it to 2022 by hand-collecting floating-rate and fixed-rate debts from 10-K reports.[2] In the spirit of Chava and Purnanandam (2007) and Chernenko and Faulkender (2011), Bretscher et al. (2018) distinguish paying versus receiving debts by reading the annual 10-K reports. That is, I hand-collect the information on paying, receiving, floating-rate, and fixed-rate debts by searching keywords "swap", "risk-management", "hedge", and "derivative" and reading the surrounding text. Bretscher et al. (2018) construct the net floating swap, which is the pay-floating-receive-fixed notional amount minus the pay-fixed-receive-floating notional amount, divided by the total debt. The IRS percentage varies from -100% (indicating that all debt is converted to fixed) to 100% (indicating all debt is converted to floating).

2.1 Descriptive Statistics

Table 1 presents descriptive statistics on the key variables. Monthly headline inflation rate, denoted by Π_t spans from January 1948 to December 2022. The average inflation rate sits at 2.41%, whereas the peak (trough) reached a substantial 14.59% (-2.99%), far surpassing (falling below) the mean. There are three main periods with high inflation rates in the sample, which are early 1980s, early 1990s, and the 2020s. The inflation shock ϵ_t^{Π}, which is the filtered innovation of this headline inflation, varies from -2.67 % and 2.14 %. A notable observation is the stickiness of the manager age, with an interquartile range between fifty and fifty-nine years.[3] Firm age, in contrast, showcases a broad range, spanning from companies founded within the same year to those with a history reaching back 181 years.[4]

[2] I thank the authors for releasing data on their website. Their data ranges from 1994 to 2014 including the firms that used swap at least once during this period.

[3] An intriguing outlier is Mark Zuckerberg, who was a manager at the notably young age of twenty-eight when Facebook went public.

[4] The oldest firm is Dun &Bradstreet Holdings, established in 1841.

The bank debt ranges from 0% to 108%, which is scaled by a firm's total debt. The mean bank debt is 57.26 %, with the 25th percentile and 95th percentile being 38.74 and 79.55, respectively. Figure A.3 plots the 90th percentile minus 10th percentile of bank debt across all firms in the sample each year. Bond issuance indicates a firm's senior secured and unsecured bond issuance divided by its total bond issuance. This ranges from 0 % to 109.96 %, with the mean being 55.57 %. The interest rate swap, which is the time-series extension of Bretscher et al. (2018)'s sample, includes firms that used IRS at least once during the sample period. IRS (%) refers to the percentage of outstanding debt that is swapped to a floating interest rate. The minimum value of -100% indicates that a firm swapped all of its debt to fixed rates, while the maximum value of 100% indicates that a firm swapped all of its debt to floating rates. During the sample period, the mean (median) is -1.58% (-2.18%), indicating that firms are more exposed to fixed-rate debts than floating-rate debts.

3 Methodology

When confronted with an unexpected inflation shock, how does a manager respond in terms of liability management based on the learning-from-experience channel? To investigate this question, this study's framework incorporates two explanatory variables: the unexpected inflation shock and inflation experience. That is, I assess the impact of past inflation experience on firm outcomes, particularly during unexpected inflationary shocks. The firm-level outcomes are a firm's floating-rate debt, fixed-rate assets, floating-to-fixed swaps, excess returns, and inflation beta.

First, I estimate an exogenous shock of inflation from a VAR(1) system in the spirit of Fang et al. (2022) and Boons et al. (2020)

$$Y_t = c + GY_{t-1} + \epsilon_t \tag{1}$$

where Y_t is a vector that includes month-t values of headline inflation rate, as well as risk-free rate, price dividend ratio, and output gap. The unexpected component of the headline inflation, denoted as ϵ_t^{Π} is the first component of the residual ϵ_t in equation (1). I implement this VAR(1), represented by equation (1) with monthly data that spans from September 1962 to December 2022. Following Chava et al. (2020) and Cooper and Priestley (2009) and many others, output gap is measured as a deviation from linear and quadratic trends of the natural log of industrial production at month t. Price-dividend ratio is the difference between the log of stock prices and the log of 12-month moving sums of market dividends (Campbell and Shiller, 1988; Campbell and Yogo, 2006; Welch and Goyal, 2008).[5]

I measure inflation experience using weighted averages of previous inflation rates in a manager's lifetime, motivated by the specification in Malmendier and Nagel (2011) and Malmendier and Nagel (2016). The learning-from-experience channel is measured with a weighting parameter that reveals the extent to which memory is completely lost or distant rates are in hysteresis. The learning-from experience is measured as the weighted average of the past inflation rates for each firm i at month t as:

$$A_{it} := b^{\text{manager}} \sum_{k=1}^{\text{manager age}_{it}-1} w_{it}(\lambda^{\text{manager}})\Pi_{t-k} \tag{2}$$

where

$$w_{it}(\lambda^{\text{manager}}) = \frac{(\text{manager age}_{it} - k)^{\lambda^{\text{manager}}}}{\sum_{k=1}^{\text{manager age}_{it}-1}(\text{manager age}_{it} - k)^{\lambda^{\text{manager}}}} \tag{3}$$

Π_{t-k} is inflation rate at month $t-k$, defined as the percentage change in the Consumer Price Indexes from a year ago. This specification stretches inflation rates as far back as a firm's founding date and a manager's birth date. The weighting function in equation (3) can be decreasing, increasing, or remain flat depending on the values of the weighting parameter λ^{manager}. Weights placed on a manager's lifetime, represented by $w_{it}(\lambda^{\text{manager}})$, are determined by the age of a manager (manager age_{it}), the number of months elapsed since the inflation was realized (k), and the parameter λ^{manager} that

[5] Data on the stock prices and market dividends are obtained from Amit Goyal's website (https://sites.google.com/view/agoyal145)

shapes the weighting function.

Using equations (2) and (3), I estimate λ^{manager} in the first-stage regression:

$$E_{it} = A_{it}(\lambda^{\text{manager}})\epsilon_t^{\Pi} + e_{it} \tag{4}$$

for a manager at firm i at month t. I use three measures for a manager: the age of the CEO, the age of the CFO, and the average age of the two. If there is more than one CEO (or CFO) in a firm, I use the average age of the multiple CEOs (or CFOs). ϵ_t^{Π} is the inflation shock estimated as the first component of the residual ϵ_t in equation (1). The dependent variable E_{it} is the survey data on expected inflation from the Michigan Survey of Consumers. Figure 3 shows expected change in prices during next year from 2000 to 2022. All individuals expect high inflation in 2020s and low inflation in 2009. In the appendix, I show that the old, less educated, and low income individuals expect high inflation rates compared to young, educated, and high income individuals (Figures A.5, A.6, and A.7).

I estimate one learning parameter λ^{manager} to find $\widehat{\lambda^{\text{manager}}}$ that minimizes SSR in equation (4) using grid search. $A_{it}(\widehat{\lambda^{\text{manager}}})$ is the experience-induced inflation expectation of a manager. Figure 1 plots the weighting function with three values of $(\widehat{\lambda^{\text{manager}}})$. For illustration, I set the manager's age to forty to show the weight placed at each piece of lifetime. This ensures that the weighting function in this figure holds for all managers aged forty. A positive value of λ yields a decreasing weighting function as the time lag k approaches a forty-year old age. A large value of λ (i.e. $\lambda = 2.74$) shows that inflation rates today are weighted with 8.9 %, whereas the rates forty years ago are weighted with 0.02 %. A large value of λ indicates a memory loss of distant rates. With a large value of λ, a manager overweighs recent rates. In contrast, a small value of lambda (i.e. $\lambda = 0.30$) shows that today's inflation rates are weighted with 3.2%, whereas forty-year-ago rates are weighted with 1.7%. A low value of λ reveals hysteresis in relation to previous rates, where these past rates receive similar weighting with recent ones. Alternatively, if $\lambda = 0$, this is an equal-weighted average of the previous inflation rates, with 2.5 % at each year. This way, estimated values of λs from the data would show memory loss and hysteresis of previous inflation rates for firms and managers.

The second-stage regression is estimated by plugging in $(\widehat{\lambda^{\text{manager}}})$ from equation (4) into A_{it}. That is, I simultaneously estimate the weights and the impact of experience on outcomes in the following regression:

$$y_{it} = A_{it}(\widehat{\lambda^{\text{manager}}})\epsilon_t^{\Pi} + +\gamma \text{Controls}_{it-1} + \mu_i + u_{it} \tag{5}$$

where y_{it} represents several dependent variables, including a firm's bank debt ratio (bank debt_{it}), bond issuance (bond_{it}), interest rate swap (IRS_{it}), and excess returns sorted on inflation beta (beta_{it}). Inflation shock ϵ_t^{Π} is the first component of inflation shock ϵ_t, which is estimated from the VAR (1) system in equation (1). μ_i is firm-fixed effect. A_{it} represents a function of the parameters in equations (2) and (3).

The coefficient b^{manager} estimated in equation (5), where A_{it} is defined at equation (2), measures the partial effects of a manager's inflation experience on bank debt, bond issuance, interest rate swap, excess returns, and inflation beta. A positive $\widehat{b^{\text{manager}}}$ indicates that a manager that went through high inflation rates is positively correlated with these outcome variables. A high (low) value of weighting parameter λ^{manager} reveals that the firm is more (less) influenced by recent inflation rates than the past rates. In the spirit of Malmendier and Nagel (2011) and Malmendier and Nagel (2016), I use a non-Bayesian approach, limiting the weighting functions to a single-parameter function λ^{manager} for a manager.

I select the grid of the parameter λ^{manager} that minimize the sum of squared residuals.[6] These estimates are initial guesses for further numerical optimization. Grid search is performed for λ^{manager} ranging from -4 to 4, using a step size of 0.2. This results in 41 grid points for each λ^{manager} leading to a total of 1,681 grid combinations. Once I identify the pair of grids that offers the smallest sum of squared residuals, I further

[6] I obtain the same values of parameters when I maximize the likelihood function of the error term u_{it} in equation (5).

do a precise search in its vicinity using a smaller interval of 0.01. The t statistics of λ^{manager} is obtained from nonlinear squared estimators using the information matrix with firm-level clusters, as outlined in Appendix A.2.

There are two groups of controls in equation (5). The first group is the 1-month lagged market's expectations, which are aggregate inflation expectations over the next one, two, three, five, and ten years, obtained from FRED. These variables aid in adjusting for market expectations, ensuring that the coefficients b^{firm} and b^{manager} are understood as the reactions of firms and managers that vary across different cross sections. Additionally, I calculate the weighting parameters λ^{firm} and λ^{manager} to determine the degree to which past inflation rates are forgotten, using the variability across cross sections. The second group of controls is a firm's characteristics, including Tobin's Q, tangibility, size, profitability, and R&D expenditure. I highlight that a firm's capital structure, such as bank debt ratio and bond issuance, shows a notable learning process. This learning process is not explained by the firm characteristics previously identified as determinants of capital structure. Definitions of these variables are presented in the Appendix A.3.

In equation (5), inflation beta of firm i at month t is a latent variable. Inflation beta is the coefficient of regressing excess returns on the inflation shock ϵ_t^{Π} on a rolling window. These inflation betas change significantly over periods, mainly due to the changing variation in cross-sectional distributions of betas. Figure A.2 shows that there are notable changes in the 90th and 10th percentiles of inflation betas throughout the sample period. Before the early 2000s, there was a broad range of inflation betas, with a gap of roughly 60% between the 90th and 10th percentiles. However, after the early 2000s, this gap reduced to about 20%, which is one-third of the previous difference. Given these trends, I am interested in identifying state variables that can predict the dispersion in inflation betas, as these would be helpful in understanding the firm exposures for inflation.

4 Results

Given a manager's concerns on inflation, I hypothesize that she reduces borrowing from floating-rate debts and decreases issuing fixed-rate assets. Furthermore, she converts floating-rate debts to fixed-rate debts by paying fixed-rate debts and receiving floating-rate debts via the IRS. Additionally, I study the consequences of these decisions on firm-level outcomes, like excess returns sorted on inflation beta. The results presented in this section demonstrate the relevance of managers' and firms' inflation experience in influencing corporate policies and firm-level outcomes.

4.1 Learning-from-experience

Consider a manager who owns in a firm in 2023. There are two possible ways that experience of previous inflation rates influence current outcomes. First, she might forget the distant rates, thereby her behaviors are dominated by the recent rates. Alternatively, she remembers previous rates and her corporate decisions incorporate the past routines formed during the past inflation rates. Inflation rates have been low for two decades since the mid-1990s to 2019, so the patterns and behaviors established during that period may still persist. In this case, the current high inflation rates have fewer effects on the firm's assets, debts, and returns than the distant low rates.

Table 2 shows that the optimal λ^{manager} for a CEO in equation (4) is 0.80 (t-stat 2.69). This result indicates that a CEO who experienced inflation in her lifetime expects future inflation rates to be high. Her weighting parameter estimate, $\widehat{\lambda^{\text{manager}}} = 0.80$, suggests that memories are sticky and influenced by the distant past. This estimate suggests that weight function is concave and downward decreasing upon number of years before today. Figure 2 shows weight function of a fifty-year-old manager for each period of her life. As an illustration, a fifty-year old CEO would place 60 % weight from today to 20 years ago, then 40% from 50 years ago to 20 years ago. This is a concave function, suggesting sticky memories and that early lifetime experiences affect expectation in inflation. Estimated learning parameter $\widehat{\lambda^{\text{manager}}}$ for a CFO and for the average age of CFO and CEO show similar magnitude with that of CEO. $\widehat{\lambda^{\text{CFO}}} = 1.00$ and $\widehat{\lambda^{\text{both}}} = 0.59$ in columns (2) and (3), both suggesting that early memories are sticky. This estimate is important in the sense that managers remember distant rates and learn from past lessons.

4.2 Liability management

I start by relating inflation experience of managers to a firm's bank debt, bond issuance, and the IRS. The dependent variable y_{it} in equation (5) is a firm's bank debt divided by its total debt, a firm's bond issuance divided by its total bond issuance, and Bretscher et al. (2018)'s net floating swap. It is important to note that bank debt is floating-rate, bond issuance is fixed-rate debt, and net floating swap is converting fixed-rate to floating-rate. In this subsection, equation (5) is estimated in yearly frequency using firm-year data from S&P Capital IQ and yearly CPI data from FRED. One-year lagged control variables include firm characteristics that are known to determine the capital structure, which are Tobin's Q, tangibility, size, profitability, and R&D expenditure. I also include 1-year lagged market expectations of inflation over the next one, two, three, five, and ten years. In the spirit of Lemmon et al. (2008), I add firm-fixed effect to account for the stylized fact that a firm's capital structure is stable over time.

Table 3 presents the results of the effects of inflation experience on bank debt and bond issuance on the 2001 to 2022 sample. The t statistics, presented in parentheses, are firm-clustered, and those for weighting parameters are calculated using the information matrix presented in Appendix A.2. I estimate equation (5) using the experience of managers. In columns (2) and (3), I use the CEO and CFO as representatives of managers, respectively. In column (4), I use the average age of the CEO and CFO. In column (1), I measure learning-from-experience with a simple dummy variable, as further discussed in Section 4.3.

Bank debt is floating-rate debt, which has high real value during high inflation rates. When a manager learned from the past inflation rates, she would borrow less floating-rate debt, such as bank debt, if she expects high inflation rate in the future. b^{manager} for a CEO in equation (2) estimated in equation (5) is -0.83 (t-stat: -3.03). This result suggests that a CEO who expects high inflation will decrease bank debt through the learning-from-experience channel. Since bank debt is floating-rate, its real value is higher during times of high inflation compared to low inflation. A CEO who has learned from past inflation acknowledges this fact and reduces bank debt when she expects high inflation rates.

The beliefs of a CFO, as well as those of a CEO, play an important role in corporate decisions (Boutros et al., 2021; Malmendier et al., 2023). For example, Bertrand and Schoar (2003) show that CFO fixed effects on firm financing are stronger than CEO fixed effects. Additionally, Chava and Purnanandam (2007) find that the CFO's compensation, as opposed to the CEO's, has a greater impact on a firm's debt structure. Motivated by these studies, I examine the experience of CFOs and their effects on the firm debt. I estimate equation (2) to (3) using CFO age instead of CEO age. This modification of the estimation highlights the impact of the CFO's experience, rather than that of the CEO, on firm financing. In Table 3, column (3) shows that b^{manager} for a CFO is -0.84 (t-stat: -3.09) and the b^{manager} estimated with the average age of CEO and CFO is -1.10 (t-stat: -2.99). These results confirm that the learning-from-experience channel leads to a decrease in bank debt for CFOs.

Bond issuance is fixed-rate liability. If a manager expects high inflation, she would be more inclined to borrow at fixed-rate liability, such as issuing bonds Botsch and Malmendier (2023); Malmendier and Nagel (2016). A manager who had experienced inflation at her lifetime would expect high inflation in the future, which in turn would make her more tilted to fixed-rate liability. This would result in higher bond issuance, as presented in Table 4. The dependent variable, bond issuance, is defined as the issuance of senior and subordinated secured and unsecured bonds divided by the firm's total debt. Across columns (2) and (4), the coefficient is statistically significant and positive. These results, combined with the findings on bank debt in Table 3, indicate that managers tend to prefer floating-rate over fixed-rate debts through the learning-from-experience channel.

Bond issuance is a fixed-rate liability. When managers expect high inflation, they are more likely to opt for fixed-rate liabilities, such as issuing bonds Botsch and Malmendier (2023); Malmendier and Nagel (2016). Managers who have experienced inflation in their lifetime are more likely to expect high inflation in the future, leading them to favor fixed-rate liabilities. This is because fixed-rate liabilities have a lower real value and therefore a lower burden compared to floating-rate liabilities during periods of high inflation. This preference results in higher bond issuance, which is higher fixed-rate liabilities, as shown in Table 4. The dependent variable, bond issuance, is defined as the issuance of senior and subordinated secured and unsecured bonds divided by the firm's total debt. In columns (2) and (4), the coefficient is both statistically significant and positive. These findings, along with the results on bank debt in Table 3, suggest that managers tend to prefer fixed-rate over floating-rate liabilities through the learning-from-experience channel.

Does a manager convert floating-rate to fixed-rate debts if she expects high inflation? The real value of the debt is lower for fixed-rate debts rather than floating-rate debts during high inflation times? Results, presented, in Table 5, show that managers respond to inflation shock based on learning-from-experience channel. I use net floating swap as a dependent variable in equation (5). The negative (positive) value of the net floating swap variable indicates that there are more (less) fixed-rate debts than floating-rate debts. In columns (2) to (4), the coefficient estimate is negative and statistically significant, after controlling for firm fixed effect, capital structure, and market expectations. Managers who experienced inflation pay floating-rate debts and receive fixed-rate debts when they expect high inflation rates in the future based on the sticky memories on past inflation rates.The results presented in Table 5 provide evidence that if a manager is worried about inflation, she converts floating-rate debts to fixed-rate debts, which reduces the real value of debt burden during high inflation.

4.3 Robustness Checks

The main estimation of this study measures inflation experience motivated by the methodology outlined in Malmendier and Nagel (2011). However, in this subsection, I use categorical variables to construct a simple measure for inflation experience. I measure early-life inflation experience of managers based on the severity of the inflation starting 5 years and ending 20 years after the manager's year of birth. This period is emphasized because prior studies indicate that the memories from early childhood form the characteristics of managers (Bernile et al., 2017). Using monthly inflation rates, extreme inflation is defined as those rates that exceed the 75th percentile between 1948 and 2022. The 75th percentile threshold 3.03% (column (1) in Table 1). Extreme deflation is characterized as months where inflation rates fall below the 25th percentile rate, which is 1.61%. Table A.2 presents the years in extreme deflation and inflation.

I categorize a manager's inflation experience into three groups using a categorical variable based on extreme inflation and deflation criteria. Managers who experienced extreme deflation during the relevant years are coded as 0. Those who experienced extreme inflation are coded 1. All others are coded as 1. Inflation and deflation years are presented in Table A.2. This measure is simpler than the main measure presented in equations (2) to (5). I regress firm borrowing (i.e. bank debt, bond issuance, and net floating swap) on this simple categorical variable.

I present results in column (1) in Tables 3, 4, 5. In Table 3, coefficient estimate is -2.94 (t-stat: -3.65). Consistent with the results from the main measure, managers who experienced extreme inflation in their lifetime tend to secure less bank debt for their firms. In Table 4, coefficient estimate is 1.42 (t-stat: 3.68), showing that managers are tilted to fixed-rate liabilities, which show less burden in high inflation times. This is consistent with the learning-from-experience channel in the main results, where the manager that experienced inflation are tilted to fixed-rate liabilities, such as bonds. Finally, in column (1) in Table 5, the manager converts floating-rate debts to fixed-rate debts, which would reduce real value of debt during high inflation times. This is again consistent with the main result, that the manager would be tilted towards fixed-rate debts if she had experienced high inflation times.

5 Conclusion

In this paper, I study the learning-from-experience channel and its impact on firm decisions, using inflation experience and liability management as a laboratory. Experience casts a long-lasting shadow for many individuals. I demonstrate that past memories are persistent, and that firm managers apply lessons learned from their past experiences to their decision-making processes.

Inflation is an important economic condition that greatly impacts the real value of liabilities. Bank debt typically has floating rates, whereas bond issuance has fixed rates. During periods of high inflation, the real value of fixed-rate debt decreases, resulting in a lower burden compared to floating-rate debt. A manager who has learned from past experiences understands this and strategically manages the firm's liabilities to favor fixed-rate over floating-rate debt. This learning-from-experience channel is crucial in managing bank debt, bond issuance, and interest rate swaps (IRS). The manager uses IRS to convert floating-rate debts into fixed-rate debts.

The weighting parameter in this study indicates that individuals do place importance on distant past rates. Despite high inflation prior to the 2020s being as far back as the 1980s, many managers are still influenced by these early inflation rates. This supports the concept of episodic memory in managers, suggesting that episodic memory involves re-experiencing the past rather than forgetting it. The weighting parameter explains how past experiences shape managers' expectations about future inflation. A potential direction for future research could involve elaborating on managers' expectations, as discussed in Boutros et al. (2021), and examining how the experience channel specifically affects managers, not households.

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Figures and Tables

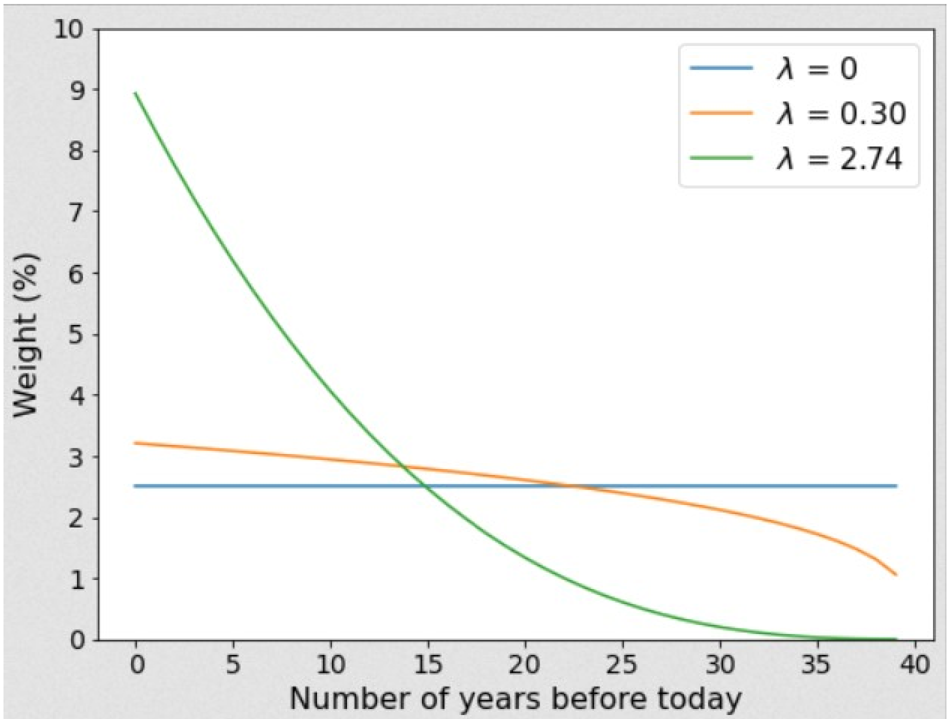


Figure 1: **Weight function based on values of learning parameters**
This figure shows the weight function with different values of λ in equation (3). For illustration, age is fixed at forty in this figure. Blue, orange, and green lines show weighting function when λ is 0, 0.3, and 2.74, respectively. Weight is plotted against the number of years before today.

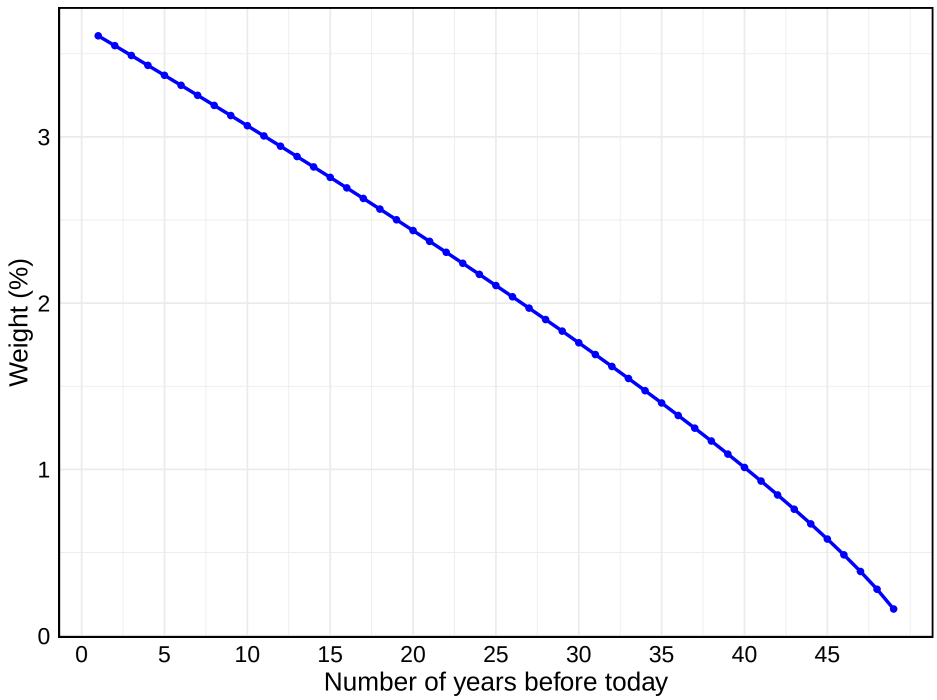


Figure 2: **Weight function based on the optimal $\widehat{\lambda^{\text{manager}}}$**
This figure shows the weight function using the optimal $\widehat{\lambda^{\text{manager}}}$ value of 0.8, estimated in equation (4), for a manager who is fifty years old. The weight is plotted against the number of years before today.

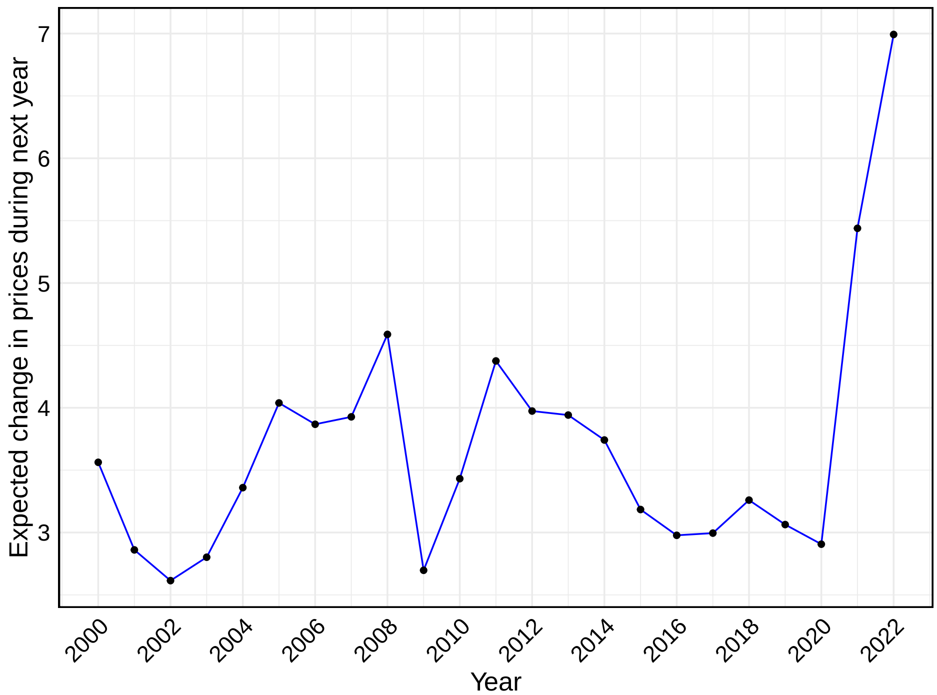


Figure 3: **Inflation Expectation**
This figure plots the monthly average of the expected change in prices for the next year, from January 2000 to December 2022. The data on inflation expectations is obtained from the Michigan Survey of Consumers.

	Π_t	R^e_{it}	ϵ^Π_t	Firm age	CEO age	CFO age	Bank debt (%)	IRS (%)
mean	2.42	0.99	-0.01	37.56	54.6	51.01	57.26	-1.58
std	1.58	13.03	0.41	28.71	7	6.68	26.77	16.54
min	-2.99	-36.46	-2.67	1	28	26	0	-100
25%	1.61	-6.02	-0.21	18	50	46	38.74	-25.49
50%	2.25	0.78	0.01	29	54.5	51	50.94	-2.18
75%	3.03	7.49	0.21	45	59	56	79.55	19.14
max	14.59	45.54	2.14	181	89	87	108.06	100

Table 1: **Descriptive Statistics.**
Data spans from January 2001 to December 2022. An exception is monthly headline inflation rate Π_t, that goes from January 1948 to December 2022, used to measure inflation experience in equation (2. Monthly excess returns R^e_{it} of firms are the returns minus the risk-free rate. Inflation shock ϵ^Π_t is the unexpected component of this inflation rate, which is estimated in VAR(1) in equation (1). Firm age is the current year minus its founding year. Manager age is the current year minus her year of birth. Bank debt (%) is a firm's bank debt divided by its total debt. Bond issuance (%) is a firm's senior and subordinate secured and unsecured bond issuance divided by its total debt. IRS (%) is the pay-floating-receive-fixed notional amount minus the pay-fixed-receive-floating notional amount, divided by the total debt, as in Bretscher et al. (2018) and Chava and Purnanandam (2007).

	Inflation expectation		
	(1)	(2)	(3)
	CEO	CFO	Both
Weighting parameter λ^{manager}	0.80	1.00	0.59
	(2.69)	(2.45)	(2.85)
Obs.	12,095	10,204	12,095

Table 2: **Estimated $\widehat{\lambda^{\text{manager}}}$**
This table reports $\widehat{\lambda^{\text{manager}}}$ estimated from simultaneous equations (2) to (4). Column (1) reports $\widehat{\lambda^{\text{manager}}}$ using CEO age in equation (2), column (2) uses CFO age, and column (3) uses the average of CEO and CFO ages. The dependent variable is expected change in prices during next year, as presented in Michigan Survey of Consumers. The t statistics for λ^{manager} are obtained from nonlinear squared estimators using the information matrix, as outlined in Appendix A.2

	Bank debt			
	(1)	(2)	(3)	(4)
	Simple	CEO	CFO	Both
Learning-from-experience b^{manager}	-2.94	-0.83	-0.94	-1.10
	(-3.65)	(-3.03)	(-3.09)	(-2.99)
Firm fixed effect	yes	yes	yes	yes
Firm characteristics	yes	yes	yes	yes
Market expectations	yes	yes	yes	yes
Obs.	12,121	12,095	10,204	12,095

Table 3: **Bank Debt**
This table reports b^{manager} in (5). Column (1) reports estimation on a simple measure of learning-from-experience channel as described in Section 4.3. Columns (2) to (4) report 2nd stage results on on learning-from-experience channel as described in Section 3. I use CEO age, CFO age, and the average of CEO and CFO age in columns (2), (3), and (4), respectively. The dependent variable is a firm's bank debt divided by its total debt. Firm characteristics are Tobin's Q, tangibility, size, profitability, and R&D expenditure. Market expectations are the aggregate expectations on inflation over the next one, two, three, five, and ten years. Variable definitions are presented at Section A.3. The first inflation rate is available in 1948. The t statistics are presented in parentheses and are clustered at the firm level. Data spans from 2001 to 2022.

	Bond Issuance			
	(1)	(2)	(3)	(4)
	Simple	CEO	CFO	Both
Learning-from-experience b^{manager}	1.42	0.12	0.37	0.39
	(3.68)	(1.92)	(2.05)	(2.14)
Firm fixed effect	yes	yes	yes	yes
Firm characteristics	yes	yes	yes	yes
Market expectations	yes	yes	yes	yes
Obs.	12,121	12,095	10,204	12,095

Table 4: **Bond Issuance**
This table reports b^{manager} in (5). Column (1) reports estimation on a simple measure of learning-from-experience channel as described in Section 4.3. Columns (2) to (4) report 2nd stage results on on learning-from-experience channel as described in Section 3. I use CEO age, CFO age, and the average of CEO and CFO age in columns (2), (3), and (4), respectively. The dependent variable is a firm's senior and subordinate secured and unsecured bond divided by its total debt. Firm characteristics are Tobin's Q, tangibility, size, profitability, and R&D expenditure. Market expectations are the aggregate expectations on inflation over the next one, two, three, five, and ten years. Variable definitions are presented at Section A.3. The first inflation rate is available in 1948. The t statistics are presented in parentheses and are clustered at the firm level. Data spans from 2001 to 2022.

	Net floating swap			
	(1)	(2)	(3)	(4)
	Simple	CEO	CFO	Both
Learning-from-experience b^{manager}	-0.10	-0.40	-0.26	-0.34
	(-2.50)	(-2.21)	(-2.81)	(-2.00)
Firm fixed effect	yes	yes	yes	yes
Firm characteristics	yes	yes	yes	yes
Market expectations	yes	yes	yes	yes
Obs.	12,121	12,095	10,204	12,095

Table 5: **Net floating swap**
This table reports b^{manager} in (5). Column (1) reports estimation on a simple measure of learning-from-experience channel as described in Section 4.3. Columns (2) to (4) report 2nd stage results on on learning-from-experience channel as described in Section 3. I use CEO age, CFO age, and the average of CEO and CFO age in columns (2), (3), and (4), respectively. The dependent variable is a firm's net floating swap in the spirit of Bretscher et al. (2018) and Chava and Purnanandam (2007). Net floating swap is the pay-floating-receive-fixed notional amount minus the pay-fixed-receive-floating notional amount, divided by the total debt. Firm characteristics are Tobin's Q, tangibility, size, profitability, and R&D expenditure. Market expectations are the aggregate expectations on inflation over the next one, two, three, five, and ten years. Variable definitions are presented at Section A.3. The first inflation rate is available in 1948. The t statistics are presented in parentheses and are clustered at the firm level. Data spans from 2001 to 2022.

A Online Appendix

A.1 Additional figures and tables

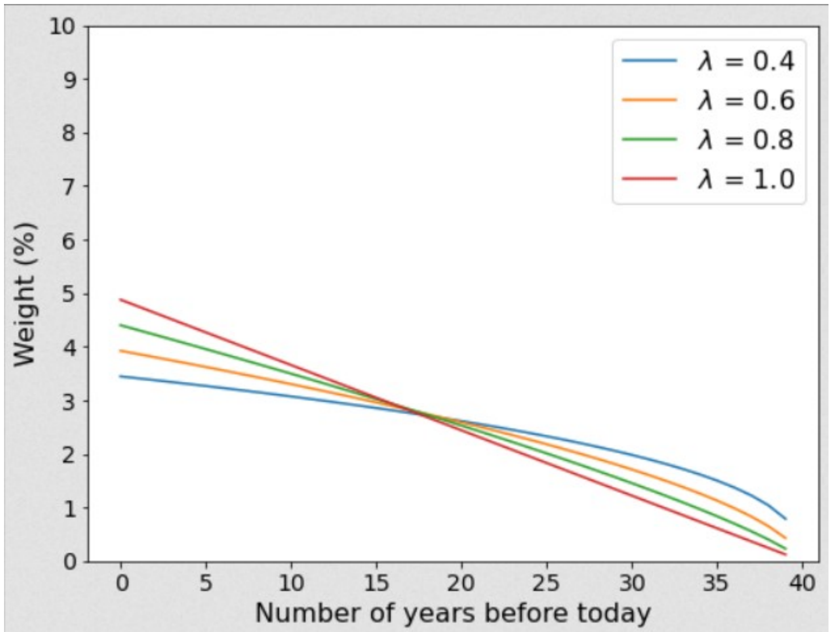


Figure A.1: Weights on experienced inflation rates for a 40-year old manager

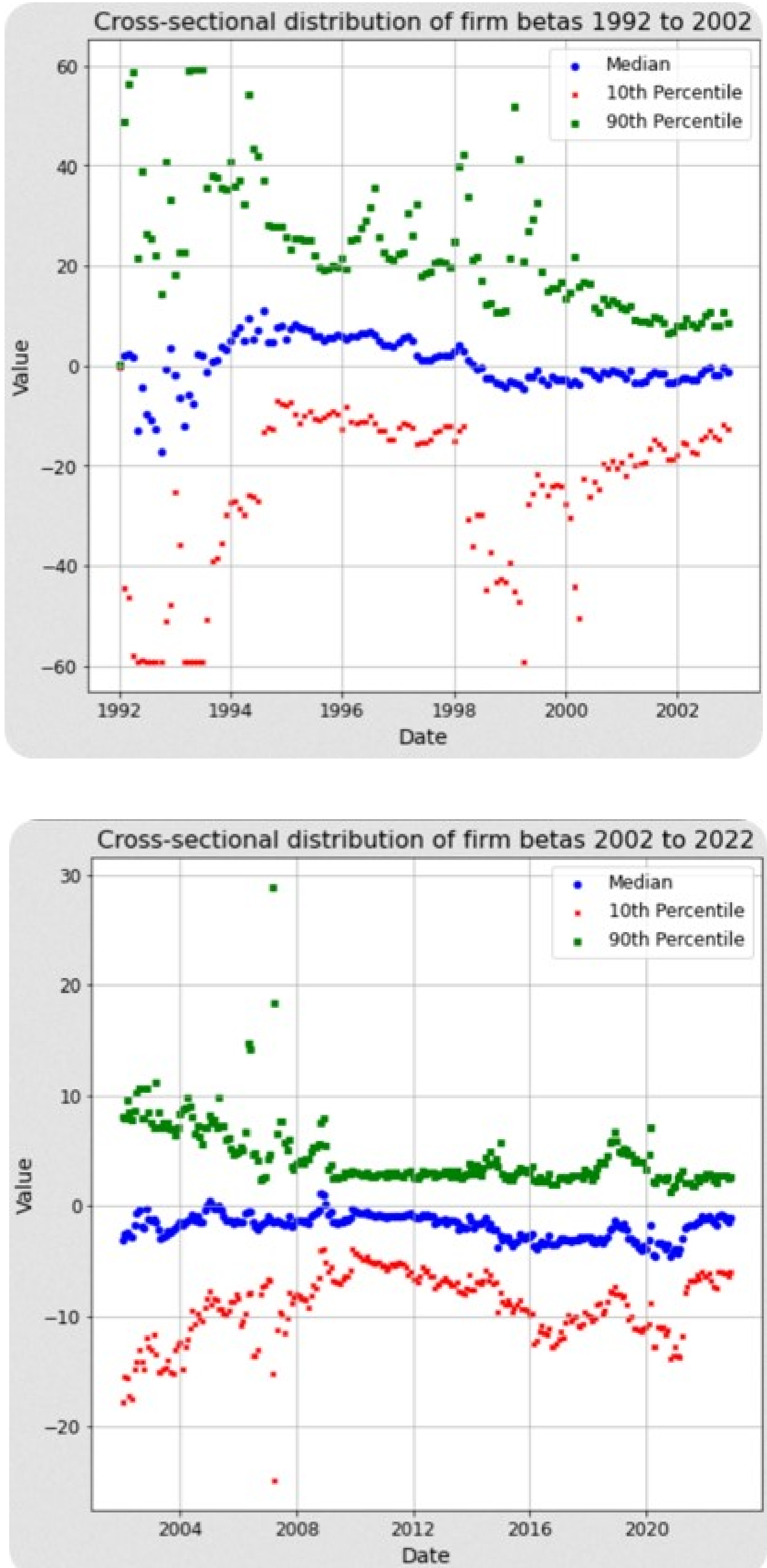


Figure A.2: Cross-sectional distribution of firm's inflation betas, January 1992 to December 2022

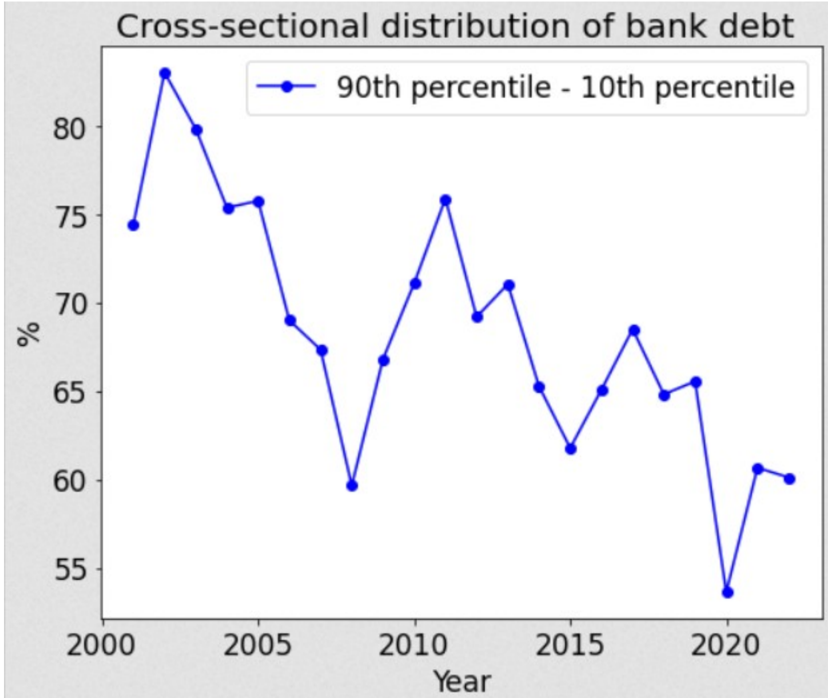
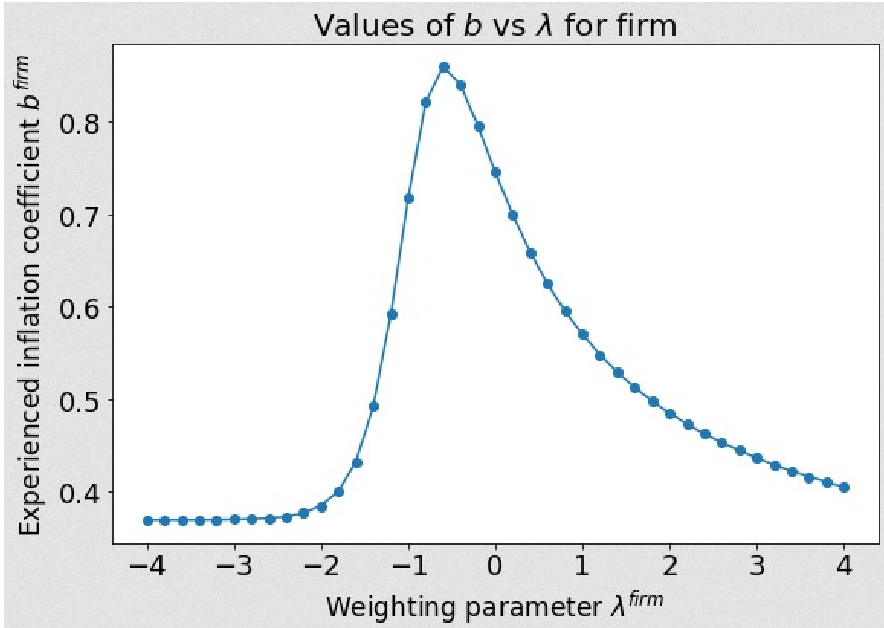


Figure A.3: Cross-sectional distribution of bank debt (%) in 2001 to 2022



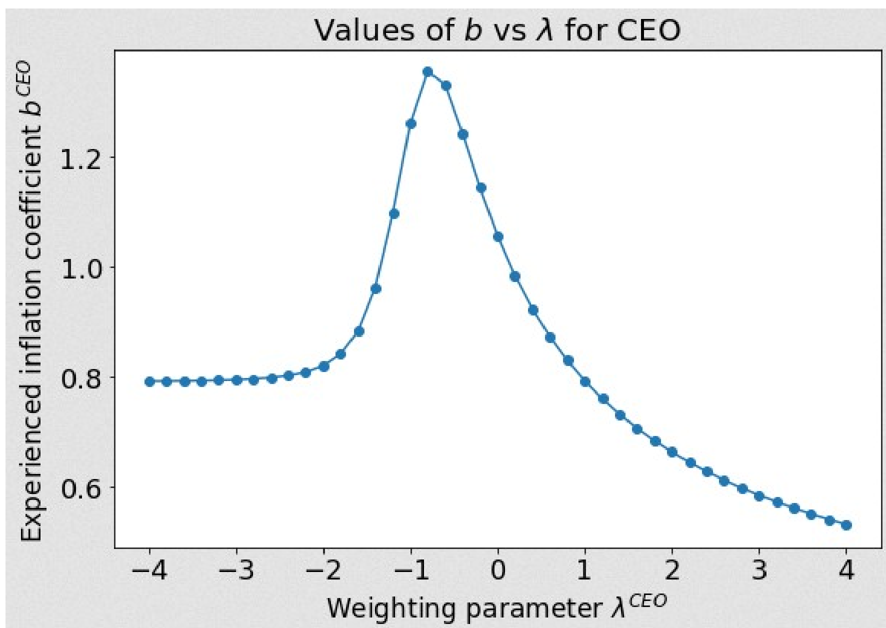


Figure A.4: Values of inflation experience coefficients b versus weighting parameter λ

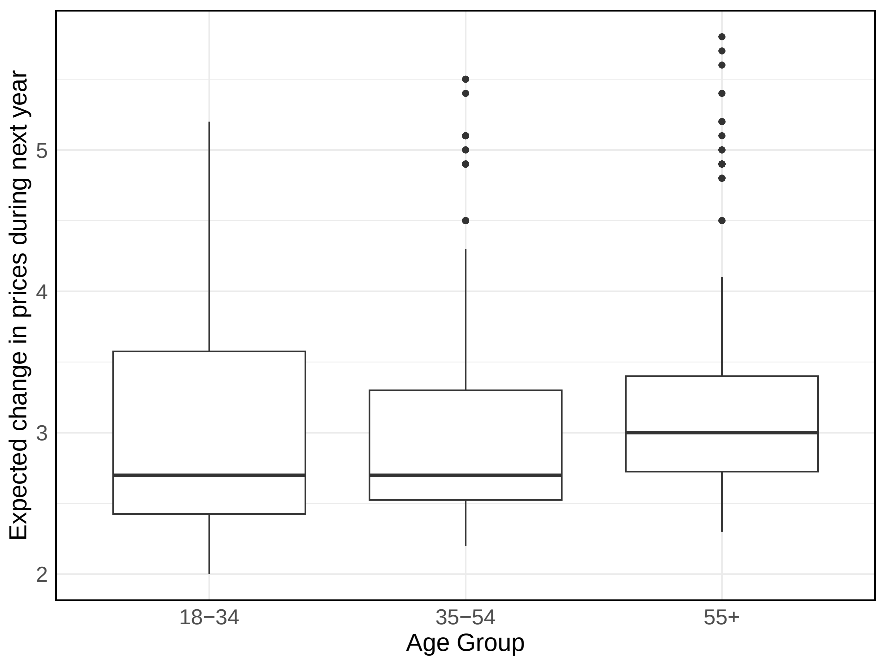


Figure A.5: **Inflation expectation by age**
Age group is defined upon summary statistics of CEO age.

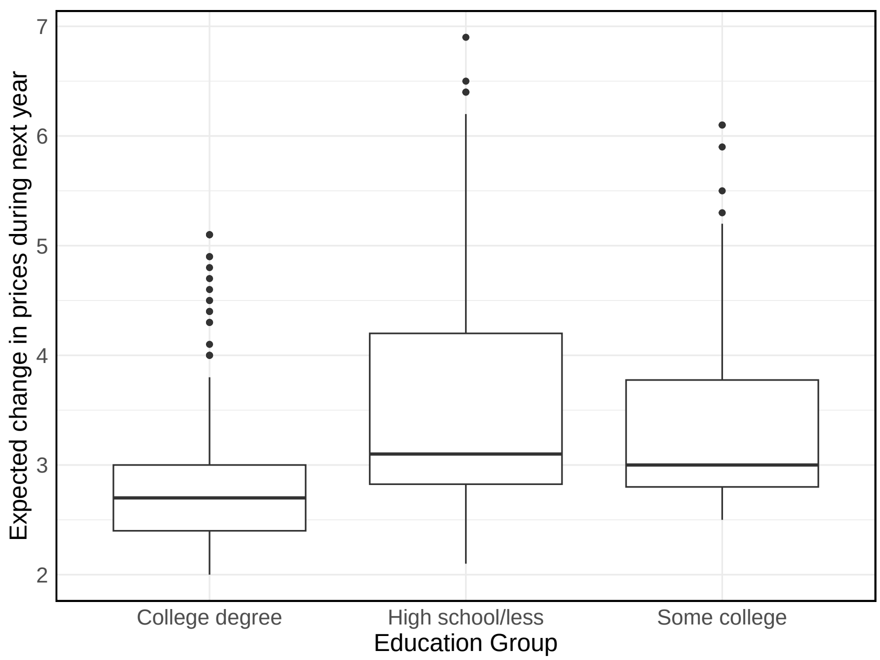


Figure A.6: **Inflation expectation by education**

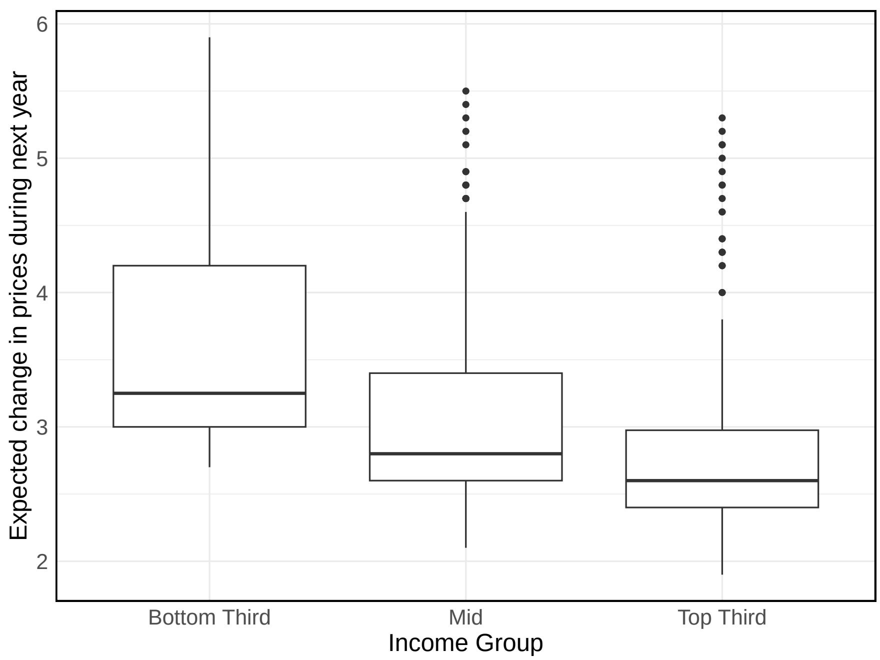


Figure A.7: **Inflation expectation by income**

Correlation matrix (%)

	R^e_{it}	CEO learning	Firm learning	Π_t	ϵ^{Π}_t	Bank debt
R^e_{it}	100	-1.95	-1.28	-7.53	-2.56	0.32
CEO cohort		100	66.28	8.45	0.10	-12.03
Firm cohort			100	4.90	-0.98	-5.04
Inflation				100	33.32	-11.51
Inflation shock					100	-5.26
Bank debt						100

Table A.1: Data spans from January 1992 to December 2022. R^e_{it} stands for firm-month excess returns. manager learning is the manager variable in equation (2) estimated from equation (5) shown as results in column (1) of Table 3. Firm learning is the firm variable in equation (2) estimated from equation (5) shown in column (2) of Table 3. Π_t is the monthly inflation rate. ϵ^{Π}_t is the inflation shock estimated from equation (1). Bank debt (%) is a firm's bank debt divided by its total debt. Due to data availability, bank debt and its correlations span from January 2001 to December 2022.

Years in extreme inflation and deflation

Inflation	1948, 1950, 1951, 1968, 1969, 1970, 1971, 1973, 1974, 1975, 1976, 1977, 1978, 1979, 1980, 1981, 1982, 1984, 1989, 1990, 1991, 2005, 2008, 2021, 2022, 2023.
Deflation	1949, 1950, 1952, 1953, 1954, 1955, 1956, 1959, 1960, 1961, 1962, 1963, 1964, 1965, 1986, 1987, 1998, 2001, 2002, 2006, 2008, 2009, 2010, 2012, 2013, 2014, 2015, 2016, 2019, 2020, 2021.

Table A.2: This table presents years in extreme inflation and deflation. Using monthly inflation rates, extreme inflation is defined as those rates that exceed the 75th percentile between 1948 and 2022. The threshold is 3.03%, as shown in column (1) in Table 1. Extreme deflation is characterized as months where inflation rates fall below the 25th percentile rate, which is 1.61%.

A.2 Standard errors of λ^{firm} and λ^{manager}

$$R_{it}^{e} = \left[b^{\text{firm}} \sum_{k=1}^{\text{firm age}_{it}-1} w_{it}(\lambda^{\text{firm}}) \Pi_{t-k} + b^{\text{manager}} \sum_{k=1}^{\text{manager age}_{it}-1} w_{it}(\lambda^{\text{manager}}) \Pi_{t-k} \right] \epsilon_t^{\Pi} + \mu_i + u_{it} \tag{A.1}$$

where

$$w_{it}(\lambda^{\text{firm}}) = \frac{(\text{firm age}_{it} - k)^{\lambda^{\text{firm}}}}{\sum_{k=1}^{\text{firm age}_{it}-1} (\text{firm age}_{it} - k)^{\lambda^{\text{firm}}}} \tag{A.2}$$

and

$$w_{it}(\lambda^{\text{manager}}) = \frac{(\text{manager age}_{it} - k)^{\lambda^{\text{manager}}}}{\sum_{k=1}^{\text{manager age}_{it}-1} (\text{manager age}_{it} - k)^{\lambda^{\text{manager}}}} \tag{A.3}$$

Π_{t-k} is the headline inflation rate at month $t-k$. R_{it}^{e} is the excess returns of firm i at month t. The error term u_{it} is

$$u_{it} = R_{it}^{e} - \left[b^{\text{firm}} \sum_{k=1}^{\text{firm age}_{it}-1} w_{it}(\lambda^{\text{firm}}) \Pi_{t-k} + b^{\text{manager}} \sum_{k=1}^{\text{manager age}_{it}-1} w_{it}(\lambda^{\text{manager}}) \Pi_{t-k} \right] \epsilon_t^{\Pi} - \mu_i \tag{A.4}$$

The parameters λ^{firm} and λ^{manager} in the model is estimated by are estimated by maximum likelihood. The restriction is $\lambda^{\text{firm}} = 0$. I test the following hypothesis

$$H_0 : \lambda^{\text{firm}} = 0 \text{ vs } H_1 : \lambda^{\text{firm}} \neq 0 \tag{A.5}$$

The asymptotic covariance matrix of the maximum likelihood estimator λ^{firm} is a matrix of parameters that must be estimated. Following Greene (2003), this estimator is computed by evaluating the actual second derivatives matrix of its log-likelihood function. This information matrix is:

$$I(\theta)^{-1} = \left(-\frac{\partial^2 \log L(\theta)}{\partial \theta' \theta} \right)^{-1} = - \begin{bmatrix} \frac{\partial^2 \log L(\theta)}{\partial (\lambda^{\text{firm}})^2} & \frac{\partial^2 \log L(\theta)}{\partial \lambda^{\text{firm}} \lambda^{\text{manager}}} \\ \frac{\partial^2 \log L(\theta)}{\partial \lambda^{\text{manager}} \lambda^{\text{firm}}} & \frac{\partial^2 \log L(\theta)}{\partial (\lambda^{\text{manager}})^2} \end{bmatrix}^{-1} \tag{A.6}$$

where $\theta = [\lambda^{\text{firm}}, \lambda^{\text{manager}}]'$ is a set of parameters and $\log L(\theta)$ is its log-likelihood function.

I assume the error term u_{it} is normally distributed with mean 0 and variance σ^2, i.e. $u_{it} \sim N(0, \sigma^2)$. The term u_{it} is influenced by λ^{firm} and λ^{manager} through the weights $w_{it}(\lambda^{\text{firm}})$ and $w_{it}(\lambda^{\text{manager}})$ in this model. Therefore, the distribution of u_{it} and its likelihood are dependent on these parameters. To obtain the MLE estimates for λ^{firm} and λ^{manager}, I write out the log-likelihood function of the entire sample in terms of these parameters. I then differentiate the log-likelihood with respect to each of the parameters. With these derivatives, I can estimate the variance-covariance matrix of by taking the inverse of the expected negative Hessian matrix of the log-likelihood function at the MLE estimates (i.e. create an information matrix).

The likelihood and the log-likelihood functions are:

$$L = \prod_{i=1}^{N} \prod_{t=1}^{T} \frac{1}{\sqrt{2\pi\sigma^2}} \exp\left(-\frac{u_{it}^2}{2\sigma^2}\right) \tag{A.7}$$

$$\log(L) = -\frac{NT}{2} \log(2\pi\sigma^2) - \frac{1}{2\sigma^2} \sum_{i=1}^{N} \sum_{t=1}^{T} u_{it}^2 \tag{A.8}$$

where $\pi \approx 3.14$ and there are firm $i = 1, \ldots, N$ and month $t = 1, \ldots T$.

The first derivative with respect to λ^{firm} is

$$\frac{\partial \log(L)}{\partial \lambda^{\text{firm}}} = \frac{b^{\text{firm}}}{\sigma^2} \sum_{i=1}^{N} \sum_{t=1}^{T} u_{it} \sum_{k=1}^{\text{firm age}_{it}-1} \frac{\partial w_{it}(\lambda^{\text{firm}})}{\partial \lambda^{\text{firm}}} \Pi_{t-k} \epsilon_t^{\Pi} \tag{A.9}$$

The second derivative is

$$\begin{aligned} \frac{\partial^2 \log(L)}{\partial (\lambda^{\text{firm}})^2} = -\frac{1}{2\sigma^2} \sum_{i=1}^{N} \sum_{t=1}^{T} \Bigg[& 2(b^{\text{firm}})^2 (\epsilon_t^{\Pi})^2 \left(\sum_{k=1}^{t-1} \Pi_{t-k} \frac{\partial w_{it}(\lambda^{\text{firm}})}{\partial \lambda^{\text{firm}}} \right)^2 \\ & -2b^{\text{firm}} \epsilon_t^{\Pi} \left(R_{it}^{e} - \epsilon_t^{\Pi} u_{it} \right) \sum_{k=1}^{t-1} \Pi_{t-k} \frac{\partial^2 w_{it}(\lambda^{\text{firm}})}{\partial (\lambda^{\text{firm}})^2} \Bigg] \end{aligned} \tag{A.10}$$

where

$$\frac{\partial w_{it}(\lambda^{\text{firm}})}{\partial \lambda^{\text{firm}}} = \frac{\log(\text{age}_{it} - k) \times (\text{age}_{it} - k)^{\lambda^{\text{firm}}} \times \sum_{k=1}^{\text{age}_{it}-1} (\text{age}_{it} - k)^{\lambda^{\text{firm}}}}{\left(\sum_{k=1}^{\text{age}_{it}-1} (\text{age}_{it} - k)^{\lambda^{\text{firm}}}\right)^2} - \frac{(\text{age}_{it} - k)^{\lambda^{\text{firm}}} \times \sum_{k=1}^{\text{age}_{it}-1} \log(\text{age}_{it} - k) \times (\text{age}_{it} - k)^{\lambda^{\text{firm}}}}{\left(\sum_{k=1}^{\text{age}_{it}-1} (\text{age}_{it} - k)^{\lambda^{\text{firm}}}\right)^2}. \tag{A.11}$$

and

$$\begin{aligned}\frac{\partial^2 w_{it}(\lambda^{\text{firm}})}{\partial (\lambda^{\text{firm}})^2} =& \frac{(-k + \text{age}_{it})^{\lambda^{\text{firm}}} \left(2 \left(\sum_{k=1}^{\text{age}_{it}-1} (-k + \text{age}_{it})^{\lambda^{\text{firm}}} \log(-k + \text{age}_{it})\right)^2\right.}{\sum_{k=1}^{\text{age}_{it}-1} (-k + \text{age}_{it})^{\lambda^{\text{firm}}}} \\ &- \frac{\sum_{k=1}^{\text{age}_{it}-1} (-k + \text{age}_{it})^{\lambda^{\text{firm}}} \log(-k + \text{age}_{it})^2}{\sum_{k=1}^{\text{age}_{it}-1} (-k + \text{age}_{it})^{\lambda^{\text{firm}}}} \\ &+ \log(-k + \text{age}_{it})^2 - \frac{2 \log(-k + \text{age}_{it}) \sum_{k=1}^{\text{age}_{it}-1} (-k + \text{age}_{it})^{\lambda^{\text{firm}}} \log(-k + \text{age}_{it})}{\sum_{k=1}^{\text{age}_{it}-1} (-k + \text{age}_{it})^{\lambda^{\text{firm}}}}\end{aligned} \tag{A.12}$$

Equations (A.9) to (A.12) are estimated using data. The true value of the variance σ^2 of the error term u_{it} is unknown. Therefore, following Greene (2003), I proxy this with variance of the residual of the regression estimated in equation (A.1). I then calculate the information matrix in equation (A.6) at the MLE estimates λ^{firm} and λ^{manager}. This matrix serves as an asymptotic variance-covariance matrix of λ^{firm} and λ^{manager} As fixed effects μ_i are added, I cluster the standard error at firm level.

A.3 Firm-level control variable definition

Profitability. Motivated by Gorodnichenko and Weber (2016), a firm's profitability is measured as a firm's operating income before depreciation (Compustat item *oibdp*) divided by its total asset (Compustat item *at*).

Size. Size is a firm's market capitalization calculated as its stock price (CRSP item *prc*) multiplied by the number of shares outstanding (CRSP item *shrout*).

Tangibility. Tangibility is a firm's net property, plant, and equipment (Compustat item *ppent*) divided by its total asset (Compustat *at*).

Tobin's q. Tobin's Q. Following Daniel and Titman (2006) and Peters and Taylor (2017) and many others, Tobin's Q is measured as the firm's market value divided by the firm's book value. The firm's market value is the market value of the outstanding equity (Compustat items *prcc* times *csho*), plus the book value of debt (Compustat items *dltt* plus *dlc*), minus the firm's current assets (Compustat item *act*). The firm's book value is the shareholders' equity (Compustat item *seq*) minus the redemption value of preferred stock (Compustat item *pstkrv*). If *seq* is missing, common equity (Compustat item *ceq*) plus the par value of preferred stock (Compustat item *pstk*) is used instead. If *pstkrv* is missing, I use liquidating value of the preferred stock (Compustat item *pstkl*) or carrying value of preferred stock (Compustat item *pstk*), in that order of preference.