An EZ way to evaluate assets

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Introduction

A consumer's attitude towards risk has been a central topic in financial economics and particularly on asset pricing.

Notable long-standing asset pricing anomalies include

- Equity Premium Puzzle (Mehra and Prescott, 1985)
- Risk Free Rate Puzzle (Weil, 1989)

Financial theory calibrates an equity premium too low (close to 0.25%) in contrast with empirical findings (around 6-7%) and a risk-free rate too high (more than 4%) in contrast with empirical findings (less than 1%)

Literature

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Epstein-Zin Preferences

- Simple power utility C-CAPM fails to explain asset pricing anomalies.
- Source of criticism: Link between risk aversion with EIS.
- Revision: Separation of risk aversion from time aversion.
- Notable work: Kreps and Porteus (1978), Epstein and Zin (1989, 1991), Bansal and Yaron (2004).

Inequality in Income or Wealth

- Increasing inequality in the US: Atkinson et al. (2011), Piketty and Saez (2014).
- Connection with asset prices; mixed findings in terms of relationship of inequality-equity premium.
- Dumas (1989), Favilukis (2013), Garleanu and Panageas (2015), Toda and Walsh (2020): negative relationship.
- Constantinides and Duffie (1996), Brogaard et al. (2015), Christou et al. (2021): positive relationship.
- Gollier (2001): Inequality has a positive (negative) impact on the equity risk premium if the risk tolerance is concave (convex).

Research Question

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We investigate how the disentanglement of EIS from risk aversion affects the relationship of inequality with the equity premium in an economy with a background risk.

- Sources of background risk in literature:

- Human capital (Bodie, Merton and Samuelson, 1992; Koo, 1995; Viceira, 2001; Cocco et al., 2005; Fagereng et al. (2018).
- Housing wealth (Cocco, 2005; Flavin and Yamashita, 2002; Yao and Zhang, 2005)
- Private business wealth (Heaton and Lucas; 2000a, 2000b).
- Fagereng et al. (2018): human capital as source of the background risk is important regarding portfolio heterogeneity; as it is large for the poor and negligible for the wealthy.

- Why not examining a complete market setting? → Inequality does not affect asset pricing in complete markets (when agents exhibit HARA preferences)!

Methodology

- Simple Arrow-Debreu exchange economy.
- Single perishable good.
- vNM utility u, ($u' > 0$) and ($u'' < 0$).
- Agents live for two periods, indexed by $t = 0$ and $t = 1$.
- At $t = 1$, S states of the world where $s = 1, \ldots s, \ldots S$ with probability ps of occurrence of state s.
- Large number of n identical agents in terms of their preferences, but heterogeneous in terms of initial endowment. Inequality is introduced through a mean preserving transfer of endowment.
- Each agent $i = 1, \ldots, n$ endowed with w_{i0} units of single perishable good at $t = 0$, and with a bundle of contingent claims (ω_{i1} , . . ., ω_{iS}).
- The average endowment can be written as $z_s = \sum_{i=1}^{n} \frac{1}{n} \omega_{is}$
- Let π_0 and π_s be the price to be paid at $t = 0$ for the delivery of 1 unit of good respectively at $t = 0$ and $t = 1$, conditional on state s.
- A non-hedgeable background risk $\tilde{y}$ is present. This risk is idiosyncratic in the population of consumers.

Investor's Problem

We adopt the formulation of Ahn et al. (2015):

$$V_i = max\left[(C_{i0} + \widetilde{y})^{\rho} + \beta\Big(\sum_{s=1}^{S} p_s(C_{is} + \widetilde{y})^{1-r}\Big)^{\frac{\rho}{1-r}}\right]^{\frac{1}{\rho}} \tag{1}$$

s.t.

$$\pi_0(C_{i0} - w_{i0}) + \sum_{s=1}^{S} \pi_s(C_{is} - w_{is}) = 0, \tag{2}$$

where r is the coefficient of relative risk aversion, $\rho = 1 - \frac{1}{1-\psi}$, and ψ is the elasticity of intertemporal substitution (EIS).

For $r > 1/\psi$ preference for early resolution of uncertainty

For $r < 1/\psi$ preference for late resolution of uncertainty

For $r = 1/\psi$ there is no preference for early or late resolution of uncertainty.

Optimization

The competitive equilibrium satisfies the following set of necessary and sufficient conditions:

$$\Omega^{\frac{1}{\rho}-1}(C_{i0}+\widetilde{y})^{\rho-1} = \lambda_i \pi_0, \;\; i = 1, \ldots n \tag{3}$$

$$\beta \frac{1-r}{\rho} \Omega^{\frac{1}{\rho}-1} \left[\frac{\rho}{1-r} \Phi \right]^{\frac{\rho}{1-r}-1} p_s (C_{is}+\widetilde{y})^{-r} = \lambda_i \pi_s, \;\; i = 1, \ldots n, \;\; s = 0, \ldots s, \ldots S \tag{4}$$

and

$$\sum_{i=1}^{n} \frac{1}{n} C_{is} = z_s \tag{5}$$

where

$$\Omega = \left[(C_{i0}+\widetilde{y})^{\rho} + \beta \left[\sum_{s=1}^{S} p_s (C_{is}+\widetilde{y})^{1-r} \right]^{\frac{\rho}{1-r}} \right]$$

and

$$\Phi = \sum_{s=1}^{S} p_s (C_{is}+\widetilde{y})^{1-r}$$

Asset Pricing

The relative price of a risky asset with respect to bonds is given by

$$\Pi = \frac{\sum_{s=1}^{S} \pi_s z_s}{\sum_{s=1}^{S} \pi_s}$$

The risk-free asset provides one unit of consumption good at $t = 1$ with probability 1. The price to be paid at $t = 0$ for that asset will be

$$\frac{1}{R} = \frac{\sum_{s=1}^{S} \pi_s}{\pi_0}$$

where R is the gross risk-free rate, z_0 is the current level of income per capita and z is the income per capita at the maturity of the gross risk-free rate.

Calibrations

Simple macroeconomy with two states of the world at $t = 1$.
The income per capita:

$$z = \begin{cases} 1, today\ with\ prob = 100\% \\ 0.99, future\ recession\ with\ prob = 62\% \\ 1.06, future\ growth\ with\ prob = 38\% \end{cases}$$

Inequality introduced with a mean preserving transfer of endowment.
Two equally weighted classes: poor and rich.
Each poor agent receives 50% of the average income and each rich agent receives 150% of the average income. Implies coefficient of variation $h = 0.5$

Parameter k is the standard deviation of the growth of labor income. We use a range of values between [0, 0.30].

Table 1: Baseline Parameterization

Parameters		**Values**
Probabilities		
p_1	Probability of realization of recession	62%
p_2	Probability of realization of growth	38%
Wealth Distribution		
h	Coefficient of variation of wealth	0, 0.5
Individual Preference		
β	Time discount factor	0.98
r	Coefficient of relative risk aversion	2
ψ	Elasticity of intertemporal substitution	0.1, 0.2, 0.5, 0.7, 1
Income per capita		
z_0	Average income at period 0	1
z_1	Average income at state 1	0.99
z_2	Average income at state 2	1.06
Background Risk		
k	Labor income risk	$[0, 0.30]$

Robustness Checks

Our qualitative results:

- Do not depend on the probability of the recession.
- Do not depend on the particular values assumed for the growth rate of the consumption per capita on each state.
- Do not depend on the choice of unequal wealth distribution.

Results of simulations for finer wealth classes (which yield similar results) are not reported for the sake of conciseness.

Results

Per Gollier's (2001) findings, when economic agents are indifferent to their temporal resolution of uncertainty, taking into account wealth inequality can cause only a marginal improvement in the equity premium, and only if the uninsurable income risk is low.

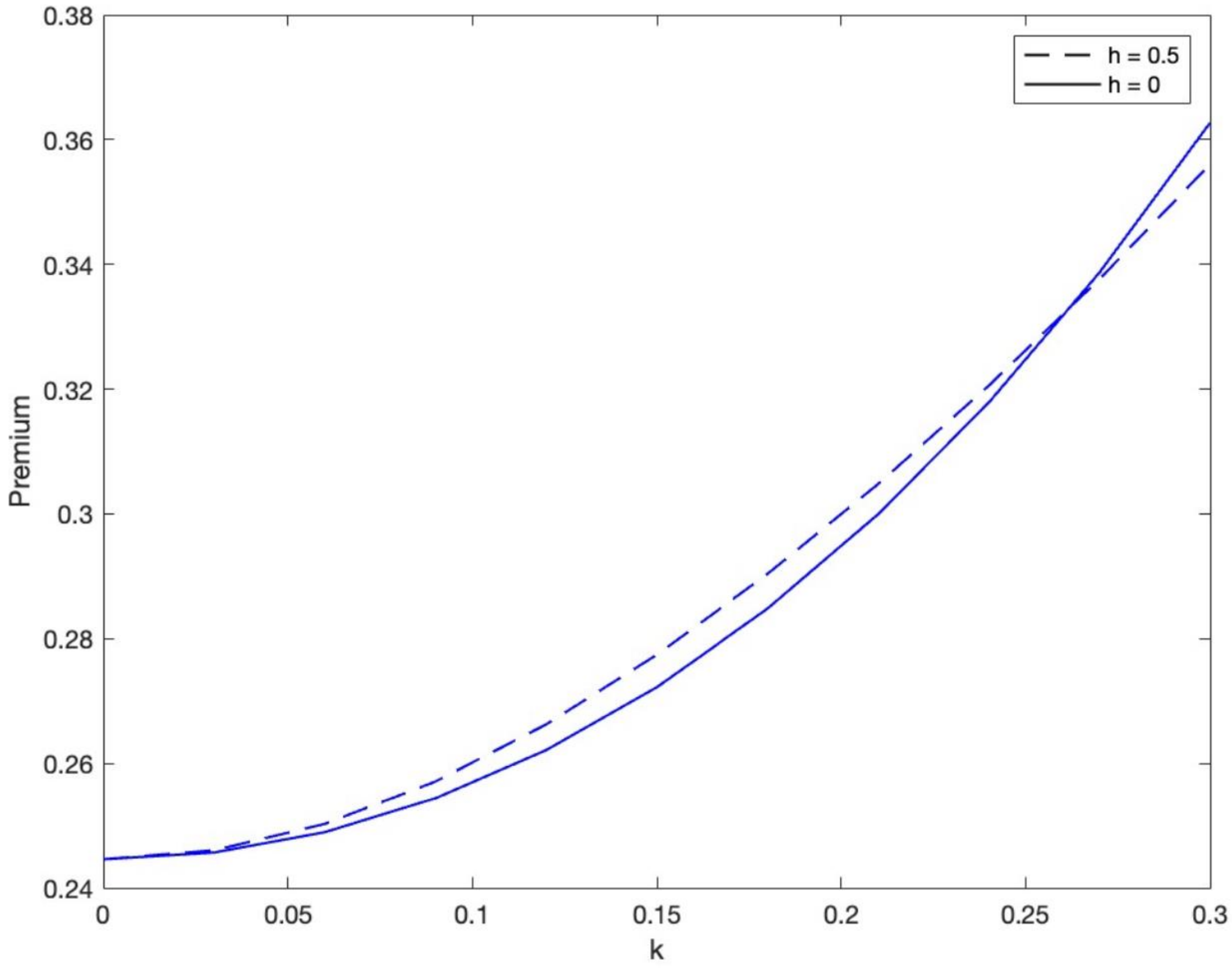

Figure 2: The equity premium (in % per year) as a function of the background risk. The economy consists of two equally weighted classes of wealth (poor and rich). The plain (dashed) lines are for the egalitarian (unequal) economy. For EIS, we have as follows: Blue: $\psi = 0.5$. Risk aversion is $r = 2$.

Results

For lower background risk, inequality produces a higher premium and for a higher level of background risk, inequality produces a lower premium.

As Figure 1 hints, for a large enough background risk, the premium reaches the historical level.

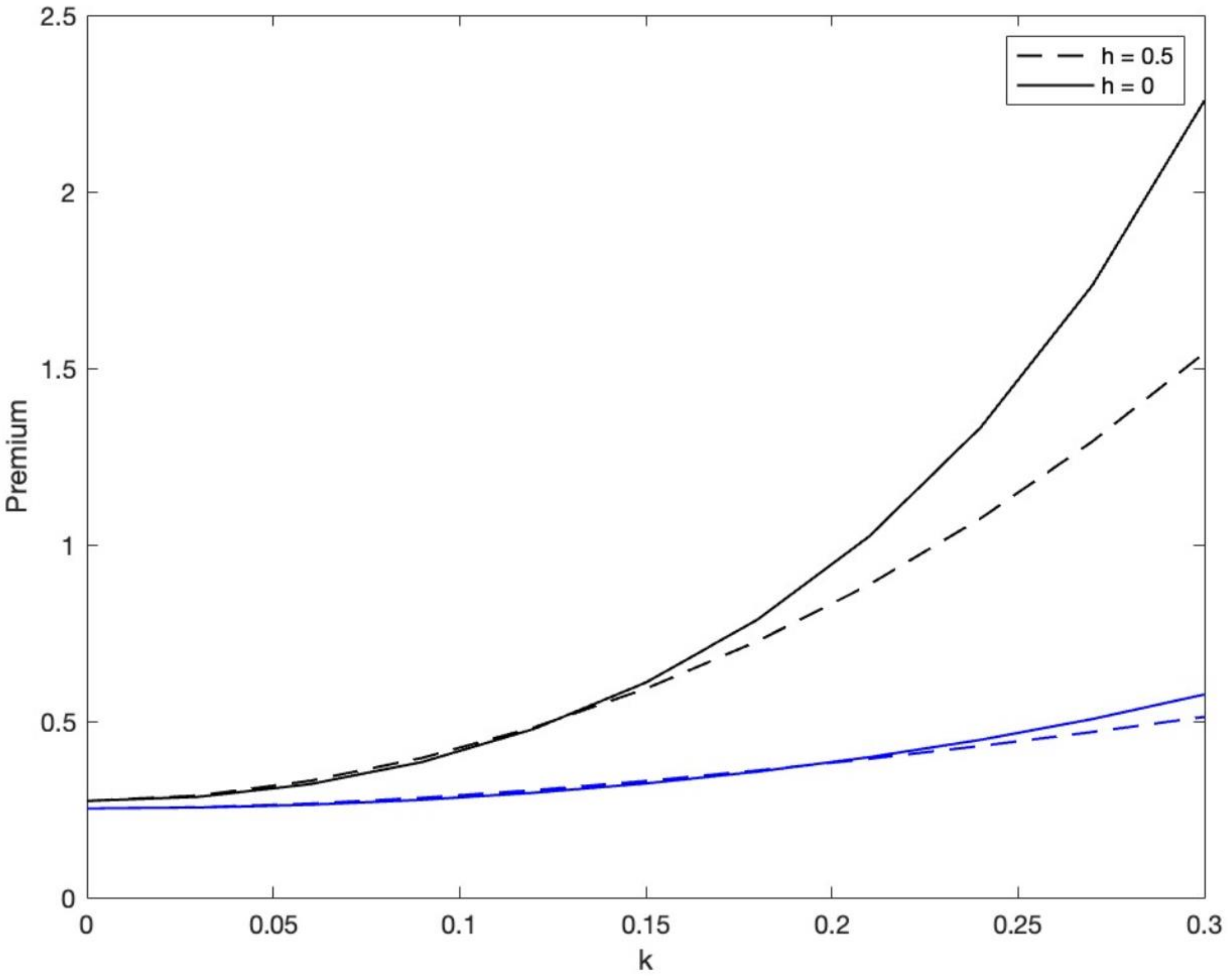

Figure 1: The equity premium (in % per year) as a function of the background risk. The economy consists of two equally weighted classes of wealth (poor and rich). The plain (dashed) lines are for the egalitarian (unequal) economy. For EIS, we have as follows: Black: $\psi = 0.1$, Blue: $\psi = 0.2$. Risk aversion is $r = 2$.

Results

Inequality raises the equity premium even for a large background risk.

Our results are consistent with theory: the lower the EIS, the higher the equity premium that is generated (Weil, 1989).

Our results also extend previous findings: the higher the EIS, the more likely that inequality will raise the premium in an economy with a large background risk.

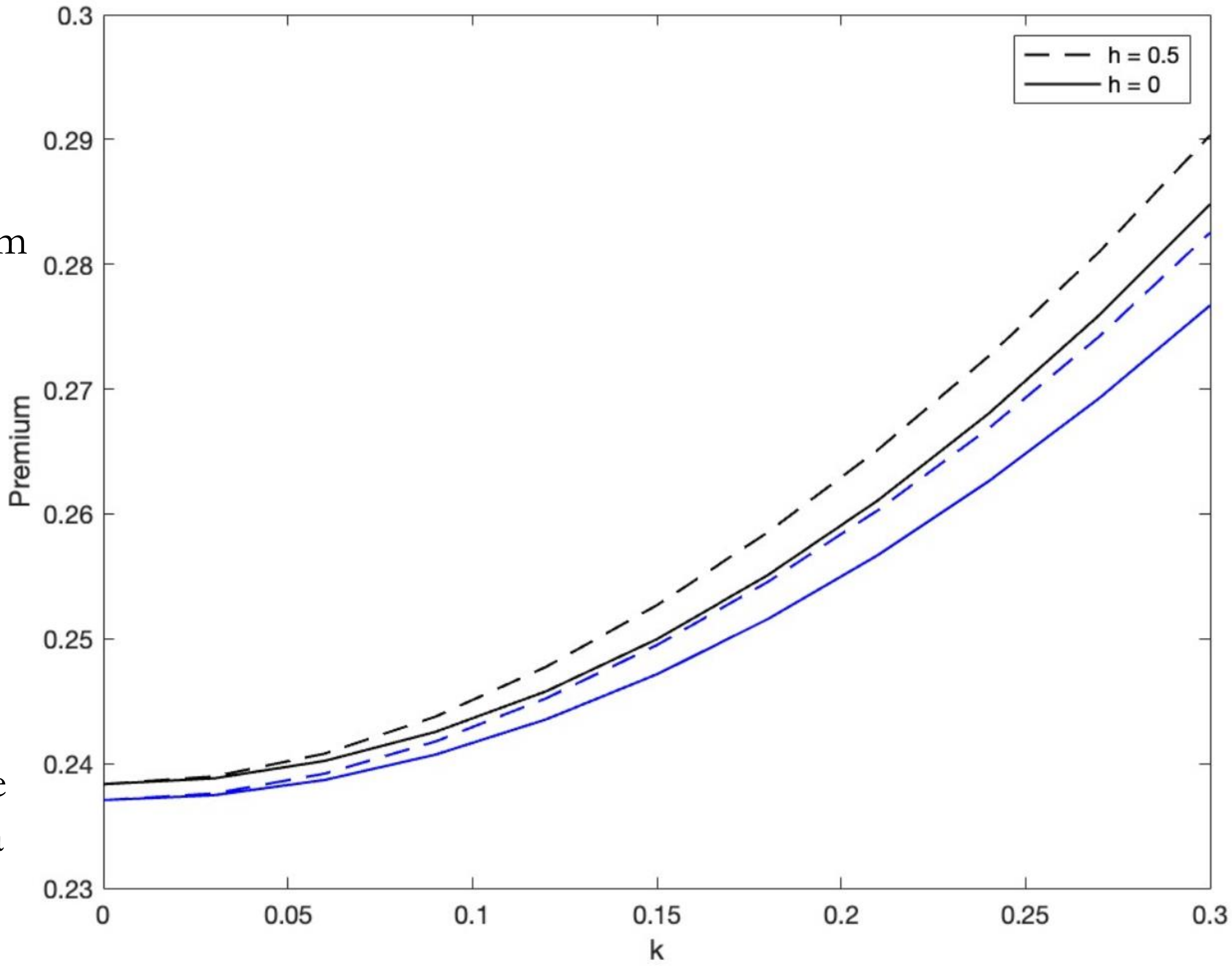

Figure 3: The equity premium (in % per year) as a function of the background risk. The economy consists of two equally weighted classes of wealth (poor and rich). The plain (dashed) lines are for the egalitarian (unequal) economy. For EIS, we have as follows: Black: $\psi = 0.7$, Blue: $\psi = 1$. Risk aversion is $r = 2$.

Intuitive explanation

Can be sought to two theoretical findings:

- The first theoretical finding refers to the concavity of the absolute risk tolerance of agents.
- The absolute risk tolerance of the wealthy is less adversely affected by background risk.
- For this to be true, the background risk has to be small, and the utility of the agents has to be HARA or hyperbolic absolute risk aversion utility (Gollier 2001), which nests CRRA utilities.
- The concavity of tolerance implies that inequality raises the premium.

- The second theoretical finding explains why inequality raises the premium even for large level of background risk.
- Specifically, when earlier resolution of uncertainty is expected, consumers reduce their precautionary savings, because risks that are realized earlier can be dispersed over more periods (Eeckhoudt et al. 2005).
- Therefore, earlier resolution of uncertainty time-diversifies the risk, implying a reduction of the background risk.

Concluding Remarks

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- Inequality can significantly affect the equity risk premium in our economy.
- When EZ agents have a preference for late resolution of uncertainty, inequality increases the premium for low background risk and decreases the premium for high background risk.
- When agents have a preference for early resolution of uncertainty, inequality increases the equity risk premium.

Our findings suggest that the shape of the absolute risk tolerance of the agents (concave or convex) is linked with the type of time preferences the agents exhibit.

➢ For inequality to increase the premium in an unequal economy, a concave absolute risk tolerance is required, which can be achieved through the presence of a low level of background risk.

➢ The reason that inequality increases the premium for agents that have a preference for early resolution of uncertainty, even for high levels of background risk is because, in this case, time-diversification of risk is allowed and plays a similar role with further reduction of the background risk.