Extrapolative Expectations, Corporate Activities, and Asset Prices*

Yao Deng†

November 2019

Job Market Paper

Abstract

This paper studies how extrapolative expectations affect corporate activities and asset prices. Empirically, an increase in misperception on earnings growth, a firm-level proxy for extrapolation, is associated with an increase in investment, debt and equity issuance, and bond and stock prices in the short term, but is predictive of a decline in all these activities and prices in the long term. These patterns are more pronounced among financially constrained firms. Theoretically, I build a firm dynamics model with extrapolative expectations and financial frictions, and show that the interaction between these two frictions is crucial in explaining the empirical findings. Intuitively, after a sequence of favorable shocks, agents extrapolate and become overoptimistic about future productivity. Firms invest and borrow more in the short term. A lower perceived default probability improves financing conditions, further increasing investment and borrowing. Future realizations then turn out worse than expected, subjecting real and financial activities and asset prices to predictable reversals in the long term.

*I am deeply indebted to Frederico Belo, Xiaoji Lin, Jianfeng Yu, Robert Goldstein, and Juliana Salomao for their continuous and invaluable guidance.

†Carlson School of Management, University of Minnesota. Email: dengx184@umn.edu

1 Introduction

Survey expectations have been shown to be extrapolative, that is, overoptimistic in good times and overpessimistic in bad times. However, there is limited evidence on how extrapolative expectations affect firms' investment, external financing, and bond and stock prices. Furthermore, the quantitative importance of extrapolative expectations is still an open question.

This paper shows that the impact of extrapolative expectations on corporate activities and asset prices is substantial. Empirically, an increase in misperception on earnings growth, a firm-level proxy for extrapolation, is associated with an increase in investment, debt and equity issuance, and bond and stock prices in the short term, but is predictive of a decline in all these activities and prices in the long term. These patterns are more pronounced among financially constrained firms. Theoretically, a firm dynamics model featuring both extrapolative expectations and financial frictions accounts for the empirical findings. The quantitative success stems from the interaction between these two frictions. Each of these frictions, in isolation, leads to much smaller quantitative effects.

Using a panel of US publicly listed firms, I first show that analysts' expectations of firms' long-term earnings growth are extrapolative, consistent with Bordalo, Gennaioli, La Porta, and Shleifer (2019). More importantly, the extrapolation component significantly predicts firms' real and financial activities and asset prices in both the short term and the long term. When firms' current earnings are high, agents are overoptimistic, and their forecasts on future earnings growth are above future realizations. This systematic predictability in forecast errors poses a clear challenge for rational expectations. To study the impact of extrapolative expectations more precisely, I extract the overreaction component from the survey expectations. I refer to the deviations of survey expectations from rational expectations as the misperception on earnings growth, or the expectation wedge, which captures the extrapolation component at the firm level. This new measure is constructed by taking the difference between the survey (subjective) and model-implied objective earnings growth expectations. I use a cross-sectional earnings model to forecast the objective earnings of individual firms.

Next I use this novel measure to examine the relationship between the misperception on earnings growth and firms' physical and intangible capital investment, employment, debt and equity issuance, and credit spread changes and stock returns. I find that overoptimism after good news is significantly associated with higher investment, debt and equity issuance, and bond and stock prices in the short term, but is predictive of a decline in all activities and asset prices in the long term. Economically, the effect is large. Take investment as an example, a one standard deviation increase in misperception in year t predicts a 1.7% increase in investment rate in year $t+1$ and a 2-4% decline in investment rate in year $t+2$ onward to $t+5$. These results are robust to standard controls. This pattern of short-term overreaction and long-term systematic reversal is more pronounced among financially constrained firms. An increase in misperception on earnings growth predicts both a much larger short-term expansion and long-term contraction in investment among constrained firms relative to unconstrained firms.

To understand these results and evaluate the quantitative effects of extrapolative expectations, I build a heterogeneous firms dynamic model with extrapolative expectations and financial frictions. In the model, firms invest in capital and finance investments either internally through accumulated earnings or externally through a mix of debt and equity. Firms face frictions when they resort to external financing. Equity financing entails issuance costs that are motivated by underwriting fees and adverse selection costs. Debt financing is costly because repayment is not enforceable and a fraction of the principal is lost in default. Firms choose to default and exit if they cannot generate enough cash flow to meet their current liabilities and the fixed cost of operation.

The main departure from a standard model is the incorporation of extrapolative expectations. To model extrapolative expectations, I adopt a psychologically founded model of beliefs from Bordalo, Gennaioli, and Shleifer (2018) which builds on the representativeness heuristic from Kahneman and Tversky (1972). According to Kahneman and Tversky, a certain attribute is judged to be excessively common in a population when that attribute is representative for the population, meaning that it occurs more frequently in the given population than in a relevant reference population. When it applies to modeling expectations in a macroeconomic context, it implies that agents overestimate the probability of a good (bad) future state when the current news is good (bad). In the model, firms' productivity is hit by aggregate and idiosyncratic shocks, both of which follow AR(1) processes. Both managers and investors form their subjective beliefs about future productivity in an extrapolative manner, that is, the current productivity shock is extrapolated into the future. Lastly, managers make optimal investment and financing decisions to maximize the value of the firm under subjective expectations. Equilibrium bond prices are endogenously determined under subjective expectations as well.

To discipline the extrapolation parameter, I calibrate the model to match the predictability of forecast errors in firm-level earnings growth forecasts, which are computed using survey data obtained from the Institutional Brokers' Estimate System (IBES) and Compustat datasets. The benchmark model does a reasonably good job at matching unconditional moments for both quantities and asset prices. More importantly, when I run the same regression analyses on model-generated data, the model produces quantitatively consistent regression coefficients of firms' investment, debt and equity issuance, and bond and stock returns on the misperception on earnings growth. Namely, an increase in misperception on earnings growth is associated with an increase in investment, debt and equity issuance, and firm-level bond and stock prices in the short term, but is predictive of a decline in all these activities and prices in the long term.

The quantitative effects of extrapolative expectations are large. After a positive aggregate shock, the average investment, debt growth, and credit spread responses under the extrapolative expectations model are about 40% higher than they are under the rational expectations model. This is driven by the interaction between extrapolative expectations and financial frictions, consistent with the intuition that the feedback from the financial market through the cost of capital further affects investment and financing responses. These interaction effects are summarized in Figure 1.

[Figure 1 here]

The economic mechanism in the model operates as follows. Firms that experience a sequence of favorable shocks become overoptimistic about future productivity, which raises the perceived value of the firm. These overoptimistic firms also invest more and borrow more in the short term. At the same time, overoptimism among investors lowers the perceived default probability, and these firms are then able to issue debt and equity at higher prices. Improved financing conditions further increase investment and borrowing. However, future realizations turn out worse than previously expected and expectations are endogenously revised downward, subjecting real and financial activities and asset prices to predictable reversals in the long term.

Finally, I show that both extrapolative expectations and financial frictions are important for the good quantitative fit of the model. Without extrapolative expectations, the model fails to reconcile the forecast error predictability fact and generates a close to zero correlation between forecast errors and current earnings over assets, compared with a correlation of -0.1 in the data and the benchmark model. The model also generates less volatile quantities and asset prices compared with the data. Without financial frictions, the model implies a counterfactually too high equity issuance fraction and leverage ratio which leads to a unrealistically high default rate. The bonds also become much less risky without bankruptcy loss and the implied credit spread is too small. Moreover, without financial frictions, the model generates opposite long-term predictability of extrapolation for investment, debt and equity issuance, and bond and stock returns, inconsistent with the reversal evidence in the data and the benchmark model.

The paper is organized as follows. Section 2 reviews previous studies related to my work. Section 3 presents the empirical results. Section 4 describes the model. Section 5 presents the model's results. Section 6 concludes. The Appendix contains additional empirical and quantitative results.

2 Related Literature

Expectations are central to decision making under uncertainty. According to the rational expectations hypothesis, agents form their beliefs about the future and make decisions using statistically optimal forecasts. A growing literature tests this hypothesis using survey data on the expectations of households, managers, financial analysts, and professional analysts. The evidence points to systematic departures from rational expectations, which take the form of predictable forecast errors. Such departures have been documented in the cases of forecasting the aggregate stock market (Greenwood and Shleifer 2014, Adam, Marcet, and Beutel 2017, Adam, Matveev, and Nagel 2018), the cross section of stock returns (La Porta 1996, Bordalo, Gennaioli, La Porta, and Shleifer 2019), credit spreads (Bordalo, Gennaioli, and Shleifer 2018), interest rates (Piazzesi, Salomao, and Schneider 2013, Cieslak 2018), corporate earnings (De Bondt and Thaler 1990, Ben-David, Graham, and Harvey 2013, Gennaioli, Ma, and Shleifer 2016, Barrero 2018, Bouchaud, Krueger, Landier, and Thesmar 2019), inflation and other macro variables (Coibion and Gorodnichenko 2012, 2015, Bordalo, Gennaioli, Ma, and Shleifer 2018, Bhandari, Borovicka, and Ho 2019), and foreign exchange rates (Dominguez 1986, Frankel and Froot 1987).

A notable departure from rational expectations points to the extrapolative structure of belief formation across both managers and investors. This empirical evidence serves as the key motivation of my paper. Using data collected by Duke University, Gennaioli, Ma, and Shleifer (2016) show that errors in chief financial officers' expectations of earnings growth are predictable from past earnings. Future realized earnings growth systematically falls short of expectations when past earnings are high and exceeds expectations when past earnings are low. Similar extrapolative evidence among US managers has been documented in Barrero (2018) using the confidential Survey of Business Uncertainty, which is run by the Federal Reserve Bank of Atlanta. Among analysts' expectations regarding credit spreads, Bordalo, Gennaioli, and Shleifer (2018) provide extrapolative expectations evidence that survey forecasts of credit spreads are excessively optimistic when these spreads are low, and that both errors and revisions in forecasts are predictable. Investors' expectations on the aggregate stock market are also found to be extrapolative, as recently summarized by Greenwood and Shleifer (2014) using data from multiple investor surveys. Many investors hold extrapolative expectations, believing that stock prices will continue rising after they have previously risen and continue falling after they have previously fallen. In the cross section of stock returns, La Porta (1996) and Bordalo, Gennaioli, La Porta, and Shleifer (2019) document that equity analysts' expectations on firms' long-term earnings growth are extrapolative, and returns on stocks with the most optimistic long-term earnings growth forecasts from analysts are lower than those for stocks with the most pessimistic forecasts.

Previous theoretical studies of extrapolative expectations are mostly qualitative (e.g., Barberis, Shleifer, and Vishny 1998, Barberis, Greenwood, Jin, and Shleifer 2015, Bordalo, Gennaioli, and Shleifer 2018, Greenwood, Hanson, and Jin 2019). Bordalo, Gennaioli, and Shleifer (2018) offer a stylized model of credit cycles with extrapolative expectations. Greenwood, Hanson, and Jin (2019) develop a behavioral model of credit cycles in which investors extrapolate past default rates and highlight the feedback loop between debt financing and actual defaults. Relative to these papers, my main contribution is to introduce extrapolative expectations into an otherwise standard quantitative firm dynamics model with financial frictions. Extrapolation is based on fundamental productivity, and default, investment, financing decisions, and asset prices are endogenously determined in equilibrium.

Other quantitative studies of extrapolative expectations, or more generally, the real effects of mispricing, include Gilchrist, Himmelberg, and Huberman (2005), Alti and Tetlock (2014), Warusawitharana and Whited (2015), Hirshleifer, Li, and Yu (2015), and Bordalo, Gennaioli, Shleifer, and Terry (2019). Hirshleifer, Li, and Yu (2015) introduce extrapolative bias into a standard production-based model with recursive preferences to reconcile salient stylized facts about business cycles and the equity premium. In a contemporaneous and related paper, Bordalo, Gennaioli, Shleifer, and Terry (2019) quantitatively study the effect of extrapolative expectations on the aggregate economy, particularly the 2008 US financial crisis. My paper differs from theirs in two aspects: (1) this paper studies the effect of extrapolative expectations on firm-level investment, debt and equity issuance, and bond and stock prices both empirically and quantitatively, whereas their paper is mostly a quantitative analysis and studies the macro consequences of extrapolative expectations; (2) this paper also focuses on the quantitative interaction effects between extrapolative expectations and financial frictions, whereas their paper abstracts from equity issuance and stochastic discount factor, thus has no feedback effect from risk premium into real activities.

Although the effect of extrapolative expectations on stock returns has been studied in the empirical literature (e.g., La Porta 1996), its real effects on firm-level investment and financing are underexplored.[1] My paper contributes to the empirical literature by (1) constructing a novel measure of misperception on earnings growth that extracts the extrapolation component from the survey expectations and then (2) analyzing the impact of extrapolation on

[1]Baker, Stein, and Wurgler (2003) study corporate investment sensitivity to nonfundamental movements in stock prices. Gulen, Ion, and Rossi (2019) study the impact of aggregate credit market sentiment on corporate investment and debt issuance. My paper differs from theirs in that I study the impact of extrapolation on earnings growth at the firm level on both real and financial activities and asset prices. More importantly, I also quantitatively evaluate the role of extrapolative expectations.

firm-level investment, debt and equity issuance, and bond and stock prices, in both the short term and the long term.

My model is closely related to the standard heterogeneous firms model with defaultable debt, as in Hennessy and Whited (2007), Gomes and Schmid (2010), Kuehn and Schmid (2014), Begenau and Salomao (2018), Salomao and Varela (2018), and Favilukis, Lin, and Zhao (2019). I complement this literature by incorporating extrapolation bias as the only departure and studying its impact on quantities and prices. More broadly, my paper is related to the strand of production-based asset pricing literature that links firm characteristics to asset returns. See, for example, Cochrane (1991), Zhang (2005), Belo, Lin, and Bazdresch (2014), İmrohoroğlu and Tüzel (2014), Kogan and Papanikolaou (2014), Kung and Schmid (2015), Croce (2014), Deng (2019), Belo, Deng, and Salomao (2019), and Ai, Li, Li, and Schlag (2019), among many others.[2]

Finally, my paper is related to the credit cycles literature that studies the question of whether credit booms create risks to future macroeconomic performance. The views can be categorized into two genres: financial frictions and irrationality. I briefly summarize the theory, limitations, empirical support for each category, and the contribution of my paper.[3]

The literature following Bernanke and Gertler (1989) and Kiyotaki and Moore (1997) assigns credit market frictions a central role in amplifying and propagating shocks to the economy. The idea is that a negative shock that reduces the net worth of credit-constrained firms forces them to curtail investment in capital. Capital prices and output then fall. The fall in the value of the collateral reduces the debt capacity of constrained firms even more, causing an additional fall in investment, capital prices, and output. The cumulative effect can be dramatic. However, the quantitative effect of financial frictions is found to be quite small (Kocherlakota 2000 and Cordoba and Ripoll 2004). Motivated by this theory, much

[2] See Kogan and Papanikolaou (2012) for a comprehensive survey of the production-based asset pricing literature.

[3] The work of Lopez-Salido, Stein, and Zakrajsek (2017) provides a more detailed review of both categories.

of the empirical work has focused on balance-sheet measures of leverage or credit growth, such as the growth of bank loans (Baron and Xiong 2017) or the growth of household debt (Mian, Sufi, and Verner 2017), among others. The general pattern is that rapid increases in outstanding credit presage economic downturns.

An alternative approach to studying credit cycles builds on the narratives of Minsky (1977), which is that investor optimism brings about the expansion of credit and investment, and leads to a crisis when such optimism abates. This focus on investor sentiment, as opposed to financial frictions, leads the empirical research to identify credit booms with proxies for the expected returns on credit assets. Greenwood and Hanson (2013) show that the credit quality of corporate debt issuers deteriorates during credit booms and that a high share of risky loans forecasts low, and even negative, corporate bond returns. Lopez-Salido, Stein, and Zakrajsek (2017) find that low credit spreads predict both a rise in credit spreads and low economic growth afterward.

My paper intends to provide an integrated view of the above two categories. Financial frictions and belief distortions complement and interact with each other, giving rise to rich dynamics in quantities and prices. I build a quantitative model featuring both frictions and show that the interaction between these two frictions amplifies the exogenous shocks and is crucial in explaining the empirical findings.

3 Empirical Findings

In this section, I explore the empirical relationships between extrapolative expectations, firms' real and financial activities, and asset prices. For the analysis of firm-level real and financial activity, I study how physical and intangible capital investment, employment, and debt and equity financing respond to expectations. For the analysis of firm-level asset prices, I study credit spread changes and stock return responses. I document both the short-term and long-term impact of extrapolation on variables of interest. I first describe the data, then propose a novel measure of extrapolation on firms' earnings growth, followed by the main empirical specifications and the results.

3.1 Data

The empirical analyses mainly draw on three categories of data: (1) data on firm-level earnings growth expectations from IBES, (2) standard firm financial data from Compustat and stock return data from the Center for Research in Security Prices (CRSP), and (3) firm-level corporate bond yield spread data from the Trade Reporting and Compliance Engine (TRACE) and the Fixed Income Securities Database (FISD). I briefly describe the data here. Section A in the Appendix contains a more detailed construction of variables and summary statistics. The analysis is annual between 1981 and 2018.

I obtain data on equity analysts' consensus forecasts of firms' long-term earnings growth rate ($MEANEST$, henceforth LTG) from the IBES Summary Statistics file from 1981, when LTG became available, to 2018. IBES defines LTG as the "expected annual increase in operating earnings over the company's next full business cycle, a period ranging from three to five years". I use monthly average consensus forecasts within a year to represent annual consensus forecasts in order to use the most available observations within each year. To compare forecasted earnings growth with realized earnings growth, I gather realized earnings data from IBES Actuals files. I exclude firms that have negative earnings when calculating realized earnings growth.

The set of dependent variables starts with capital formation. I measure the firm investment rate as $\frac{CAPX_{i,t}}{K_{i,t-1}}$ where $CAPX$ is capital expenditures and K is net property plant and equipment. Intangible capital is defined as $SG\&A + R\&D$ (sales, general and administrative plus research and development). Employment is number of employees (EMP). The set of financing variables includes debt issuance and equity issuance. Following Greenwood and Hanson (2013), I define debt issuance as the change in assets minus the change in book equity, scaled by lagged assets. Equity issuance is measured by the sale of common and preferred stock ($SSTK$) scaled by lagged assets. All of the above variables are winsorized every year at the 1st and 99th percentiles.

Corporate bond data are from the merged dataset of TRACE for bond transactions and FISD for bond issue and issuer characteristics. Data on yield (T_YLD_PT) and monthly return (RET_EOM) are the main focus. For firms with multiple corporate bonds, the equally weighted average yield and return are calculated to represent the firm-level yield and return. TRACE was launched in 2002. Thus, corporate bond data are from 2002 to 2018. Finally, I take stock returns from CRSP between 1981 and 2018 that are listed on the NYSE, AMEX, or Nasdaq and have share codes 10 and 11. Delisting returns are added when available. The risk-free rate is downloaded from the Fama and French Data Library.

3.2 Measuring extrapolation on earnings growth expectations

In this subsection, I first test the rationality of analysts' long-term earnings growth forecasts and provide evidence that expectations are formed in an extrapolative manner. However, subjective expectations alone are confounded by objective or rational expectations on earnings growth. To study the impact of extrapolative expectations more precisely, I then develop a measure of misperception on earnings growth, or the expectation wedge, which is the difference between subjective and objective earnings growth expectations.

3.2.1 Extrapolative expectations evidence

First, I show that the subjective expectations on firms' long-term earnings growth are indeed extrapolative. One way to test the rationality of expectations, as proposed in Coibion and

Gorodnichenko (2015), is to use information on forecast errors (realizations minus forecasts) and forecast revisions (over time differences among forecasts on the same object). Since analysts' forecast revisions at t summarize all information received by forecasters in this period, over- or underreaction to information can then be assessed by correlating their forecast revisions with the subsequent forecast errors. Under rational expectations, forecast errors should be unpredictable using any information available at t. If expectations overreact, forecasts on the same object are revised upward too much and should predict a negative forecast error, (i.e., lower realizations than expected). I test this hypothesis for my sample by running the following firm-level regression:

$$Actual_{i,t+h} - LTG_{i,t} = \alpha + f_i + \beta(LTG_{i,t} - LTG_{i,t-k}) + \epsilon_{i,t+h}, \tag{1}$$

where $Actual_{i,t+h} - LTG_{i,t}$ is the forecast error, defined as the difference between actual realized earnings growth over $h = 3, 4, 5$ years and current forecast LTG, and $LTG_{i,t} - LTG_{i,t-k}$ is the forecast revision on LTG over the past $k = 1, 2, 3$ years. I include firm fixed effects. The results are robust to including both firm and time fixed effects, as reported in Table A2 in the Appendix. Table 1 summarizes the results.

[Table 1 here]

Consistent with extrapolative expectations, an upward forecast revision on LTG is associated with an overreaction of news and is predictive of a lower future realization than expected. The estimated β coefficient is negative and highly statistically significant at different forecast horizons $h = 3, 4, 5$ as well as for different revision periods $k = 1, 2, 3$. These results are consistent with the findings in Bordalo, Gennaioli, La Porta, and Shleifer (2019) indicating extrapolative expectations.

3.2.2 Misperception on earnings growth

To extract the extrapolation component (i.e., the misperception component) from the subjective expectations, I construct a measure of misperception on earnings growth, defined as the difference between the subjective earnings growth forecasts, *LTG* from IBES data, and the objective earnings growth forecasts.

The construction requires taking a stand on the objective (rational) earnings forecast. To this end, I borrow insights from the accounting literature and use a cross-sectional earnings model to forecast earnings of individual firms, following Hou, Van Dijk, and Zhang (2012), who have adopted an extension and variation of the cross-sectional profitability models in Fama and French (2000, 2006). Specifically, I use the Fama and MacBeth (1973) approach: for each year from 1981 to 2018, I run the following cross-sectional regression of earnings on lagged earnings, total assets, dividend payment, dividend dummy, and negative earnings dummy:

$$E_{i,t+h} = \beta_0 + \beta_1 E_{i,t} + \beta_2 A_{i,t} + \beta_3 D_{i,t} + \beta_4 DD_{i,t} + \beta_5 NE_{i,t} + \epsilon_{i,t+h}, \tag{2}$$

where $E_{i,t+h}$ denotes the earnings of firm i in year $t+h$ ($h = 3,4,5$ to be consistent with the *LTG* forecast horizon), $A_{i,t}$ is the total assets, $D_{i,t}$ is the dividend payment, $DD_{i,t}$ is a dummy variable that equals 1 for dividend payers and 0 otherwise, and $NE_{i,t}$ is a dummy variable that equals 1 for firms with negative earnings and 0 otherwise. These variables capture a large amount of variation in earnings with the average regression R^2 up to over 80%. The fitted values of the regression are the objective earnings at horizon $h = 3,4,5$ years, and I take the average across horizons to be close to the *LTG* forecast horizon. Then, together with current period earnings, objective earnings growth is computed.

Figure 2 (top panel) plots the distribution of misperception on earnings growth, the difference between subjective and objective forecasts on earnings growth. Misperception centers on zero, implying that the subjective expectations are neither always overoptimistic nor always overpessimistic.

[Figure 2 here]

So when is misperception on earnings growth positive (overoptimism) or negative (overpessimism)? Extrapolative expectations predict that when current earnings are high, overoptimistic subjective expectations are higher than objective expectations, resulting in positive misperception. On the contrary, when current earnings are low, overpessimistic subjective expectations are lower than objective expectations, resulting in negative misperception. Figure 2 (bottom panel) provides a binned scatter plot of this relationship between year t misperception on earnings growth and year t earnings over total assets. The relationship is clearly positive and confirms that misperception captures the extrapolation component in the subjective forecast. In what follows, I study whether the misperception on earnings growth matters for various firm activities and asset prices in both the short term and the long term.

3.3 Misperception and investment

Managers make optimal corporate decisions under their subjective expectations. Above I show that their subjective expectations clearly deviate from rational expectations and display an extrapolative structure. In this subsection, I study the relationship between misperception on earnings growth and corporate investment decisions. I run the following panel regression:

$$IK_{i,t+h-1\to t+h} = \alpha_h + f_i + \beta_h Mis_{i,t} + \gamma_h X_{i,t} + \epsilon_{i,t+h}, \tag{3}$$

where $IK_{i,t+h-1\to t+h}$ is the firm-level physical capital investment rate from year $t+h-1$ to year $t+h$, $h = 0, 1, 2, 3, 4, 5$. The expression $Mis_{i,t}$ is the misperception on earnings growth in year t, f_i is the firm fixed effect, and $X_{i,t}$ is a vector of control variables.

I first conduct univariate analysis where I only control for the current period investment rate when predicting the future investment rate (i.e., $X_{i,t}$ only contains $IK_{i,t}$ for $h \geqslant 1$). Panel A in Table 2 presents the results. Consistent with the intuition, an increase in misperception on earnings growth in year t is associated with an increase in the contemporaneous and year $t+1$ investment rate and a decline in the investment rate from year $t+2$ up to year $t+5$, after controlling for the current period investment rate. The coefficients are also statistically significant at the 1% level with standard errors clustered by firm. In economic terms, a one standard deviation increase in misperception in year t correlates with a 4.88% increase in the contemporaneous investment rate and a 1.71% increase in the year $t+1$ investment rate. The long-term effects are that a one standard deviation increase in misperception in year t predicts a 1.71%, 3.47%, 4.09%, and 4.14% decline in the investment rate in year $t+2$, $t+3$, $t+4$, and $t+5$, respectively.

I also perform several robustness tests. In Panel B, I control for a range of well-known determinants of investment from previous literature at the same time. They include Tobin's Q, cash flow, firm size, individual firms' excess stock return, and book leverage. The relationship between misperception on earnings growth and investment maintains the same pattern as in univariate analysis and is highly significant. To preserve space, I drop the estimated coefficients and t-statistics on controls, but all the controls are statistically significant and economically meaningful in the direction as suggested by the literature (reported in the Appendix). Figure 3 visualizes the regression results and the pattern of short-term overreaction and long-term systematic reversals. In Table A5 in the Appendix, I add time fixed effects in the panel regression, which helps to assess the extent to which extrapolative expectations load on the idiosyncratic component of firm profitability. The coefficients in Panel A remains mostly significant, although with a smaller magnitude, implying that managers seem to significantly extrapolate the idiosyncratic component of past profitability. Taken together, these results indicate that subjective expectations are an important determinant of corporate investment beyond the traditional variables, and particularly, overoptimism leads to high short-term investment and a predictable contraction in investment in the long term.

[Table 2 here]

[Figure 3 here]

In the Appendix, I also examine the relationship between misperception on earnings growth and other types of firm real activities that are investments in intangible capital and employment. The regression specification is identical to equation 3 except that the left-hand-side variable is intangible capital growth and employment growth rather than physical capital investment. Table A3 and Table A4 in the Appendix report the results for intangible capital investment and employment, respectively. The implications of extrapolative expectations are largely the same with physical capital investment. When managers are overoptimistic about firms' earnings growth in year t, they also seem to increase intangible capital investment and employment contemporaneously and in year $t + 1$, but they are predicted to cut both intangible capital investment and employment starting from year $t + 2$ up to year $t + 5$.

Overall, the results in this subsection confirm that the effects of extrapolative expectations are not limited to capital investment but extend to a broader set of real activities, such as intangible capital investment and employment.

3.4 Misperception and external financing

In the previous subsection, I showed that a high level of misperception on earnings growth leads to high corporate investment in the short term and a decline in investment in the long term. In this subsection, I turn to investigating how misperception on earnings growth affects external financing for firms.

Firms finance their investment using a mix of debt and equity. When managers are overoptimistic about future productivity after a sequence of favorable shocks, they want to borrow more to finance their expanding investment needs. At the same time, in the financial market, extrapolative investors are overoptimistic about firm fundamentals and willing to provide relaxed financing terms, further increasing firms' investment and borrowing. In future periods, however, excess optimism wanes on average, making both real quantities and asset prices subject to reversals. I formally test this intuition on debt issuance and equity issuance as follows:

$$ISS_{i,t+h-1\to t+h} = \alpha_h + f_i + \beta_h Mis_{i,t} + \gamma_h X_{i,t} + \epsilon_{i,t+h}, \tag{4}$$

where $ISS_{i,t+h-1\to t+h}$ is the firm-level debt issuance ($DISS$) or equity issuance ($EISS$) from year $t+h-1$ to year $t+h$, $h = 0, 1, 2, 3, 4, 5$. The expression $Mis_{i,t}$ is the misperception on earnings growth in year t, f_i is the firm fixed effect, and $X_{i,t}$ is a vector of control variables. Table 3 summarizes the regression results for debt issuance (Panels A and B) and equity issuance (Panels C and D).

[Table 3 here]

3.4.1 Debt issuance

Panel A in Table 3 presents the univariate regression results where $X_{i,t}$ is empty. As expected, an increase in misperception on earnings growth in year t is associated with an increase in the contemporaneous and year $t+1$ debt issuance and a decline in the debt issuance from year $t+2$ up to year $t+5$. The coefficients are also statistically significant at the 1% level. In economic terms, a one standard deviation increase in misperception in year t correlates with a 1.71% increase in the contemporaneous debt issuance and a 0.67% increase in the year $t+1$ debt issuance. The long-term effects are that a one standard deviation increase in misperception in year t predicts a 0.79%, 1.14%, 1.21%, and 1.67% decline in the debt issuance in year $t+2$, $t+3$, $t+4$, and $t+5$, respectively.

Panel B reports the results with controls. The relationship between misperception on earnings growth and debt issuance maintains the same pattern as in univariate analysis and is mostly significant. Figure 4 (top panel) visualizes the regression results and the pattern of short-term overreaction and long-term systematic reversals. In Table A5 in the Appendix, I add time fixed effects, and the patterns are consistent. These results indicate that overoptimism after good news leads to high debt issuance in the short term and a predictable decline in debt issuance in the long term.

[Figure 4 here]

3.4.2 Equity issuance

Panel C in Table 3 presents the univariate regression results where $X_{i,t}$ is empty. Similar to debt issuance policies, an increase in misperception on earnings growth in year t is associated with an increase in the contemporaneous equity issuance and a decline in the equity issuance later on. The coefficients are also statistically significant at the 1% level. In economic terms, a one standard deviation increase in misperception in year t correlates with a 0.79% increase in the contemporaneous equity issuance. Different from debt issuance, the reversal in the equity issuance starts in year $t+1$ with a decline of 0.98%, and a similar magnitude of decline continues up to year $t+5$.

Panel B reports the results with controls, and the relationship maintains the same pattern as in univariate analysis and is statistically significant. Figure 4 (bottom panel) visualizes the regression results. Consistent patterns show up after including time fixed effects, as reported in Table 5 in the Appendix.

Taken together, driven by overoptimism on firms' future fundamentals after good shocks, both investment and financing are significantly affected. The above evidence on external financing points to an integrated view of an increase in both debt and equity issuance in the short term, and reductions in both types of issuance in the long term.

3.5 Misperception and asset prices

While corporate decisions are made under managers' subjective beliefs, asset prices are determined by investors' perception. After observing a firm experiencing a sequence of favorable shocks, extrapolative investors' overoptimism on firm fundamentals would have an impact on the pricing of the firm's financial claims. Specifically, overoptimism in good times lowers the perceived default probability of the firm too much, and the prices of both credit and equity will rise in the short term. However, on average, overoptimism diminishes in the next periods as future realizations turn out worse than expected; thus, bond and stock prices are likely to reverse in the long term. I formally test the impact of extrapolative expectations on firm-level asset prices as follows:

$$RET_{i,t+h-1\to t+h} = \alpha_h + f_i + \beta_h Mis_{i,t} + \gamma_h X_{i,t} + \epsilon_{i,t+h}, \tag{5}$$

where $RET_{i,t+h-1\to t+h}$ is the firm-level bond yield spread changes ($\triangle CS$) or excess stock returns ($RETS$) from year $t+h-1$ to year $t+h$, $h = 0, 1, 2, 3, 4, 5$. The expression $Mis_{i,t}$ is the misperception on earnings growth in year t, f_i is the firm fixed effect, and $X_{i,t}$ is a vector of control variables. Table 4 summarizes the regression results for yield spread changes (Panels A and B) and excess stock returns (Panels C and D).

[Table 4 here]

3.5.1 Firm-level yield spread changes

Panel A in Table 4 presents the univariate regression results where $X_{i,t}$ is empty. Consistent with the intuition, an increase in misperception on earnings growth in year t is associated with a drop in the contemporaneous bond yield spread. However, the yield spread is predicted to increase starting from year $t+1$. That is, bond investors predictably earn low excess future returns, right after overly optimistic expectations of firms' fundamentals. The coefficients are also statistically significant at the 1% level up to year $t+3$. In terms of economic magnitude, a one standard deviation increase in misperception in year t correlates with a 0.24% decrease in the contemporaneous yield spread. But in year $t+1$, the yield spread is predicted to rise 0.29% relative to the previous year, and the magnitude of the increase in the yield spread change is similar for year $t+2$ and year $t+3$. These results on firm-level bond yield changes (a proxy for returns) are similar in spirit to the aggregate evidence documented in Greenwood and Hanson (2013), who find that a high level of aggregate credit market sentiment forecasts low excess returns to corporate bondholders and that this occurs precisely after good news.

Panel B reports the results with controls, and the reversal pattern in year $t+1$ stays statistically significant. Figure 5 (top panel) visualizes the regression results. These results imply that bond investors seem to share similar beliefs with managers and are overoptimistic in good times and overpessimistic in bad times, consistent with the survey evidence of professional forecasters on the aggregate credit spread documented in Bordalo, Gennaioli, and Shleifer (2018). In this subsection, I provide new evidence of firm-level corporate bond return predictability owing to extrapolative expectations.

[Figure 5 here]

3.5.2 Firm-level stock returns

Panel C in Table 4 presents the univariate regression results where $X_{i,t}$ is empty. I find that an increase in misperception on earnings growth in year t is associated with a high contemporaneous stock return but is predictive of low future stock returns from year $t+1$ up to year $t+5$. The coefficients are also statistically significant at the 1% level. In terms of economic magnitude, a one standard deviation increase in misperception in year t correlates with a 1.24% increase in the contemporaneous stock return but predicts a sharp 9.85% decline in the stock return in year $t+1$. The predictive power of misperception in year t persists up to year $t+5$, with declining magnitude. Panel D reports the results with controls, and the patterns stay the same. Figure 5 (bottom panel) visualizes the regression results.

These results, taken together, indicate that the contemporaneous relationship between the stock return and misperception on earnings growth implies that the subjective expectations move in the correct direction as firm fundamentals are indeed improving. The reversal pattern indicates that the subjective expectations overreact to good news and the predictability of returns is caused by the correction of expectations. La Porta (1996) and Bordalo, Gennaioli, La Porta, and Shleifer (2019) show that companies whose analysts are the most optimistic about earnings growth earn poor returns relative to companies whose analysts are the most pessimistic about earnings growth. In this subsection, I use a newly constructed return predictor, misperception on earnings growth, which extracted the extrapolation component from analysts' subjective forecasts, and provide new return predictability results.

3.6 Conditioning on financial constraint

As will be discussed below, my model's intuition suggests that both the short-term overreaction and the long-term reversal relationships between extrapolation and firm activities and asset prices should be stronger among financially constrained firms. The amplification effects of productivity shocks stemming from financial market imperfections, as originated from Bernanke and Gertler (1989) and Kiyotaki and Moore (1997), are further amplified under extrapolative expectations. The idea is that, after a sequence of good shocks, financing conditions are particularly relaxed for financially constrained firms. Overoptimistic managers have higher investment and borrowing needs, and at the same time, the cost of capital drops substantially for these firms because of a lower perceived default probability, which further amplifies the reactions of these firms.

I test this additional hypothesis by grouping firms based on widely used firm-level financial constraint measures. The financial constraint proxies are the size and age index of Hadlock and Pierce (2010) and size alone measured as log sales. I sort firms based on their financial constraint measure into quartiles every year. As before, five relationships are of interest, and I run each panel regression with the same set of controls among firms in the unconstrained and constrained firms quartiles, respectively. I report the regression results using the size and age index in Table 5. To save space, I move largely consistent results conditioning on size to the Appendix in Table A6.

[Table 5 here]

The results show that both the short-term and the long-term effects of misperception on earnings growth on investment, financing, and asset prices are more pronounced among financially constrained firms. For example, Panel A in Table 5 presents the results for the investment rate. An increase in misperception on earnings growth is associated with a much higher contemporaneous investment rate among constrained firms relative to unconstrained firms. And the subsequent declines in the investment rate are also mostly concentrated among constrained firms. Debt issuance and asset prices exhibit similar patterns. Overoptimism in good times is not associated with equity issuance for unconstrained firms. But financially constrained firms resort to both equity and debt issuance under overoptimism. Results in this subsection have important implications for the potential complementary role between extrapolative expectations and financial frictions, which will be discussed in detail in Section 5.

To summarize, I document that overoptimism after good news is associated with higher investment, debt and equity issuance, and bond and stock prices in the short term, but with a decline in all real and financial activities and asset prices in the long term. This pattern of short-term overreaction and long-term systematic reversal is more pronounced among financially constrained firms.

4 Model

In this section, I present a firm dynamics model with extrapolative expectations and financial frictions to understand the links between expectations, financial market frictions, firms' real and financing activities, and asset prices. The only departure from a standard firm dynamics model with financial frictions (e.g., Hennessy and Whited 2007, Gomes and Schmid 2010, Kuehn and Schmid 2014, Begenau and Salomao 2018) is that I introduce extrapolative expectations into the model. This approach allows me to study the implications of extrapolative expectations, interacting with financial frictions, for both asset prices and firms' real and financing policies.

I have also solved a two-period version of the model, which is in Appendix B. This model qualitatively captures the main results and carries intuition similar to the full dynamics model but is easier to understand. The full dynamics model shows that the relationship between extrapolative expectations, financial frictions, firms' real and financing policies, and asset prices can matter not only qualitatively but also quantitatively.

4.1 Technology

A large number of firms produce a homogeneous good in a perfectly competitive environment. Firms use physical capital to produce this good (Y_{it}) with a decreasing returns to scale technology and are hit with idiosyncratic and aggregate technology shocks. The production function for firm i is given by

$$Y_{it} = Z_t S_{it} K_{it}^{\alpha}, \tag{6}$$

in which Z_t is aggregate productivity, S_{it} is idiosyncratic productivity, K_{it} denotes the book value of the firm's assets, and $0 < \alpha < 1$ is the capital share of production.

Aggregate productivity is driven by the stochastic process

$$z_{t+1} = \rho_z z_t + \sigma_z \epsilon^z_{t+1}, \tag{7}$$

in which $z_{t+1} = log(Z_{t+1})$, ϵ^z_{t+1} is an i.i.d. standard normal shock, and ρ_z and σ_z are the autocorrelation and conditional volatility of aggregate productivity, respectively.

Idiosyncratic productivity follows the AR(1) process

$$s_{it+1} = \bar{s}(1 - \rho_s) + \rho_s s_{it} + \sigma_s \epsilon^s_{it+1}, \tag{8}$$

in which $s_{it+1} = log(S_{it+1})$, ϵ^s_{it+1} is an i.i.d. standard normal shock that is uncorrelated across all firms in the economy and independent of ϵ^z_{t+1}, and $\bar{s}$, ρ_s, and σ_s are the mean, autocorrelation, and conditional volatility of firm-specific productivity, respectively.

Physical capital accumulation is given by

$$K_{it+1} = (1 - \delta)K_{it} + I_{it}, \tag{9}$$

where I_{it} represents investment and δ denotes the capital depreciation rate.

To generate slow convergence to the optimal firm size implied by the decreasing returns to scale assumption and idiosyncratic productivity, I introduce adjustment costs for capital. The capital adjustment costs include planning and installation costs, learning to use the new equipment, or the fact that production is temporarily interrupted. I assume that capital investment entails convex asymmetric adjustment costs, denoted as G_{it}, which are given by

$$G_{it} = \frac{c_{it}}{2}\left(\frac{I_{it}}{K_{it}}\right)^2 K_{it}, \tag{10}$$

in which

$$c_{it} \equiv c_0 \mathbf{1}_{\{I_{it}<0\}} + c_1 \left(1 - \mathbf{1}_{\{I_{it}<0\}}\right), \tag{11}$$

and $\mathbf{1}_{\{I_{it}<0\}}$ is an indicator that equals one when the firm divests, and $c_0 > c_1 > 0$ implies costly reversibility of capital. The costly reversibility can arise because of resale losses due to transaction costs or the market for lemons phenomenon.

4.2 Financing

Corporate investment as well as any distributions can be financed with either internal funds or net new issues, which can take the form of new defaultable debt or new equity. Debt has a tax benefit but is not enforceable, so firms can choose to default and incur a bankruptcy cost. Equity financing is also costly, which is captured by linear equity issuance costs. The optimal level of leverage is determined by trading off its benefit and cost.

I assume that debt comes in the form of one-period securities and refer to the stock of outstanding defaultable debt at the beginning of period t as B_{it} for firm i. In addition to the principal, the firm is also required to pay a coupon C per unit of outstanding debt. Let Q_{it} denote the price of a new bond issuance that comes due at period $t+1$. The bond price is determined endogenously below.

The firm can also raise external funds by means of seasoned equity offerings. In this case, it incurs issuance costs. These costs are motivated by underwriting fees and adverse selection costs. I adopt a very simple formulation by choosing linear equity issuance costs from existing literature, captured by λ. Formally, letting E_{it} denote the net payout to equity holders, total issuance costs are given by the function

$$\Lambda(E_{it}) = \mathbf{1}_{\{E_{it}<0\}} \lambda E_{it}, \tag{12}$$

with $\lambda \geq 0$ and where $\mathbf{1}_{\{E_{it}<0\}}$ equals 1 if $E_{it} < 0$ and 0 otherwise, implying that these costs apply only in the region where the firm is raising new equity finance so that the net payout, E_{it}, is negative.

Taxable corporate profits are equal to output less capital depreciation and interest expenses: $Y_{it} - \delta K_{it} - CB_{it}$. It follows that the firm's budget constraint can be written as

$$E_{it} = (1-\tau)Y_{it} - (K_{it+1} - (1-\delta)K_{it}) - G_{it} - c_f + \tau(\delta K_{it} + CB_{it}) + Q_{it}B_{it+1} - (1+C)B_{it}, \quad (13)$$

where again E_{it} denotes the equity payout. Equity payout is thus defined as the residual of the after-tax firm revenue less investment and investment adjustment costs, less the fixed cost of operation c_f, plus tax rebates from capital depreciation and interest payments, plus funds raised through debt and less the principal amount and coupon payment of debt that is repaid. Finally, firms do not incur costs when paying dividends. Distributions to shareholders are then defined as the equity payout net of issuance costs.

4.3 Subjective expectations

Managers make optimal investment and financing decisions, and investors price financial assets under subjective expectations, which are assumed to be extrapolative. To model extrapolative expectations, I adopt a psychologically founded model of beliefs from Bordalo, Gennaioli, and Shleifer (2018), which builds on the representativeness heuristic from Kahneman and Tversky (1972). According to Kahneman and Tversky, a certain attribute is judged to be excessively common in a population when that attribute is representative for the population, meaning that it occurs more frequently in the given population than in a relevant reference population. When it applies to modeling expectations in a macroeconomic context, it implies that agents overestimate the probability of a good future state when the current news is good and the converse is true when current news is bad. Formally, when the productivity processes are given by equations 7 and 8, the extrapolative expectations on future productivity are modeled as follows:

$$\hat{\mathbb{E}}_t[z_{t+1}] = \rho_z z_t + \theta \rho_z (z_t - \rho_z z_{t-1}), \tag{14}$$

$$\hat{\mathbb{E}}_t[s_{it+1}] = \bar{s}(1 - \rho_s) + \rho_s s_{it} + \theta \rho_s (s_{it} - \rho_s s_{it-1}), \tag{15}$$

where θ governs the degree of overreaction to the information received in the current period. When $\theta = 0$, it goes back to the rational expectations framework. When $\theta > 0$, expectations incorporate conditional mean shifts extrapolating in the direction of recent news. The belief distortion is on the conditional expectations and is a linear function of news. Unconditional forecasts are unbiased because the average news is zero by definition. Moreover, this modeling of extrapolative expectations is also forward looking and satisfies the law of iterated expectation.

Figure 6 illustrates the idea of extrapolation by plotting the conditional probability distribution of future aggregate productivity after good news. After good news, the extrapolative distribution of future productivity (solid line) incurs a right shift of the objective distribution (dashed line), which assigns a higher conditional probability of future good states and a lower conditional probability of future bad states. It generates extrapolation and neglect of risk at the same time.

[Figure 6 here]

4.4 Valuation

The equity value of the firm, V_{it}, is defined as the discounted sum of all future equity distributions. I assume that equity holders will choose to close the firm and default on their debt repayments if the prospects for the firm are sufficiently bad, that is, whenever V_{it}

reaches zero. The timeline in the model is as follows. At the beginning of each period, firms carry debt to be repaid and capital for current period production. Upon observing current period realized productivity shocks, a firm receives gross revenue. The firm then optimally decides its equity payout by choosing capital and debt for the next period capital and debt based on their perceived future productivity. At the same time, it must pay its operating cost and its previous period debt. Every period the firm faces the decision of whether or not to repay its debt. Debt is repaid if the firm's value is positive; otherwise, it defaults and exits.

The firm takes as given the stochastic discount factor $M_{t,t+1}$ used to value the cash flow arriving in period $t+1$ (and subsequent periods). I specify the stochastic discount factor to be a function of the aggregate shock in the economy:

$$M_{t,t+1} = \frac{1}{1+r_f} \frac{e^{-\gamma(z_{t+1}-z_t)}}{\hat{\mathbb{E}}_t[e^{-\gamma(z_{t+1}-z_t)}]}, \tag{16}$$

where r_f is the risk-free rate and $\gamma > 0$ is the price of risk. The risk-free rate is set to be constant. This allows me to focus on risk premia as the main driver of the results in the model as well as to avoid parameter proliferation.

Managers jointly choose investment and financing strategies to maximize the equity value of each firm, under subjective expectations. Each period the value of the firm is the maximum between the value of repayment and 0, the value of default:

$$V_{it} = max\{V_{it}^{ND}, V_{it}^{D} = 0\}. \tag{17}$$

The repayment value is

$$V^{ND}(z_t, z_{t-1}, s_{it}, s_{it-1}, K_{it}, B_{it}) = \underset{K_{it+1}, B_{it+1}}{max} E_{it} + \Lambda(E_{it}) \\ + \hat{\mathbb{E}}_t \left\{ M_{t,t+1} max \left[0, V^{ND}(z_{t+1}, z_t, s_{it+1}, s_{it}, K_{it+1}, B_{it+1}) \right] \right\}, \quad (18)$$

where the subjective conditional expectation $\hat{\mathbb{E}}_t$ is taken by integrating over the joint conditional distribution of aggregate and idiosyncratic shocks. The complexity of the problem is reflected in the dimensionality of the state space necessary to construct the equity value of the firm. This includes the current capital stock, the debt level, and the current and previous level of aggregate and firm-level productivity.

4.5 Default and bond pricing

I now turn to the endogenous bond pricing under subjective expectations, taking into account the possibility of default by equity holders. The market value of debt must satisfy the condition

$$Q_{it} = \hat{\mathbb{E}}_t \left[M_{t,t+1} \left((1 + C) \left(1 - \mathbf{1}_{\{V_{it+1}=0\}} \right) + RC_{it+1} \mathbf{1}_{\{V_{it+1}=0\}} \right) \right], \quad (19)$$

where RC_{it+1} denotes the recovery on a bond in default and $\mathbf{1}_{\{V_{it+1}=0\}}$ is an indicator function that takes the value of one when the firm defaults and zero when it remains active. Following Hennessy and Whited (2007), creditors are assumed to recover the fraction of the firm's current assets and profits net of liquidation costs. Formally, the default payoff is equal to

$$RC_{it} = (1 - \epsilon) \frac{(1 - \tau)Y_{it} - c_f + (1 - \delta)K_{it}}{B_{it}}, \quad (20)$$

where ϵ represents bankruptcy costs, for example, any costs related to the liquidation and renegotiation of the firm after default.

The yield on the defaultable bond at period t can be computed as

$$\frac{1+C}{Q_{it}}, \tag{21}$$

so that the yield spread is the difference between the yield on the defaultable bond and the risk-free interest rate:

$$\frac{1+C}{Q_{it}} - r_f. \tag{22}$$

The perceived default probability depends on the state variables. The more debt a firm needs to repay and the lower its stock of capital, the higher the probability of default and, therefore, the lower the price of the bond. After a sequence of negative productivity shocks, investors' perceived default probability is higher, and the bond price will be lower as well.

4.6 Optimal decisions

Firm's optimal investment and financing decisions can be summarized in the following Euler equations for capital and debt. Define $\triangle$ as the set of states for which a firm chooses to default, that is, $V_{it} \leqslant 0$:

$$\underbrace{\underbrace{1+\frac{\partial G_{it}}{\partial K_{it+1}}}_{direct\ effect} - \underbrace{\frac{\partial Q_{it}}{\partial K_{it+1}}B_{it+1} - \frac{\partial \Lambda(E_{it})}{\partial K_{it+1}}}_{indirect\ effect}}_{total\ cost} =$$

$$\underbrace{\hat{\mathbb{E}}_t\left[M_{t+1}(1-\triangle)\left((1-\tau)\alpha Z_{t+1}S_{it+1}K_{it+1}^{\alpha-1} + 1 - \delta - \frac{\partial G_{it+1}}{\partial K_{it+1}} + \tau\delta + \frac{\partial \Lambda(E_{it+1})}{\partial K_{it+1}}\right)\right]}_{expected\ benefit}, \tag{23}$$

$$\underbrace{\underbrace{Q_{it}}_{direct\ effect} + \underbrace{\frac{\partial Q_{it}}{\partial B_{it+1}} B_{it+1} + \frac{\partial \Lambda(E_{it})}{\partial B_{it+1}}}_{indirect\ effect}}_{total\ benefit} = \underbrace{\hat{\mathbb{E}}_t \left[M_{t+1}(1-\triangle)(1+C-\tau C) \right]}_{expected\ cost}. \tag{24}$$

Equation 23 presents the Euler equation for capital and shows that, at the optimum, the total cost of one extra unit of capital should be equal to its expected future benefit under subjective expectations. The expected benefit is given by the marginal product of capital, plus its non-depreciated value net of the reduction in future adjustment costs, plus the tax shield of depreciation and the reduction in equity issuance costs, at states of repayment. The total cost of one extra unit of capital is given by the direct cost of investment and the indirect impact of this investment on a firm's overall cost of external funds. The first component of the indirect effect stems from the endogenous effect of current investment on a firm's bond prices. That is, as a firm's next-period capital affects the likelihood of its future repayment, current investment affects the firm's current cost of debt and, as a result, the overall cost of this investment. The second component of the indirect effect captures the effect that increasing investment might force firms to issue equity, thus increasing the total cost of this investment.

Equation 24 presents the Euler equation for debt and shows that firms optimally choose to issue debt until the funds raised equal their expected future cost under subjective expectations. The benefit of one extra unit of debt depends directly on the current bond price and indirectly on its endogenous effect on the firm's overall cost of funds. Since by issuing more debt firms increase their default probability, current debt issuance affects bond prices and, hence, the total benefit of issuing debt.

Optimal conditions illustrate the role of endogenous default on firms' investment and borrowing choices. Since current choices affect the next period default probability, they also affect current financing costs and, hence, a firm's current optimal investment and borrowing decisions. This link between current choices and the likelihood of future default intertwines firms' investment and debt decisions. Endogenous default generates a borrowing constraint in equilibrium.

From the Euler equations, one can already see how the two key frictions in the model, financial frictions and extrapolation expectations, jointly determine optimal investment and financing decisions and equilibrium bond prices. In particular, without financial frictions, the indirect effects in the Euler equations are gone. Without extrapolative expectations, the expected benefit/cost components and bond prices are formed under rational expectations. In the next section, I quantitatively analyze the role of each friction and their interactions.

5 Model Results

In this section, I study the model implications for firms' real and financial activities and asset prices.

5.1 Numerical algorithm

To solve the model, the numerical dynamic programming approach is complicated by the joint determination of the equity value (equations 17 and 18) and bond pricing (equation 19). I solve the model at an annual frequency. First, I guess the default policy and its implied bond price schedule. Then, I solve the Bellman equation for equity value using value function iteration on discrete grids. If the updated optimal default policy is consistent with the initial guess, the iteration stops. Otherwise, with the updated default policy and bond price schedule, I repeat the process. Details on solving the model are in Appendix C. The numerical approach here is also highly computationally intensive, given the large state space, that is, four exogenous state variables, two endogenous state variables, and an endogenous default rule. However, heavily parallelization is implemented to make the problem feasible.

5.2 Calibration

I use parameter values reported in previous studies, whenever possible, or by matching the selected moments in the data. The parameters can be categorized into four groups: the firm's technology, financing, expectation formation, and stochastic discount factor. Table 6 reports the parameter values used in the baseline calibration.

[Table 6 here]

Firm's technology: I set the capital share of production α to be 0.65, in line with the evidence in Cooper and Ejarque (2003). The annual capital depreciation rate δ is set to 10%, as in standard macroeconomics literature. In the model, the aggregate productivity shock is essentially a profitability shock. I calibrate the persistence ρ_z and conditional volatility σ_z of the aggregate productivity shock to match the autocorrelation and volatility of aggregate profits growth. In the data, I measure aggregate profits growth using data from the National Income and Product Accounts (NIPA).

At the firm level, I calibrate the persistence ρ_s and conditional volatility σ_s of the idiosyncratic productivity shock to match the cross-sectional dispersion in leverage and profitability. The long-run average level of idiosyncratic productivity $\bar{s}$ is a scaling variable. Together with the fixed cost of operation c_f, they are calibrated to match the average default rate and average leverage. I calibrate the investment c_1 and disinvestment c_0 adjustment cost parameters to match the autocorrelation and cross-sectional volatility of firm-level investment rates.

Financing: Firms can issue debt and equity. I set the corporate tax rate τ to 0.20, consistent with Gomes and Schmid (2010). The corporate bond coupon rate C is set to 3% per annum. Upon default, bond investors can recover approximately 40% of the asset value. Thus, the bankruptcy cost parameter ϵ is set to 0.60.[4] Firms face a linear cost when issuing

[4]This is standard in the literature. As reported in Exhibit 7 in Moody's report: the senior unsecured bond recovery rate from 1983 to 2017 was 37.74% (https://www.researchpool.com/download/?report_id=1751185&show_pdf_data=true).

new equity. I calibrate the equity issuance cost parameter λ to match the fraction of equity issuance.

Expectation: The extrapolation parameter θ is disciplined by the predictability in forecast errors in firms' earnings growth moment. Under rational expectations where $\theta = 0$, forecast errors should be unpredictable using any current available information. By contrast, under extrapolative expectations where $\theta > 0$, overoptimism about future earnings growth in good times leads to future disappointment and vice versa, resulting in a negative correlation between future forecast errors in earnings growth and the current level of profitability. Therefore, the correlation between forecast errors and current profitability pins down the extrapolation parameter in a clean and disciplined way.

Stochastic discount factor: To calibrate the stochastic discount factor, I set the real risk-free rate to 2.9% per annum, as estimated in Campbell and Cochrane (1999), implying a time discount factor β of 0.9718. Given the calibrated conditional volatility of aggregate shocks and the extrapolation parameter, I calibrate the price of risk parameter γ to match the mean and volatility of the aggregate stock market return and its Sharpe ratio as closely as possible.

To generate the model's implied moments, I simulate 3,000 firms for 600 years. I drop the first 500 years to neutralize the impact of the initial condition. The remaining 100 years of simulated data are treated as those from the economy's stationary distribution. I then simulate 100 artificial samples and report the cross-sample average results as model moments. In all simulations, defaulting firms are replaced with newborn firms, which have a small capital stock and zero leverage, such that the mass of firms is constant over time. Note that when simulating the model, the realized aggregate and idiosyncratic productivity are determined according to the true data-generating process, whereas optimal policies and asset prices are determined under subjective beliefs of the productivity.

5.3 Value and policy functions

In this subsection, I analyze the model-implied value and policy functions. I show that under extrapolative expectations, not only current productivity states but also previous period productivity states matter for optimal policies and equity and debt values. The state space is multidimensional, and plotting the entire value function is infeasible. For this reason, I focus on a particular region within the state space. I set the current and previous period aggregate productivity state and leverage level to their simulated means. Figure 7 plots the value function and policy functions for investment, debt issuance, and the price of debt as a function of capital. Each line in the figure corresponds to different realizations of idiosyncratic news but otherwise identical states. The solid line refers to a realization of good idiosyncratic news, and the dashed line refers to a realization of bad idiosyncratic news.

[Figure 7 here]

The perceived equity value (top left panel) increases with its capital stock. However, conditional on capital, firms that experienced good news (solid line) become overoptimistic, and their perceived firm value is higher than firms that experienced bad news (dashed line). These overoptimistic firms also invest more (top right panel) and issue more debt (bottom left panel). Overoptimistic beliefs held by lenders lower the perceived default probability, and these firms are then able to issue debt at a higher bond price (bottom right panel). This mechanism is crucial in generating excessive investment, borrowing, and overpricing after good news and their subsequent reversals.

5.4 Moments for quantities and prices

The benchmark calibration of the model does a good job of matching unconditional moments for quantities at both the aggregate and firm level as well as asset pricing moments. These moments include traditional quantities and asset prices moments as well as the systematic predictability of the forecast errors moment, which governs the expectations formation process. Table 7 reports the moments for quantities and asset prices generated by the model and in the data.

[Table 7 here]

Aggregate quantities: The calibration of the aggregate productivity process generates a volatility of aggregate profits growth of 14.7% and an autocorrelation of 0.332, largely consistent with the data. I also validate the model by analyzing the cyclicality of the average leverage, credit spread, and default rate generated by the model. Note that those moments are untargeted for my calibration. In line with the data, average leverage is countercyclical because the market value of equity is more sensitive to aggregate shocks than the book value of debt.[5] Countercyclical leverage renders defaults more likely in bad times. The average credit spread is also countercyclical, as in the data.

Cross-sectional quantities: I now illustrate the model's quantitative implications for optimal firm behaviors. The calibration of the idiosyncratic productivity process helps to explain the volatility of cross-sectional leverage and profitability. Capital investment adjustment frictions generate a reasonable volatility and autocorrelation of the investment rate. Under extrapolative expectations, firms' policies are more volatile because of overoptimism in good times and overpessimism in bad times. Firms finance capital expenditures through equity and bond issuances. The model captures a realistic average fraction of equity issuance of 9%, as in the data. The model generates a leverage ratio of 55%, which is higher than in the data (45%) because of the one-period bond structure. The default rate, which is closely related to the fixed cost parameter, has a magnitude similar to that in the data.

Most importantly, the model is able to capture the predictability of forecast errors. The

[5] I define leverage as the ratio of the book value of debt to the market value of equity plus the book value of debt, $LEV = B/(B + V)$.

correlation between forecast errors in long-term earnings growth and current earnings over assets is about -0.12 in my sample. Under extrapolative expectations, overreaction in recent news leads to future disappointments and thus generates a correlation of about -0.09 with a relatively small $\theta = 0.15$. Under rational expectations, forecast errors should be unpredictable and would fail to match this moment presented in the data.

Asset prices: The model generates a large excess equity return of 7.47% and the volatility of the excess equity return is 17.4%, compared with 7.90% and 17% in the data, respectively. The Sharpe ratio is also close to the data (0.43 in the model and 0.46 in the data). Finally, I turn to the pricing of the corporate bond. The average credit spread level and the volatility of changes in the credit spread are untargeted moments in the calibration so that I can analyze the model's performance on credit risk. It is well known that the standard structural models of corporate default, such as Merton (1974) or Leland (1994), fail to explain observed credit spreads given the low historical default rates. This fact is documented in Huang and Huang (2012) and is typically referred to as the credit spread puzzle. Several papers also document that credit spreads appear too volatile relative to what could be explained by the volatility of default rates or fundamentals (see, for example, Collin-Dufresn, Goldstein, and Martin 2001).

In my model, I report the average equally weighted credit spread, which has a magnitude similar to that in the data, given the low actual default rates. Further, under extrapolative expectations, the model generates volatile changes in the credit spread. These results have two main drivers. First, as default rates are strongly countercyclical, investors require a risk premium on defaultable bonds and equity claims as well. Second, extrapolative expectations amplify the effect. Overoptimism in good times and overpessimism in bad times induce a larger perceived covariance between systematic risks and the asset returns than the rational expectations model. Extrapolation also makes the asset returns more volatile because of overreaction to news about fundamentals. Thus, with extrapolative expectations, only a low level of the price of risk γ 3 is needed to generate a sizable and volatile equity premium and credit spread.

5.5 Firm-level regressions

As documented in the empirical part of the paper, overoptimism in firms' earnings growth after good news is associated with an increase in investment, debt and equity issuance, and bond and stock prices in the short term, but is predictive of a systematic reversal in the long term. The objective of this subsection is to show that with extrapolative expectations, the model can help reproduce these empirical patterns.

To test the effect of extrapolative expectations on firms' real and financial activities, I regress the contemporaneous and future investment rate, or the issuance of debt and equity, on the misperception on earnings growth, defined as the difference between subjective and objective forecasts on earnings growth. I follow the procedure in the empirical part to construct objective expectations on earnings growth. Table 8 reports the regression results for investment, and Table 9 reports the regression results for debt and equity issuance, both for the model and for real-world data. Firm-level regressions employ a panel regression with firm fixed effects. The results in this table are all univariate to facilitate a comparison of the model and data, but the data section above presents a more thorough empirical analysis.

[Table 8 here]

[Table 9 here]

Consistent with the empirical patterns, a high level of misperception on earnings growth is associated with high levels of investment and debt and equity issuance in the short term and is predictive of a decline in both real and financial activities in the long term. These results suggest that after good recent news, managers extrapolate and form overoptimistic expectations on firms' future productivity. They choose to invest and borrow more under subjective expectations. However, future realized productivity then turns out to be worse than expected, and expectations are revised downward. Future investment and financing activities are then reversed downward as a consequence of initial overreaction.

In addition to firms' real and financial activities, extrapolative expectations also have an impact on asset prices since investors hold extrapolative expectations as well. I rerun the same regressions but use realized bond and stock returns as the dependent variables.[6] Table 10 presents the regression results. An increase in misperception on earnings growth forecasts low future returns on both bond and stock, consistent with the fact that investors price debt and equity under excessive optimistic beliefs in good times and are negatively surprised by future realized fundamentals.

[Table 10 here]

In sum, extrapolative expectations not only help match unconditional moments in the data but also help generate firm-level contemporaneous and predictive patterns in real and financial activities and asset prices, as documented in the data.

5.6 Inspecting the mechanism

In this subsection, I inspect the model mechanism by first analyzing the impulse responses and then studying different model specifications quantitatively.

5.6.1 Impulse responses

To simulate the impulse response, I run my model with 30,000 firms for 800 periods, kick the aggregate productivity level up to a prespecified level in period 801, and then allow the

[6] I use realized bond returns instead of bond yield spread changes as the dependent variable because in the model, the bond is a one-period defaultable bond, and therefore it makes sense to predict next-period realized bond returns. Here I do the same in the data for a fair comparison.

model to continue to run as before. Average responses across all firms in the economy are then computed. Hence, I am simulating the average response to a one-period impulse and its gradual decay.

Figure 8 plots the impulse responses of the real and financial quantities to a positive aggregate productivity shock. I compare the average responses between the benchmark model and the rational expectations model in which the only difference is that the extrapolation parameter θ is zero. After a positive TFP shock, the perceived future TFP level increases in both models. However, the perceived TFP level is higher under extrapolative expectations than it is under rational expectations because of the overreaction to good news. Thus, investment and debt issuance are higher under extrapolative expectations as a response, and both gradually return to trend. For bond prices, after good news, the perceived default probability drops more under extrapolative expectations and thus incurs a bigger drop in the credit spread.

[Figure 8 here]

The quantitative effects of extrapolative expectations are large. After a positive TFP shock, the average investment, debt growth, and credit spread responses under the extrapolative expectations model are about 40% higher than they are under the rational expectations model. This is driven by both the overoptimistic investment needs and the relaxed financing conditions in the financial market.

However, overoptimism after good news has implications on future responses even after small bad news. To further illustrate the role of extrapolative expectations, Figure 9 plots the impulse responses to a negative aggregate productivity shock right after a positive aggregate productivity shock. In this case, because extrapolative firms have overinvested and overlevered after the preceding positive shock, the subsequent decline in investment and debt issuance in the extrapolative expectations model is large and severe, compared with its rational expectations counterpart. The credit spread under extrapolative expectations also drops too much after a good shock but incurs a much bigger reversal after a bad shock. The extrapolative expectations model generates more volatile dynamics for both quantities and asset prices.

[Figure 9 here]

5.6.2 Interaction between extrapolative expectations and financial frictions

I now discuss how various model ingredients contribute to the results by comparing several alternative models. Particularly, Table 11 presents data moments (Data column), results from the benchmark model with both extrapolative expectations and financial frictions (X + FF column), a model with rational expectations and financial frictions (RE + FF column), a model with rational expectations and no financial frictions (RE + NFF column), and a model with extrapolative expectations and no financial frictions (X + NFF column).

[Table 11 here]

I change only one or two parameters, keeping all other parameters the same across different models in order to identify the key mechanisms. The benchmark model features extrapolative expectations ($\theta = 0.15$) and financial frictions ($\epsilon = 0.60$, $\lambda = 0.10$). The RE + FF model features rational expectations ($\theta = 0$) and financial frictions ($\epsilon = 0.60$, $\lambda = 0.10$). The RE + NFF model features rational expectations ($\theta = 0$) and no financial frictions ($\epsilon = 0$, $\lambda = 0$). The X + NFF model features extrapolative expectations ($\theta = 0.15$) and no financial frictions ($\epsilon = 0$, $\lambda = 0$).

First, I analyze the impact of extrapolative expectations by comparing model X + FF with model RE + FF. Under rational expectations, forecast errors in earnings growth should not be predictable by any information available today. This is shown by the correlation moment related to forecast errors, which is close to zero under rational expectations. However, in the data, there is systematic predictability in both CFOs' and analysts' forecast errors. The rational expectations model fails to reconcile this empirical fact. Extrapolative expectations also amplify the productivity shocks and make corporate policies more volatile than they are under rational expectations. Owing to the overreaction to news, the perceived covariance between systematic risks and asset returns is higher under extrapolative expectations than under rational expectations. This mechanism contributes to higher and more volatile equity returns and credit spread under extrapolative expectations.

Second, I analyze the impact of financial frictions by comparing the benchmark model with the models featuring no financial frictions. Without equity issuance costs, firms would choose to issue more equity in equilibrium. Without bankruptcy costs for bonds, firms optimally choose much higher leverage. For example, under model X + NFF, the leverage ratio is about 74%, much higher than in the benchmark model and data. More leverage leads to a higher default rate. However, without bankruptcy loss, the bonds become much less risky and the credit spread in the model is close to zero even though this model features extrapolative expectations.

Moreover, I compare the predictability of misperception on earnings growth for corporate activities and asset prices in both the short term and the long term across alternative models. Since the predictor, misperception, is not defined under rational expectations, I focus on the comparison between model X + FF and model X + NFF. In the data, misperception on earnings growth predicts positively on investment, debt and equity issuance, and bond and stock prices in the short term, but negatively in the long term. Without financial frictions, the effect of extrapolation gives rise to consistent predictability in the short term, but opposite predictability in the long term for all activities and asset prices. The regression coefficients of all activities and asset prices in year $t + 2$ on misperception in year t in Table 11 are positive under model X + NFF, inconsistent with the reversal evidence in the data and the benchmark model.

To further understand the interaction effects between extrapolative expectations and financial frictions, I plot the impulse responses of investment and debt issuance to a negative aggregate productivity shock across all four models in Figure 10. As shown in the figure, financial frictions themselves amplify the effect of a productivity shock, which is the financial accelerator mechanism. Extrapolative expectations also amplify the exogenous shock due to the overreaction to news. The interaction between these two frictions gives rise to the strongest responses. The intuition is that the feedback from the financial market through the cost of capital further affects investment and financing responses.

[Figure 10 here]

To summarize, my model's key features are frictions in the expectation formation and frictions in the financial markets. When I turn off some of these features one at a time, the model can still match some parts of the data; however, all these features are necessary to produce a reasonable correlation between forecast error and profits, sizable credit spreads with realistic default rates, realistic leverage ratio and equity issuance policies, a sizable and volatile equity premium, and consistent predictability patterns on corporate activities and asset prices.

6 Conclusion

In the data, both CFOs and financial market participants appear to form expectations in an extrapolative manner. This paper studies the impact of extrapolative expectations on firms' real and financial activities and asset prices both empirically and theoretically. Overoptimism in good times is associated with an increase in investment, debt and equity issuance, and firm-level bond and stock prices in the short term, but is predictive of a decline in all these activities and prices in the long term. Small and financially constrained firms are more sensitive to misperception. These findings are consistent with a firm dynamics model featuring both extrapolative expectations and financial frictions. The interaction between extrapolative expectations and financial frictions amplifies the responses of quantities and asset prices to shocks by 40% compared with the rational expectations model.

Taken together, these results suggest that subjective expectations, interacting with financial market frictions, are central to understanding and predicting firms' real and financial activities and asset prices.

References

Adam, K., A. Marcet, and J. Beutel (2017). Stock price booms and expected capital gains. *American Economic Review 107*(8), 2352–2408.

Adam, K., D. Matveev, and S. Nagel (2018). Do survey expectations of stock returns reflect risk-adjustments? *Working paper*.

Ai, H., J. E. Li, K. Li, and C. Schlag (2019). The collateralizability premium. *Working paper*.

Alti, A. and P. C. Tetlock (2014). Biased beliefs, asset prices, and investment: A structural approach. *The Journal of Finance 69*(1), 325–361.

Baker, M., J. C. Stein, and J. Wurgler (2003). When does the market matter? stock prices and the investment of equity-dependent firms. *The Quarterly Journal of Economics 118*(3), 969–1005.

Barberis, N., R. Greenwood, L. Jin, and A. Shleifer (2015). X-capm: An extrapolative capital asset pricing model. *Journal of Financial Economics 115*(1), 1–24.

Barberis, N., A. Shleifer, and R. Vishny (1998). A model of investor sentiment. *Journal of Financial Economics 49*(3), 307–343.

Baron, M. and W. Xiong (2017). Credit expansion and neglected crash risk. *The Quarterly Journal of Economics 132*(2), 713–764.

Barrero, J. M. (2018). The micro and macro of managerial beliefs. *Working paper*.

Begenau, J. and J. Salomao (2018). Firm financing over the business cycle. *The Review of Financial Studies 32*(4), 1235–1274.

Belo, F., Y. Deng, and J. Salomao (2019). Estimating and testing investment-based asset pricing models. *Working paper, University of Minnesota.*

Belo, F., X. Lin, and S. Bazdresch (2014). Labor hiring, investment, and stock return predictability in the cross section. *Journal of Political Economy 122*(1), 129–177.

Ben-David, I., J. R. Graham, and C. R. Harvey (2013). Managerial miscalibration. *The Quarterly Journal of Economics 128*(4), 1547–1584.

Bernanke, B. and M. Gertler (1989). Agency costs, net worth, and business fluctuations. *The American Economic Review*, 14–31.

Bhandari, A., J. Borovicka, and P. Ho (2019). Survey data and subjective beliefs in business cycle models. *Working paper*.

Bordalo, P., N. Gennaioli, R. La Porta, and A. Shleifer (2019). Diagnostic expectations and stock returns. *Journal of Finance.*

Bordalo, P., N. Gennaioli, Y. Ma, and A. Shleifer (2018). Over-reaction in macroeconomic expectations. *NBER Working Paper* (w24932).

Bordalo, P., N. Gennaioli, and A. Shleifer (2018). Diagnostic expectations and credit cycles. *The Journal of Finance 73*(1), 199–227.

Bordalo, P., N. Gennaioli, A. Shleifer, and S. Terry (2019). Real credit cycles. Technical report, Mimeo, Harvard University.

Bouchaud, J.-p., P. Krueger, A. Landier, and D. Thesmar (2019). Sticky expectations and the profitability anomaly. *The Journal of Finance 74*(2), 639–674.

Bradshaw, M. T. and R. G. Sloan (2002). Gaap versus the street: An empirical assessment of two alternative definitions of earnings. *Journal of Accounting Research 40*(1), 41–66.

Campbell, J. Y. and J. H. Cochrane (1999). By force of habit: A consumption-based explanation of aggregate stock market behavior. *Journal of Political Economy 107*(2), 205–251.

Cieslak, A. (2018). Short-rate expectations and unexpected returns in treasury bonds. *The Review of Financial Studies 31*(9), 3265–3306.

Cochrane, J. H. (1991). Production-based asset pricing and the link between stock returns and economic fluctuations. *The Journal of Finance 46*(1), 209–237.

Coibion, O. and Y. Gorodnichenko (2012). What can survey forecasts tell us about information rigidities? *Journal of Political Economy 120*(1), 116–159.

Coibion, O. and Y. Gorodnichenko (2015). Information rigidity and the expectations formation process: A simple framework and new facts. *American Economic Review 105*(8), 2644–78.

Collin-Dufresn, P., R. S. Goldstein, and J. S. Martin (2001). The determinants of credit spread changes. *The Journal of Finance 56*(6), 2177–2207.

Cooper, R. and J. Ejarque (2003). Financial frictions and investment: requiem in q. *Review of Economic Dynamics 6*(4), 710–728.

Cordoba, J.-C. and M. Ripoll (2004). Credit cycles redux. *International Economic Review 45*(4), 1011–1046.

Croce, M. M. (2014). Long-run productivity risk: A new hope for production-based asset pricing? *Journal of Monetary Economics 66*, 13–31.

Davis, S. J. and J. Haltiwanger (1992). Gross job creation, gross job destruction, and employment reallocation. *The Quarterly Journal of Economics 107*(3), 819–863.

De Bondt, W. F. and R. Thaler (1990). Do security analysts overreact? *American Economic Review 80*(2), 52–57.

Deng, Y. (2019). Product market competition and the profitability premium. *Working paper, University of Minnesota.*

Dominguez, K. M. (1986). Are foreign exchange forecasts rational?: New evidence from survey data. *Economics Letters 21*(3), 277–281.

Fama, E. F. and K. R. French (1992). The cross-section of expected stock returns. *the Journal of Finance 47*(2), 427–465.

Fama, E. F. and K. R. French (2000). Forecasting profitability and earnings. *The Journal of Business 73*(2), 161–175.

Fama, E. F. and K. R. French (2006). Profitability, investment and average returns. *Journal of Financial Economics 82*(3), 491–518.

Fama, E. F. and J. D. MacBeth (1973). Risk, return, and equilibrium: Empirical tests. *Journal of Political Economy 81*(3), 607–636.

Favilukis, J. Y., X. Lin, and X. Zhao (2019). The elephant in the room: the impact of labor obligations on credit markets. *Available at SSRN 2648763*.

Frankel, J. A. and K. A. Froot (1987). Using survey data to test standard propositions regarding exchange rate expectations. *The American Economic Review*, 133–153.

Gennaioli, N., Y. Ma, and A. Shleifer (2016). Expectations and investment. *NBER Macroeconomics Annual 30*(1), 379–431.

Gilchrist, S., C. P. Himmelberg, and G. Huberman (2005). Do stock price bubbles influence corporate investment? *Journal of Monetary Economics 52*(4), 805–827.

Gomes, J. F. and L. Schmid (2010). Levered returns. *The Journal of Finance 65*(2), 467–494.

Greenwood, R. and S. G. Hanson (2013). Issuer quality and corporate bond returns. *The Review of Financial Studies 26*(6), 1483–1525.

Greenwood, R. and A. Shleifer (2014). Expectations of returns and expected returns. *The Review of Financial Studies 27*(3), 714–746.

Greenwood, R. M., S. G. Hanson, and L. J. Jin (2019). Reflexivity in credit markets. *NBER Working Paper* (w25747).

Gulen, H., M. Ion, and S. Rossi (2019). Credit cycles, expectations, and corporate investment. *Working paper*.

Hadlock, C. J. and J. R. Pierce (2010). New evidence on measuring financial constraints: Moving beyond the kz index. *The Review of Financial Studies 23*(5), 1909–1940.

Hennessy, C. A. and T. M. Whited (2007). How costly is external financing? evidence from a structural estimation. *The Journal of Finance 62*(4), 1705–1745.

Hirshleifer, D., J. Li, and J. Yu (2015). Asset pricing in production economies with extrapolative expectations. *Journal of Monetary Economics 76*, 87–106.

Hou, K., M. A. Van Dijk, and Y. Zhang (2012). The implied cost of capital: A new approach. *Journal of Accounting and Economics 53*(3), 504–526.

Huang, J.-Z. and M. Huang (2012). How much of the corporate-treasury yield spread is due to credit risk? *The Review of Asset Pricing Studies 2*(2), 153–202.

İmrohoroğlu, A. and Ş. Tüzel (2014). Firm-level productivity, risk, and return. *Management Science 60*(8), 2073–2090.

Kahneman, D. and A. Tversky (1972). Subjective probability: A judgment of representativeness. *Cognitive psychology 3*(3), 430–454.

Kiyotaki, N. and J. Moore (1997). Credit cycles. *Journal of Political Economy 105*(2), 211–248.

Kocherlakota, N. R. (2000). Creating business cycles through credit constraints. *Federal Reserve Bank of Minneapolis. Quarterly Review 24*(3), 2.

Kogan, L. and D. Papanikolaou (2012). Economic activity of firms and asset prices. *Annu. Rev. Financ. Econ. 4*(1), 361–384.

Kogan, L. and D. Papanikolaou (2014). Growth opportunities, technology shocks, and asset prices. *The Journal of Finance 69*(2), 675–718.

Kuehn, L.-A. and L. Schmid (2014). Investment-based corporate bond pricing. *The Journal of Finance 69*(6), 2741–2776.

Kung, H. and L. Schmid (2015). Innovation, growth, and asset prices. *The Journal of Finance 70*(3), 1001–1037.

La Porta, R. (1996). Expectations and the cross-section of stock returns. *The Journal of Finance 51*(5), 1715–1742.

Leland, H. E. (1994). Corporate debt value, bond covenants, and optimal capital structure. *The Journal of Finance 49*(4), 1213–1252.

Lopez-Salido, D., J. C. Stein, and E. Zakrajsek (2017). Credit-market sentiment and the business cycle. *The Quarterly Journal of Economics 132*(3), 1373–1426.

McGrattan, E. R. (1999). Application of weighted residual methods to dynamic economic models. In *Computational Methods for the Study of Dynamic Economies*. Oxford University Press, Inc.

McKeon, S. (2013). Firm-initiated versus investor-initiated equity issues. *Manuscript, University of Oregon*.

Merton, R. C. (1974). On the pricing of corporate debt: The risk structure of interest rates. *The Journal of Finance 29*(2), 449–470.

Mian, A., A. Sufi, and E. Verner (2017). Household debt and business cycles worldwide. *The Quarterly Journal of Economics 132*(4), 1755–1817.

Minsky, H. P. (1977). The financial instability hypothesis: An interpretation of keynes and an alternative to 'standard' theory. *Challenge 20*(1), 20–27.

Piazzesi, M., J. Salomao, and M. Schneider (2013). Trend and cycle in bond premia. *Working paper*.

Salomao, J. and L. Varela (2018). Exchange rate exposure and firm dynamics. *Working paper*.

Tauchen, G. (1986). Finite state markov-chain approximations to univariate and vector autoregressions. *Economics Letters 20*(2), 177–181.

Warusawitharana, M. and T. M. Whited (2015). Equity market misvaluation, financing, and investment. *The Review of Financial Studies 29*(3), 603–654.

Zhang, L. (2005). The value premium. *The Journal of Finance 60*(1), 67–103.

Table 1. Extrapolation in earnings growth forecasts

This table presents the estimated coefficients of firm-level forecast error predictability regressions: $Actual_{i,t+h} - LTG_{i,t} = \alpha + f_i + \beta(LTG_{i,t} - LTG_{i,t-k}) + \epsilon_{i,t+h}$, where $Actual_{i,t+h} - LTG_{i,t}$ is the forecast error, defined as the difference between actual realized earnings growth over $h = 3, 4, 5$ years and current analysts' long-term earnings growth forecasts LTG, $LTG_{i,t} - LTG_{i,t-k}$ is the forecast revision of LTG over the past $k = 1, 2, 3$ years, and f_i is the firm fixed effect. Standard errors are clustered by firm. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

	$Actual_{t+3} - LTG_t$	$Actual_{t+4} - LTG_t$	$Actual_{t+5} - LTG_t$
$LTG_t - LTG_{t-1}$	-0.492***	-0.516***	-0.517***
[t]	[-10.14]	[-12.43]	[-14.72]
$LTG_t - LTG_{t-2}$	-0.631***	-0.615***	-0.566***
[t]	[-15.41]	[-18.58]	[-20.42]
$LTG_t - LTG_{t-3}$	-0.650***	-0.599***	-0.553***
[t]	[-15.59]	[-17.78]	[-18.89]

Table 2. Misperception and corporate investment

This table presents the estimated coefficients from regressing the investment rate up to five years in the future on current misperception on earnings growth and controls: $IK_{i,t+h-1\rightarrow t+h} = \alpha_h + f_i + \beta_h Mis_{i,t} + \gamma_h X_{i,t} + \epsilon_{i,t+h}$, where $IK_{i,t+h-1\rightarrow t+h}$ is the firm-level physical capital investment rate from year $t+h-1$ to year $t+h$, $h = 0, 1, 2, 3, 4, 5$. The expression $Mis_{i,t}$ is the misperception on earnings growth in year t, f_i is the firm fixed effect, and $X_{i,t}$ is a vector of control variables, including the year t investment rate, Tobin's Q, cash flow, firm size, individual firms' excess stock return, and book leverage. Misperception is the difference between the survey and model-implied objective earnings growth expectations. Panel A presents univariate regressions. Panel B includes controls. Standard errors are clustered by firm. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Panel A						
IK	Year 0	Year 1	Year 2	Year3	Year 4	Year 5
Mis	0.205***	0.072***	-0.072***	-0.146***	-0.172***	-0.174***
[t]	[17.61]	[7.98]	[-6.76]	[-13.52]	[-13.77]	[-14.44]
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	No	No	No	No	No
Obs.	61708	54856	48633	43329	38921	35128
$adjR^2$	0.35	0.38	0.33	0.33	0.33	0.34
Panel B						
IK	Year 0	Year 1	Year 2	Year3	Year 4	Year 5
Mis	0.205***	0.062***	-0.030**	-0.068***	-0.079***	-0.077***
[t]	[17.61]	[5.58]	[-2.44]	[-5.62]	[-5.87]	[-5.61]
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	Yes	Yes	Yes	Yes	Yes
Obs.	61708	53808	47775	42591	38274	34552
$adjR^2$	0.35	0.46	0.39	0.37	0.36	0.36

Table 3. Misperception and external financing

This table presents the estimated coefficients from regressing debt issuance (Panels A and B) and equity issuance (Panels C and D) up to five years in the future on current misperception on earnings growth and controls: $ISS_{i,t+h-1\to t+h} = \alpha_h + f_i + \beta_h Mis_{i,t} + \gamma_h X_{i,t} + \epsilon_{i,t+h}$, where $ISS_{i,t+h-1\to t+h}$ is the firm-level debt issuance $DISS$ or equity issuance $EISS$ from year $t+h-1$ to year $t+h$, $h = 0, 1, 2, 3, 4, 5$. The expression $Mis_{i,t}$ is the misperception on earnings growth in year t, f_i is the firm fixed effect, and $X_{i,t}$ is a vector of control variables, including the year t investment rate, Tobin's Q, cash flow, firm size, individual firms' excess stock return, and book leverage. Misperception is the difference between the survey and model-implied objective earnings growth expectations. Panels A and C present univariate regressions. Panels B and D include controls. Standard errors are clustered by firm. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Panel A

$DISS$	Year 0	Year 1	Year 2	Year3	Year 4	Year 5
Mis	0.072***	0.028***	-0.033***	-0.048***	-0.051***	-0.070***
[t]	[11.68]	[4.85]	[-5.10]	[-6.65]	[-6.80]	[-8.78]
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	No	No	No	No	No
Obs.	60538	53890	47714	42442	38064	34352
$adjR^2$	0.09	0.06	0.04	0.03	0.03	0.03

Panel B

$DISS$	Year 0	Year 1	Year 2	Year3	Year 4	Year 5
Mis	0.072***	0.003	-0.028***	-0.018**	-0.020**	-0.042***
[t]	[11.68]	[0.44]	[-3.36]	[-2.08]	[-2.27]	[-4.36]
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	Yes	Yes	Yes	Yes	Yes
Obs.	60538	53487	47211	41919	37571	33879
$adjR^2$	0.09	0.15	0.09	0.07	0.05	0.05

Panel C

$EISS$	Year 0	Year 1	Year 2	Year3	Year 4	Year 5
Mis	0.033***	-0.041***	-0.054***	-0.045***	-0.030***	-0.025***
[t]	[6.72]	[-9.65]	[-11.77]	[-10.63]	[-7.85]	[-6.29]
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	No	No	No	No	No
Obs.	61893	55061	48810	43494	39069	35267
$adjR^2$	0.14	0.11	0.11	0.12	0.10	0.11

Panel D

$EISS$	Year 0	Year 1	Year 2	Year3	Year 4	Year 5
Mis	0.033***	-0.038***	-0.036***	-0.032***	-0.021***	-0.024***
[t]	[6.72]	[-6.93]	[-6.83]	[-6.25]	[-4.86]	[-5.41]
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	Yes	Yes	Yes	Yes	Yes
Obs.	61893	53819	47789	42606	38291	34569
$adjR^2$	0.14	0.16	0.13	0.13	0.11	0.12

Table 4. Misperception and firm-level asset prices

This table presents the estimated coefficients from regressing firm-level yield spread changes (Panels A and B) and excess stock returns (Panels C and D) up to five years in the future on current misperception on earnings growth and controls: $RET_{i,t+h-1\to t+h} = \alpha_h + f_i + \beta_h Mis_{i,t} + \gamma_h X_{i,t} + \epsilon_{i,t+h}$, where $RET_{i,t+h-1\to t+h}$ is the firm-level bond yield spread changes $\triangle CS$ or excess stock returns $RETS$ from year $t+h-1$ to year $t+h$, $h = 0, 1, 2, 3, 4, 5$. The expression $Mis_{i,t}$ is the misperception on earnings growth in year t, f_i is the firm fixed effect, and $X_{i,t}$ is a vector of control variables, including the year t investment rate, Tobin's Q, cash flow, firm size, individual firms' excess stock return, and book leverage. Misperception is the difference between the survey and model-implied objective earnings growth expectations. Panels A and C present univariate regressions. Panels B and D include controls. Standard errors are clustered by firm. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

			Panel A			
$\triangle CS$	Year 0	Year 1	Year 2	Year3	Year 4	Year 5
Mis	-0.010***	0.012***	0.011***	0.012***	0.001	-0.008**
[t]	[-3.11]	[2.94]	[2.88]	[2.80]	[0.28]	[-2.02]
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	No	No	No	No	No
Obs.	8225	8319	8069	7889	7726	7533
$adjR^2$	0.19	0.19	0.19	0.19	0.19	0.19
			Panel B			
$\triangle CS$	Year 0	Year 1	Year 2	Year3	Year 4	Year 5
Mis	-0.010***	0.010***	0.004	0.002	-0.006	-0.002
[t]	[-3.11]	[2.88]	[0.79]	[0.53]	[-0.99]	[-0.32]
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	Yes	Yes	Yes	Yes	Yes
Obs.	8225	7990	7784	7634	7485	7311
$adjR^2$	0.19	0.20	0.19	0.19	0.19	0.19
			Panel C			
$RETS$	Year 0	Year 1	Year 2	Year3	Year 4	Year 5
Mis	0.052***	-0.414***	-0.306***	-0.187***	-0.174***	-0.099***
[t]	[3.46]	[-23.76]	[-16.28]	[-9.58]	[-8.41]	[-4.87]
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	No	No	No	No	No
Obs.	61875	55040	48806	43477	39053	35252
$adjR^2$	0.01	0.07	0.07	0.05	0.05	0.05
			Panel D			
$RETS$	Year 0	Year 1	Year 2	Year3	Year 4	Year 5
Mis	0.052***	-0.285***	-0.155***	-0.072***	-0.081***	-0.014
[t]	[3.46]	[-12.65]	[-6.40]	[-2.88]	[-3.02]	[-0.57]
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	Yes	Yes	Yes	Yes	Yes
Obs.	61875	53821	47794	42599	38279	34558
$adjR^2$	0.01	0.12	0.09	0.06	0.06	0.07

Table 5. Conditioning on financial constraint

This table presents the estimated coefficients from regressing the investment rate (Panel A), debt issuance (Panel B), equity issuance (Panel C), excess stock return (Panel D), and firm-level credit spread change (Panel E) up to five years in the future on current misperception on earnings growth and controls, conditional on financial constraint. Financial constraint is measured by the size and age index of Hadlock and Pierce (2010). All results include the firm fixed effect and the following controls: the year t investment rate, Tobin's Q, cash flow, firm size, individual firms' excess stock return, and book leverage. Standard errors are clustered by firm. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Panel A: Investment rate						
IK	Year 0	Year 1	Year 2	Year3	Year 4	Year 5
Unconstrained quartile	0.170***	0.057***	0.029**	-0.002	-0.027*	-0.029*
[t]	[13.34]	[5.01]	[2.29]	[-0.12]	[-1.89]	[-1.88]
Constrained quartile	0.408***	0.118***	-0.081**	-0.116***	-0.071	-0.100**
[t]	[14.02]	[3.30]	[-2.09]	[-3.14]	[-1.62]	[-1.99]
Panel B: Debt issuance						
$DISS$	Year 0	Year 1	Year 2	Year3	Year 4	Year 5
Unconstrained quartile	0.072***	0.004	-0.032**	-0.027*	-0.005	-0.006
[t]	[5.56]	[0.26]	[-2.24]	[-1.80]	[-0.31]	[-0.38]
Constrained quartile	0.089***	-0.036**	-0.060***	-0.038	-0.009	-0.016
[t]	[7.55]	[-1.97]	[-2.94]	[-1.56]	[-0.36]	[-0.55]
Panel C: Equity issuance						
$EISS$	Year 0	Year 1	Year 2	Year3	Year 4	Year 5
Unconstrained quartile	-0.003	-0.001	-0.008***	-0.007*	-0.003	-0.001
[t]	[-1.08]	[-0.32]	[-2.70]	[-1.76]	[-0.68]	[-0.56]
Constrained quartile	0.125***	-0.067***	-0.061***	-0.064***	0.003	-0.023
[t]	[8.82]	[-3.88]	[-3.88]	[-3.97]	[0.20]	[-1.35]
Panel D: Stock return						
$RETS$	Year 0	Year 1	Year 2	Year3	Year 4	Year 5
Unconstrained quartile	0.054	-0.248***	-0.07	-0.129***	-0.023	-0.093**
[t]	[1.59]	[-6.09]	[-1.51]	[-2.65]	[-0.43]	[-1.98]
Constrained quartile	0.134***	-0.495***	-0.182***	-0.105	-0.136	0.097
[t]	[3.83]	[-8.57]	[-2.80]	[-1.39]	[-1.62]	[1.28]
Panel E: Credit spread change						
$\triangle CS$	Year 0	Year 1	Year 2	Year3	Year 4	Year 5
Unconstrained quartile	-0.006	0.013***	0.008**	0.006**	-0.001	-0.002
[t]	[-1.52]	[3.45]	[2.33]	[2.03]	[-0.29]	[-0.48]
Constrained half	-0.018**	0.019**	0.012	-0.008	-0.025	-0.025
[t]	[-2.30]	[2.51]	[1.01]	[-0.67]	[-1.64]	[-1.34]

Table 6. Calibration

This table presents the model's calibrated parameters. The model is solved at an annual frequency.

Parameter	Symbol	Benchmark
Technology		
Returns to scale	α	0.65
Persistence of aggregate productivity	ρ_z	0.80
Conditional volatility of aggregate productivity	σ_z	0.09
Persistence of idiosyncratic productivity	ρ_s	0.90
Conditional volatility of idiosyncratic productivity	σ_s	0.10
Average level of idiosyncratic productivity	$\bar{s}$	-1.20
Depreciation rate of capital	δ	0.10
Disinvestment adjustment cost	c_0	4
Investment adjustment cost	c_1	0.10
Fixed cost of operation	c_f	0.15
Financing		
Corporate tax rate	τ	0.20
Corporate bond coupon rate	C	0.03
Bankruptcy cost	ϵ	0.60
Equity issuance cost	λ	0.10
Expectation		
Extrapolation	θ	0.15
Stochastic discount factor		
Time discount factor	β	0.97
Price of risk	γ	3

Table 7. Moments for quantities and prices

This table compares the moments for quantities at both the aggregate and firm level and asset prices from the data to the model. I simulate 100 artificial samples, each consisting of 3,000 firms and 100 years, and report the cross-sample averages.

Moments	Data	Model
Real quantities: Aggregate level		
Volatility of aggregate profits growth	0.14	0.15
Autocorrelation of aggregate profits growth	0.30	0.33
Correlation between leverage and output growth	-0.11	-0.69
Correlation between default rate and output growth	-0.29	-0.42
Correlation between credit spread and output growth	-0.51	-0.16
Real quantities: Cross section		
Correlation between forecast error and profits	-0.12	-0.09
Average leverage	0.45	0.55
Average default rate	0.02	0.02
Average fraction of equity issuance	0.09	0.06
Volatility of cross-sectional investment rate	0.25	0.16
Autocorrelation of investment rate	0.41	0.36
Volatility of cross-sectional leverage	0.09	0.09
Volatility of cross-sectional profitability	0.06	0.05
Asset prices		
Aggregate excess stock market return (%)	7.90	7.47
Volatility of excess stock market return	0.17	0.17
Sharpe ratio of aggregate stock market	0.46	0.43
Average real risk-free rate (%)	2.90	2.90
Average credit spread (%)	1.18	1.26
Volatility of changes in credit spread (%)	0.62	1.79

Table 8. Effects of extrapolation on investment

This table presents the estimated coefficients from regressing the investment rate up to five years in the future on current misperception on earnings growth in the data and on simulated data from the model: $IK_{i,t+h-1\to t+h} = \alpha_h + f_i + \beta_h Mis_{i,t} + \gamma_h X_{i,t} + \epsilon_{i,t+h}$, where $IK_{i,t+h-1\to t+h}$ is the firm-level physical capital investment rate from year $t+h-1$ to year $t+h$, $h = 0, 1, 2, 3, 4, 5$. The expression $Mis_{i,t}$ is the misperception on earnings growth in year t, f_i is the firm fixed effect, and $X_{i,t}$ only contains $IK_{i,t}$ for $h \geqslant 1$. Misperception is the difference between the subjective and model-implied objective earnings growth expectations. Standard errors are clustered by firm. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

IK	Year 0	Year 1	Year 2	Year3	Year 4	Year 5
			Data			
Mis	0.205***	0.072***	-0.072***	-0.146***	-0.172***	-0.174***
$[t]$	[17.61]	[7.98]	[-6.76]	[-13.52]	[-13.77]	[-14.44]
R^2	0.35	0.38	0.33	0.33	0.33	0.34
			Model			
Mis	0.242***	-0.029***	-0.042***	-0.094***	-0.104***	-0.096***
$[t]$	[130.99]	[-16.17]	[-16.18]	[-25.47]	[-24.38]	[-21.12]
R^2	0.13	0.23	0.09	0.06	0.06	0.05

Table 9. Effects of extrapolation on financing

This table presents the estimated coefficients from regressing debt issuance (Panel A) or equity issuance (Panel B) up to five years in the future on current misperception on earnings growth in the data and on simulated data from the model: $ISS_{i,t+h-1\to t+h} = \alpha_h + f_i + \beta_h Mis_{i,t} + \epsilon_{i,t+h}$, where $ISS_{i,t+h-1\to t+h}$ is the firm-level debt ($DISS$) or equity ($EISS$) issuance from year $t+h-1$ to year $t+h$, $h = 0, 1, 2, 3, 4, 5$. The expression $Mis_{i,t}$ is the misperception on earnings growth in year t, and f_i is the firm fixed effect. Misperception is the difference between the subjective and model-implied objective earnings growth expectations. Standard errors are clustered by firm. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Panel A: Debt issuance						
$DISS$	Year 0	Year 1	Year 2	Year3	Year 4	Year 5
Data						
Mis	0.072***	0.028***	-0.033***	-0.048***	-0.051***	-0.070***
$[t]$	[11.68]	[4.85]	[-5.10]	[-6.65]	[-6.80]	[-8.78]
R^2	0.09	0.06	0.04	0.03	0.03	0.03
Model						
Mis	0.169***	0.008***	-0.037***	-0.080***	-0.084***	-0.075***
$[t]$	[102.66]	[6.61]	[-23.00]	[-34.37]	[-30.98]	[-25.38]
R^2	0.08	0.02	0.02	0.03	0.03	0.03
Panel B: Equity issuance						
$EISS$	Year 0	Year 1	Year 2	Year3	Year 4	Year 5
Data						
Mis	0.033***	-0.041***	-0.054***	-0.045***	-0.030***	-0.025***
$[t]$	[6.72]	[-9.65]	[-11.77]	[-10.63]	[-7.85]	[-6.29]
R^2	0.14	0.11	0.11	0.12	0.10	0.11
Model						
Mis	0.009***	-0.007***	-0.015***	-0.026***	-0.030***	-0.028***
$[t]$	[28.32]	[-20.83]	[-30.18]	[-33.27]	[-31.23]	[-26.35]
R^2	0.03	0.04	0.06	0.08	0.07	0.05

Table 10. Effects of extrapolation on asset prices

This table presents the estimated coefficients from regressing the firm-level bond return (Panel A) or excess stock return (Panel B) up to five years in the future on current misperception on earnings growth in the data and on simulated data from the model: $RET_{i,t+h-1\to t+h} = \alpha_h + f_i + \beta_h Mis_{i,t} + \epsilon_{i,t+h}$, where $RET_{i,t+h-1\to t+h}$ is the firm-level bond ($RETB$) or stock ($RETS$) excess return from year $t+h-1$ to year $t+h$, $h = 0, 1, 2, 3, 4, 5$. The expression $Mis_{i,t}$ is the misperception on earnings growth in year t, and f_i is the firm fixed effect. Misperception is the difference between the subjective and model-implied objective earnings growth expectations. Standard errors are clustered by firm. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Panel A: Bond return						
$RETB$	Year 0	Year 1	Year 2	Year3	Year 4	Year 5
Data						
Mis		-0.077***				
$[t]$		[-3.30]				
R^2		0.02				
Model						
Mis	-	-0.0001**	-	-	-	-
$[t]$	-	[-6.37]	-	-	-	-
R^2	-	0.03	-	-	-	-
Panel B: Stock return						
$RETS$	Year 0	Year 1	Year 2	Year3	Year 4	Year 5
Data						
Mis	0.052***	-0.414***	-0.306***	-0.187***	-0.174***	-0.099***
$[t]$	[3.46]	[-23.76]	[-16.28]	[-9.58]	[-8.41]	[-4.87]
R^2	0.01	0.07	0.07	0.05	0.05	0.05
Model						
Mis	0.388***	-0.159***	-0.241***	-0.275***	-0.176***	-0.091***
$[t]$	[20.78]	[-14.40]	[-11.56]	[-9.69]	[-6.02]	[-3.23]
R^2	0.02	0.03	0.02	0.02	0.02	0.01

Table 11. Model comparisons

This table compares selected moments from several alternative models to the baseline model. The benchmark model (X + FF) features extrapolative expectations ($\theta = 0.15$) and financial frictions ($\epsilon = 0.60$, $\lambda = 0.10$). The X + NFF model features extrapolative expectations ($\theta = 0.15$) and no financial frictions ($\epsilon = 0$, $\lambda = 0$). The RE + FF model features rational expectations ($\theta = 0$) and financial frictions ($\epsilon = 0.60$, $\lambda = 0.10$). The RE + NFF model features rational expectations ($\theta = 0$) and no financial frictions ($\epsilon = 0$, $\lambda = 0$).

	Data	X + FF	X + NFF	RE + FF	RE + NFF
Parameter					
Bankruptcy cost (ϵ)	NA	0.60	0	0.60	0
Equity issuance cost (λ)	NA	0.10	0	0.10	0
Extrapolation (θ)	NA	0.15	0.15	0	0
Moments: Quantities					
Correlation between forecast error and profits	-0.12	-0.088	-0.102	-0.001	-0.001
Average leverage	0.45	0.551	0.742	0.536	0.694
Average default rate	0.02	0.018	0.022	0.010	0.015
Average fraction of equity issuance	0.09	0.064	0.106	0.133	0.177
Volatility of cross-sectional investment rate	0.25	0.158	0.107	0.131	0.105
Autocorrelation of investment rate	0.41	0.356	0.348	0.454	0.431
Moments: Asset prices					
Aggregate stock market excess return (%)	7.90	7.472	10.231	4.447	5.546
Volatility of stock market excess return	0.17	0.174	0.231	0.138	0.165
Sharpe ratio of aggregate stock market	0.46	0.432	0.445	0.323	0.337
Average credit spread (%)	1.18	1.255	0.005	0.352	0.010
Volatility of changes in credit spread (%)	0.62	1.792	0.011	0.304	0.016
Long-term predictability of misperception					
Investment rate	-0.07	-0.042	0.394	-	-
Debt issuance	-0.03	-0.037	0.436	-	-
Equity issuance	-0.05	-0.015	0.045	-	-
Bond return	-0.08	-0.0001	0.0004	-	-
Stock return	-0.31	-0.241	0.607	-	-

Figure 1. Interaction effects between extrapolative expectations and financial frictions

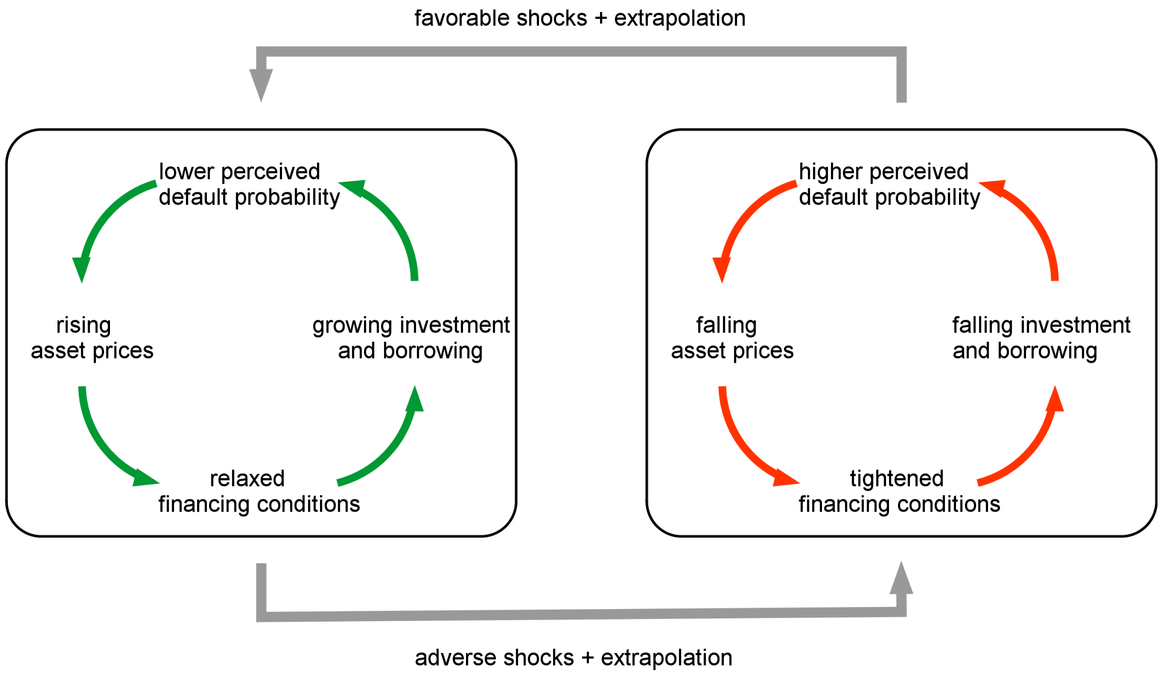


Figure 2. Misperception on earnings growth

The top panel plots the distribution of misperception on earnings growth, defined as the difference between subjective and model-implied objective earnings growth expectations. The histogram represents a panel of 63,338 firm years, covering the period from 1981 to 2018. The bottom panel is a binned scatter plot of year t misperception on earnings growth on year t earnings over total assets.

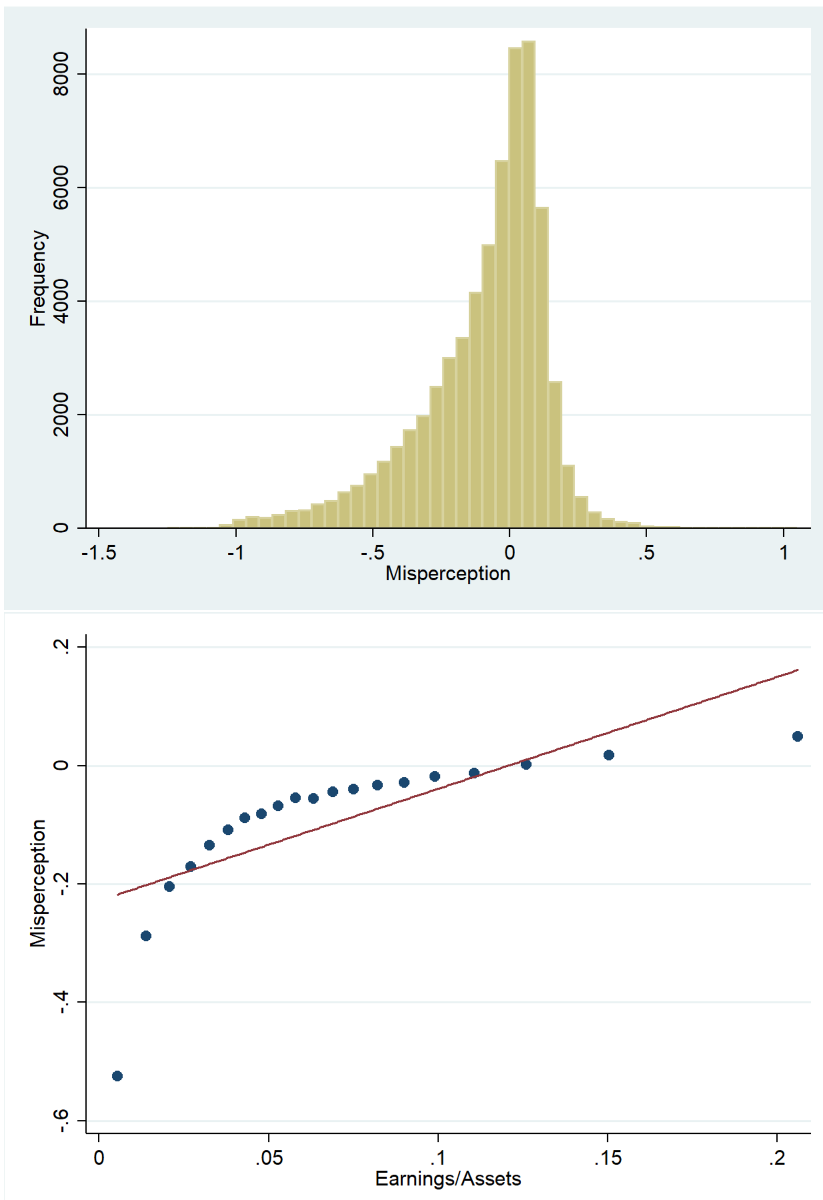


Figure 3. Misperception and corporate investment

This figure plots the estimated coefficients and 95% confidence interval (y-axis) from regressing the investment rate up to five years in the future on current misperception on earnings growth and controls. Misperception is the difference between the survey and model-implied objective earnings growth expectations. The x-axis is horizon h.

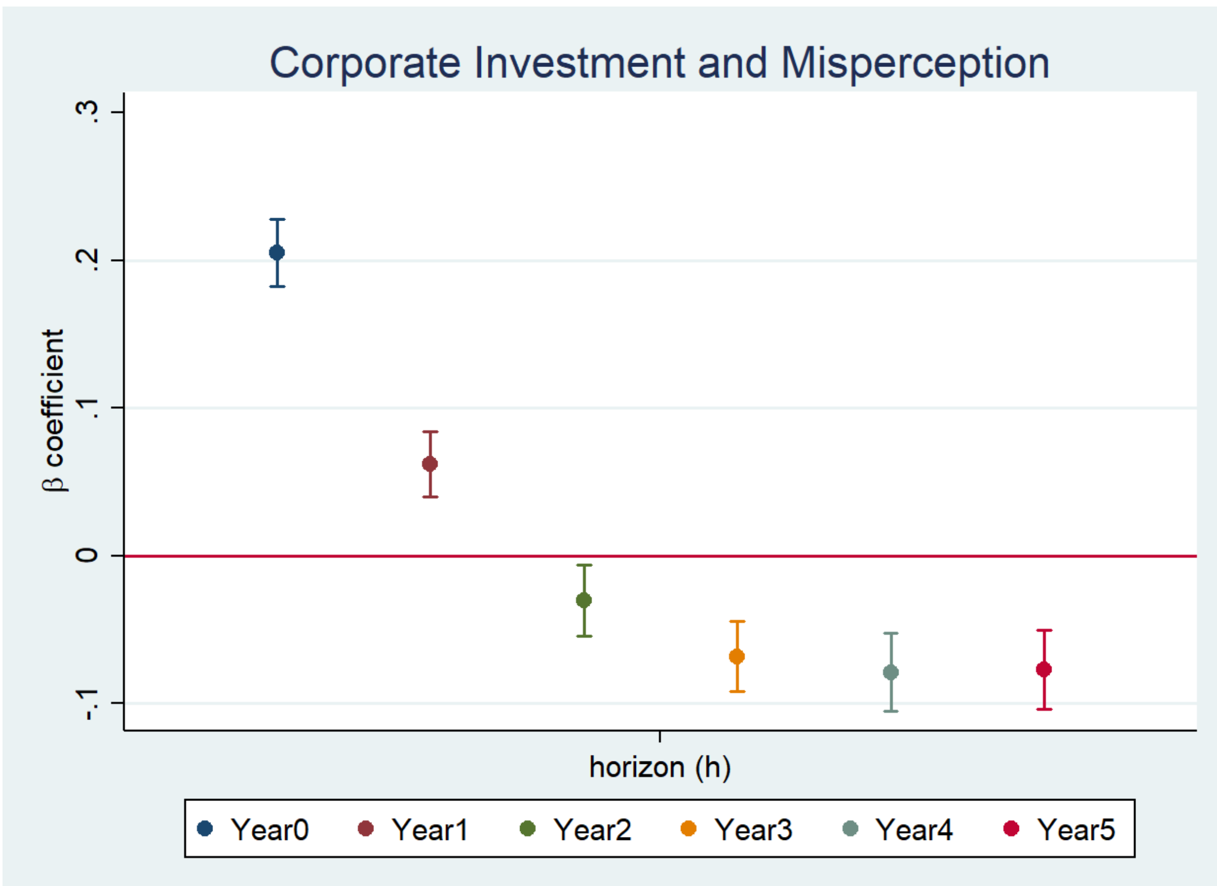


Figure 4. Misperception and external financing

This figure plots the estimated coefficients and 95% confidence interval (y-axis) from regressing debt issuance (top panel) and equity issuance (bottom panel) up to five years in the future on current misperception on earnings growth and controls. Misperception is the difference between the survey and model-implied objective earnings growth expectations. The x-axis is horizon h.

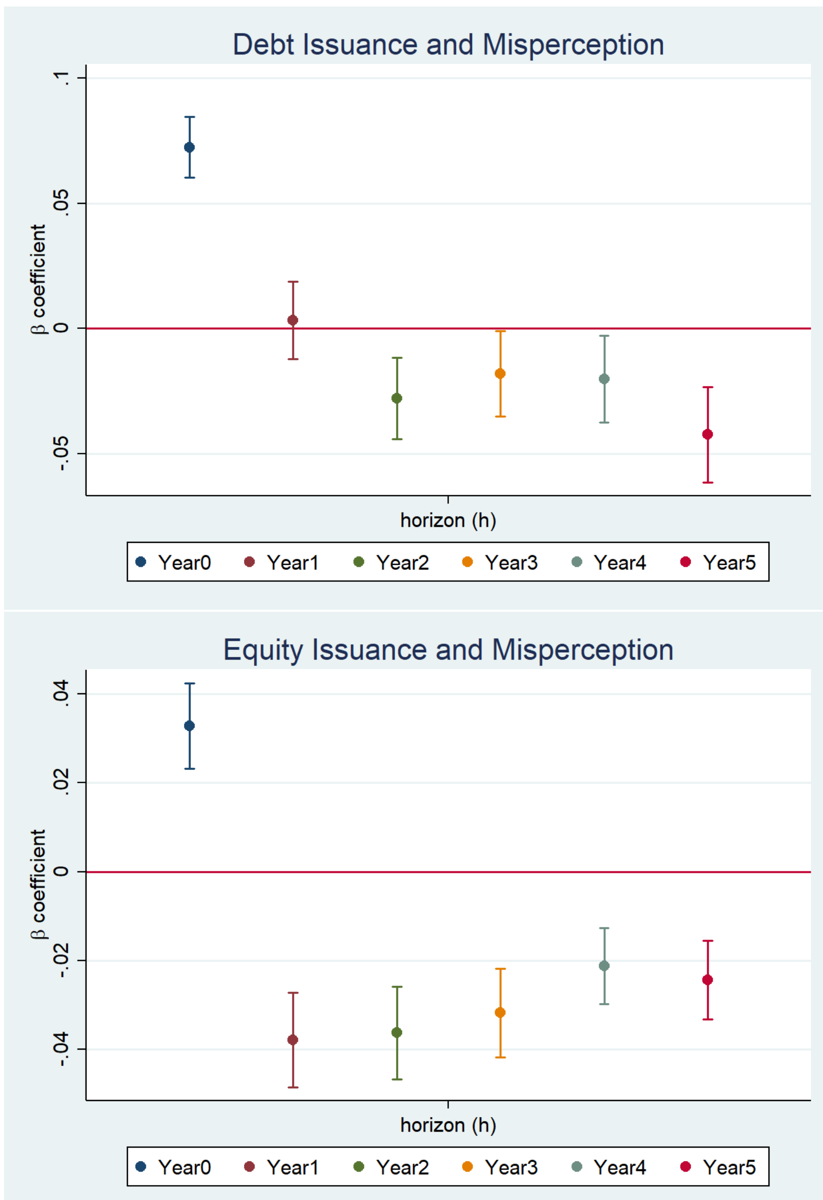


Figure 5. Misperception and asset prices

This figure plots the estimated coefficients and 95% confidence interval (y-axis) from regressing firm-level yield spread changes (top panel) and firm-level excess stock returns (bottom panel) up to five years in the future on current misperception on earnings growth and controls. Misperception is the difference between the survey and model-implied objective earnings growth expectations. The x-axis is horizon h.

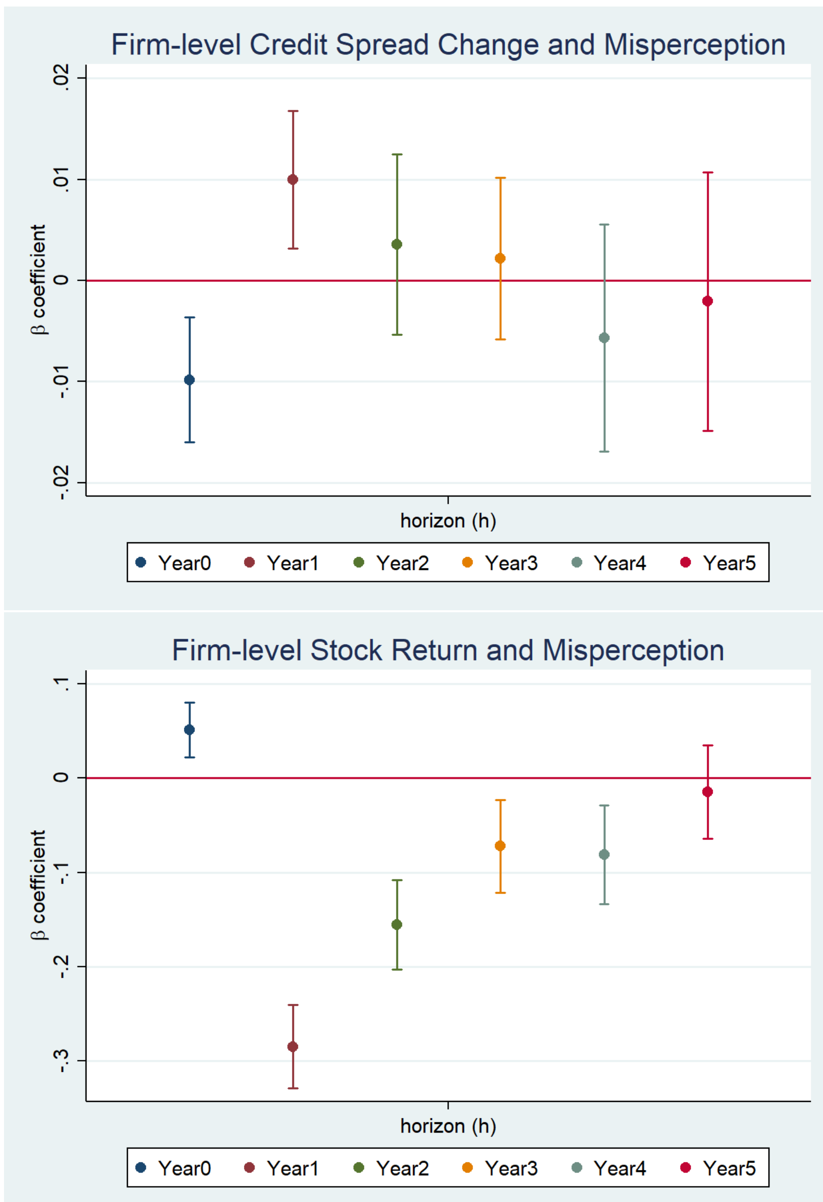


Figure 6. Illustration of extrapolative expectations

This figure plots the conditional probability distribution of future aggregate productivity after good news. The solid line is under extrapolative expectations, and the dashed line is under rational expectations.

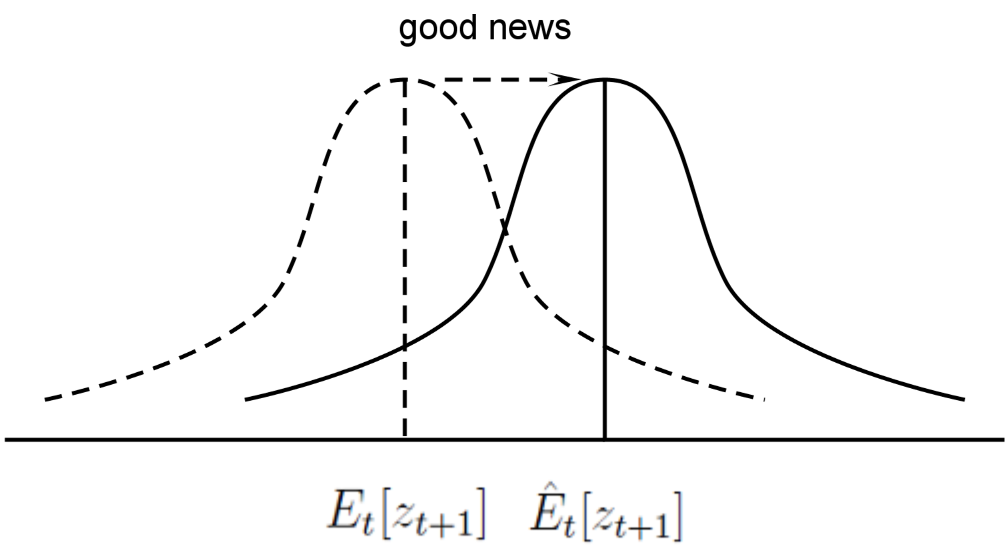


Figure 7. Value and policy functions

This figure plots the perceived value of equity (top left panel), the policy for the investment-to-capital ratio (top right panel), the policy for issuing new debt (bottom left panel), and the price of debt (bottom right panel) as functions of capital. The two lines correspond to identical current idiosyncratic productivity levels, aggregate productivity levels, and leverage levels, but distinct values of previous idiosyncratic productivity levels. The solid line refers to a realization of good news, and the dashed line refers to a realization of bad news.

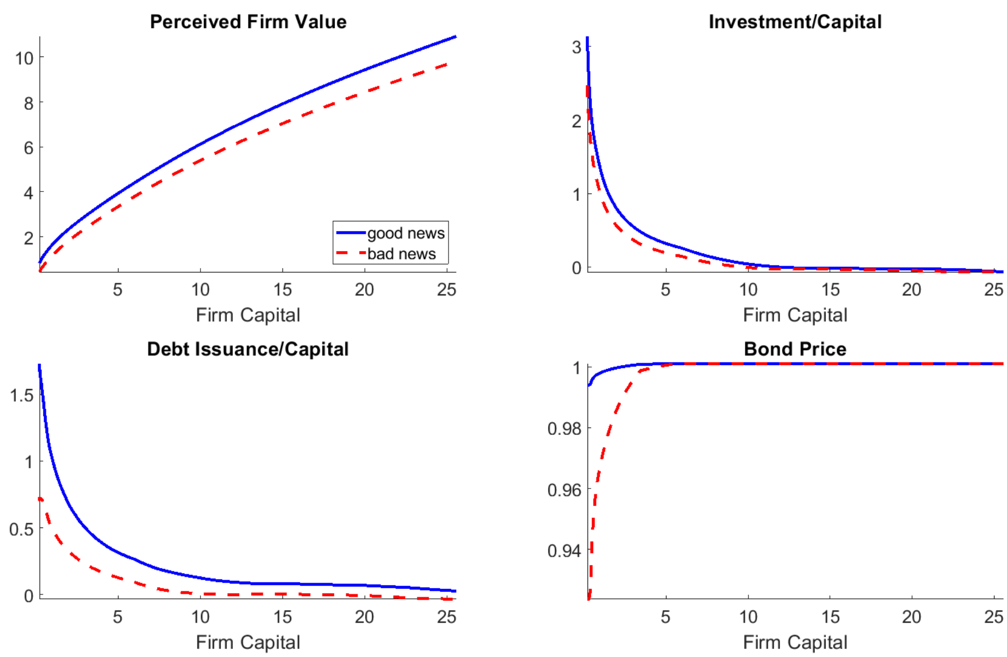


Figure 8. Impulse response functions: after a good shock

This figure plots the percentage deviations of the average perceived TFP level, investment, and debt growth from their values in period 0 of two model specifications: the model under extrapolative expectations (red circle) and the model under rational expectations (blue cross). All plots are based on simulations of 30,000 firms of 1,000 periods. I impose a positive aggregate productivity shock in the period labeled 1, allowing a normal evolution of the economy afterward.

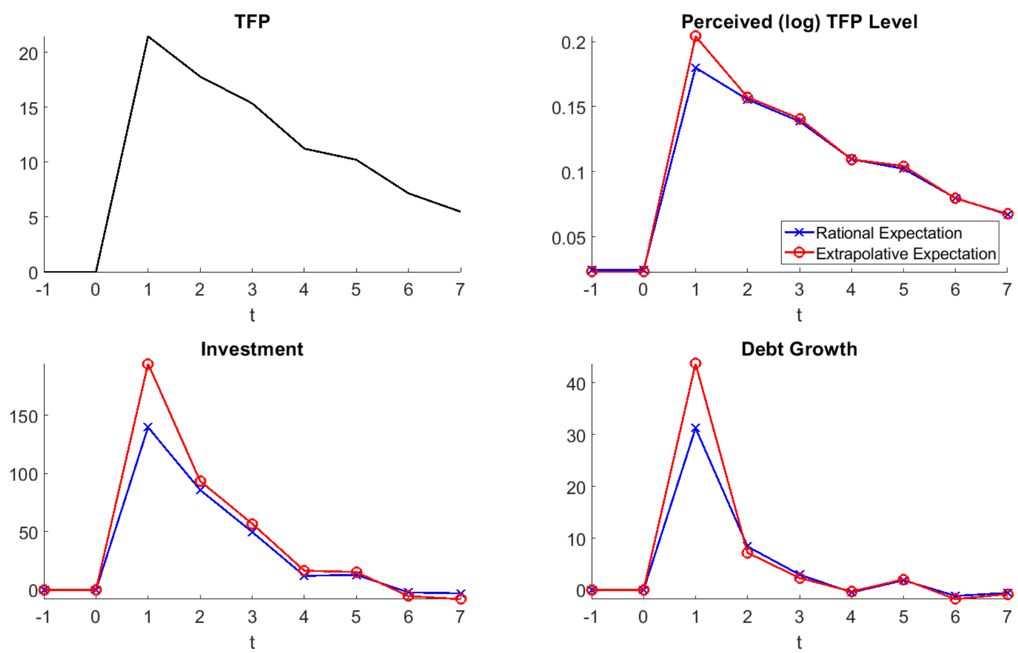


Figure 9. Impulse response functions: a negative shock after good news

This figure plots the percentage deviations of the average perceived TFP level, investment, and debt growth from their values in period 0 of two model specifications: the model under extrapolative expectations (red circle) and the model under rational expectations (blue cross). All plots are based on simulations of 30,000 firms of 1,000 periods. I impose a negative aggregate productivity shock following a positive shock, allowing a normal evolution of the economy afterward.

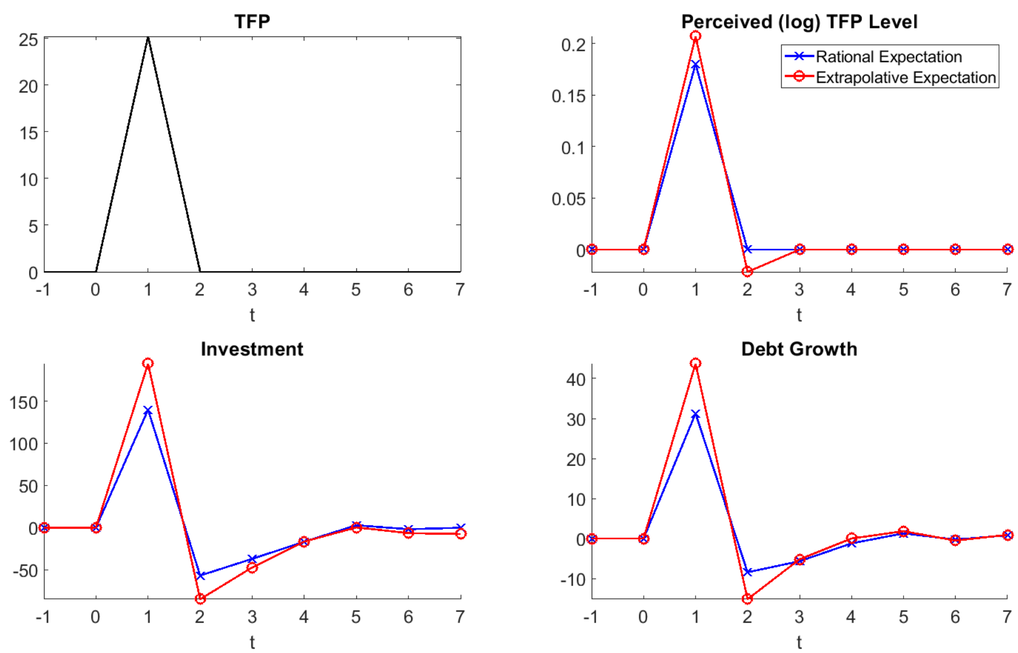
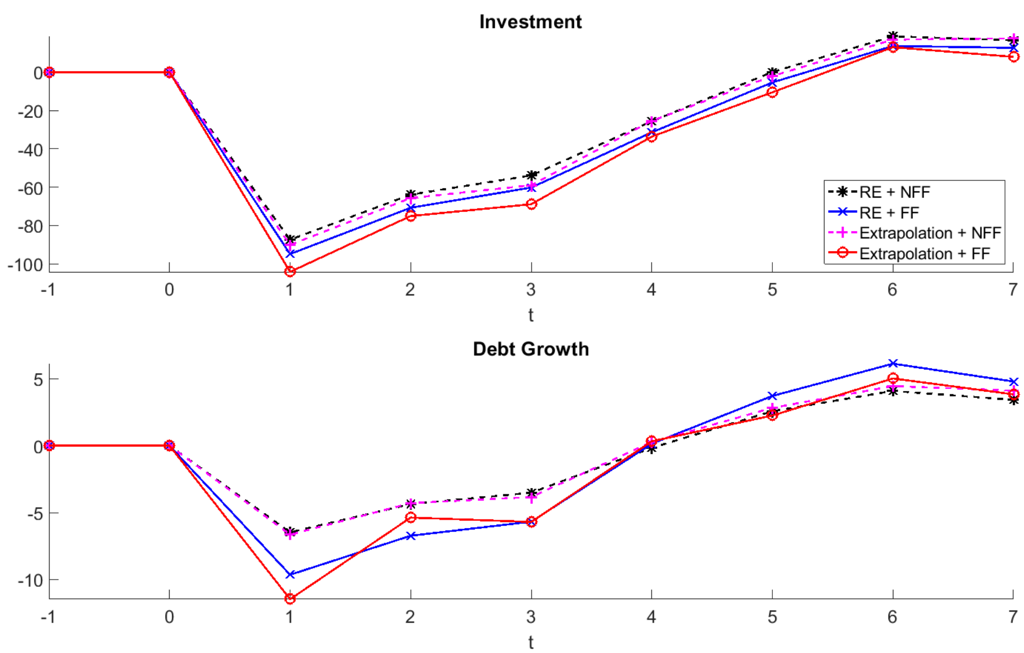


Figure 10. Impulse response functions: interaction effects

This figure plots the percentage deviations of the average investment and debt growth from their values in period 0 after a negative aggregate productivity shock of four model specifications: 1) rational expectations without financial frictions (black star); 2) rational expectations with financial frictions (blue cross); 3) extrapolative expectations without financial frictions (magenta plus); and 4) extrapolative expectations with financial frictions (red circle). All plots are based on simulations of 30,000 firms of 1,000 periods. I impose a negative aggregate productivity shock in the period labeled 1, allowing a normal evolution of the economy afterward.



Appendix

A. Data

Data used in the empirical analysis is described in detail in this section. Sources include Compustat, CRSP, IBES, TRACE, and FISD. Table A1 presents descriptive statistics of main variables used in the firm-level panel regressions.

I draw financial information for US publicly held companies from Compustat. Sample is annual from 1981 to 2018. I use Compustat fiscal-year annual company data from balance sheet, income statement, and cash flow statement. Financial, utilities and public sector firms are excluded (i.e. SIC between 6000 and 6999, 4900 and 4999, and equal to or greater than 9000). When Compustat reports more than one annual data for the same-company in a given fiscal year (e.g. when a company changes its fiscal-year end month), I drop the first chronologically dated observations and keep only the last data for that fiscal year, ensuring one data point per firm-fiscal year. I drop any firm-year observations having zero or negative total assets, sales, employment, and/or market equity.

My main empirical tests involve either variables in ratios, levels, and/or in changes from one fiscal year to the next. When measuring changes from one year to the next, I define the growth rate as in Davis and Haltiwanger (1992), where for any variable x_t the growth rate is $\triangle x_t = (x_t - x_{t-1})/(\frac{1}{2}x_t + \frac{1}{2}x_{t-1})$, which for positive values of x_t and x_{t-1} yields growth rates bounded between -2 and 2. Moreover, whenever both x_t and x_{t-1} are zero, I set the corresponding growth rate equal to zero.

The set of dependent variables starts with capital formation. I measure firm investment rate as $\frac{CAPX_{i,t}}{K_{i,t-1}}$ where $CAPX$ is capital expenditures, and K is net property plant and equipment. Intangible capital is defined as $SG\&A + R\&D$ (sales, general and administration plus research and development). Employment is number of employees (EMP). The set of financing variables includes debt issuance and equity issuance. Following Greenwood and Hanson (2013), I define debt issuance as the change in assets minus the change in book equity, scaled by lagged assets. The results for debt issuance are similar for other measures, such as total debt ($DLTT + DLC$) over assets, or debt net sale ($DLTIS - DLTR + DLCCH$) over assets. Equity issuance is measured by sale of common and preferred stock ($SSTK$) scaled by lagged assets. Since equity issuances are all funds received from the issuance of common and preferred stock. They include the exercise of stock options or warrants for employee compensation. Therefore, this measure may overstate equity issuances for financing reasons. I address this concern following McKeon (2013) by considering only equity issuances that are larger than 2% of market value.

The set of firm-level controls include the following variables. Tobin's Q is computed as market value of assets ($AT + ME - BE$) over total assets, where book equity (BE) and market equity (ME) follow the definitions in Fama and French (1992). Cash flows are earnings over total assets. Firm size is defined as log $SALE$. Individual firm's stock return is RET from CRSP. Book leverage ratio is computed as book value of debt ($DLTT + DLC$) over total assets. All above variables are winsorized every year at the 1 and 99 percentiles.

I download earnings growth forecasts and realized earnings data from the IBES Adjusted Summary History database. I require nonmissing IBES permanent ticker (*ticker*), long-term earnings growth forecast (LTG), fiscal year end realized earning per share ($FY0A$), and shares outstanding ($SHOUT$). I keep only US firms by $usfirm = 1$ and only firms reporting in US dollars by *curcode* $= USD$. I use mean consensus forecast ($MEANEST$) and confirm that all results are robust to median consensus forecast ($MEDEST$). I use monthly average consensus forecasts within a year to represent annual consensus forecast in order to use the most of available observations within each year. I confirm that all results are robust if I use forecast made at year end month (December).

I also compare the expectations between managers and analysts. I use managers' forecasts on earnings per share from IBES Guidance dataset. I compare managers' forecasts with analysts' consensus forecasts on the same object at the time the guidance was captured. The correlation is very high, about 0.95 if I demean by firm. Since manager guidance dataset covers a shorter period of time and a smaller set of firms, I use analysts' forecasts in my main analyses. Similarly, Gennaioli, Ma, and Shleifer (2016) also reports a high correlation between CFOs' forecasts on earnings growth and analysts' forecasts. The high correlation between managers and analysts indicates that both groups share similar beliefs about general business outlook.

To compare forecasted earnings growth with realized earnings growth, I gather realized earnings data from IBES Actuals files. While Compustat mainly records Generally Accepted Accounting Principles (GAAP) earnings, managers and analysts often use so-called "Street earnings", which adjust for certain nonrecurring items (Bradshaw and Sloan 2002). These are the numbers that analyst forecasts aim to match. Therefore, I collect street earnings to make sure I use the same measure of earnings as managers and analysts. Realized earnings are computed by realized earnings per share ($FY0A$) times shares outstanding ($SHOUT$). I exclude firms that have negative earnings when calculating realized earnings growth. I follow the recommendation from WRDS on choosing the proper horizon in order to compare realized earnings growth with analysts' forecasts (LTG). I construct objective earnings forecasts by running cross sectional regressions using 3, 4, and 5 years ahead earnings, respectively and take the average of fitted values from these forecasts. My results are robust if I only choose the forecasting horizon to be 4 years.

To link Compustat and IBES, I complete two steps. First, Compustat provides a linking header table between *gvkey* and IBES ticker *ibtic* in security table. Second, I link the missing ones after first step via *iclink* macro which links CRSP and IBES, and finally I merge IBES and Compustat.

Corporate bond data are from the merged dataset of FINRA's TRACE for bond transactions and Mergent FISD for bond issue and issuer characteristics and can be downloaded from WRDS Bond Returns dataset. Data on yield (T_YLD_PT) and monthly return calculated based on last price at which bond was traded in a given month and accrued coupon interest (RET_EOM) are the main focus. For firms which have multiple corporate bonds, equally weighted average yield and return are calculated to represent firm-level yield and return. TRACE was launched in 2002. Thus, corporate bond data are from 2002 to 2018. Finally, I take stock returns from CRSP between 1981 and 2018 that are listed on NYSE, AMEX, or Nasdaq and have share codes 10 and 11. Delisting returns are added when available. Risk free rate is downloaded from Fama and French Data Library.

B. Two-Period Model

In this section, I solve a simplest two-period model that is otherwise as similar as possible to the baseline model to illustrate the key mechanism.

B.1 Environment

Firms produce employing a decreasing returns to scale technology, i.e. $y = zk^{\alpha}$, where $\alpha \in (0,1)$ and z denotes the total factor productivity (TFP), which is the only source of uncertainty in the model. Firms are endowed with an initial capital stock k_0 and need to decide its next period's capital stock k_1. They can raise debt to fund investment and pay quadratic investment adjustment cost $g(k_0, k_1) = \frac{c_1}{2}(\frac{k_1-(1-\delta)k_0}{k_0})^2 k_0$. They produce in the next period and incur in a fixed operational cost to produce c_f.

Firms finance their investment employing external financing. These bonds take the form of one-period bonds, which I denote with b. The bonds are issued at discount price q with face value 1. For simplicity, I assume that firms can not issue equity and, hence, cannot see negative income in the first period.

The timeline is as follows. In the first period, z_0 gets realized. Firms choose their investment in physical capital and how much debt to borrow, based on their subjective expectations of z_1. In the second period, z_1 gets realized, and firms decide whether to repay their debt and produce, or default and exit the market.

B.2 Extrapolative expectations

The data-generating process for TFP is assumed to satisfy

$$z_{t+1} = \rho z_t + \epsilon_{t+1}, \quad \epsilon \sim N(0, \sigma^2). \tag{25}$$

Agents perceive next period productivity as follows

$$\hat{E}_t[z_{t+1}] = \rho z_t + \theta \rho \epsilon_t. \tag{26}$$

Under the two-period framework,

$$\hat{E}_0[z_1] = \rho z_0 + \theta \rho \epsilon_0. \tag{27}$$

Agents overreact to the information received in the first period by the term $\theta\rho\epsilon_0$. If there's good news to the economy in the first period, agents are too optimistic about the second period productivity, by overweighting the conditional probability of good states. Conversely, if there's bad news to the economy in the first period, agents become too pessimistic about the second period productivity, by overweighting the conditional probability of bad states. When $\theta = 0$, it goes back to rational expectations framework.

B.3 Firms' optimization problem

A firm's problem can be expressed as a function of its investments, debt issuance, and the discounted expected value of the firm in the second period. Firms make optimal decisions under their subjective beliefs $\hat{E}$. Formally,

$$V_0 = \underset{k_1, b}{max} k_0 - k_1 - \frac{c_1}{2}(\frac{k_1 - (1-\delta)k_0}{k_0})^2 k_0 + q(z_0, k, b)b$$
$$+ \beta \hat{E}_0[max(0,\ z_1 k_1^{\alpha} + (1-\delta)k_1 - b - c_f)]. \quad (28)$$

The value of the firm in the second period is given by

$$V_1 = max(0,\ z_1 k_1^{\alpha} + (1-\delta)k_1 - b - c_f). \quad (29)$$

I can define the TFP threshold that makes a firm's second-period profit equal to zero and the firm indifferent between repaying or defaulting. In particular, define $\tilde{z}$ that makes $V_1 = 0$. If the second-period realized TFP is higher than the threshold $z_1 > \tilde{z}$, firm repays its debt obligation and produce. Instead, if $z_1 < \tilde{z}$, firm defaults and exits the market. More precisely, the TFP threshold is given by

$$\tilde{z} = \frac{b + c_f - (1-\delta)k_1}{k_1^{\alpha}}. \quad (30)$$

Above equation shows that the higher the debt burden, the higher the TFP threshold and, hence, higher is the firm's default probability. Inversely, the higher the capital stock, the lower the TFP threshold, and lower its default probability. A high fixed cost makes default more likely as well.

B.4 Debt pricing

Assume risk free bonds pay interest rate r. Firms' bonds are not enforceable, i.e. firms can default on their debt obligations. Default probability is endogenously determined by the value of the firm in the second period, thus their investment and borrowing decisions in the first period. The firm repays whenever its net second-period income is positive, and default otherwise. I assume investors discount equally each future state of the world at risk free rate for simplicity, and earn zero profits in expectations. Upon default, shareholders receive the threshold value, e.g. zero. Bondholders receive the recuperation value:

$$(1-\xi)(\frac{(1-\delta)k_1}{b} - c_f), \tag{31}$$

where ξ represents bankruptcy costs, e.g. any costs related the liquidation and renegotiation of the firm after default.

No arbitrage condition gives the discounted price of bonds,

$$q(z_0, k_1, b) = \frac{1 - P\hat{r}ob(default) + P\hat{r}ob(default)(1-\xi)(\frac{(1-\delta)k_1}{b} - c_f)}{1+r}, \tag{32}$$

where $P\hat{r}ob(default)$ is endogenously determined under agent's subjective belief.

B.5 Firms' optimal decisions

I turn now to study firms' optimal investment and borrowing decisions. To illustrate these choices, I present below the Euler equations for capital and debt.

$$\underbrace{\underbrace{1 + g_{k_1}}_{direct\ effect} - \underbrace{\frac{\partial q(z_0, k_1, b)}{\partial k_1} b}_{bond\ price\ effect}}_{total\ cost} = \underbrace{\beta \hat{E}_0[(1 - P\hat{r}ob(default))(z_1 \alpha k_1^{\alpha-1} + 1 - \delta)]}_{expected\ benefit}, \tag{33}$$

$$\underbrace{\underbrace{q(z_0,k_1,b)}_{direct\ effect} + \underbrace{\frac{\partial q(z_0,k_1,b)}{\partial b} b}_{bond\ price\ effect}}_{total\ benefit} = \underbrace{\beta \hat{E}_0[1 - \hat{Prob}(default)]}_{expected\ cost}. \tag{34}$$

Equation (33) presents the Euler equation for capital and shows that, at the optimum, the total cost of one extra unit of capital should be equal to its expected future benefit. The expected benefit is given by the marginal product of capital (MPK) and undepreciated value at states of repayment. Note that MPK is decreasing as k_1 increases. Importantly, the total cost of one extra unit of capital is given by the direct cost of investment and the indirect impact of this investment on a firm's current debt issuance. This indirect effect stems from the endogenous effect of current investment on a firm's bond prices. That is, as a firm's next-period capital affects its future repayment likelihood, current investment affects firms' current cost of funds and, as a result, the overall cost of this investment. The relation between bond price and capital is

$$\frac{\partial q(z_0,k_1,b)}{\partial k_1} > 0. \tag{35}$$

Equation (34) presents the Euler equation for debt and shows that firms optimally choose to issue bonds until the funds raised equal their expected future cost. The benefit of one extra unit of debt depends directly on the current bond price of this debt, and indirectly on its endogenous effect on the firm's overall cost of funds. Since by issuing more debt firms increase their default probability, current debt issuance affects bond prices and, hence, the total benefit of issuing debt, through

$$\frac{\partial q(z_0,k_1,b)}{\partial b} < 0. \tag{36}$$

B.6 Qualitative results

This section presents the model's qualitative implications using both a numerical illustration that employs certain parameterization. I solve four model specifications and compare their optimal policies and asset prices. Those four cases of models are (1) rational expectations and no financial frictions, (2) extrapolative expectations and no financial frictions, (3) rational expectations and financial frictions, and (4) extrapolative expectations and financial frictions.

I set the following parameter values common to all four models, $\alpha = 0.7$, $\delta = 0.28$, $c_1 = 0.3$, $c_f = 0.56$, $r = 0.04$, $\beta = 1/(1 + r)$, $\rho = 0.5$, $\sigma = 0.15$. The only parameters differ across four models are the one governing extrapolative expectations and the one captures bankruptcy cost when default. I set $\theta = 0$ for rational expectations case and $\theta = 0.5$ for extrapolative expectations case. I set $\xi = 1$ for maximal financial frictions case and $\xi = 0.3$ and recuperation value is capped at 0.55 for low financial frictions case. I present the low financial frictions case, instead of no financial frictions case because in the simple two-period model, it's hard to obtain reasonable policies under two sets of very extreme parameters.

Figure A1 presents how the model's key variables change along the productivity in equilibrium. Note that in the two-period model with only one shock, the horizontal axis can be interpreted as either boom and recession (over time), or high and low productivity (cross section). The key variables are investment rate, borrowing, leverage and price of debt. In good times, firms under extrapolative expectations are overoptimistic and choose to invest and borrow more and hold higher leverage, comparing to rational expectations model. They are also able to issue debt at a higher price.

[Figure A1 here]

Figure A2 plots how the bond price and perceived default probability change with respect to the capital stock and total leverage of the firm. Larger capital stock results in lower default probability and higher bond price. Higher leverage yields higher default probability and lower bond price.

[Figure A2 here]

Figure A3 shows the interaction effects between extrapolative expectations and financial frictions. The effects of extrapolation are much stronger with financial frictions than without. Both lines in the figure plots the percentage difference in optimal policies (investment rate, borrowing, leverage) and bond price between extrapolative expectations and rational expectations. The red solid line is with financial frictions and the blue dashed line is without financial frictions. The effects of extrapolation are amplified with financial frictions.

[Figure A3 here]

Intuition is as follows. When there is no financial frictions, there is no expected loss given default and extrapolative expectations have a mild impact on bond price comparing to rational expectations model. With financial frictions, extrapolative expectations also make expected loss given default more volatile over time, i.e. in good times, expected loss is lower than that under rational expectations, and in bad times, expected loss is higher than that under rational expectations. Thus bond price is more volatile comparing to no financial frictions case.

To sum up, this is how extrapolative expectations interact with financial frictions under this simple two-period model. In good times, extrapolative expectations alleviate the impact of financial frictions. And in bad times, extrapolative expectations intensify the impact of financial frictions.

C. Numerical Algorithm

I now describe the numerical algorithm used to solve the model which requires the joint determination of the equity value and the bond pricing. The value function and the optimal decision rules are solved on a grid in a discrete state space. I specify two grids of 100 points for capital and 50 points for debt, respectively, with upper bounds that are large enough to be nonbinding. The grids for capital are constructed recursively following McGrattan (1999), that is, $k_i = k_{i-1} + c_{k1}exp(c_{k2}(i-2))$, where $i = 1, ..., n$ is the index of grids points and c_{k1} and c_{k2} are two constants chosen to provide the desired number of grid points and upper bound, given the pre-specified lower bound. The advantage of this recursive construction is that more grid points are assigned around lower bounds, where the value function has most of its curvature. I then discretize the rational and perceived extrapolative transitions of the exogenous productivity states according to Tauchen (1986). I use 5 grid points for both aggregate and idiosyncratic productivity states.

I first guess a default policy and compute the implied bond price schedule. Then given the bond price schedule and default policy, I solve the firm's equity value function problem for the optimal policies with standard dynamic programming value function iteration. Then I compute updated default policy and bond price schedule. If updated default policy converges to the initial guess, exit the iteration. If not, then repeat from the beginning.

Note that the optimization problem is solved under subjective expectations, that is, the transition probabilities are the ones perceived by extrapolative agents. After the model is solved, the simulations of realized productivity are done under true data-generating process, that is, the transition probabilities are the ones under rational expectations.

Table A1. Descriptive statistics

This table presents summary statistics of all main variables used in the empirical regression analysis. Sample period is annual from 1981 to 2018. Notation $\triangle x$ stands for growth rate of variable x, defined as $(x_t - x_{t-1})/(0.5 * x_t + 0.5 * x_{t-1})$, standard deviation is Std., while P1, P50, and P90 stand for the 1st, 50th, and 90th percentiles, respectively. Data sources include Compustat, IBES, CRSP, TRACE, and FISD. Corporate bond data are from 2002 to 2018.

Variables	Obs.	Mean	Std.	P1	P50	P99
Earnings growth forecast	83,909	0.180	0.114	-0.023	0.154	0.577
Objective earnings growth	63,338	0.264	0.244	-0.006	0.184	1.116
Misperception on earnings growth	63,338	-0.094	0.238	-0.872	-0.030	0.320
Investment rate	83,622	0.361	0.404	0.002	0.238	2.178
$\triangle$Intangible capital investment	83,909	0.114	0.252	-0.535	0.083	0.993
$\triangle$Employment	81,900	0.066	0.225	-0.566	0.038	0.822
Earnings over assets	76,923	0.032	0.123	-0.549	0.050	0.227
Debt issuance	80,864	0.082	0.222	-0.239	0.028	1.073
Equity issuance	83,871	0.045	0.185	0.000	0.000	0.949
Yield spread change	9,273	-0.001	0.062	-0.075	-0.002	0.095
Excess stock return	83,823	-0.045	0.581	-1.963	0.024	1.246

Table A2. Extrapolation in earnings growth forecasts, firm and time fixed effects

This table presents the estimated coefficients of firm-level forecast error predictability regressions with both firm and time fixed effects.

	$Actual_{t+3} - LTG_t$	$Actual_{t+4} - LTG_t$	$Actual_{t+5} - LTG_t$
$LTG_t - LTG_{t-1}$	-0.367***	-0.418***	-0.436***
[t]	[-7.59]	[-10.18]	[-12.46]
$LTG_t - LTG_{t-2}$	-0.514***	-0.524***	-0.499***
[t]	[-12.58]	[-16.01]	[-18.10]
$LTG_t - LTG_{t-3}$	-0.533***	-0.514***	-0.503***
[t]	[-12.89]	[-15.39]	[-17.31]

Table A3. Misperception and intangible capital investment

This table presents the estimated coefficients from regressing the annual changes in intangible capital investment (research and development + selling, general and administrative expense from Compustat) up to five years in the future on current misperception on earnings growth and controls: $\triangle INTAN_{i,t+h-1\rightarrow t+h} = \alpha_h + f_i + \beta_h Mis_{i,t} + \gamma_h X_{i,t} + \epsilon_{i,t+h}$, where $\triangle INTAN_{i,t+h-1\rightarrow t+h}$ is the annual changes in intangible capital investment from year $t+h-1$ to year $t+h$, $h = 0, 1, 2, 3, 4, 5$. The expression $Mis_{i,t}$ is the misperception on earnings growth in year t, f_i is the firm fixed effect, and $X_{i,t}$ is a vector of control variables, including the year t investment rate, Tobin's Q, cash flow, firm size, individual firms' excess stock return, and book leverage. Misperception is the difference between the survey and model-implied objective earnings growth expectations. Panel A presents univariate regressions. Panel B includes controls. Standard errors are clustered by firm. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

			Panel A			
$\triangle INTAN$	Year 0	Year 1	Year 2	Year3	Year 4	Year 5
Mis	0.172***	0.068***	-0.045***	-0.105***	-0.090***	-0.106***
[t]	[22.46]	[9.44]	[-5.72]	[-12.44]	[-9.91]	[-11.33]
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	No	No	No	No	No
Obs.	61921	55067	48828	43504	39077	35274
$adjR^2$	0.14	0.11	0.08	0.07	0.06	0.06
			Panel B			
$\triangle INTAN$	Year 0	Year 1	Year 2	Year3	Year 4	Year 5
Mis	0.172***	0.142***	0.026***	-0.015	0.009	-0.013
[t]	[22.46]	[15.49]	[2.60]	[-1.42]	[0.79]	[-1.11]
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	Yes	Yes	Yes	Yes	Yes
Obs.	61921	53825	47804	42616	38297	34576
$adjR^2$	0.14	0.21	0.15	0.12	0.10	0.09

Table A4. Misperception and employment

This table presents the estimated coefficients from regressing the annual changes in employment up to five years in the future on current misperception on earnings growth and controls: $\triangle EMP_{i,t+h-1\to t+h} = \alpha_h + f_i + \beta_h Mis_{i,t} + \gamma_h X_{i,t} + \epsilon_{i,t+h}$, where $\triangle EMP_{i,t+h-1\to t+h}$ is the annual changes in employment from year $t+h-1$ to year $t+h$, $h = 0, 1, 2, 3, 4, 5$. The expression $Mis_{i,t}$ is the misperception on earnings growth in year t, f_i is the firm fixed effect, and $X_{i,t}$ is a vector of control variables, including the year t investment rate, Tobin's Q, cash flow, firm size, individual firms' excess stock return, and book leverage. Misperception is the difference between the survey and model-implied objective earnings growth expectations. Panel A presents univariate regressions. Panel B includes controls. Standard errors are clustered by firm. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Panel A						
$\triangle EMP$	Year 0	Year 1	Year 2	Year3	Year 4	Year 5
Mis	0.162***	0.038***	-0.064***	-0.095***	-0.098***	-0.105***
[t]	[24.34]	[5.82]	[-8.72]	[-12.25]	[-12.10]	[-12.63]
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	No	No	No	No	No
Obs.	60569	53953	47892	42761	38468	34753
$adjR^2$	0.17	0.12	0.11	0.10	0.10	0.09
Panel B						
$\triangle EMP$	Year 0	Year 1	Year 2	Year3	Year 4	Year 5
Mis	0.162***	0.064***	-0.010	-0.016*	-0.016*	-0.037***
[t]	[24.34]	[8.09]	[-1.22]	[-1.71]	[-1.67]	[-3.58]
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	Yes	Yes	Yes	Yes	Yes
Obs.	60569	52765	46917	41911	37722	34087
$adjR^2$	0.17	0.24	0.18	0.15	0.14	0.13

Table A5. Panel regressions with both firm and time fixed effect

This table reports the relation between corporate investment, external financing and misperception on earnings growth with both firm and time fixed effects.

Panel A: Investment rate						
IK	Year 0	Year 1	Year 2	Year3	Year 4	Year 5
Mis	0.265***	0.124***	-0.011	-0.087***	-0.115***	-0.126***
[t]	[23.21]	[13.72]	[-1.10]	[-8.31]	[-9.39]	[-10.90]
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	No	No	No	No	No
Obs.	61708	54856	48633	43329	38921	35128
$adjR^2$	0.39	0.41	0.35	0.36	0.36	0.36
Panel B: Debt issuance						
$DISS$	Year 0	Year 1	Year 2	Year3	Year 4	Year 5
Mis	0.091***	0.053***	-0.005	-0.020***	-0.024***	-0.044***
[t]	[14.81]	[9.11]	[-0.74]	[-2.67]	[-3.23]	[-5.59]
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	No	No	No	No	No
Obs.	60538	53890	47714	42442	38064	34352
$adjR^2$	0.12	0.09	0.06	0.06	0.05	0.05
Panel C: Equity issuance						
$EISS$	Year 0	Year 1	Year 2	Year3	Year 4	Year 5
Mis	0.051***	-0.032***	-0.049***	-0.040***	-0.024***	-0.020***
[t]	[10.24]	[-7.53]	[-10.70]	[-9.73]	[-6.56]	[-5.03]
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	No	No	No	No	No
Obs.	61893	55061	48810	43494	39069	35267
$adjR^2$	0.15	0.12	0.12	0.13	0.11	0.11

Table A6. Conditioning on size

This table presents the estimated coefficients from regressing the investment rate (Panel A), debt issuance (Panel B), equity issuance (Panel C), excess stock return (Panel D), and firm-level credit spread change (Panel E) up to five years in the future on current misperception on earnings growth and controls, conditional on firm size. All results include the firm fixed effect and the following controls: the year t investment rate, Tobin's Q, cash flow, firm size, individual firms' excess stock return, and book leverage. Standard errors are clustered by firm. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Panel A: Investment rate						
IK	Year 0	Year 1	Year 2	Year3	Year 4	Year 5
Bottom size quartile	0.299***	-0.104***	-0.280***	-0.265***	-0.260***	-0.226***
[t]	[12.40]	[-3.39]	[-7.98]	[-8.14]	[-7.22]	[-5.78]
Top size quartile	0.205***	0.038***	0.036***	-0.001	-0.014	-0.038***
[t]	[10.64]	[4.21]	[2.99]	[-0.11]	[-1.03]	[-2.60]
Panel B: Debt issuance						
$DISS$	Year 0	Year 1	Year 2	Year3	Year 4	Year 5
Bottom size quartile	0.057***	-0.050***	-0.064***	-0.049**	-0.017	-0.006
[t]	[5.73]	[-2.89]	[-3.64]	[-2.39]	[-0.84]	[-0.26]
Top size quartile	0.098***	-0.020	-0.005	-0.010	-0.016	-0.038*
[t]	[5.85]	[-1.39]	[-0.36]	[-0.71]	[-0.93]	[-1.95]
Panel C: Equity issuance						
$EISS$	Year 0	Year 1	Year 2	Year3	Year 4	Year 5
Bottom size quartile	0.076***	-0.089***	-0.101***	-0.084***	-0.038***	-0.056***
[t]	[6.61]	[-5.58]	[-6.42]	[-4.75]	[-2.80]	[-3.67]
Top size quartile	0.009**	-0.004	-0.004	-0.005*	-0.004	-0.002
[t]	[2.28]	[-1.15]	[-1.30]	[-1.94]	[-1.23]	[-0.67]
Panel D: Stock return						
$RETS$	Year 0	Year 1	Year 2	Year3	Year 4	Year 5
Bottom size quartile	0.178***	-0.600***	-0.272***	-0.123**	-0.181***	-0.01
[t]	[5.81]	[-12.60]	[-5.22]	[-2.16]	[-2.96]	[-0.18]
Top size quartile	0.089**	-0.167***	-0.055	-0.078	-0.087	-0.045
[t]	[2.55]	[-3.95]	[-1.09]	[-1.59]	[-1.60]	[-0.91]
Panel E: Credit spread change						
$\triangle CS$	Year 0	Year 1	Year 2	Year3	Year 4	Year 5
Bottom size half	-0.021	0.038*	0.018	0	-0.004	0.018
[t]	[-1.42]	[1.95]	[0.74]	[-0.02]	[-0.19]	[0.77]
Top size quartile	-0.009***	0.007**	-0.002	0.006	-0.002	0.004
[t]	[-2.82]	[2.42]	[-0.43]	[0.99]	[-0.31]	[0.45]

Table A7. Misperception and corporate investment

This table presents the estimated coefficients from regressing the investment rate up to five years in the future on current misperception on earnings growth and controls. These regressions are the same as those presented in the main text, but here, I also report coefficients associated with all of the controls.

IK	Year 0	Year 1	Year 2	Year3	Year 4	Year 5
Mis	0.205***	0.062***	-0.030**	-0.068***	-0.079***	-0.077***
$[t]$	[17.61]	[5.58]	[-2.44]	[-5.62]	[-5.87]	[-5.61]
IK		0.126***	-0.025***	-0.021***	-0.022***	-0.014**
$[t]$		[14.43]	[-3.01]	[-2.90]	[-3.21]	[-2.27]
$Tobin's\ Q$		0.045***	0.018***	0	-0.004**	-0.005***
$[t]$		[14.02]	[6.71]	[0.03]	[-2.01]	[-2.76]
$Cash\ flow$		0.493***	0.488***	0.377***	0.306***	0.224***
$[t]$		[7.12]	[7.16]	[5.80]	[4.97]	[3.81]
$Size$		-0.068***	-0.073***	-0.066***	-0.060***	-0.053***
$[t]$		[-24.12]	[-23.39]	[-22.33]	[-20.69]	[-18.52]
$RETS$		-0.068***	-0.073***	-0.066***	-0.060***	-0.053***
$[t]$		[-24.12]	[-23.39]	[-22.33]	[-20.69]	[-18.52]
$Leverage$		-0.131***	-0.112***	-0.057***	-0.002	0.032**
$[t]$		[-9.22]	[-7.46]	[-3.88]	[-0.16]	[2.13]
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	61708	53808	47775	42591	38274	34552
$adjR^2$	0.35	0.46	0.39	0.37	0.36	0.36

Table A8. Misperception and external financing

This table presents the estimated coefficients from regressing debt issuance (Panel A) and equity issuance (Panel B) up to five years in the future on current misperception on earnings growth and controls. These regressions are the same as those presented in the main text, but here, I also report coefficients associated with all of the controls.

			Panel A			
DISS	Year 0	Year 1	Year 2	Year3	Year 4	Year 5
Mis	0.072***	0.003	-0.028***	-0.018**	-0.020**	-0.042***
[*t*]	[11.68]	[0.44]	[-3.36]	[-2.08]	[-2.27]	[-4.36]
IK		0.004	-0.009**	-0.008**	-0.010***	-0.002
[*t*]		[0.84]	[-2.30]	[-2.04]	[-2.71]	[-0.43]
Tobin's Q		0.011***	0.001	-0.003***	-0.004***	-0.005***
[*t*]		[6.82]	[1.03]	[-2.70]	[-3.72]	[-4.64]
Cash flow		0.375***	0.321***	0.240***	0.292***	0.239***
[*t*]		[8.80]	[8.13]	[6.47]	[7.59]	[6.16]
Size		-0.036***	-0.036***	-0.034***	-0.032***	-0.027***
[*t*]		[-18.45]	[-19.44]	[-18.31]	[-17.67]	[-14.20]
RETS		0.026***	0.018***	0.006**	0.004*	0.003
[*t*]		[11.99]	[8.02]	[2.52]	[1.75]	[1.23]
Leverage		-0.360***	-0.248***	-0.165***	-0.103***	-0.081***
[*t*]		[-28.49]	[-21.65]	[-14.85]	[-8.99]	[-7.06]
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	60538	53487	47211	41919	37571	33879
$adjR^2$	0.09	0.15	0.09	0.07	0.05	0.05
			Panel B			
EISS	Year 0	Year 1	Year 2	Year3	Year 4	Year 5
Mis	0.033***	-0.038***	-0.036***	-0.032***	-0.021***	-0.024***
[*t*]	[6.72]	[-6.93]	[-6.83]	[-6.25]	[-4.86]	[-5.41]
IK		0	0	0.002	0.004	0.005**
[*t*]		[0.15]	[-0.11]	[0.77]	[1.50]	[1.98]
Tobin's Q		0.011***	0	0	-0.001**	-0.001
[*t*]		[7.81]	[-0.22]	[-0.22]	[-2.50]	[-1.22]
Cash flow		0.099***	0.073***	0.055***	0.069***	0.089***
[*t*]		[3.88]	[3.39]	[2.79]	[3.73]	[5.57]
Size		-0.017***	-0.015***	-0.010***	-0.008***	-0.006***
[*t*]		[-14.14]	[-13.31]	[-10.22]	[-7.89]	[-7.40]
RETS		0.022***	0.001	-0.002**	-0.002**	-0.001
[*t*]		[14.04]	[0.72]	[-2.09]	[-2.37]	[-1.41]
Leverage		0.059***	0.014***	0.012**	0.003	0.012***
[*t*]		[9.18]	[2.90]	[2.48]	[0.72]	[2.58]
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	61893	53819	47789	42606	38291	34569
$adjR^2$	0.14	0.16	0.13	0.13	0.11	0.12

Table A9. Misperception and firm-level asset prices

This table presents the estimated coefficients from regressing yield spread changes (Panel A) and excess stock returns (Panel B) up to five years in the future on current misperception on earnings growth and controls. These regressions are the same as those presented in the main text, but here, I also report coefficients associated with all of the controls.

Panel A

$\triangle CS$	Year 0	Year 1	Year 2	Year3	Year 4	Year 5
Mis	-0.010***	0.010***	0.004	0.002	-0.006	-0.002
[t]	[-3.11]	[2.88]	[0.79]	[0.53]	[-0.99]	[-0.32]
IK		-0.005	-0.001	0	0.006	0.002
[t]		[-0.41]	[-0.16]	[0.08]	[0.77]	[0.15]
$Tobin's\ Q$		0.004***	0.003***	0.001	0.001	-0.002***
[t]		[5.43]	[3.92]	[1.10]	[0.42]	[-3.11]
$Cash\ flow$		0.002	-0.008	0.017	-0.018	-0.044*
[t]		[0.09]	[-0.49]	[1.10]	[-0.87]	[-1.81]
$Size$		0.002	0.004*	0.002	0.002**	-0.001
[t]		[1.09]	[1.83]	[1.09]	[2.19]	[-1.10]
$RETS$		-0.017***	0.003	0.001	0.003**	0.008***
[t]		[-11.39]	[1.29]	[0.85]	[2.23]	[3.73]
$Leverage$		-0.018**	-0.038***	-0.051*	-0.049*	-0.039
[t]		[-2.48]	[-2.62]	[-1.77]	[-1.87]	[-1.42]
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	8225	7990	7784	7634	7485	7311
$adjR^2$	0.19	0.20	0.19	0.19	0.19	0.19

Panel B

$RETS$	Year 0	Year 1	Year 2	Year3	Year 4	Year 5
Mis	0.052***	-0.285***	-0.155***	-0.072***	-0.081***	-0.014
[t]	[3.46]	[-12.65]	[-6.40]	[-2.88]	[-3.02]	[-0.57]
IK		-0.102***	-0.059***	0.034***	-0.002	-0.019
[t]		[-9.68]	[-5.16]	[2.86]	[-0.18]	[-1.60]
$Tobin's\ Q$		-0.078***	-0.044***	-0.047***	-0.019***	-0.001
[t]		[-20.72]	[-14.18]	[-15.40]	[-5.79]	[-0.49]
$Cash\ flow$		1.130***	0.276***	0.308***	0.252**	0.083
[t]		[12.07]	[2.88]	[3.28]	[2.48]	[0.87]
$Size$		-0.083***	-0.061***	-0.044***	-0.045***	-0.041***
[t]		[-19.81]	[-15.13]	[-11.59]	[-11.90]	[-10.26]
$RETS$		-0.088***	-0.097***	0.005	-0.005	-0.147***
[t]		[-13.37]	[-14.40]	[0.73]	[-0.70]	[-22.05]
$Leverage$		-0.133***	0.013	0.055*	0.078***	0.101***
[t]		[-5.13]	[0.47]	[1.92]	[2.67]	[3.49]
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	61875	53821	47794	42599	38279	34558
$adjR^2$	0.01	0.12	0.09	0.06	0.06	0.07

Figure A1. Policy functions in the two-period model

This figure plots the optimal policies and bond prices for different levels of productivity in the two-period model. The solid red line refers to the extrapolative expectations model and the dashed blue line refers to the rational expectations model.

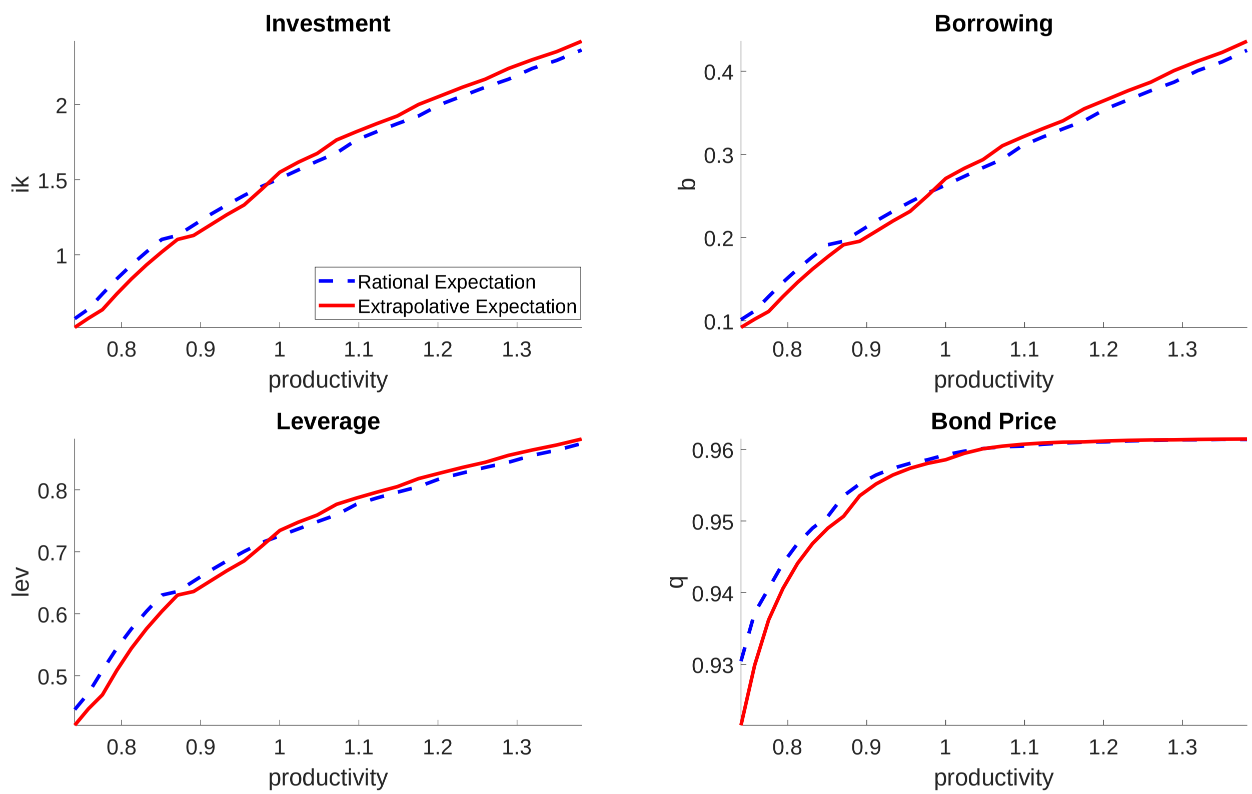


Figure A2. Price of debt in the two-period model

This figure summarizes the default probability and bond prices as a function of firm capital (k) and leverage (b/k) in the two-period model.

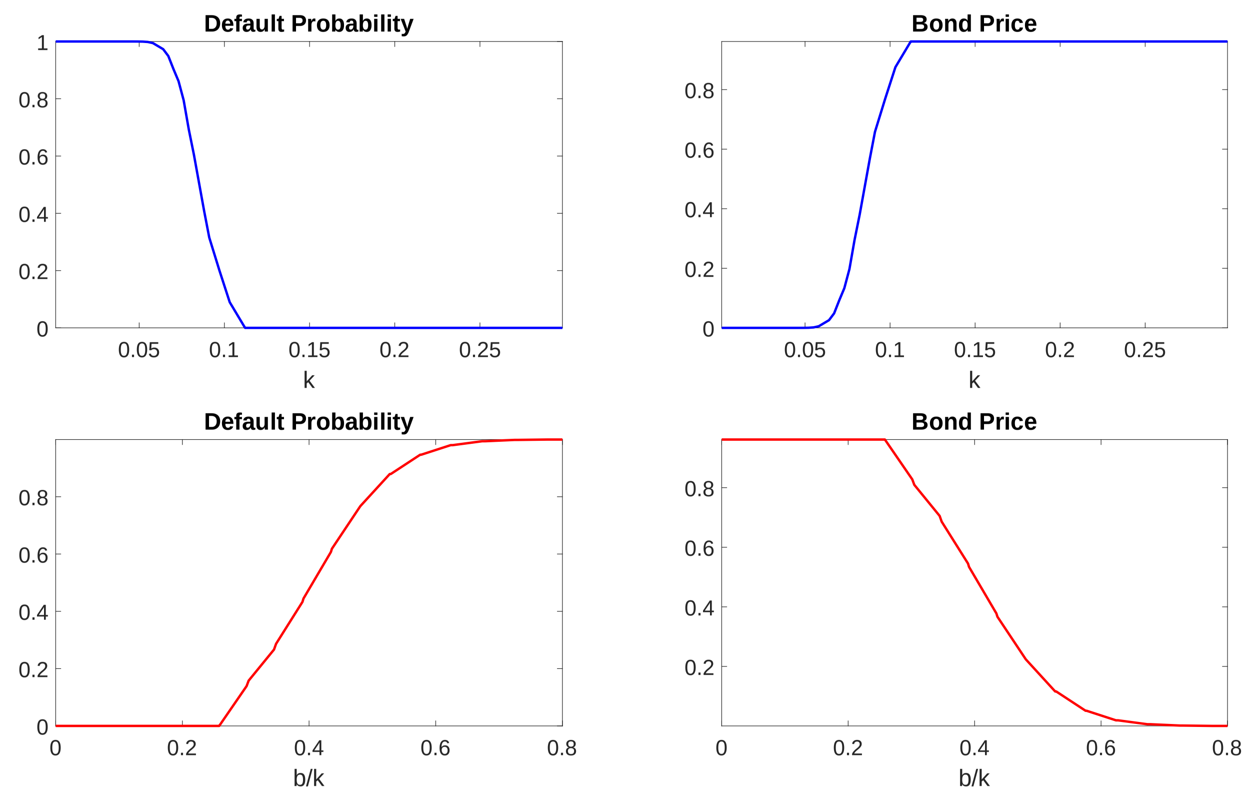


Figure A3. Interaction effects in the two-period model

This figure plots the percentage differences in optimal policies and asset prices between the extrapolative expectations model specification and the rational expectations model specification for different levels of productivity in the two-period model. The solid red line refers to the case where both model specifications feature financial frictions. The dashed blue line refers to the case where both model specifications do not feature any financial frictions.