What Drives Corporate Asset Prices: Short- or Long-Run Risk? *

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This paper investigates the relative impact of various types of systematic risk on corporate asset prices. Equity risk premium and credit spreads are priced in a consumption-based corporate finance model with time-varying macroeconomic conditions. I decompose the risk premia into different sources of systematic risk compensation and show that long-run risk commands most of the risk premium (about 70%), for both equities and bonds. The role of long-run risk in the equity risk premium is amplified in recessions, but remains stable over the business cycle for credit spreads. The relative importance of short- vs. long-run risk also varies at the cross-section, thus providing new testable implications.

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1 Introduction

The nature of risk premia is central for the understanding of asset prices. It is now widely accepted that there exist different sources of systematic risk, which carry separate risk premium. First, firm cash-flow shocks are partly systematic as they correlate positively with aggregate consumption. Because these shocks are short-lived, the associated premium can be viewed as a compensation for *short-run* risk. Second, the expected cash-flow growth rate is exposed to aggregate economic conditions. That is, firms tend to grow less rapidly in recessions when expected consumption growth is also low. Because expected growth rates are persistent, as they vary slowly over the business cycle, the corresponding risk premium is a compensation for *long-run* risk. Consumption based asset pricing models postulate that the first type of systematic risk is the main driver of equity risk premium.[1] More recent studies document that the second type helps explain some asset pricing moments.[2] It remains important, however, to understand the role of each type of risk for the equity risk premium and corporate credit spreads.

This paper contributes to the literature in various dimensions. First, it decomposes and quantifies the level of systematic risk and the associated risk premium. Second, it compares the role of systematic risk across asset classes, equity versus debt. And third, it separates the risk premia into the different sources of systematic risk to analyze their relative importance, both over the business cycle and at the cross-section.

I propose a consumption-based asset pricing model that allows analyzing both types of systematic risk, individually or in tandem. The environment is characterized by time-varying macroeconomic conditions, which determine the expected growth rates of firm cash-flows and aggregate consumption, as in Bansal and Yaron (2004), Bhamra, Kuehn, and Strebulaev (2010a; 2010b), and Chen (2010). The representative agent is of an Epstein-Zin type. That is, this agent is not only averse to short-run risk, but also has preference for early resolution of uncertainty, i.e. averse to long-run risk.[3] The approach to derive corporate asset prices follows the structural corporate finance

[1] See Rubinstein (1976), Lucas (1978), Breeden and Litzenberger (1978), and Breeden (1979).

[2] Bansal and Yaron (2004) and Bhamra, Kuehn, and Strebulaev (2010b) show that time-varying expected growth rates (and volatilities) generate high levels of the equity risk premium, while Bhamra, Kuehn, and Strebulaev (2010a) and Chen (2010) finds that such types of risk can explain the credit-spread puzzle.

[3] The coefficient of elasticity of intertemporal substitution (EIS) is greater than the inverse of the coefficient of RRA.

models developed by Fischer, Heinkel and Zechner (1989), Leland (1994), and Hackbarth, Miao and Morellec (2006).[4] The firm's optimal capital structure and default decisions are endogenously determined.

The contribution is to separate the quantity from the price of risk, and to disentangle the asset pricing implications of each source of systematic risk. I derive the credit spread in the full model and isolate the quantity of risk component by assuming that the agent is risk neutral, i.e. she does not command any risk premium. This is the pure compensation for holding default-risky corporate bonds. The credit spread premium is defined by the difference between the total credit spread and its default-risk compensation. Then, I separate the risk premia associated with each type of systematic risk. The credit spread premium component that relates to short-run risk is obtained by assuming that the agent has CRRA preferences.[5] The long-run risk premium is obtained by subtracting the short-run risk premium from the total credit spread premium. The same methodology applies for the equity risk premium.

The model is calibrated to real consumption and aggregate firm profits data over the period 1952Q1–2015Q4. I respectively use U.S. real non-durables goods plus service consumption expenditures and U.S. corporate profits before tax, both from the Bureau of Economic Analysis. Short-run risk is determined by the correlation between consumption and corporate profits. Aggregate economic conditions are considered to be time-varying and to switch between two states. That is, the economy is either in expansion or in recession. The conditional expected growth rates of consumption and firm cash-flows are computed using the NBER classification. The random transition from one state to another is modeled by a two-states Markov-regime switching model, following Hamilton (1989)'s approach. The transition matrix reveals that the states of the economy tend to be persistent.

The main findings are as follow. First, systematic risk affects the expected excess return differently for equities versus bonds. For corporate bonds, the quantity of risk represents around 63% of the total credit spread, while the corresponding risk premium captures 37%. This magnitude is similar to what is observed empirically.[6] In contrast, the compensation for systematic risk

[4] See also Goldstein, Ju, and Leland (2001) and Strebulaev (2007).

[5] A CRRA agent has no preference for early resolution of the uncertainty, because the coefficient of elasticity of intertemporal substitution is equal to the inverse of the coefficient of relative risk aversion.

[6] Longstaff, Mithal, and Neis (2005) show that the default component represents 56% for A-rated bonds, 71% for

represents 100% of the equity risk premium, by definition.

Second, long-run risk commands a greater risk premium than short-run risk, when the agent has a preference for early resolution of the uncertainty. This lends support to Bansal and Yaron (2004), Tedongap (2014) and Bansal, Kiku, Shaliastovich, and Yaron (2014), who show that long-run risk can help explain some stylized facts in asset pricing. I find that the long-run risk component represents 72.8% of the total risk premium embedded into equity prices. The remaining 27.2% represents a compensation for short-run risk, which arises when the investor is risk averse to cash-flow shocks that positively correlate with aggregate consumption shocks. In contrast, the long-run risk component of the credit spread premium represents 68.5%. These results show that the impact of aversion to long-run risk, when the agent has recursive preferences, is significantly higher than the aversion to short-run risk.

Third, the model shows how these risk premia vary over the business cycle. Long-run risk represents 89.9% of equity risk premium in periods of economic downturns, but only 60.6% during periods of economic expansion. Hence, the relative importance of long-run risk appears to be strongly countercyclical for equity valuation. In contrast, the proportion of long-run risk in the credit spread premium is stable over time, i.e. around 69%. Hence, stockholders price more their preference for early resolution of the uncertainty during recessions than bondholders do.

Fourth, I find that the relative importance of these risk premia differs at the cross-section, as it varies with firm characteristics. When idiosyncratic volatility increases, the proportion of the credit spread premium due to long-run risk decreases. However, the model predicts that the allocation of long-run vs. short-run risk in the equity risk premium is almost insensitive to the level of indiosyncratic risk. When firms perform well and financial leverage decreases, the proportion of the long-run risk premium decreases for equities but increases for bonds. These are novel testable predictions. This paper also shows how preferences affect optimal debt and default decisions. When the investor cares about long-run risk, the firm chooses to issue less debt and a lower default barrier. This means that default probability is expected to be lower when corporate assets are valued by an agent with recursive preferences. Hence, preferences affect the firms' optimal decisions.

Finally, I consider an extension of the model in which cash-flow volatility varies over the business

BBB-rated bonds, and 83% for BB-rated bonds. Elton, Gruber, Agrawal, and Mann (2001) report that systematic risk may explain up to 46% of the credit spread for 10-year corporates spread.

cycle. This creates a second source of long-run risk. I show that the conditional equity risk premium is more countercyclical with time-varying cash-flow volatility, as reported in Bansal and Yaron (2004). In presence of this additional source of risk, the proportion of the long-run risk component in the equity risk premium decreases to 76.1% in recession (from 89.9% without time-varying volatility) and increases to 67.6% in expansion (from 60.6% without time-varying volatility). In contrast, the conditional credit spread premium increases in both states.

Overall, this paper helps us better understand the role of investor preferences and systematic risk in corporate asset valuation. The results show that the compensation for long-run risk appears to be the main component of the equity risk premium and corporate credit spreads. This paper thus highlights the importance of the risk premium associated with an expected cash flow growth rate that is time-varying and exposed to aggregate economic conditions. Yet the classical risk premium associated with the consumption beta is not negligible, as it accounts for one third of the total risk premium.

The remainder of the article is organized as follows. Section 2 reviews the literature. Section 3 describes the economy, details the sources of the systematic risks embedded into the model, and the pricing of claims, Sections 4 and 5 present respectively the data and the methodology proposed to measure the risk premiums, Section 6 studies the model's implications, while Section 7 concludes. Proofs and others additional materials are contained in the Appendices.

2 Literature review

Asset pricing models like the capital asset pricing model (CAPM) of Markowitz (1952), Sharpe (1964) and Lintner (1965) (and subsequent models as in Black, Jensen and Scholes (1972); Fama and MacBeth (1973) have postulated that the sensitivity to market or systematic volatility is the only risk that is needed to describe average returns.

However, since the 1970's, several papers (see Basu (1977); Banz (1981); Shanken (1985); Fama and French (1992; 1993)) proposed new approaches to improve the pricing performances and provide answers to some of the inconsistencies of the CAPM, shown for example by empirical analysis of cross-sectional asset data. In particular, the empirical asset pricing model proposed by Fama and French (1992; 1993) is perhaps the most important. They demonstrate that CAPM has virtually no explanatory power to explain the cross-section of average returns on assets of portfolios sorted by size and book-to-market equity ratios, among others characteristics.

A second important trend of the literature has developed theoretical models to improve the pricing performances of the CAPM via a consumption-based approach: the Consumption Capital Asset Pricing Model (CCAPM). The main innovation of the CCAPM models lied on the introduction of the macroeconomic risk into asset pricing. According to these first models, the risk premia should be proportion to the consumption beta (correlation between the firm's cash flow and the consumption).

One line of this literature built on the market-based CAPM of Sharpe (1964) and Lintner (1965), and on the Intertemporal CAPM developed by Merton (1973). The very first models of CCAPM were issued by Rubinstein (1976), Lucas (1978), Breeden and Litzenberger (1978), and Breeden (1979). However, the tests conducted on this line of the CCAPM models were not concluding.[7] Others authors have also argued that there exist some issues regarding the accuracy of the consumption data due to the way they are recorded.[8]

Among the CCAPM models, another set of papers has introduced new features in the hope to enhance the pricing performances.[9] In particular, Epstein and Zin (1989) and Weil (1989) have developed preferences, which allow for the separation between the intratemporal relative risk aversion (CRRA) from the elasticity of intertemporal substitution (EIS). By introducing this separability, it is now feasible to isolate, the aversion to future economic uncertainty from the aversion to the current correlation between consumption and firm's cash-flows. The later type of aversion is measured through the consumption beta.

Alongside these papers, many empirical works have explored conditional versions of the consumption CAPM as for example Jagannathan and Wang (2007) and Lettau and Ludvigson (2001a; 2001b).[10] In particular, Lettau and Ludvigson (2001a; 2001b) explore a conditional version of the consumption CAPM or CCAPM, by expressing the stochastic discount factor not in an un-

[7]See Hansen and Singleton (1983), Mehra and Prescott (1985), Chen, Roll, and Ross (1986) and, Hansen and Jagannathan (1991).

[8]For example, Grossman, Melino, and Shiller (1987) and Breeden, Gibbons, and Litzenberger (1989)

[9]See Pye (1972) and Greenig (1986) with time-multiplicative utility functions. See also Sundaresan (1989), Constantinides (1990), Abel (1990), and Campbell and Cochrane (1999) with habit formation.

[10]Predecessor works that have studies conditional versions of the CCAPM are Harvey (1991), Ferson and Harvey (1991), Jagannathan and Wang (1996), and Ferson and Harvey (1999).

conditional linear model setting, as in traditional derivations of the CCAPM, but as a conditional factor model. Empirically, their model performs as good as the Fama-French three-factor model in explaining the cross-section of average returns of portfolios sorted by size and book-to-market value. Lettau and Ludvigson's conditional model captures the countercyclical risk premium and improves the performance of the CCAPM. The reason is that the correlation between stocks and the consumption growth increases more in bad times, when risk aversion is high, compare to the good times when the risk aversion is low. According to their findings, this conditionality on risk premia is missed by unconditional CCAPM models because they produce constant risk premia over time.

This indicates that the most suitable assets pricing models should incorporate not only investors preferences but also conditional pricing. Bansal and Yaron (2004)and recent papers by Bhamra, Kuehn, and Strebulaev (2010a; 2010b) and Chen (2010), have successfully developed consumption-based models with a representative agent with Epstein-Zin-Weil type of preference and in a time-varying macroeconomic environment. This type of agent is not only risk-averse but also dislikes the uncertainty about the future macroeconomic conditions. These papers achieve the objective to disentangle the impact of these two types of preferences on equity and debt and show that these preferences help resolve the credit spread puzzle and to generate reasonable levels of equity risk premium. However, this paper emphasizes on how much pure long-run risk actually influences risk premia.

3 The model setup

The economy consists of a representative agent and several firms. The agent provides capital to the firm by buying equity and bond. There is no friction in the economy.

3.1 Firm cash-flows

Let assume the representation firm has a stream of cash-flows, denoted by X_t, which is given by the stochastic process:

$$\frac{dX_t}{X_t} = \mu_{s_t} dt + \sigma^{id} dB_t^{id} + \sigma^g dB_t, \quad s_t = \{R, E\}. \tag{1}$$

First, cash-flows are affected by continuous systematic shocks, dB_t. Second, the expected growth rate varies with global conditions. In this economy, there are two different economic conditions - expansion, E and, recession, R. The state of the economy, s_t, switches from one economic condition to another randomly. The switching is modeled through a two-states Markov process. This random change in the state of the economy happens infrequently. Therefore, each state tends to be persistent. The firm state-dependent cash-flows growth rate, μ_{s_t}, is procyclical so that $\mu_E > \mu_R$. Cash-flows also experience idiosyncratic shocks, dB_t^{id}, so that, the total volatility of cash-flows equals to $\sigma_X = \sqrt{(\sigma^{id})^2 + (\sigma^g)^2}$. The standard Brownian motions measure B_t^{id} and B_t are independent.

3.2 Representative agent

3.2.1 Consumption

The representative agent prices firm claims. Her consumption has an exogenous stream C_t. Let assume C_t follows the stochastic process:

$$\frac{dC_t}{C_t} = \theta_{s_t} dt + \sigma dB_{C,t}, \quad s_t = \{R, E\}, \tag{2}$$

where, the state-dependent consumption growth rate, θ_{s_t}, is procyclical so that $\theta_E > \theta_R$ and σ is the consumption volatility. The standard Brownian motion under the physical measure $B_{C,t}$ represents the continuous shocks to the consumption. Because firm cash-flows correlate with these shocks, the processes $B_{C,t}$ and B_t are correlated.

3.2.2 Stochastic discount factor

The representative agent has Epstein-Zin-Weil preference.[11] This preference separates the impacts of risk aversion, γ from the elasticity of intertemporal substitution, defined by the EIS coefficient,

[11]This type of utility function, developed by Kreps and Porteus (1978), Epstein and Zin (1989), Duffie and Epstein (1992), and Weil (1989).

ψ. In equilibrium, the state-price density dynamic follows:

$$\frac{d\pi_t}{\pi_t} = -r_{s_t}dt + \frac{dM_t}{M_t} \tag{3}$$

$$= -r_{s_t}dt - \Theta^B dB_t + \Theta^P_{s_t} dN_{s_t,t}, \tag{4}$$

where M_t is a martingale under the physical measure, $N_{s_t,t}$ a Poisson process which jumps upward by one whenever the state of the economy switches from the state s_t to the state $\overline{s_t} \neq s_t$, $\Theta^B = \gamma\sigma$ is the market price of risk due to Brownian shocks in the state s_t, $\Theta^P_{s_t} = \Delta_{s_t} - 1$ is the market price of risk due to random changes of the state of economy from $s_t = \{R, E\}$, where Δ_{s_t}, is the change in the state-price density π_t at the transition time from state $s_t = \{R, E\}$.

3.2.3 Price of short-run risk

Firms cash-flows are affected by macroeconomic shocks, that also affects consumption. Call, ρ, the coefficient of correlation between cash-flows and consumption. The agent cannot diversify away those shocks that positively correlate with her consumption. This will lead the agent to ask a price for this risk above the compensation that a risk neutral agent should demand. This additional compensation is obtained by viewing the firm's cash flows as more risky than in reality. In this regard, the agent derives a risk-neutral measure of cash flows growth rate, $\hat{\mu}_{s_t}$, by reducing the physical rate so that $\hat{\mu}_{s_t} = \mu_{s_t} - \gamma\rho\sigma^g\sigma$, where γ is the constant coefficient of relative risk aversion which is independent from the EIS. The agent has risk aversion if $\gamma > 0$ and is risk neutral if $\gamma = 0$.

3.2.4 Price of long-run risk

The time-varying consumption and cash flows growth rates incorporates the long-run risk into the model. More precisely, these consumption and cash flows moments depend on the state of the economy. Consequently, in presence of the long-run risk, the agent prices assets as if recessions last longer than in reality and so expansion last shorter than in reality. This preference originates from the fact that the agent does not like not knowing when next recession will arrive since this state of the economy corresponds to weaker cash-flows growth rates at the time when consumption growth is also low.

Call, λ_{s_t}, the probability per unit of time of leaving state s_t. Hence, the quantity $1/\lambda_{s_t}$ is the expected duration of state s_t. However, recessions are shorter than expansions, so that $1/\lambda_R < 1/\lambda_E$. Thus, the physical probabilities λ_R and λ_E are converted to their risk-neutral counterparts $\hat{\lambda}_R$ and $\hat{\lambda}_E$ through the factor Δ_E, which is the change in the state-price density π_t at the transition time from expansion to recession. The risk-neutral probabilities per unit of time of changing state are then given by

$$\hat{\lambda}_E = \Delta_E \lambda_E \text{ and } \hat{\lambda}_R = \Delta_R \lambda_R = \frac{1}{\Delta_E}\lambda_R. \tag{5}$$

When $\psi > \frac{1}{\gamma}$, the agent has preference for earlier resolution of the uncertainty, i.e. $\Delta_E > 1$. In contrast, the agent is indifferent to earlier resolution of the uncertainty about the future states of the economy if $\Delta_E = \Delta_R = 1$, i.e. when $\psi = \frac{1}{\gamma}$. This is a CRRA agent who would use the actual probability to price assets, i.e. $\hat{\lambda}_E = \lambda_E$ and $\hat{\lambda}_R = \lambda_R$.

3.3 Asset prices

Equity and debt are issued at initial time $s_0 = \{R, E\}$, thus their values depend on the financing states as well as on the current $s_t = \{R, E\}$.

3.3.1 Bond price

The present debt value, B_{s_t}, is the discounted coupon stream c before default plus the present value of the recovered firm asset liquidation value at default ($\phi_{s_D} A_{s_D}$), where ϕ_{s_t} is the state-dependent asset recovery rate and A_{s_t} is the firm asset liquidation value. Hence,

$$B_{s_t} = E_t\left[\int_t^{t_D} c\frac{\pi_u}{\pi_t}du \mid s_t\right] + E_t\left[\frac{\pi_u}{\pi_t}\phi_{t_D}A_{t_D}du \mid s_t\right]. \tag{6}$$

The credit spread, CS_{s_t}, for the present state $s_t = \{R, E\}$ is defined by

$$CS_{s_t} = \frac{c^*}{B_{s_t}} - r_{B,s_t} \tag{7}$$

where c^* is the optimal coupon value and r_{B,s_t} is the perpetual risk-free discount.

3.3.2 Stock price

The stock value, S_{s_t}, is the after-tax discounted value of future cash-flows, X_t less coupon payments, c before bankruptcy is declared by the stockholders.

$$S_{s_t} = (1-\tau)\, E_t \left[\int_t^{t_D} \frac{\pi_u}{\pi_t} (X_t - c)\, du \mid s_t \right] \tag{8}$$

where t_D is the random default time. The absolute priority rule holds so that at default equity value is worthless.

The levered equity risk premium, RP_{s_t}, for the current state $s_t = \{R, E\}$ is

$$RP_{s_t} = \gamma\rho\sigma^B_{s_t}\sigma + (1 - \triangle_{s_t})\sigma^P_{s_t}\lambda_{s_t} \tag{9}$$

with $\sigma^B_{s_t} = \frac{X_t}{S_{s_t}}\frac{\partial S_{s_t}}{\partial X_t}\sigma^g$ is the systematic volatility of stock returns caused by Brownian shocks, where S_{s_t} represents the equity value and $\sigma^P_{s_t} = \frac{S_j}{S_i} - 1,\ i \neq j = \{R, E\}$ the volatility of stock returns caused by the change of state of the economy. The first term $(\gamma\rho\sigma^B_{s_t}\sigma)$ corresponds to the compensation asked by investors to bear the short-run risk and the second term, $(1-\triangle_{s_t})\sigma^P_{s_t}\lambda_{s_t}$, to the price associated to the long-run risk, where Δ_{s_t}, is the change in the state-price density π_t at the transition time from state $s_t = \{R, E\}$.

3.4 Firm decisions

The coupon value is chosen by shareholders at the time debt is issued to maximize the firm value $c_{s_0} = argmax(D_{s_0} + S_{s_0})$, where $s_0 = \{R, E\}$ is the financing state. The shareholders also determine the ex-ante default boundaries, X_{D,s_t}, corresponding to each state of the economy with the objective to optimize the equity value, so that:

$$\frac{\partial S_{s_t}}{\partial X_t}\,|_{X_t=X_{D,s_t}} \quad = \quad 0 \tag{10}$$

4 Data and model calibration

This section presents the calibration of the model. Table 1 summarizes the parameter values. The model is calibrated to match the salient aspects of the market.

Table 1 [about here]

NBER dates are used to characterize the U.S. business cycle. The state of the economy can be either expansion (E) or recession (R). The switch from one state to another, which occurs randomly, is modeled by a Markov chain. The actual probability of transition from one state to another, λ_{s_t}, the actual long-run probability of being in each state, f_{s_t}, and the actual rate of news arrival, denoted by p, are estimated using a two-state Markov-regime switching model on NBER recession dates over the period 1952Q1-2015Q4.[12] The estimation approach is based on Hamilton (1989) and detailed in Appendix F. Real non-durables goods plus service consumption expenditures obtain from the Bureau of Economic Analysis is used as proxy of the aggregate consumption. The estimates of the actual probabilities of being in a expansion and in recession are respectively $f_E = 85.16\%$ and $f_R = 14.84\%$. When calibrating the conditional moments of consumption growth to the NBER recession dates, I obtain a U.S. consumption growth rate of $\theta_L = 0.65\%$ in recession and $\theta_E = 2.20\%$ in expansion, while its unconditional systematic volatility is $\sigma = 0.86\%$.

The cash-flows data are the quarterly corporate profits (without inventory valuation and capital consumption adjustment) in billions of dollar before tax from the US Bureau of Economic Analysis. I use information over the period 1952Q1-2015Q4 to compute the moments of the representative

[12] Following Boguth and Kuehn (2013) and Lettau, Ludvigson, and Wachter (2008), I use postwar data. Romer (1989) has shown that data on consumption recorded at the prewar period are not reliable since they contain significant measurement errors.

firm cash-flows growth.[13] The conditional growth rate is thus equal to $\mu_R = -13.47\%$ in recession and $\mu_E = 5.62\%$ in expansion while its unconditional standard deviation $\sigma^g = 11.82\%$. The debt recovery rate is set to $\alpha_R = 40\%$ in recession and $\alpha_E = 70\%$ in expansion. Chen (2010) estimates that mean bond recovery rate is 41.8%. Longstaff, Mithal, and Neis (2005) use a recovery rate of 50% and Duffee (1999), 44% using Moody's data. The corporate tax rate τ is set at 15%.

Regarding the representative agent's preferences, I consider a coefficient of risk aversion $\gamma = 10$, a coefficient of elasticity intertemporal substitution (EIS) $\psi = 1.5$, and an annual discount rate equal to $\beta = 3.0\%$.

With this calibration, the default probability is very high in recession (around 12%), whereas this probability is less than 1% in expansion. The equity risk premium is 0.88% in expansion and 3.56% in recession, showing that the equity risk premium is countercyclical. Interestingly, the unconditional credit spread obtained by computing $f_R \times CS_R^{full} + f_E \times CS_E^{full}$, is equal to 117 bps and the unconditional equity risk premium, obtained by computing $f_R \times RP_R^{full} + f_E \times RP_E^{full}$, is equal to 1.282%. This is consistent with the admitted observation that the risk levels embedded into stocks should not be significantly higher than those carried by bonds. This unconditional equity risk premium computed by assuming rational expectation, is consistent with what similar models will predict. Bhamra, Kuehn, and Strebulaev (2010a; 2010b) and Chen (2010) simulate an economy consisting of a cross-section of firms which helps increase significantly the equity risk premium, with the objective to resolve the equity premium puzzle. However, this paper addresses the question of the relative impact of the short-run risk, as in CAPM model, versus the long-run risk, as in models that incorporate macroeconomic risk. Here, I focus on modeling an individual firm which is sufficient to achieve this goal.

5 Methodology to measure the risk premia

This section describes the procedure that I follow to separately retrieve the long- and short-run risk components of risk premia. For bond pricing, the actual compensation demanded by investors is the sum of the default risk component and risk premia. Hence, the default risk component is the remaining part of the credit spread after the risk premia component is removed.

[13] The earnings data start in 1952 to match the consumption data.

5.1 Measuring the short-run risk premium

If investors have no aversion to the short-run risk, this means that they use the physical cash-flow growth rate μ_{s_t}, instead of the risk neutral one $\hat{\mu}_{s_t}$ to price corporate claims. In this case, the investors are neutral regarding the fact that corporate cash-flows are correlated to their consumption. Hence, I measure the short-run risk premium by comparing the full model with a model that sets $\hat{\mu}_{s_t} = \mu_{s_t}$. For corporate bonds, the short-run risk premium is $CS_{s_t}^{SR} = CS_{s_t}^{full} - CS_{s_t}^{\hat{\mu}_{s_t}=\mu_{s_t}}$. For equity, the short-run risk premium is $RP_{s_t}^{SR} = RP_{s_t}^{full} - RP_{s_t}^{\hat{\mu}_{s_t}=\mu_{s_t}}$. Analytically, the equity risk premium due to short-run risk equals to $\gamma\rho\sigma^B\sigma$ as shown in the section 3.3.2.

5.2 Measuring the long-run risk premium

Similarly, if investors do not care about long-run risk they use the physical probability of being in state s_t, f_{s_t} instead of the risk neutral one $\hat{f}_{s_t}$ to price firm assets. Hence, I measure the long-run risk premium by comparing the full model with a model that sets $\hat{f}_{s_t} = f_{s_t}$. For corporate bonds, the long-run risk premium equals to $CS_{s_t}^{LR} = CS_{s_t}^{full} - CS_{s_t}^{\hat{f}_{s_t}=f_{s_t}}$. For equity, the long-run risk premium yields $RP_{s_t}^{LR} = RP_{s_t}^{full} - RP_{s_t}^{\hat{f}_{s_t}=f_{s_t}}$. Analytically, the equity risk premium related to the preference for early resolution of the uncertainty equals to $(1 - \triangle_{s_s})\sigma_{s_s}^P \lambda_{s_t}$, where $\lambda_{s_t} = pf_{s_t}$ as shown in the section 3.3.2.

5.3 Measuring the compensation for default risk

The default risk component is obtained by assuming that investors have CRRA preferences. That is, they use physical measure of cash-flow growth rate μ_{s_t} and actual probability of being in state s_t, f_{s_t}. Alternatively, this compensation, embedded into the credit spread, is measured by subtracting premia due to long- and short-run risks from the full model predictions. Hence, for corporate bonds, the default risk component equals to $CS_{s_t}^{Q} = CS_{s_t}^{full} - CS_{s_t}^{LR} - CS_{s_t}^{SR}$. For the equity risk premium, the compensation for default risk is worthless, i.e. $RP_{s_t}^{Q} = RP_{s_t}^{full} - RP_{s_t}^{LR} - RP_{s_t}^{SR} = 0$.

6 Theoretical predictions

This part presents and discusses the theoretical predictions of the paper. The main objective are to disentangle, first, the impacts of investor preferences from default risk component into corporate asset prices, then, compare the relative proportions of the long- and short-run risk premia. Without loss of generality, it is assumed that firms finance themselves in expansion. Predictions are done for the same economy but assuming various types of agent. In the last section, I compare different economies in which the firm can account for investor preferences while choosing its optimal policies.

6.1 Quantity vs price of risk

This section presents the findings concerning the quantity and price of risk embedded into the equity risk premium and credit spread. The predictions are done for the full model which I compare with the three following special cases: i) when the agent does not about long-run risk, ii) when the investor has no aversion to the short-run risk and, finally iii) when the investor is risk-neutral. The economy is the same for all cases, i.e. coupon and barriers are kept constant to those of the full model for all cases. I used the methodology explained in the section 5 to produce the risk premia due to the two systematic risks (short- and long-run risks) and, then, the quantity of risk, which is also obtained from the case iii) predictions. The table 2 reports the main results for the four cases (full model, case i, case ii and case iii) and the table 3 reports the quantity of risk and the risk premiums related to each type of systematic risk as well as their weights into both the total equity risk premium and credit spread.

Tables 2 and 3 [about here]

The proportion of the default risk, into the credit spread, is about 63% (or 74.34 bps), the remaining representing the credit spread premium (42.7 bps). In a risk-neutral setting, Chen, Collin-Dufresne, and Goldstein (2009) find an average four-year Baa credit spreads of 86.8 bps and 5.6 bps for Aaa. This proportion of default risk in bond spread (i.e. 63%) stays constant across the states of the economy. Similar structural models are designed to capture the average spread of A-rated and B-rated bonds.[14] This finding also matches those of Longstaff, Mithal, and Neis (2005), who have estimated that the default component accounts for 51% of the spread for AAA-rated and 71% for BBB-rated bonds.

Since it is a premium for holding stocks, the equity risk premium carries no quantity of risk. Indeed, for a risk-neutral agent to both short-run ($\gamma = 0$) and the long-run ($\Delta_E = \Delta_R = 1$) risks, the equity risk premium yields zero, as it can be seen with the equation 9. The figure 1 summarizes these findings.

Figure 1 [about here]

The remaining sections focus on the risk prices embedded into corporate assets.

6.2 Importance of the preference for earlier resolution of the uncertainty

The unconditional price of long-run risk represents 72.8% of the equity risk premium. Hence, a little than one-fourth of the equity risk premium originates from the correlation between firm cash flows and consumption. 68.5% of the credit risk premium comes from investors' willingness to see a quick resolution of the uncertainty regarding the subsequent states of the economy and the remaining is due to the short-run risk. This confirms the macroeconomic risk as the main source of uncertainty in the pricing of corporate assets and this is particularly true in an economy in which the investor prefers quicker resolution of uncertainties regarding the future conditions.

However, many reasons may explain the weak impact of the risk aversion on corporate assets prices compared to the aversion to macroeconomic risk.

For equity pricing, this stylized fact has been extensively reported [15]. Chen, Roll, and Ross (1986) performed an empirical test of classical consumption-based models, which postulate that the main factor in asset pricing should be the covariance with the aggregate consumption as in the classical CCAPM models like Rubinstein (1976) or Lucas (1978). They found that this factor is

[14] Bhamra, Kuehn, and Strebulaev (2010a; 2010b) restrict their analysis, as in many other papers, to BBB-rated debt. As they pointed out the spreads of top graded bonds (AAA or AA-rated) are mostly dominated by factors other than credit risk, and that structural models work well for low-grade bonds (B-rated and below). Similarly, Chen (2010) also focus mainly on Baa-rated firms (Baa in Moody's being equivalent to BBB in the S&P notation system).

[15] See Hansen and Singleton (1983), Mehra and Prescott (1985) and, Hansen and Jagannathan (1991).

not sufficient to explain stock prices. This also provides evidence for the Fama and French (1993) findings that the correlation with the market alone cannot explain stocks prices. Bansal and Yaron (2004) provide empirical support for a model with aggregate consumption and dividend processes that contain a small persistent expected growth rate component and a conditional volatility component, in conjunction with Epstein-Zin-Weil preferences to explain many asset pricing puzzles. This underpins further the preeminent role of long-run risk in driving corporate assets prices. Here, the poor impact of the short-run risk, on equity value, can easily be measured. The associated equity premium is measured by $\gamma\rho\sigma^B_{s_t}\sigma$, with $\sigma^B_{s_t} = \frac{X_t}{S_{s_t}}\frac{\partial S_{s_t}}{\partial X_t}\sigma^g = \frac{\partial ln S_{s_t}}{\partial ln X_{s_t}}\sigma^g$ the systematic volatility of stock returns induced by Brownian shocks. However, the U.S. consumption growth volatility σ is around 1% (see Table 1) in the data, the corporate earnings growth volatility σ^g is around 12% and, the correlation between earnings and the consumption ρ is about 25%. Because of the fact that the term $\frac{\partial ln S_{s_t}}{\partial ln X_{s_t}}$ (which is the responsiveness of stock price to a change in cash-flow) is bounded, $\gamma\rho\sigma^B_{s_t}\sigma$ will stay relatively small. Consequently, the short-run risk will have a limited impact on stocks. A recent work by Bali and Zhou (2016) proposes a conditional intertemporal capital asset pricing model with time-varying market risk and economic uncertainty. As in the approach developed in this paper, the risk price on equity is composed of two separate terms; the first term compensates for the standard market risk and the second term represents additional premium for economic uncertainty. They back up their model with empirical analysis to test whether the time-varying conditional covariances of equity returns with the market or economic uncertainty predicts the time-series and cross-sectional variation in stock returns. This study also concludes that exposures to economic uncertainty better predict stock returns. This finding is also supported by Lettau, Ludvigson, and Wachter (2008) who document that the fall in macroeconomic risk has lead to exceptional high aggregate stock prices in the 1990 and that this phenomenon persists today.

Regarding the bond pricing, using credit default swap (CDS) spreads, Tang and Yan (2010) document that average credit spreads are decreasing in GDP growth rate, but increasing in GDP growth volatility and that, credit spreads are lower for smaller systematic jump risk. These results support the role of macroeconomic uncertainties in corporate bonds value as well.

As pointed out in Fama and French (1993), common factors seem to drive the returns on stocks and bonds. They document that stock and bond returns are related through shared variation in the bond-market factors. Besides low-grade corporates, the bond-market factors, namely maturity and default risk (but not directly the market risk) capture the common variation in bond returns. Most importantly, they have identified five factors including the market risk that may explain average returns on both stocks and bonds. The implications of these results are twofold. First, the aversion due to the correlation between consumption and cash-flows (a proxy for the market risk) does not have significant repercussions on credit risk spread premium. Second, others common factors, which at least some of them are likely to vary with macroeconomic conditions, capture more of risk premia than market risk alone.

This paper provides support to these results and gives a better understanding as to why the long-run risk is dominant.

6.3 Countercyclical risk premia

The equity risk premium is 3.59% in bad times and 0.88% in good times. In particular, the compensation asked by investors to bear the risk associated with the uncertainty about future economic conditions represents 89.9% of the equity risk premium or an annual required rate of return of 3.23%, in bad times, while it worths 60.62% in recession or 0.53%.

On average, the credit spread premium is 49.7 bps in bad times and 41.5 bps in good times. However, Regardless of the state of the economy, the proportion of the credit spread premium due to the long-run risk represents 70% of the total price of risk while the remaining 30% comes from the sensitivity of the firm cash-flow to the consumption.

Lettau and Ludvigson (2001a; 2001b)[16] explore a conditional version of the consumption CAPM and found that their model performs as good as the Fama-French three-factor model in explaining the cross-section of average returns of portfolios sorted by size and book-to-market value. They document that countercyclical risk premium help improve assets pricing.

[16] Bekaert, Engstrom, and Xing (2009), Bansal, Kiku, Shaliastovich, and Yaron (2014) and Bali and Zhou (2016) also provide support for time-varying risk prices.

6.4 Investors' preferences

I start by analyzing the sensitivity of the risk premia to the risk aversion coefficient. Unsurprisingly, as shown in the figure 3, when the investor's risk aversion increases, both prices due to LRR and SRR go up. This means higher credit spread premium and equity risk premium when investors are more risk averse. Theoretically, the term $\gamma\rho\sigma^B_{s_t}\sigma$, that represents the risk premium due to investor's risk aversion clearly increases with the coefficient γ. The price of risk due to the uncertainty about future states of the economy is driven by the term $(1-\triangle_{s_t})\sigma^P_{s_t}\lambda_{s_t}$. However, the jump in the state-price density $\triangle_{s_t}$ decreases with respect the coefficient of risk aversion γ, increasing the premium due to the LRR increases. More importantly, the weight of the LRR in the risk premia increases when investors are more risk averse. Tang and Yan (2010) document that credit spreads are lower when investor sentiment is high, i.e. when the risk aversion is low.

Figure 3 and Table 4 [about here]

Concerning the EIS, high ψ leads to high credit spread premium but the proportion of the premium due to the uncertainty about future states of the economy decreases. The equity risk premium is lower for higher EIS coefficient, however the weights of LRR and SRR remains constant.

Figure 4 and Table 5 [about here]

6.5 Firm characteristics and cross-sectional asset pricing

This section attempts to identify cross-sectional assets pricing factors among firms. Investors' preferences may affect differently asset prices according to firms' characteristics. In particular, leverage, idiosyncratic volatility and firm performances are explored. Cross-sectional pricing implications of the time-varying macroeconomic conditions have studied by Boguth and Kuehn (2013), Bansal, Kiku, Shaliastovich, and Yaron (2014) and Tedongap (2014), whereas this paper explores the impacts of time-varying expected growth rates.

6.5.1 Leverage

In this section, I explore the importance of the preferences in the cross-section of firm according to their leverage. The pricing implication of the leverage has been extensively studied in the literature. Since, the capital structure decisions are endogenized, leverage cannot be used as a parameter. Another parameter, namely the bankruptcy cost, is used after verifying that decreasing the bankruptcy cost translates into higher optimal leverage (See Leland (1994)).

An increase of 10% in bankruptcy cost translates into a reduction of about 5% in leverage. In turn, higher leverages induce higher credit spread and equity risk premium due to both investor risk aversion and preference for earlier resolution of the uncertainty. As shown in the Table 6, an increase of 5 % in the optimal leverage, increases the equity risk premium and credit spread premium by respectively 3% and 5%. Hence, firms with high optimal leverage have also higher risk premia in level but not in proportion of the total risk premium, which stays constant.

There findings corroborate Bhandari (1988) who find empirical evidence that there exists a positive relation between leverage and expected stock returns. This characteristic is shown to have pricing implication for bond also (Yu, 2005).

Figure 6 and Table 6 [about here]

6.5.2 Idiosyncratic volatility

The idiosyncratic volatility introduces cross-sectional heterogeneity in risks across firms.

As asset pricing theory (Merton (1973)) suggests, the equity risk premium should not change with respect to the idiosyncratic volatility. One reason is that shareholders are able to get rid of firm level idiosyncratic volatility by diversification. In fact, empirical works have found diverging results regarding the relation between firms' specific volatility and average stock returns. Fama and French (1993) model suggest that creating portfolios by sorting on specific volatility will produce no difference in average stock returns. Hence, a firm's stock price is almost not affected by its specific volatility. Malkiel and Xu (2002) and Jones and Rhodes-Kropf (2003) argue that in a market in which investors are not able to diversify risk, they will demand a premium for holding stocks with high idiosyncratic volatility. In contrast, Ang, Hodrick, Xing, and Zhang (2006) and Babenko, Boguth, and Tserlukevich (2016) examine this cross-sectional relationship between idiosyncratic volatility and average stock return, where idiosyncratic volatility is defined relative to the standard Fama and French (1993) model. They find that stocks with high idiosyncratic volatility have low average returns. As in Ang, Hodrick, Xing, and Zhang (2006) and Babenko, Boguth, and

Tserlukevich (2016), this paper's approach provides a negative relationship between idiosyncratic volatility and equity risk premium (see upper panels of Figure 7). This is the case for both the short-run and long-run risks. This paper further predicts that the weights of LRR and SRR in equity premium do not change with idiosyncratic volatility.

Regarding bond valuation, the level of the price of risk embedded into the credit spread increases with firm specific volatility. Moreover, even if the impact of LRR is higher, SRR's impact also increases as the firm specific volatility goes up. An increase in volatility from 25% to 35% leads to a nearly 80 % increase of the credit spread premium, i.e. from 42.7 to 77.5 bps. In term of proportion, the impact of the LRR is reduced for firms with high level of idiosyncratic volatility. In the cross-section, Tang and Yan (2010) found out that firm-level cash-flow volatility raises credit spreads. Exploring the quality of a firm's information disclosure on the term structure of its bond yield spreads, Yu (2005) documents that firms with high volatility behave differently compared to firms with low volatility.

Figure 7 and Table 7 [about here]

6.5.3 Firm performance

This section explores the role of the preferences in the cross-section of firms according to the cash-flows level. Indeed, high cash-flow ceteris paribus means better financial wealth. As such, the cash-flows level is a proxy for firm performance. As it is shown in the figure 5, risk premia for equity and bond are high for firms with low cash-flows level. Compared to the baseline case, both the credit spread premium and the equity risk premium increases by around 30 to 35% when the firm cash-flows level is reduced by 25%. More importantly, the increase in risk premia is more pronounced for firms more distress firms. This approach predicts that equity risk premium could be as high as 17%. As reported in Martin (2017), the equity premium is extremely volatile and rose above 20% in the midst of the 2008 crisis.

This captures the observation that firm performance is a pricing factor. This seems to confirm the claim of Fama and French (1992) that cross-sectional irregularities are related to risk of financial distress. When market conditions deteriorate, firms are more likely to exhibit more marked cross-sectional differences.

Figure 5 [about here]

6.6 Preferences and firm optimal decisions

Investors' preferences modify not only the pricing of corporate claims but also impact firm's optimal default and debt policies. In reality, managers account for investor's preference by adjusting the firms' optimal decisions accordingly. By considering three special case economy (see Table 8), an economy populated by an agent who i) is risk averse (to the SRR), ii) has preference for quicker resolution of uncertainties and, iii) is risk neutral, one can quantify these impacts. Announced literally, the firm endogenizes preferences while choosing its optimal policies which in turn affect the price of corporate claims.

Table 8 and Figure 8 [about here]

When the investor only cares about LRR, the firm chooses lower coupon compared to an economy in which he cares only about the correlation between cash-flows and consumption. The optimal default barrier is also lower in the former case. Hence, the firm alters more its optimal debt and default level in presence of agent who cares more about the LRR than when the agent only takes into account the SRR. The firm adjusts its policies to reduce its risk exposure, in particular by reducing its debt level. Together with these reduction, the default probability and leverage are, according to expectations, reduced. Yet, despite these adjustments, the total credit spread and equity risk premium are higher in an economy populated with a representative agent who cares about future macroeconomic conditions than in an economy with a risk averse agent. The reason is that the quantity of risk increases much that the risk premium when each source of risk is added in the economy. This is understandable since, in the case of a agent risk neutral agent, the firm will opt for a higher optimal default and debt policies than for the others economies.

6.7 Incorporating time-varying volatility

Now let consider that the volatility of consumption and cash-flow growth are state-dependent. The consumption and cash-flow volatilities, respectively σ_{s_t} and $\sigma^g_{s_t}$, are countercyclical in nature, implying that $\sigma_E < \sigma_R$ and $\sigma^g_E < \sigma^g_R$. Hence in the equations 1 and 2, σ and σ^g are replaced by

σ_{s_t} and $\sigma_{s_t}^g$, where $\sigma_R = 1.23\%$ in recession and $\sigma_E = 0.80\%$ in expansion and $\sigma_R^g = 24.61\%$ in recession and $\sigma_E^g = 9.59\%$ in expansion.

Equity risk premium is more countercyclical with time-varying volatility of consumption and cash-flow, as reported in Bansal and Yaron (2004). This feature introduces more (less) risk in recessions (expansion). With time-varying volatility, the conditional total price of risk in equity risk premium is 4.45% in recession as opposed to 3.56% without and 0.80% in expansions as compared to 0.88% without. However, because of the countercyclicality of volatility, the proportion of the LRR becomes only 76.6% (instead of 89.9% without time-varying volatility) and 67.6% (instead of 60.6% without time-varying volatility).

Credit spread premium increases in both states, respectively from 49.64 to 58.46 bps in recessions and from 41.51 to 47.21 bps in expansion when adding time-varying volatility to the model.

Table 9, Table 10 and Table 11 [about here]

This approach allows to retrieve separately from discount rate news, risk premia due to consumption volatility news as in Boguth and Kuehn (2013) and Bansal, Kiku, Shaliastovich, and Yaron (2014).

7 Concluding remarks

Investor's preferences influence firm decisions, hence affecting the valuation of the firm's claims. Thus, a better assessment of the systematic risks that firms face is a good way to apprehend the risk premium embedded into corporate securities.

This paper proposes a new approach, constructed in a consumption based asset pricing environment, to understand the impact of investor preferences for the pricing of stocks and corporate bonds. This pricing of the firm's assets is done after considering two sources of systematic risks that can affect expected cash-flows, i.e. the time-varying macroeconomic conditions and the instantaneous correlation between the consumption and the firms cash-flows. Firms' react to investor's preferences regarding these systematic risks by adjusting their default and debt decisions, in order to reduce the impacts of these preferences. The present approach allows putting the emphasize on the levels of the risk premia associated to each of these systematic risks and in various situations. This provides evidence that the preference for the earlier resolution of the uncertainty is preponderant into the equity risk premium and credit spread. This study also shows that equity and bond react differently to the investors' preferences and predicts that firm performance, leverage and idiosyncratic volatility are pricing factors for both equity and corporate bond.

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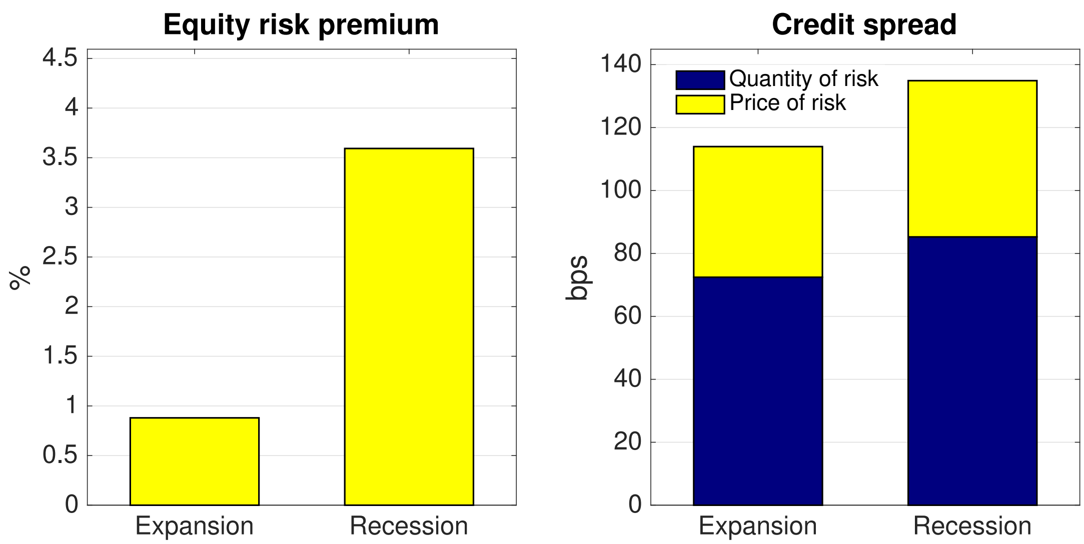

Figure 1: **Quantity vs price of risk.** This figure compares the quantity and the price of risk embedded into the credit spread for the two situations when the coupon and boundaries are exogenous and then endogenously determined by the shareholders. The first four upper panels display predictions on conditional credit spread, the conditional levels on the first two upper panels (exogenous policies on the left and endogenous policies on the right) and the proportions on the middle panels (exogenous policies on the left and endogenous policies on the right). The last two panels display predictions on conditional level of equity risk premium (exogenous policies on the left and endogenous policies on the right). The quantity and prices of systematic risk are computed using the procedure explained in the section 5. Predictions are done for the full model. I use the parameters of the baseline calibration (see Table 1).

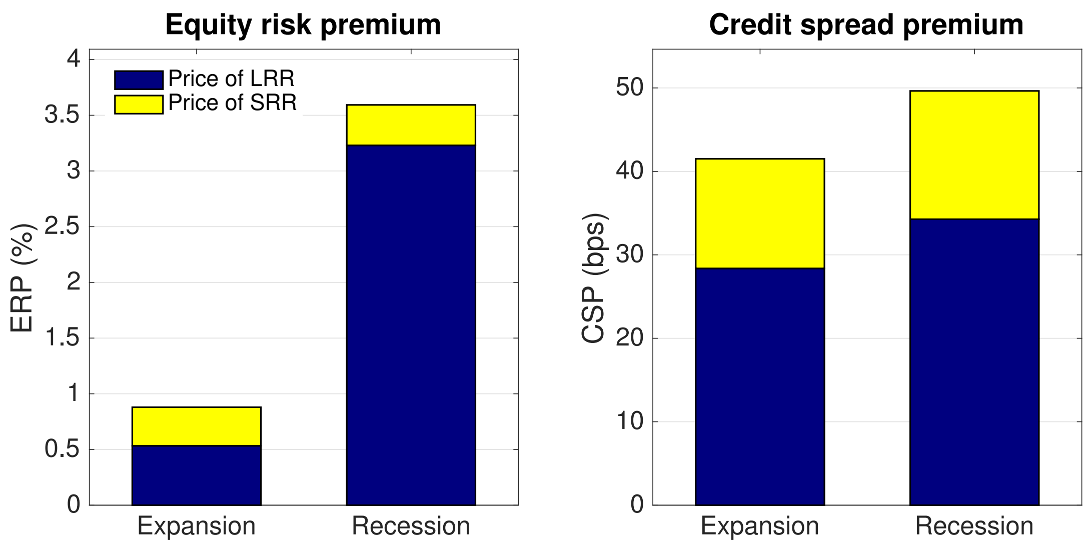

Figure 2: **Prices of long- vs short-run risk.** This figure compares the prices of the long- and short-run risk embedded into the equity risk premium and credit spread premium for the two situations when the coupon and boundaries are exogenous and then endogenously determined by the shareholders. The upper (credit spread) and lower (equity risk premium) panels display predictions with exogenous policies on the left, and with endogenous policies on the right. The upper panels display predictions on the conditional prices of systematic risk in the credit spread and the lower panels the prices of systematic risk in the equity risk premium. The prices of systematic risk are computed using the procedure explained in the section 5. Predictions are done for the full model. I use the parameters of the baseline calibration (see Table 1).

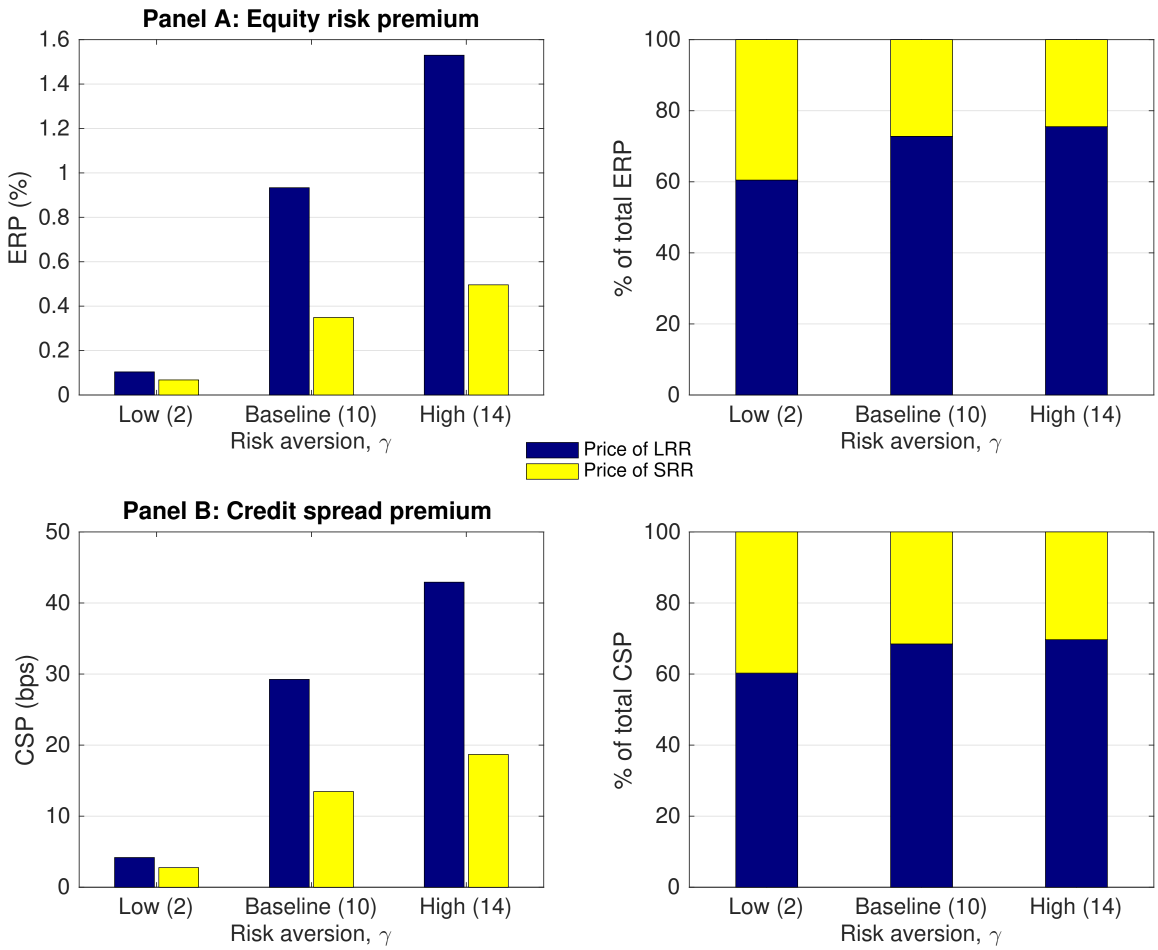

Figure 3: **Price of risk and level of risk aversion.** This figure shows the impact of investors' risk aversion on the equity risk premium and credit spread premium for different level of risk aversion, high, $\gamma = 14$ and low, $\gamma = 2$ that I compare with the baseline predictions. The upper panels show the prices of risk due to short- and long-run risk in the equity risk premium in level (top-left panel) and in proportion of the total equity risk premium (top-right panel), while the lower panels show the prices of risk due to short- and long-run risk in the credit spread premium in level (down-left panel) and in proportion of the total credit spread (down-right panel). The coupon and default boundaries are fixed to those of the full model, i.e. baseline case. Unless otherwise specified, I use the parameters of the baseline calibration (see Table 1).

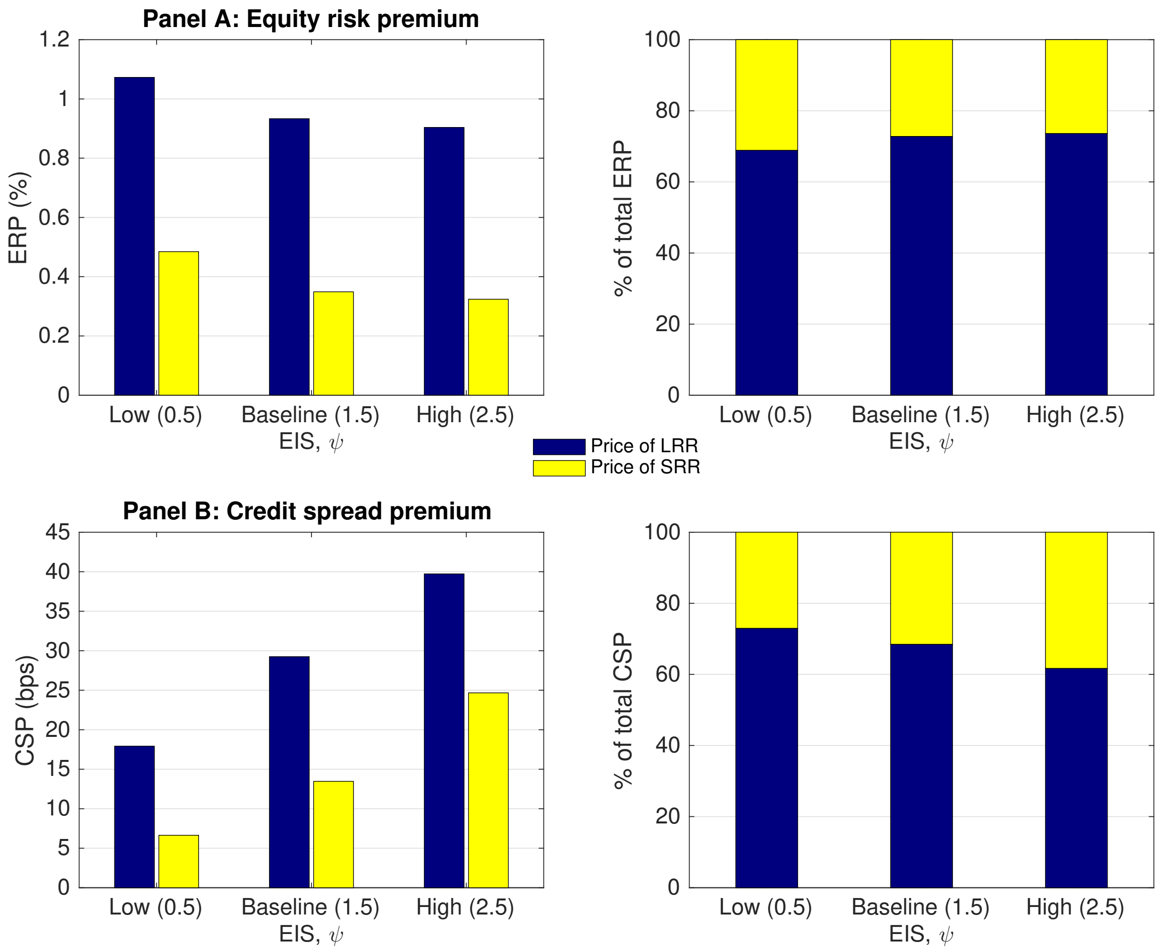

Figure 4: **Price of risk and level of EIS coefficient.** This figure shows the impact of EIS coefficient on the equity risk premium and credit spread premium for different level of risk aversion, high, $\psi = 2.5$ and low, $\psi = 0.5$ that I compare with the baseline predictions. The upper panels show the prices of risk due to short- and long-run risk in the equity risk premium in level (top-left panel) and in proportion of the total equity risk premium (top-right panel), while the lower panels show the prices of risk due to short- and long-run risk in the credit spread premium in level (down-left panel) and in proportion of the total credit spread (down-right panel). The coupon and default boundaries are fixed to those of the full model, i.e. baseline case. Unless otherwise specified, I use the parameters of the baseline calibration (see Table 1).

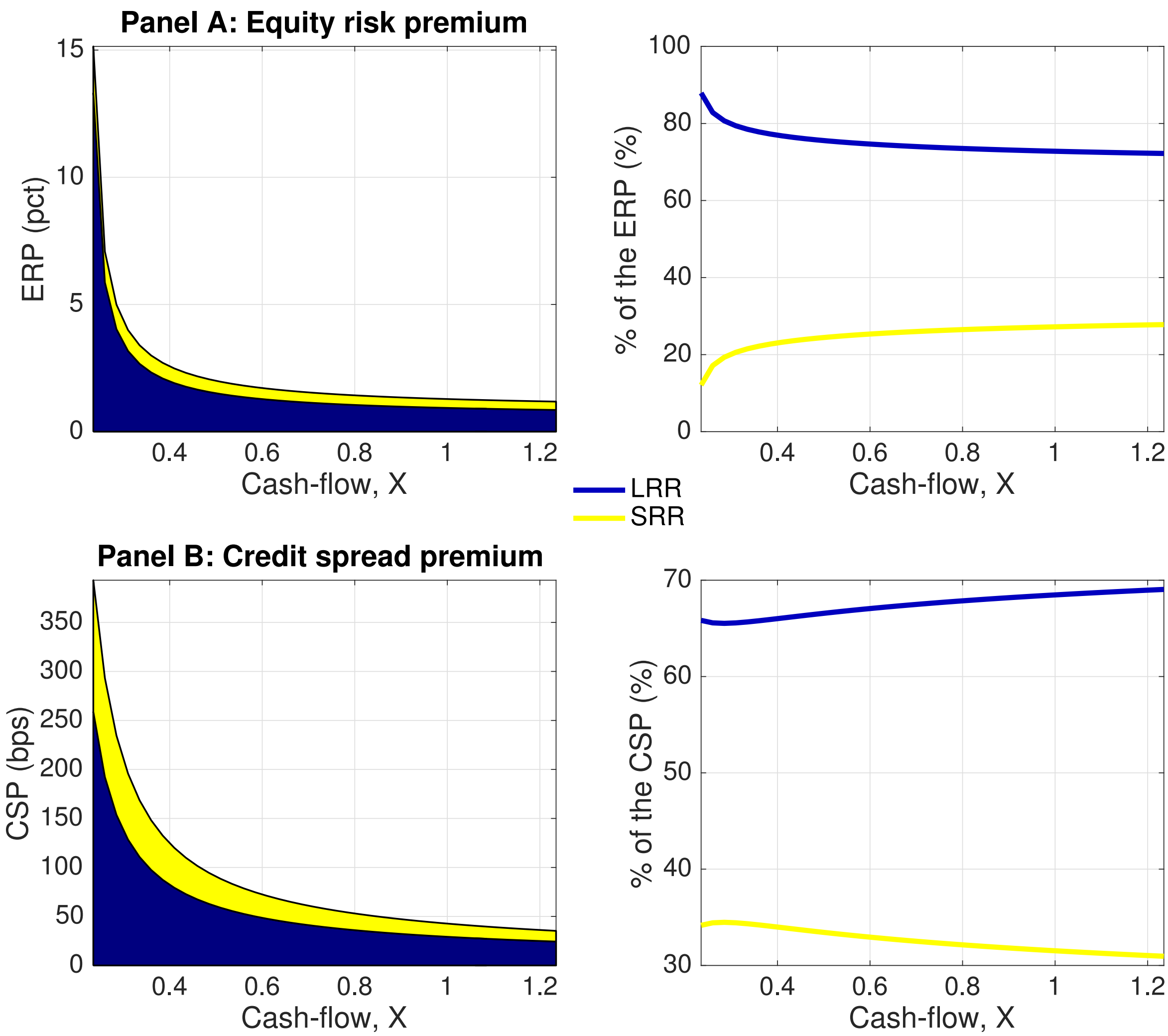

Figure 5: **Cash-flow, equity risk premium and credit spread premium.** This graph shows how investors preferences influence the equity risk premium and credit spread premium for different cash-flows level. The upper panels show the prices of risk due to short- and long-run risk in the equity risk premium in level (top-left panel) and in proportion of the total equity risk premium (top-right panel), while the lower panels show the prices of risk due to short- and long-run risk in the credit spread premium in level (down-left panel) and in proportion of the total credit spread (down-right panel). The coupon and default boundaries are fixed to those of the full model, i.e. baseline case. Unless otherwise specified, the parameters are those of the baseline calibration (see Table 1).

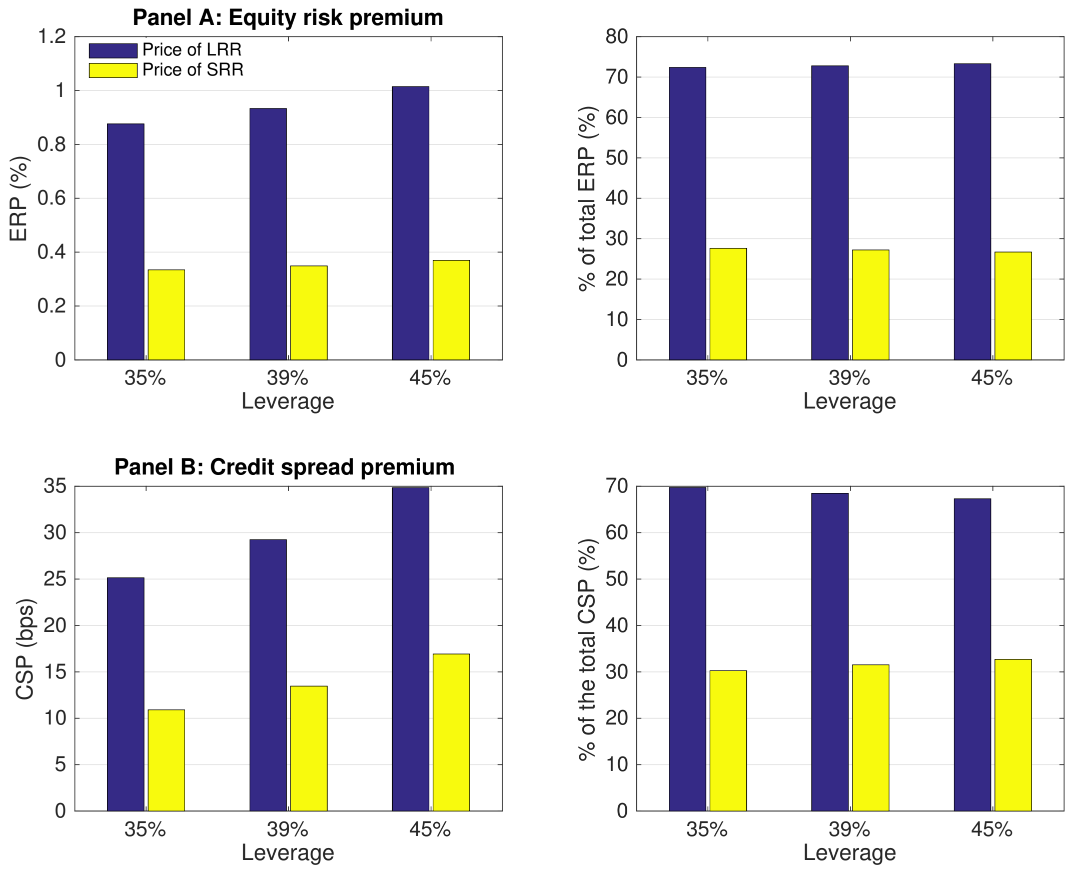

Figure 6: **Leverage, equity risk premium and credit spread premium.** This graph shows how investors preferences influence the equity risk premium and credit spread premium for different leverage level. The upper panels show the prices of risk due to short- and long-run risks in the equity risk premium in level (top-left panel) and in proportion of the total equity risk premium (top-right panel), while the lower panels show the prices of risk due to short- and long-run risks in the credit spread premium in level (down-left panel) and in proportion of the total credit spread (down-right panel). The coupon and default boundaries are fixed to those of the full model, i.e. baseline case. Unless otherwise specified, the parameters of those of the baseline calibration (see Table 1).

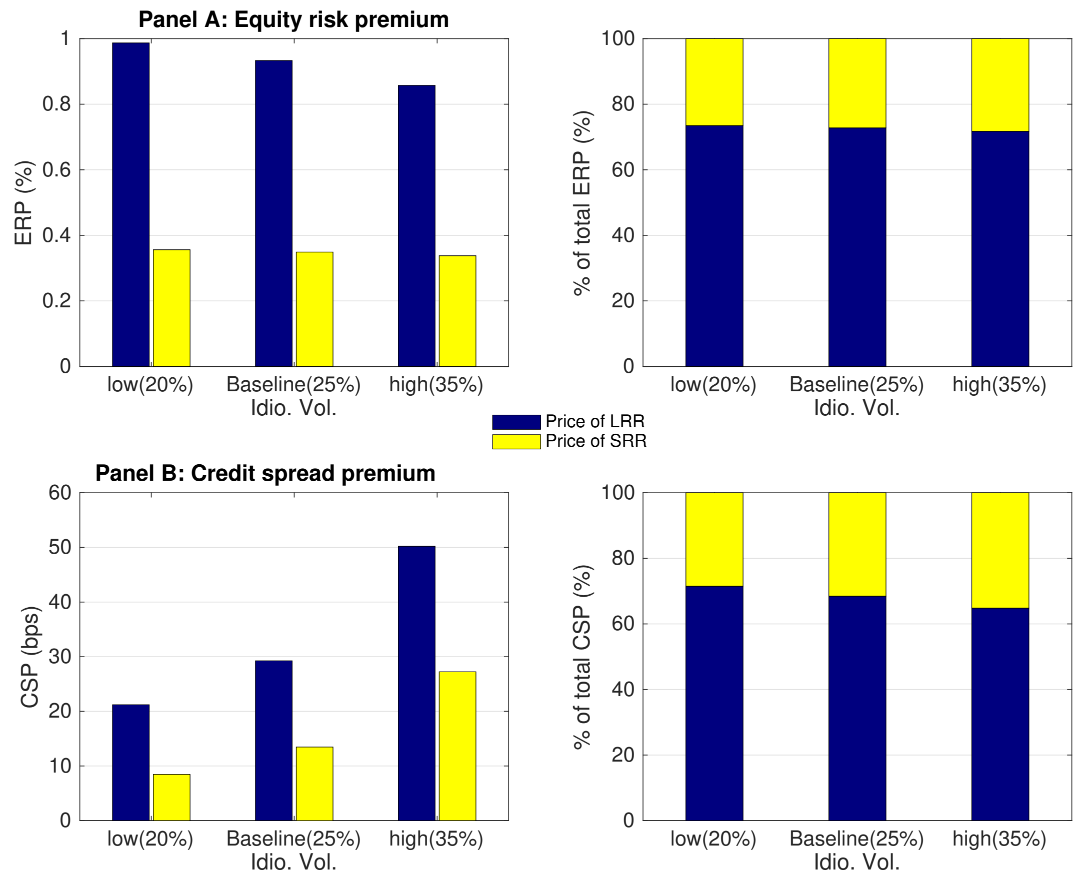

Figure 7: **Idiosyncratic volatility, equity risk premium and credit spread premium.** This graph shows how investors preferences influence the equity risk premium and credit spread premium for different idiosyncratic volatility level. The upper panels show the prices of risk due to short- and long-run risk in the equity risk premium in level (top-left panel) and in proportion of the total equity risk premium (top-right panel), while the lower panels show the prices of risk due to short- and long-run risk in the credit spread in level (down-left panel) and in proportion of the total credit spread (down-right panel). The coupon and default boundaries are fixed to those of the full model, i.e. baseline case. Unless otherwise specified, the parameters of those of the baseline calibration (see Table 1).

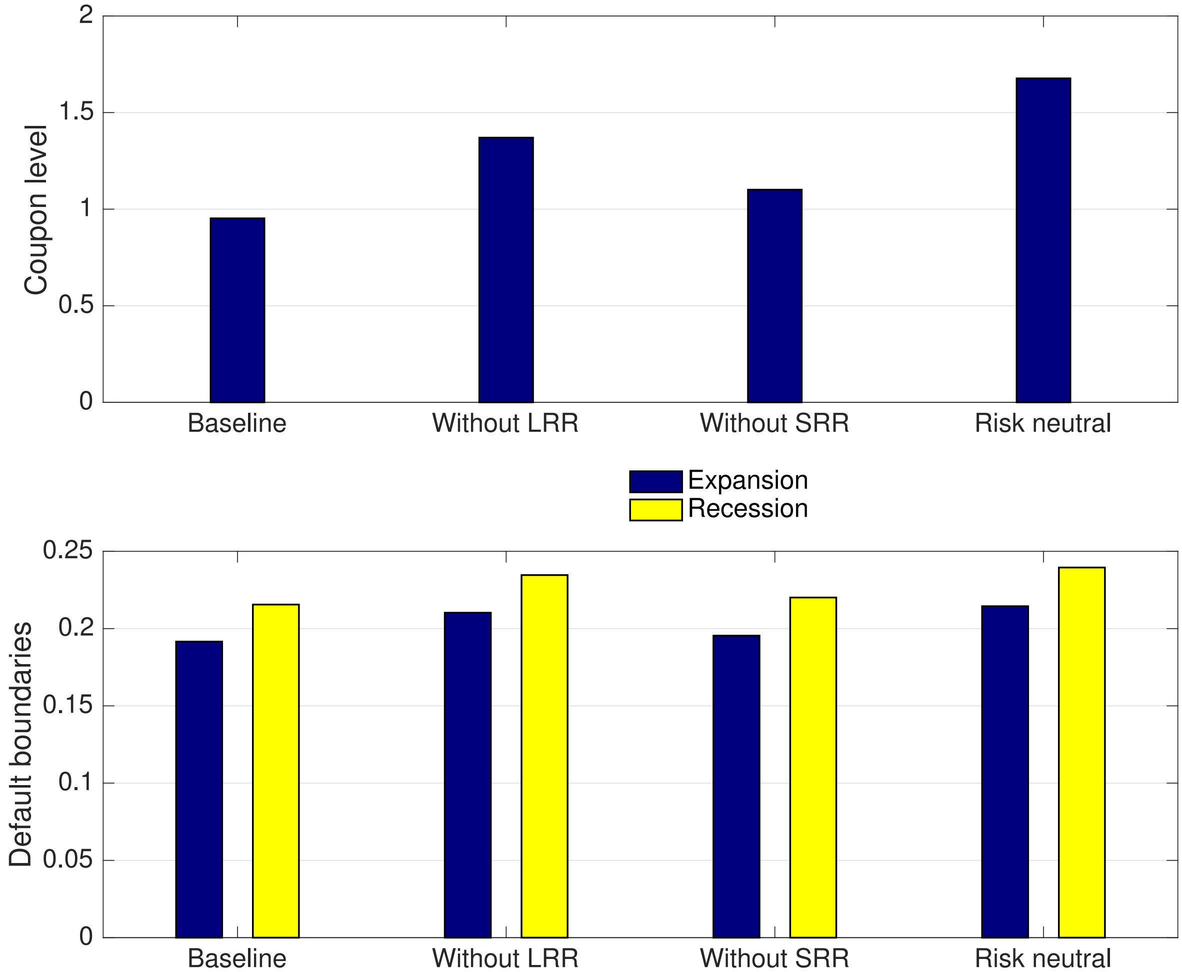

Figure 8: **Conditional coupon level and default boundaries.** This figure displays the coupon level and the conditional default boundaries for the full model which are compared to those of three special cases. I consider first a model in which the investor does not care about the uncertainty regarding the timing of the resolution of the uncertainty (without long-run risk - LRR), i.e. $\hat{\lambda}_{s_t} = \lambda_{s_t}$; then, a model in which the investor is not averse to the correlation between cash-flows and consumption (without short-run risk - SRR), i.e. $\hat{\mu}_{s_t} = \mu_{s_t}$ and finally a model in which the investor is risk-neutral. The upper panel displays the coupon levels and the lower panel the default boundaries. The results are reported for the case when financing occurs in expansion ($s_0 = H$). I use the parameters of the baseline calibration (see Table 1).

Table 1 : **Model calibration.**
This table reports the parameter values used for the calibration of the model. The state of the economy is determined by the NBER recession dates in the U.S. over the period 1952Q1-2015Q4. The state $s_t = E$ refers to an expansion, whereas the state $s_t = R$ corresponds to a recession. The frequency of the data is quarterly and the values are annualized, when applicable.

Variable	Notation	Value		Source
Panel A: Economic environment and agent preferences				
		Recession	Expansion	
State of the economy	s_t	R	E	
Consumption growth rate (%)	θ_{s_t}	0.65	2.20	Bureau of Economic
Consumption growth volatility (%)	σ	0.86	0.86	Analysis,1952Q1-2015Q4
Actual long-run probability (%)	f_{s_t}	14.84	85.16	NBER recessions dates
Consumer time preference	β	0.03	0.03	
Risk aversion coefficient	γ	10.0	10.0	
Elasticity of intertemporal substitution	ψ	1.5	1.5	
Panel B: Firm characteristics				
cash-flows growth rate (%)	μ_{s_t}	-13.47	5.62	Bureau of Economic
Systematic cash-flows growth volatility (%)	σ^s	11.82	11.82	Analysis,1952Q1-2015Q4
Idiosyncratic cash-flows growth volatility (%)	σ^{id}	25	25	
Correlation	ρ	0.2496	0.2496	
Tax rate (%)	τ	15	15	
Bankruptcy costs (%)	ϕ_{s_t}	60	30	

Table 2 : **The impact of investors preferences on corporate assets.**
This table reports theoretical predictions for the full model, which I compare with three special cases. I consider first the situation in which the investor does not care about the uncertainty regarding the timing of the resolution of the uncertainty, $\hat{\lambda}_{s_t} = \lambda_{s_t}$ (Column 2). Then, I consider the situation in which the investor is not averse to the correlation between cash-flows and consumption, $\hat{\mu}_{s_t} = \mu_{s_t}$ (Column 3) and finally the one in which the investor is risk-neutral (Column 4). The coupon and default boundaries are those of the full model so as to keep the same economy, that of the full model, in all three cases. The results are reported for the case when financing occurred in expansion. The equity and debt values are normalized by the full model value. Panel A contains the predictions for the case when the economy is currently in recession and Panel B in expansion. Unless otherwise specified, I use the parameters of the baseline calibration (see Table 1).

Predictions for different scenarios	Full model	Without aversion to the LRR	Without aversion to the SRR	Risk neutrality
Panel A : Conditional on current state being recession				
Coupon	0.9525	0.9525	0.9525	0.9525
Default boundary	0.2156	0.2156	0.2156	0.2156
Equity risk premium (%)	3.59	0.36	3.02	0.00
Credit spread (bps)	134.90	100.63	122.30	85.26
Equity value (normalized)	100.00	159.23	123.58	207.25
Debt value (normalized)	100.00	105.67	102.33	108.87
Leverage (%)	43.24	33.58	38.68	28.58
Default probability - 5y (%)	12.15	12.15	12.15	12.15
Panel B : Conditional on current state being expansion				
Coupon	0.9525	0.9525	0.9525	0.9525
Default boundary	0.1916	0.1916	0.1916	0.1916
Equity risk premium (%)	0.88	0.35	0.48	0.00
Credit spread (bps)	113.95	85.58	103.14	72.44
Equity value (normalized)	100.0	153.33	122.24	197.85
Debt value (normalized)	100.0	104.71	102.06	107.47
Leverage (%)	38.45	29.90	34.27	25.33
Default probability - 5y (%)	0.21	0.21	0.21	0.21

Table 3 : **Contribution of each type of systematic risk.**
This table reports theoretical predictions for the full model, the price of risk associated to the long- and the short-run risk (Columns 2 and 3) and finally the quantity of risk (Column 5). The coupon and default boundaries are those of the full model so as to keep the same economy, that of the full model, in all three cases. The results are reported for the case when financing occurred in expansion. Panel A contains the predictions for the case when the economy is currently in recession and Panel B in expansion. Unless otherwise specified, I use the parameters of the baseline calibration (see Table 1).

	Full model	Price of the LRR	Price of the SRR	Total price of risk	Total quantity of risk
	Panel A: *Conditional on current state being recession*				
Equity risk premium					
In percentage	3.59	3.23	0.36	3.59	0.00
% of the total ERP		89.9	10.11		
Credit spreads					
In bps	134.90	34.27	15.37	49.64	85.26
% of the CSP		69.03	30.97		
% of the total CS		26.31	11.33	36.80	63.20
	Panel B: *Conditional on current state being expansion*				
Equity risk premium					
In percentage	0.88	0.53	0.35	0.88	0.00
% of the ERP		60.62	39.38		
Credit spreads					
In bps	113.95	28.37	13.14	41.51	72.44
% of total CSP		68.36	31.64		
% of the total CS		39.16	18.14	36.43	63.57

Table 4 : **Risk aversion, equity risk premium and credit spread.**
This table reports theoretical predictions for the full model, which I compare with three special cases. I consider first the case in which the investor does not care about the uncertainty regarding the timing of the resolution of the uncertainty, i.e. $\hat{\lambda}_{s_t} = \lambda_{s_t}$ (Column 2). Then, I consider a model in which the investor is not averse to the correlation between cash-flows and consumption, i.e. $\hat{\mu}_{s_t} = \mu_{s_t}$ (Column 3) and finally a model in which the investor is risk-neutral (Column 4). The coupon and default boundaries are those of the full model so as to keep the same economy, that of the full model, in all three cases. Panel A report the credit spread (Panel A1) and equity risk premium (panel A2) obtained for two different levels of risk aversion, high, $\gamma = 14$ and low, $\gamma = 2$ that I compare with the baseline predictions and the Panel B the contribution of each type of systematic risk. The results are reported for the case when financing occurs in expansion ($s_0 = E$). Equity risk premiums and credit spreads are weighted average, where the weights are given by the actual long-run distribution, f_{s_t}. Unless otherwise specified, I use the parameters of the baseline calibration (see Table 1).

Panel A: Equity risk premium and credit spread

	Full model (A)	Without aversion to LRR (B)	Without aversion to SRR (C)	Risk neutrality (D)
Panel A1: Equity risk premium (pct)				
Low CRRA	0.171	0.068	0.102	0.00
Baseline	1.282	0.349	0.855	0.00
High CRRA	2.026	0.496	1.351	0.00
Panel A2: Credit spread (bps)				
Low CRRA	82.81	78.63	80.17	75.87
Baseline	117.06	87.81	105.98	74.34
High CRRA	135.14	92.21	120.28	73.53

Panel B : Decomposition of the price of risk

	Price of LRR (A) - (B)	Price of SRR (A) - (C)	Total (A) - (D)
Panel B1: Equity risk premium (pct)			
Low CRRA	0.104	0.068	0.171
Baseline	0.933	0.349	1.282
High CRRA	1.530	0.496	2.026
Panel B2: Credit spread premium (bps)			
Low CRRA	4.18	2.76	6.94
Baseline	29.25	13.47	42.71
High CRRA	42.93	18.68	61.61

Table 5 : **EIS coefficient, equity risk premium and credit spread.**
This table reports theoretical predictions for the full model, which I compare with three special cases. I consider first the case in which the investor does not care about the uncertainty regarding the timing of the resolution of the uncertainty, i.e. $\hat{\lambda}_{s_t} = \lambda_{s_t}$ (Column 2). Then, I consider a model in which the investor is not averse to the correlation between cash-flows and consumption, i.e. $\hat{\mu}_{s_t} = \mu_{s_t}$ (Column 3) and finally a model in which the investor is risk-neutral (Column 4). The coupon and default boundaries are those of the full model so as to keep the same economy, that of the full model, in all three cases. Panel A report the credit spread (Panel A1) and equity risk premium (panel A2) obtained for two different levels of EIS coefficient, high, $\psi = 2.5$ and low, $\psi = 0.5$ that I compare with the baseline predictions and the Panel B the contribution of each type of systematic risk. The results are reported for the case when financing occurs in expansion ($s_0 = E$). Equity risk premiums and credit spreads are weighted average, where the weights are given by the actual long-run distribution, f_{s_t}. Unless otherwise specified, I use the parameters of the baseline calibration (see Table 1).

Panel A: Equity risk premium and credit spread

	Full model (A)	Without aversion to LRR (B)	Without aversion to SRR (C)	Risk neutrality (D)
Panel A1: Equity risk premium (pct)				
Low EIS	1.557	0.484	0.975	0.00
Baseline	1.282	0.349	0.855	0.00
High EIS	1.228	0.324	0.829	0.00
Panel A2: Credit spread (bps)				
Low EIS	123.45	105.52	116.39	98.88
Baseline	117.06	87.81	105.98	74.34
High EIS	109.04	69.31	94.51	44.65

Panel B : Decomposition of the price of risk

	Price of LRR (A) - (B)	Price of SRR (A) - (C)	Total (A) - (D)
Panel B1: Equity risk premium (pct)			
Low EIS	1.073	0.484	1.557
Baseline	0.933	0.349	1.282
High EIS	0.904	0.324	1.228
Panel B2: Credit spread premium (bps)			
Low EIS	17.92	6.64	24.56
Baseline	29.25	13.47	42.71
High EIS	39.72	24.66	64.39

Table 6 : **Leverage, equity risk premium and credit spread.**
This table reports theoretical predictions for the full model, which I compare with three special cases. I consider first the case in which the investor does not care about the uncertainty regarding the timing of the resolution of the uncertainty, i.e. $\hat{\lambda}_{s_t} = \lambda_{s_t}$ (Column 2). Then, I consider a model in which the investor is not averse to the correlation between cash-flows and consumption, i.e. $\hat{\mu}_{s_t} = \mu_{s_t}$ (Column 3) and finally a model in which the investor is risk-neutral (Column 4). The coupon and default boundaries are those of the full model so as to keep the same economy, that of the full model, in all three cases. Panel A report the credit spread (Panel A1) and equity risk premium (panel A2) obtained for two different levels of leverage, high, 45% and low, 35% that I compare with the baseline predictions (39%) and the Panel B the contribution of each type of systematic risk. The results are reported for the case when financing occurs in expansion ($s_0 = E$). Equity risk premiums and credit spreads are weighted average, where the weights are given by the actual long-run distribution, f_{s_t}. Unless otherwise specified, I use the parameters of the baseline calibration (see Table 1).

Panel A: Equity risk premium and credit spread				
	Full model (A)	Without aversion to LRR (B)	Without aversion to SRR (C)	Risk neutrality (D)
Panel A1: Equity risk premium (pct)				
Low leverage	1.211	0.334	0.812	0.00
Baseline	1.282	0.349	0.855	0.00
High leverage	1.384	0.369	0.917	0.00
Panel A2: Credit spread (bps)				
Low leverage	107.54	82.40	98.20	71.48
Baseline	117.06	87.81	105.98	74.34
High leverage	129.77	94.91	116.31	77.99

Panel B : Decomposition of the price of risk			
	Price of LRR (A) - (B)	Price of SRR (A) - (C)	Total (A) - (D)
Panel B1: Equity risk premium (pct)			
Low leverage	0.876	0.334	1.211
Baseline	0.933	0.349	1.282
High leverage	1.015	0.369	1.384
Panel B2: Credit spread premium (bps)			
Low leverage	25.14	10.91	36.05
Baseline	29.25	13.47	42.71
High leverage	34.86	16.93	51.78

Table 7 : **Idiosyncratic volatility, equity risk premium and credit spread.**
This table reports theoretical predictions for the full model, which I compare with three special cases. I consider first a model in which the investor does not care about the uncertainty regarding the timing of the resolution of the uncertainty, i.e. $\hat{\lambda}_{s_t} = \lambda_{s_t}$ (Column 2). Then, I consider a model in which the investor is not averse to the correlation between cash-flows and consumption, i.e. $\hat{\mu}_{s_t} = \mu_{s_t}$ (Column 3) and finally a model in which the investor is risk-neutral (Column 4). The coupon and default boundaries are fixed to those of the full model in the baseline case. Panel A report the credit spread (Panel A1) and equity risk premium (panel A2) obtained for two different levels of idiosyncratic volatility, high, $\sigma^{id} = 35\%$ and low, $\sigma^{id} = 20\%$ that I compare with the baseline predictions and the Panel B the contribution of each type of systematic risk. The results are reported for the case when financing occurs in expansion ($s_0 = E$). Equity risk premiums and credit spreads are weighted average, where the weights are given by the actual long-run distribution, f_{s_t}. Unless otherwise specified, I use the parameters of the baseline calibration (see Table 1).

Panel A: Equity risk premium and credit spread

	Full model (A)	Without aversion to LRR (B)	Without aversion to SRR (C)	Risk neutrality (D)
Panel A1: Equity risk premium (pct)				
Low id. volatility	1.343	0.356	0.886	0.00
Baseline	1.282	0.349	0.855	0.00
High id. volatility	1.195	0.338	0.810	0.00
Panel A2: Credit spreads (bps)				
Low id. volatility	73.64	52.43	65.79	43.98
Baseline	117.06	87.81	105.98	74.34
High id. volatility	224.59	174.38	204.94	147.14

Panel B : Decomposition of the price of risk

	Price of LR Risk (A) - (B)	Price of SR Risk (A) - (C)	Total (A) - (D)
Panel B1: Equity risk premium (pct)			
Low id. volatility	0.987	0.356	1.343
Baseline	0.933	0.349	1.282
High id. volatility	0.857	0.338	1.195
Panel B2: Credit spread premium (bps)			
Low id. volatility	21.21	8.45	29.66
Baseline	29.25	13.47	42.71
High id. volatility	50.22	27.24	77.45

Table 8 : **The impact of investors preferences on corporate assets - Endogenous policy.**
This table reports theoretical predictions for the full model, which I compare with three special models. I consider first a model in which the investor does not care about the uncertainty regarding the timing of the resolution of the uncertainty, $\hat{\lambda}_{s_t} = \lambda_{s_t}$ (Column 2). Then, I consider a model in which the investor is not averse to the correlation between cash-flows and consumption, $\hat{\mu}_{s_t} = \mu_{s_t}$ (Column 3) and finally a model in which the investor is risk-neutral (Column 4). The coupon and default boundaries are endogenous, i.e., shareholders now consider investors preferences in their decision making. The results are reported for the case when financing occurred in expansion. The equity and debt values are normalized by the full model value. Panel A contains the predictions for the case when the economy is currently in recession and Panel B in expansion. Unless otherwise specified, I use the parameters of the baseline calibration (see Table 1).

Predictions for different economies	Full model	When agent is averse to the SRR	When agent is averse to the LRR	Risk neutrality
Panel A : Conditional on current state being recession				
Coupon	0.9525	1.3702	1.1009	1.6771
Default boundary	0.2156	0.2346	0.2201	0.2395
Equity risk premium (%)	3.59	0.42	3.22	0.00
Credit spread (bps)	134.90	125.24	131.03	121.57
Equity value (normalized)	100.00	132.39	114.22	160.02
Debt value (normalized)	100.00	145.81	116.40	178.89
Leverage (%)	43.24	45.52	43.70	45.99
Equity return volatility (%)	51.46	52.17	51.88	52.62
Default probability - 5y (%)	12.15	15.38	12.90	16.26
Panel B : Conditional on current state being expansion				
Coupon	0.9525	1.3702	1.1009	1.6771
Default boundary	0.1916	0.2103	0.1954	0.2145
Equity risk premium (%)	0.88	0.39	0.49	0.00
Credit spread (bps)	113.95	105.74	110.22	102.20
Equity value (normalized)	100.0	131.12	114.46	158.82
Debt value (normalized)	100.0	144.91	116.39	178.56
Leverage (%)	38.45	40.84	38.84	41.25
Equity return volatility (%)	42.22	43.52	42.47	43.81
Default probability - 5y (%)	0.21	0.34	0.23	0.38

Table 9 : **The impact of investors preferences on corporate assets - Time-varying volatility.** This table reports theoretical predictions for the full model, which I compare with three special cases. I consider first the situation in which the investor does not care about the uncertainty regarding the timing of the resolution of the uncertainty, $\hat{\lambda}_{s_t} = \lambda_{s_t}$ (Column 2). Then, I consider the situation in which the investor is not averse to the correlation between cash-flows and consumption, $\hat{\mu}_{s_t} = \mu_{s_t}$ (Column 3) and finally the one in which the investor is risk-neutral (Column 4). The coupon and default boundaries are those of the full model so as to keep the same economy, that of the full model, in all three cases. The results are reported for the case when financing occurred in expansion. The equity and debt values are normalized by the full model value. Panel A contains the predictions for the case when the economy is currently in recession and Panel B in expansion. Unless otherwise specified, I use the parameters of the baseline calibration (see Table 1).

Predictions for different scenarios				
	Full model	Without aversion to the LRR	Without aversion to the SRR	Risk neutrality
Panel A : Conditional on current state being recession				
Coupon	0.9363	0.9363	0.9363	0.9363
Default boundary	0.1990	0.1990	0.1990	0.1990
Equity risk premium (%)	4.45	1.06	3.01	0.00
Credit spread (bps)	151.66	110.51	136.08	93.19
Equity value (normalized)	100.00	161.15	125.16	210.54
Debt value (normalized)	100.00	106.78	102.82	110.37
Leverage (%)	42.27	32.67	37.56	27.74
Default probability - 5y (%)	17.57	17.57	17.57	17.57
Panel B : Conditional on current state being expansion				
Coupon	0.9363	0.9363	0.9363	0.9363
Default boundary	0.1901	0.1901	0.1901	0.1901
Equity risk premium (%)	0.80	0.26	0.48	0.00
Credit spread (bps)	123.74	90.48	111.28	76.53
Equity value (normalized)	100.0	155.45	123.14	200.47
Debt value (normalized)	100.0	105.53	102.34	108.47
Leverage (%)	37.79	29.20	33.55	24.74
Default probability - 5y (%)	0.14	0.14	0.14	0.14

Table 10 : **Contribution of each type of systematic risk - Time-varying volatility.**
This table reports theoretical predictions for the full model, the price of risk associated to the long- and the short-run risk (Columns 2 and 3) and finally the quantity of risk (Column 5). The coupon and default boundaries are those of the full model so as to keep the same economy, that of the full model, in all three cases. The results are reported for the case when financing occurred in expansion. Panel A contains the predictions for the case when the economy is currently in recession and Panel B in expansion. Unless otherwise specified, I use the parameters of the baseline calibration (see Table 1).

		Price of the			
	Full model	LRR	SRR	Total price of risk	Total quantity of risk
	Panel A: *Conditional on current state being recession*				
Equity risk premium					
In percentage	4.45	3.387	1.064	4.45	0.00
% of the total ERP		76.09	23.91		
Credit spreads					
In bps	151.66	41.15	17.31	58.46	93.19
% of the price of risk		70.38	29.62		
% of the total CS		27.13	11.42	38.55	61.45
	Panel B: *Conditional on current state being expansion*				
Equity risk premium					
In percentage	0.80	0.54	0.26	0.80	0.00
% of the ERP		67.62	32.38		
Credit spreads					
In bps	123.74	33.26	13.95	47.21	76.53
% of the price of risk		70.45	29.55		
% of the total CS		26.88	11.27	38.15	61.85

Table 11 : **Impact of the time-varying volatility in risk premia.**
This table reports theoretical predictions for the full model, the price of risk associated to the long- and the short-run risk (Columns 2 and 3) and finally the quantity of risk (Column 5). The coupon and default boundaries are those of the full model so as to keep the same economy, that of the full model, in all three cases. The results are reported for the case when financing occurred in expansion. Panel A contains the predictions for the case when the economy is currently in recession and Panel B in expansion. Unless otherwise specified, I use the parameters of the baseline calibration (see Table 1).

	In recession		In expansion	
	Total	LRR impact	Total	LRR impact
Equity risk premium	%	Proportion	%	Proportion
T-V growth and volatility	4.45	76.1%	0.80	67.6%
T-V growth only	3.59	89.9%	0.88	60.6%
Credit spreads premium	bps	Proportion	%	Proportion
T-V growth and volatility	58.46	70.4%	47.21	70.5%
T-V growth only	49.64	69.1%	41.51	68.4%

Appendix

I present the main point of the model which is a static version of the model of Bhamra, Kuehn, and Strebulaev (2010a, b). The model uses a state-dependent approach to derive endogenously each state optimum coupon and default boundaries which in turn are used to compute the firms claims, i.e. equity and debt. The Arrow-Debreu default claims which measure the present value of the jump in the state-price density from one state to another allow to introduce the state-dependency in the pricing.

A Consumption and cash-flows dynamics

The economy is populated by the N firms and a representative agent. Firm cash-flows vary with continuous shocks and time-varying macroeconomic conditions. All variables are in real terms.

A.1 Consumption

Let C_t denote the perpetual stream of consumption in the economy. The output level follows the process

$$\frac{dC_t}{C_t} = \theta_{s_t} dt + \sigma_{s_t} dB_t, \quad s_t = \{R, E\}, \tag{11}$$

where θ_{s_t} and σ_{s_t} are the drift and volatility of output, and B_t is a standard Brownian motion under the physical measure.

This economy is characterized by the long-run risk, which creates variation in the business cycle. I assume that the economy is governed by two states such that the first and second moments of output growth, θ_{s_t} and σ_{s_t}, are state-dependent. The state of the economy at time t is determined by s_t, which is equal to R in recession and to E in expansion. The first moment is procyclical, while the second one is countercyclical such that $\theta_E > \theta_R$ and $\sigma_E < \sigma_R$. The evolution of s_t is given by a 2-state Markov chain. All agents can observe the current state of the economy.

A.2 Firm cash-flows

The firm i has a stream of cash-flows, denoted by $X_{i,t}$, which is given by

$$\frac{dX_{i,t}}{X_{i,t}} = \mu_{i,s_t} dt + \sigma_i^{id} dB_{i,t}^{id} + \sigma_{i,s_t}^{s} dB_t, \quad s_t = \{R, E\}, \tag{12}$$

where μ_{i,s_t} is the conditional growth rate of the firm i's cash-flows, while σ_i^{id} and σ_i^g capture respectively the idiosyncratic and systematic volatility of the firm i's earning growth rate. The standard Brownian motion $B_{i,t}^{id}$ is the shock specific to firm i, which is uncorrelated to the shock to consumption B_t. The firm i's total earning volatility is equal $\sigma_{X_i,s_t} = \sqrt{\left(\sigma_i^{id}\right)^2 + \left(\sigma_{i,s_t}^g\right)^2}$. The procyclical nature of economic growth implies that $\mu_{i,E} > \mu_{i,R}$.

The firms' cash-flows depend on the macroeconomic environment in two ways. First, all firms share common shocks coming from the country level economic conditions. As consequence, firm cash-flows shocks are correlated with the shocks to the aggregate consumption, so that: $dB_t dB_{C,t} = \rho dt$, where ρ is the constant coefficient of correlation between cash-flows and consumption. Second, the firms cash-flows follow the business cycle, which is determined by the state s_t.

B State-price density and equilibrium risk-free rate

In this section, I provide the formula of the state-price density and the equilibrium risk-free rate.[17] The state-price density is initially derived by Duffie and Skiadas (1994) for the general class of stochastic differential utility function proposed by Duffie and Epstein (1992). This type of utility function incorporates not only the agent's risk aversion but also the aversion for intertemporal resolution of the uncertainty in the economy.

The representative agent's state-price density π_t, in the case $\psi \neq 1$, is given by

$$\pi_t = \left(\beta e^{-\beta t}\right)^{\frac{1-\gamma}{1-\frac{1}{\psi}}} C_t^{-\gamma} \left(p_{C,s_t} e^{\int_0^t p_{C,s_u}^{-1} du}\right)^{-\frac{\gamma-\frac{1}{\psi}}{1-\frac{1}{\psi}}}, \tag{13}$$

[17] For additional details and complete derivation, I refer the reader to the Appendix of Bhamra, Kuehn, and Strebulaev (2010b) in the case of two states, and to the Appendix of Chen (2010) for N states.

where p_{C,s_t} is the price-consumption ratio that satisfies the following implicit non-linear equation:

$$p_{C,s_t}^{-1} = \overline{r}_{s_t} - \theta_{s_t} + \gamma\sigma_{s_t}^2 - \left(1 - \frac{1}{\psi}\right)\lambda_{s_t}\left(\frac{\left(\frac{p_{C,\bar{s}_t}}{p_{C,s_t}}\right)^{\frac{1-\gamma}{1-\frac{1}{\psi}}} - 1}{1-\gamma}\right), \; s_t, \bar{s}_t \in \{R, E\}, \bar{s}_t \neq s_t \tag{14}$$

with

$$\overline{r}_{s_t} = \beta + \frac{1}{\psi}\theta_{s_t} - \frac{1}{2}\gamma\left(1 + \frac{1}{\psi}\right)\sigma_{s_t}^2. \tag{15}$$

The dynamics of the state-price density π_t follow the following stochastic differential equation

$$\frac{d\pi_t}{\pi_t} = -r_{s_t}dt + \frac{dM_t}{M_t} \tag{16}$$

$$= -r_{s_t}dt - \Theta_{s_t}^B dB_t + \Theta_{s_t}^P dN_{s_t,t}, \tag{17}$$

where M is a martingale under the physical measure, $N_{s_t,t}$ a Poisson process which jumps upward by one whenever the state of the economy switches from s_t to $\overline{s_t} \neq s_t$, $\Theta_{s_t}^B = \gamma\sigma_{s_t}^2$ is the market price of risk due to Brownian shocks in state s_t, and $\Theta_{s_t}^P = \Delta_{s_t} - 1$ is the market price of risk due to Poisson shocks when the economy switches out of state $s_t = \{R, E\}$.

Finally, r_{s_t} represents the equilibrium real risk-free rate, which is given by

$$r_{s_t} = \begin{cases} \overline{r}_L + \lambda_L\left[\frac{\gamma-\frac{1}{\psi}}{1-\gamma}\left(\Delta^{-\frac{\gamma-1}{\gamma-\frac{1}{\psi}}} - 1\right) - (\Delta^{-1} - 1)\right] & , \; s_t = R \\ \overline{r}_H + \lambda_H\left[\frac{\gamma-\frac{1}{\psi}}{1-\gamma}\left(\Delta^{\frac{\gamma-1}{\gamma-\frac{1}{\psi}}} - 1\right) - (\Delta - 1)\right] & , \; s_t = E \end{cases} \tag{18}$$

with $\Delta_H = \Delta_L^{-1} = \Delta$, where Δ is the solution of $G(\Delta) = 0$ from

$$G(x) = x^{-\frac{1-\frac{1}{\psi}}{\gamma-\frac{1}{\psi}}} - \frac{\overline{r}_H + \gamma\sigma_H^2 - \theta_H + \lambda_H\frac{1-\frac{1}{\psi}}{\gamma-1}\left(x^{\frac{\gamma-1}{\gamma-\frac{1}{\psi}}} - 1\right)}{\overline{r}_L + \gamma\sigma_L^2 - \theta_L + \lambda_L\frac{1-\frac{1}{\psi}}{\gamma-1}\left(x^{-\frac{\gamma-1}{\gamma-\frac{1}{\psi}}} - 1\right)}, \quad \psi \neq 1 \tag{19}$$

The agent has preference for earlier resolution of uncertainty in the case when $\gamma > \frac{1}{\psi}$ and thus cares about the rate of news arrival, denoted by p. When p is small, the speed at which information arrives is low, thereby increasing the risk of the intertemporal substitution for an agent averse to such risk. The rate at which the distribution for the state of the economy converges to its steady state is given by $p = \lambda_R + \lambda_E$, where λ_{s_t} is the probability per unit of time of leaving state s_t. The quantity $1/\lambda_{s_t}$ is the expected duration of state s_t. Recessions are shorter than expansions, such that $1/\lambda_R < 1/\lambda_E$.

The physical probabilities λ_R and λ_E are converted to their risk-neutral counterparts $\hat{\lambda}_R$ and $\hat{\lambda}_E$ through a risk distortion factor Δ_E, which is defined as the change in the state-price density π_t at the transition time from expansion to recession. The risk-neutral probabilities per unit of time of changing state are then given by

$$\hat{\lambda}_E = \Delta_E \lambda_E \quad \text{and} \quad \hat{\lambda}_R = \frac{1}{\Delta_E} \lambda_R. \tag{20}$$

The agent prefers earlier resolution of the uncertainty, which implies that $\Delta_E > 1$. Hence, this agent prices securities as if recessions last longer ($\lambda_R > \hat{\lambda}_R$) and expansions shorter ($\lambda_E < \hat{\lambda}_E$) than in reality. The risk-neutral rate of news arrival is $\hat{p} = \hat{\lambda}_R + \hat{\lambda}_E$, which implies that the long-run risk-neutral distribution is determined by $\left(\hat{f}_R, \hat{f}_E\right) = \left(\frac{\hat{\lambda}_E}{\hat{p}}, \frac{\hat{\lambda}_R}{\hat{p}}\right)$.

The equilibrium risk-free rate prevailing in equilibrium in state s_t is given by (see Appendix A)

$$r_{s_t} \quad = \quad \overline{r}_{s_t} - \left(\frac{\gamma - \frac{1}{\psi}}{\gamma - 1}\right) \lambda_{s_t} \left(1 - \Delta_{s_t}^{\frac{\gamma-1}{\gamma-\frac{1}{\psi}}}\right) + \lambda_{s_t} \left(1 - \Delta_{s_t}\right), \quad \psi \neq 1, \; s_t = \{R, E\}, \tag{21}$$

where

$$\overline{r}_{s_t} \quad = \quad \beta + \frac{1}{\psi} \theta_{s_t} - \frac{1}{2} \gamma \left(1 + \frac{1}{\psi}\right) \sigma_{s_t}^2. \tag{22}$$

Higher uncertainty ($\sigma_E < \sigma_R$) and lower economic growth ($\theta_E > \theta_R$) in recession induce greater demand for the risk-free bond, thereby reducing the equilibrium interest rate ($r_E > r_R$). The risk-free interest rate is therefore procyclical.

C Arrow-Debreu default claims

This Appendix derives two kinds of Arrow-Debreu claims that are used to discount cash flows. The first kind captures the default triggered by the firm's earning falling below the default boundary, whereas the second kind additionally accounts for the default related to a change in the state of the economy. In the second case, default can occur instantaneously because of a change in state although the firm's earning remains unchanged. This situation can occur when the economy is in good economic state ($s_t = E$) and switches to the bad state ($s_D = R$), and the firm's earning is above the good state's default boundary, but below the bad state's default boundary. The reason is that the default boundary is countercyclical ($X_{D,R} > X_{D,E}$), as shown in Bhamra, Kuehn, and Strebulaev (2010a, p.4238). The first kind of the Arrow-Debreu claims is defined as

$$q_{s_t s_D} = E_t \left[\frac{\pi_{t_D}}{\pi_t} Prob\left(s_D \mid s_t\right) \mid s_t \right], \tag{23}$$

while the second kind corresponds to

$$q'_{s_t s_D} = E_t \left[\frac{\pi_{t_D}}{\pi_t} \frac{X_{t_D}}{X_{s_t}} Prob\left(s_D \mid s_t\right) \mid s_t \right]. \tag{24}$$

C.1 First kind

The Arrow-Debreu default security $q_{s_t s_D}$ is the present time t value of a security that pays one unit of consumption at the moment of default t_D, where s_t represents the present state of the economy, and s_D the state at the default time. The time of default is the first time that the earning level of the firm falls to the boundary X_{D,s_D}. By definition, this Arrow-Debreu claim is given by

$$q_{s_t s_D} = E_t \left[\frac{\pi_{t_D}}{\pi_t} Prob\left(s_D \mid s_t\right) \mid s_t \right], \tag{25}$$

which is solution of the two ordinary differential equations (ODE)

$$\frac{1}{2}\sigma_{i,s_t}^2 X^2 \frac{d^2 q_{s_t s_D}}{dX^2} + \mu_{s_t} X \frac{dq_{D,s_t s_D}}{dX} \quad + \hat{\lambda}_{s_t}\left(q_{j s_D} - q_{s_t s_D}\right) - r_{s_t} q_{s_t s_D} \quad = 0,\ s_t = \{R, E\}, \tag{26}$$

where σ_{i,s_t} denotes the firm's earning growth volatility in state s_t.

The above ODEs are obtained by applying Ito's Lemma to the classical non-arbitrage condition

$$E_t^Q \left[dq_{s_t s_D} - r_{s_t} q_{s_t s_D} \right] \;=\; 0, \tag{27}$$

The Arrow-Debreu claim payoffs are such that:

$$q_{s_t s_D}(X) = \begin{cases} 1, & s_t = s_D, \quad X \leq X_{D,s_t} \\ 0, & s_t \neq s_D, \quad X \leq X_{D,s_t}. \end{cases}, \; s_t, s_D = \{R, E\} \tag{28}$$

Therefore, each state of the economy is characterized by a specific default boundary. The default barriers are higher in recession and lower in expansion, that is $X_{D,E} \leq X_{D,R}$. Each of the four Arrow-Debreu claims is then determined over three separate intervals: $X \geq X_{D,R}$, $X_{D,R} \geq X \geq X_{D,E}$, and $X \leq X_{D,E}$.

From the payoff equations, I can infer the values of the four Arrow-Debreu claims in the interval $X \leq X_{D,E}$. For the interval $X \geq X_{D,R}$, I are looking for a solution of the following general form:

$$q_{s_t s_D}(X) = h_{s_t s_D} X^k, \tag{29}$$

which implies that k must be a root of the quartic equation

$$\left[\frac{1}{2}\sigma_{i,E}^2 k(k-1) + \mu_R k + \left(-\hat{\lambda}_R - r_R\right)\right]\left[\frac{1}{2}\sigma_{i,E}^2 k(k-1) + \mu_E k + \left(-\hat{\lambda}_E - r_E\right)\right] - \hat{\lambda}_R \hat{\lambda}_E = 0. \tag{30}$$

The Arrow-debreu claims can be written as

$$q_{s_t s_D}(X) = \sum_{m=1}^{4} h_{s_t s_D m} X^{k_m} \tag{31}$$

with $k_1, k_2 < 0$ and $k_3, k_4 > 0$. However, when Y goes to infinity the Arrow-Debreu claims must be null, which indicates that I should have $h_{s_t s_D,3} = h_{s_t s_D,4} = 0$. I then obtain

$$q_{Rs_D}(Y) = \sum_{m=1}^{2} h_{Rs_D,m} X^{k_m} \tag{32}$$

$$q_{Es_D}(Y) = \sum_{m=1}^{2} h_{Es_D,m} \varepsilon(k_m) X^{k_m}, \tag{33}$$

where

$$\varepsilon(k_m) = -\frac{\hat{\lambda}_H}{\frac{1}{2}\sigma_{i,H}^2 k(k-1) + \mu_E k - \left(\hat{\lambda}_E + r_E\right)} = -\frac{\frac{1}{2}\sigma_{i,R}^2 k(k-1) + \mu_R k - \left(\hat{\lambda}_R + r_R\right)}{\hat{\lambda}_R}. \tag{34}$$

Finally, over the interval $X_{D,R} \geq X \geq X_{D,E}$, both $q_{D,RR}$ and $q_{D,RE}$ are known from the payoffs equations and are respectively equal to 1 and 0. Then,

$$q_{ER}(X) = \frac{\hat{\lambda}_E}{r_E + \hat{\lambda}_E} + \sum_{m=1}^{2} s_{R,m} X^{j_m} \tag{35}$$

$$q_{EE}(X) = \sum_{m=1}^{2} s_{E,m} X^{j_m}, \tag{36}$$

where

$$\frac{1}{2}\sigma_{i,E}^2 j(j-1) + \mu_R j - \left(\hat{\lambda}_E + r_E\right) = 0 \tag{37}$$

with $j_1 < j_2$.

To summarize, the four Arrow-Debreu claims can be written as follows

$$q_{RR} = \begin{cases} \sum_{m=1}^{2} h_{RR,m} X^{k_m}, & X \geq X_{D,R} \\ 1, & X_{D,R} \geq X \geq X_{D,E} \\ 1, & X \leq X_{D,E} \end{cases} \tag{38}$$

$$q_{RE} = \begin{cases} \sum_{m=1}^{2} h_{RE,m} X^{k_m}, & X \geq X_{D,E} \\ 0, & X_{D,R} \geq X \geq X_{D,E} \\ 0, & X \leq X_{D,E} \end{cases} \tag{39}$$

$$q_{ER} = \begin{cases} \sum_{m=1}^{2} h_{RR,m} \varepsilon\left(k_m\right) X^{k_m}, & X \geq X_{D,R} \\ \frac{\hat{\lambda}_E}{r_E+\hat{\lambda}_E} + \sum_{m=1}^{2} s_{R,m} X^{j_m}, & X_{D,R} \geq X \geq X_{D,E} \\ 0, & X \leq X_{D,E} \end{cases} \tag{40}$$

$$q_{EE} = \begin{cases} \sum_{m=1}^{2} h_{RE,m} \varepsilon\left(k_m\right) X^{k_m}, & X \geq X_{D,R} \\ \sum_{m=1}^{2} s_{E,m} X^{j_m}, & X_{D,R} \geq X \geq X_{D,E} \\ 1, & X \leq X_{D,E}. \end{cases} \tag{41}$$

The eight constants are determined by eight boundary conditions, which are

$$\lim_{X \to X_{D,R}} q_{EE} = 1, \quad \lim_{X \to X_{D,R}} q_{RE} = 0 \tag{42}$$

$$\lim_{X \to X_{D,R}^{+}} q_{ER} = \lim_{X \to X_{D,R}^{-}} q_{ER}, \quad \lim_{X \to X_{D,R}^{+}} q_{EE} = \lim_{X \to X_{D,R}^{-}} q_{EE} \tag{43}$$

$$\lim_{X \to X_{D,R}^{+}} \dot{q}_{ER} = \lim_{X \to X_{D,R}^{-}} \dot{q}_{ER}, \quad \lim_{X \to X_{D,R}^{+}} \dot{q}_{EE} = \lim_{X \to X_{D,R}^{-}} \dot{q}_{EE} \tag{44}$$

$$\lim_{X \to X_{D,E}} q_{ER} = 0, \quad \lim_{X \to X_{D,E}} q_{EE} = 1. \tag{45}$$

C.2 Second kind

I use the same approach to derive the second kind of Arrow-Debreu default claims, which account for the possibility that a default can when the state of the economy changes. The only claim that is different from that of the first kind is q_{HL}, whose expression is now given by

$$q_{ER}^{'} = \begin{cases} \sum_{m=1}^{2} h_{RR,m} \varepsilon\left(k_m\right) X^{k_m}, & X \geq X_{D,R} \\ \frac{\hat{\lambda}_E}{r_E + \hat{\lambda}_E - \mu_E} \frac{X}{X_{D,R}} + \sum_{m=1}^{2} s_{R,m} X^{j_m}, & X_{D,R} \geq X \geq X_{D,E} \\ 0, & X \leq X_{D,E}. \end{cases} \tag{46}$$

D Corporate debt

The present debt value, D_{s_t}, is the discounted perpetual coupon stream before default s plus the present value of the after-tax firm recovered asset value at default. Hence, the debt value is:

$$\begin{aligned} D_{s_t} &= E_t\left[\int_t^{t_D} c\frac{\pi_u}{\pi_t} du \mid s_t\right] + E_t\left[\frac{\pi_u}{\pi_t}\phi_{t_D} A_{t_D} du \mid s_t\right] && (47) \\ &= \frac{c}{r_{B,s_t}} - \sum_{s_D}\left(\frac{c}{r_{B,s_D}} - \phi_{t_D} A_{t_D}\right) q_{s_t s_D}, \quad s_t, s_D = \{R, E\} && (48) \end{aligned}$$

where ϕ_{s_t} is the state-dependent asset recovery rate, $A_{s_t} = (1-\tau)\frac{X}{r_{A,s_t}}$ is the firm asset liquidation value, $r_{B,s_t} = r_{s_t} + \frac{r_j - r_{s_t}}{\hat{p} + r_j}\hat{p}\hat{f}_j, \quad j \neq s_t$ is the bond discount rate and $r_{A,s_t} = r_{s_t} - \hat{\mu}_{s_t} + \frac{(r_j - \hat{\mu}_j) - \left(r_{s_t} - \hat{\mu}_{s_t}\right)}{\hat{p} + r_j - \hat{\mu}_j}\hat{p}\hat{f}_j, \quad j \neq s_t$, is the risky discount rate with $\hat{\mu}_{s_t} = \mu_{s_t} - \gamma\rho\sigma_{s_t}^{g}\sigma_{s_t}$.

E Equity value

The equity value, S_{s_t}, is the after-tax discounted value of future cash-flows (i.e. EBIT) less coupon payments before bankruptcy is declared by the stockholders

$$S_{s_t} = (1-\tau) E_t\left[\int_t^{t_D} \frac{\pi_u}{\pi_t}\left(X_t - c\right) du \mid s_t\right], \quad s_t = \{R, E\},$$

hence

$$S_{s_t} \;=\; A_{t_D} - (1-\tau)\frac{c}{r_{B,s_t}} - \sum_{s_D}\left((1-\tau)\frac{c}{r_{B,s_D}} - A_{t_D}\right) q_{s_t s_D}, \quad s_t, s_D = \{R, E\} \qquad (49)$$

where A_{t_D} is the asset recovery rate at the time the shareholders decide to declare bankruptcy (see section D).

F Estimation of the transition probabilities

This section describes the estimation of the transition probabilities considered in the paper. I estimate a Markov regime-switching model with two regimes using the NBER recession dates over the period 1952Q1-2015Q4. The transition probability matrix, is obtained by maximum likelihood using the Hamilton (1989)'s approach. There are some issues with the estimation when using consumption date between of the period spanning the 2007-09 financial crisis. This originates from the fact that the consumption growth slowdown was so pronounced during this period that it is recognized as representing by itself one more regime. To overcome that, I have replaced the consumption data by the NBER dates and put 1 or 0 when the economy is respectively in recession or in expansion. The estimation gives the following transition matrix:

$$T = \begin{bmatrix} T_{RR} & T_{RE} \\ T_{ER} & T_{EE} \end{bmatrix} = T = \begin{bmatrix} 0.9603 & 0.2275 \\ 0.0397 & 0.7725 \end{bmatrix} \qquad (50)$$

where T_{ij} denotes the probability of a switch from state i to state j.

The actual long-run probability f_{s_t} to be in the state $s_t \in \{R, E\}$ is determined by $f_R = \left(1 + \frac{T_{RE}}{T_{ER}}\right)^{-1}$ and $f_E = 1 - f_R$. The probability λ_{s_t} that the economy leaves the state $s_t \in \{R, E\}$ is then given by $\lambda_R = pf_E$ and $\lambda_E = pf_R$, with $p = -4ln\left(1 - \frac{T_{RE}}{1-f_R}\right)$.