Disasters, Recoveries, and Predictability

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2008

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- Gabaix [2007]: time-varying risk of disasters can explain many asset pricing puzzles.
- An alternative to leading asset pricing models?

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- Can the disaster model account for other facts beyond the equity premium puzzle?
    - time-series predictability of stock returns
    - cross-sectional predictability of expected returns

Outline

1. Review of the Barro-Rietz model
2. Recoveries in the Data and in the Model (*AER P&P*)
3. Time–Series Predictability (*FRL*)
4. Cross-Section Predictability (*WP*)

Barro-Rietz model

- Representative agent:

$$E \sum_{t=0}^{\infty} \beta^t \frac{C_t^{1-\gamma}}{1-\gamma}.$$

- Endowment Economy.
- Consumption = dividend process:

$$\begin{aligned} \Delta \log C_t &= \mu + \sigma \varepsilon_t, \text{ with probability } 1-p, \\ &= \mu + \sigma \varepsilon_t + \log(1-b), \text{ with probability } p, \\ & \varepsilon_t \text{ iid } N(0,1). \end{aligned}$$

Barro-Rietz: theoretical results

- Risk-free rate:

$$\log R_f = -\log\beta + \gamma\mu - \frac{\gamma^2\sigma^2}{2} - \log\left(1 - p + p(1-b)^{-\gamma}\right).$$

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$$\log\frac{ER^e}{R^f} = \sigma^2\gamma + \log\left(\frac{\left(1-p+p(1-b)^{-\gamma}\right)\left(1-p+p(1-b)\right)}{1-p+p(1-b)^{1-\gamma}}\right).$$

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- Constant P-D ratio.

Barro-Rietz: Calibration

Parameter	Meaning	Value
β	discount factor	0.97
μ	trend growth	0.025
σ	std dev of business cycle shocks	0.02
γ	risk aversion	4
p	probability of disaster	0.017
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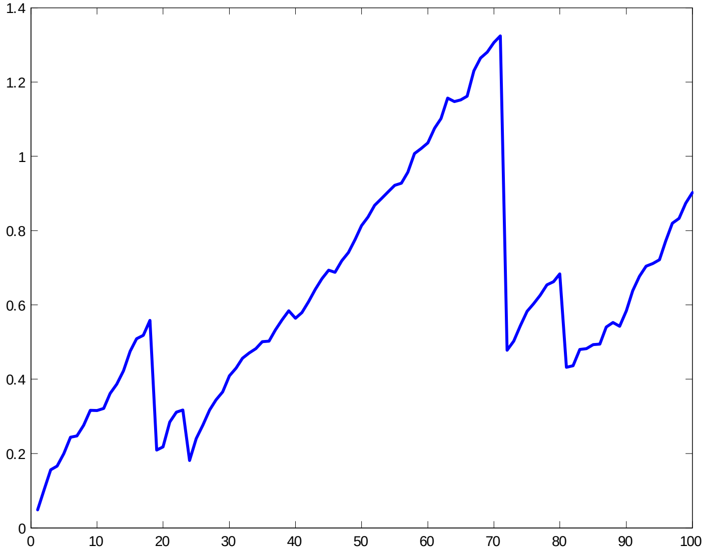
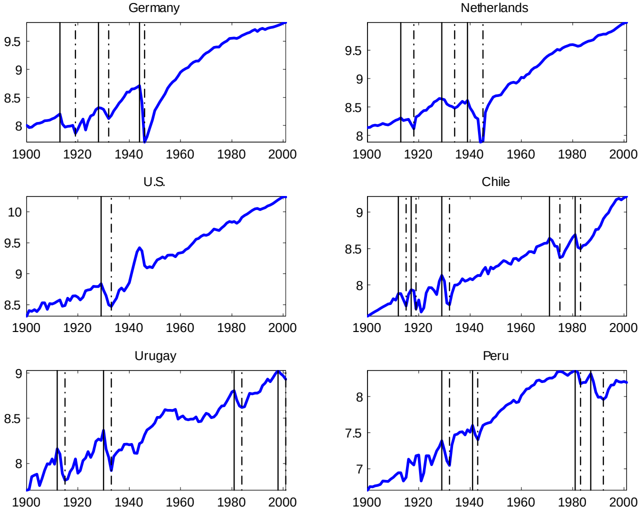
- **Results driven by large disasters: if keep only disasters $< 40\%$, EP $= 0.8\%$.**

Simulating a path of Log GDP in the Barro Model



Disasters in the Data



Measuring Recoveries

in %	All disasters		Disaster $\geq$ 25%	
	57 events		27 events	
Years after Trough	Growth from Trough	Loss from Peak	Growth from Trough	Loss from Peak
0	0.0	-29.8	0.0	-41.5
1	**11.1**	-22.8	**16.1**	-32.7
2	**20.9**	-16.8	**31.3**	-24.2
3	26.0	-13.7	38.6	-20.4
4	31.5	-10.2	45.5	-16.9
5	37.7	-6.1	52.2	-13.4

- The iid assumption is violated...

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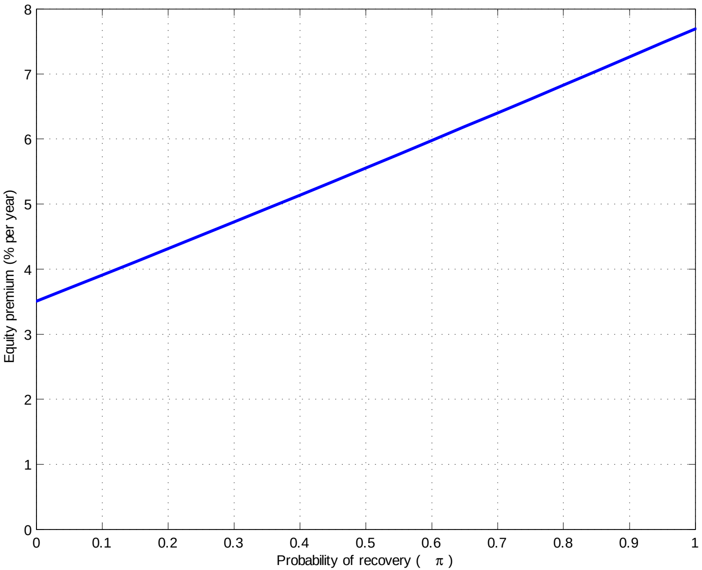
- $\pi = 0$: Barro-Rietz model.
- $\pi = 1$: Sure recovery.

Equity Premium with Recoveries



Explanation

- How does P/D ratio change if you expect a recovery?

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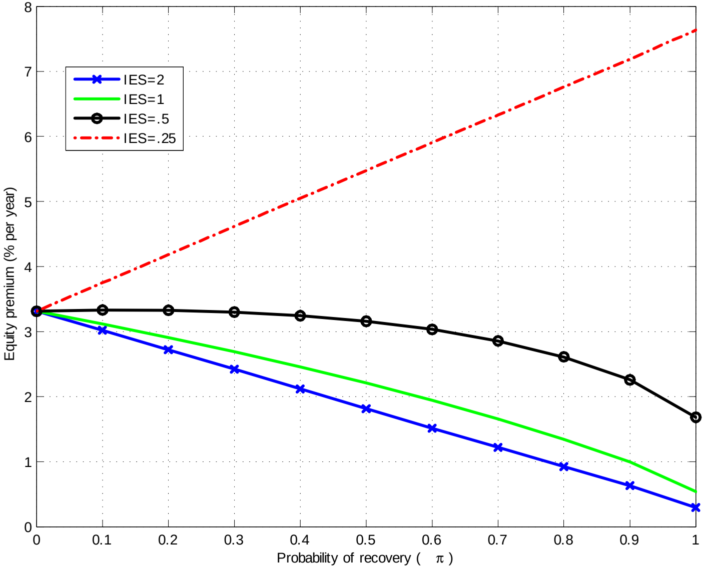
- With low IES, $\frac{P_t}{C_t}$ falls **more** following a disaster if there is a possible recovery.
- Ex-ante equities are **riskier**.

Effect of Recoveries with Epstein-Zin utility



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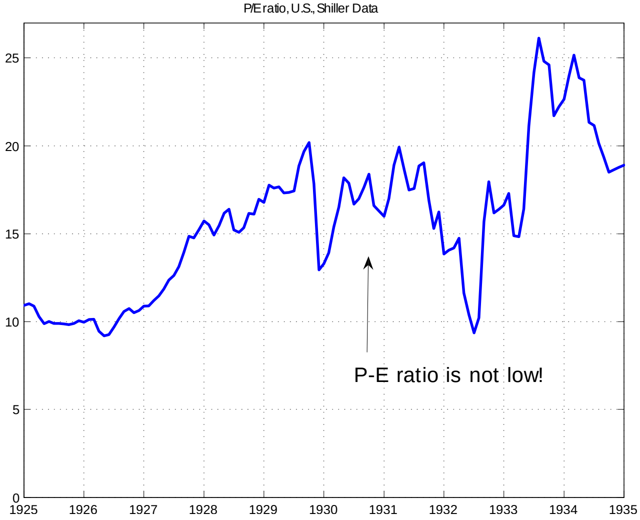
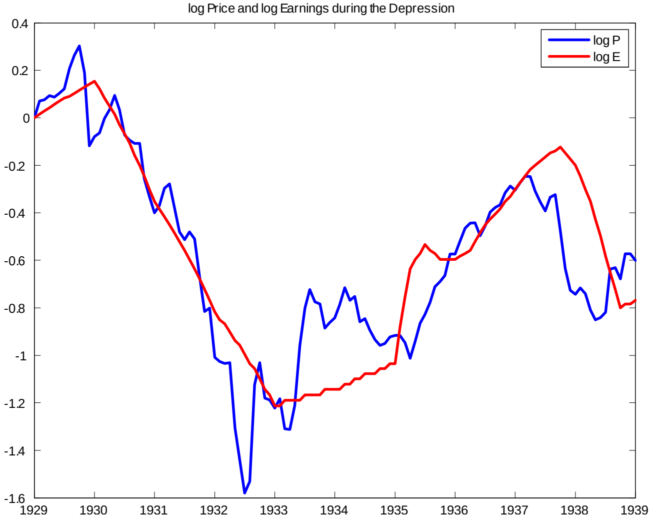
- Empirically: interest rate not so high, but P-D ratios fall (modestly).
- May need higher risk in disasters to fit these data.

P-E ratio not really low in the Great Depression



Prices and Earnings fell by similar amount



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- Is the disaster model consistent with these patterns?

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- Intuition: high p_t leads to more (precautionary) savings, low interest rates, and high equity risk premium.

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- "Interest rate too volatile in the model"

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- One resolution: size of dividend disaster change over time, but **not** size of consumption disaster:

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- Then, interest rates are constant and volatile risk premia.

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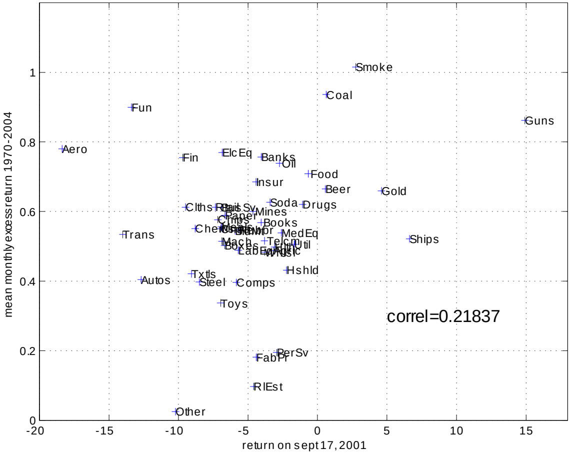
  2. Gabaix-style model: time-varying prob of disaster, and perhaps no disaster realized in sample.

- Use the return on 9/17 as a proxy for exposure to disaster:



9/11 as 'Natural Experiment'

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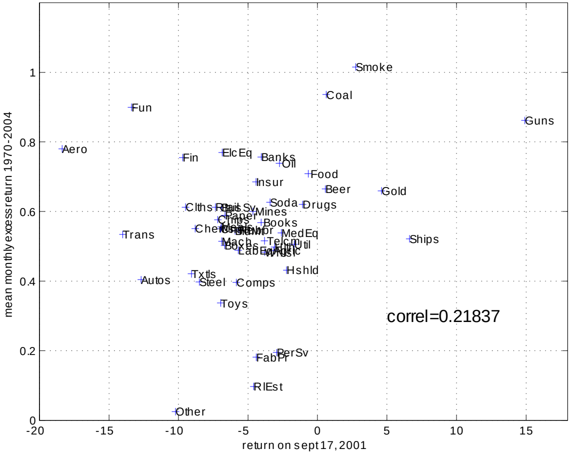
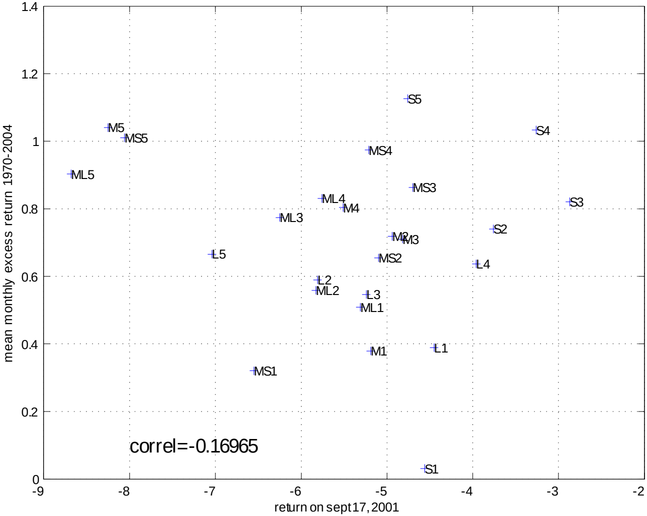


- Mean return of defense, gold, tobacco stocks is not low!

Fama-French 25 returns on 9-17 vs. mean excess returns



Data from 9-17-01

	$E(R)$	Return on 9-17
HML	0.40	**-0.93**
t-stat	3.47	
SMB	0.24	**0.24**
t-stat	2.19	
UMD	0.76	**2.72**
t-stat	5.01	
SV-SG	0.49	**-0.20**
t-stat	4.14	

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- Data: US, portfolios of stocks, 1926-2006.

Evaluating the "Disaster CAPM"

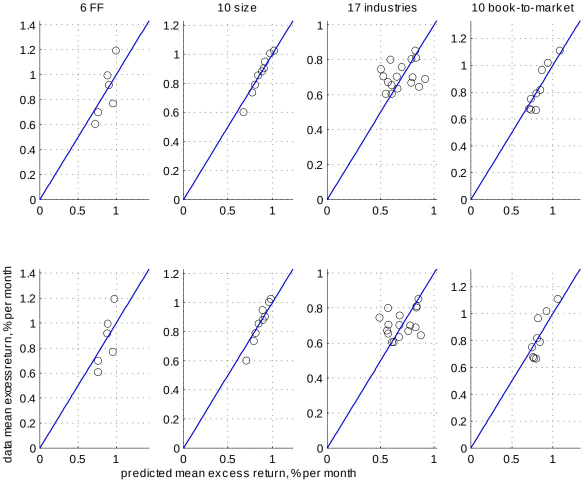
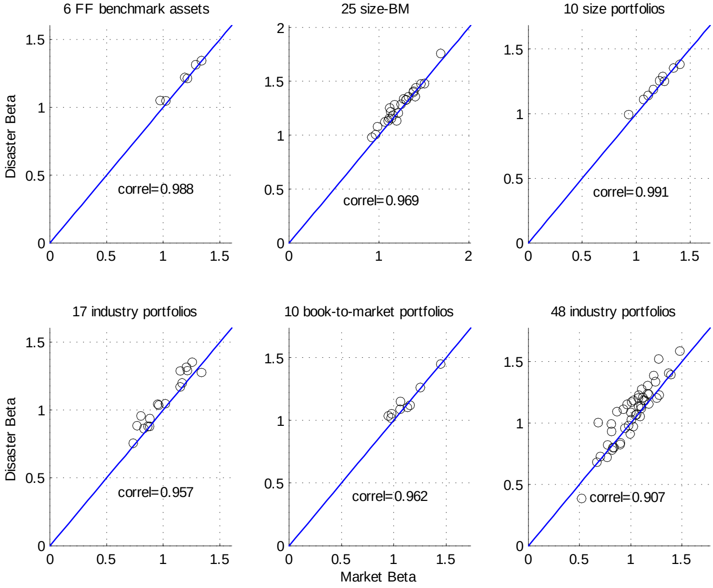


Figure: CAPM (top panel) and Disaster CAPM (bottom panel).

Disaster Beta and Market Beta are highly correlated



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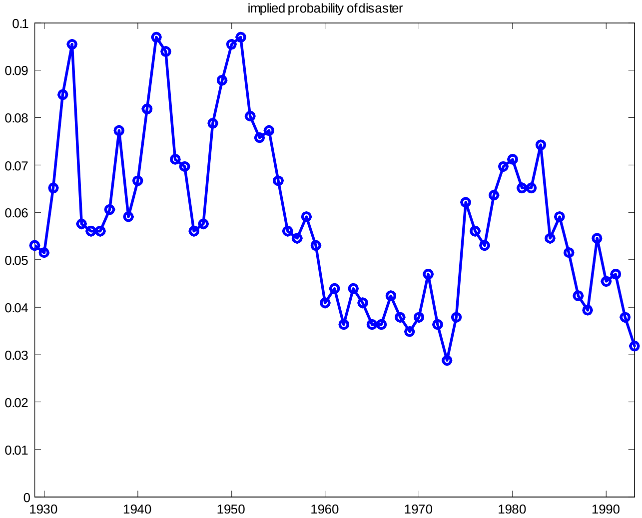
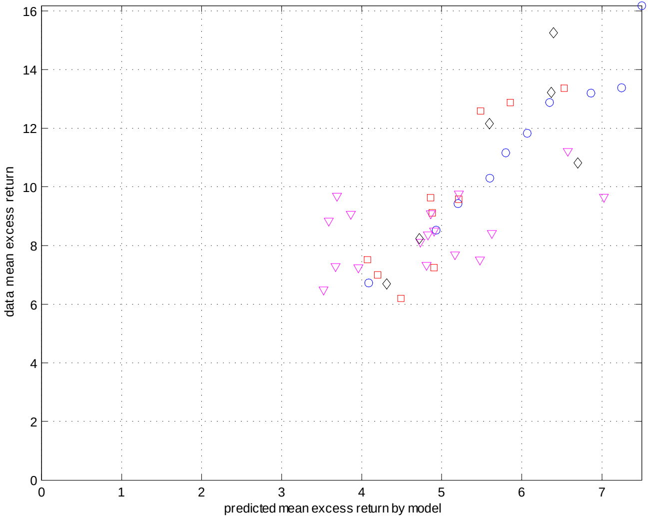
- given p_t, construct the SDF M and test the conditions $E(MR_i^e) = 0$.

Implied Probability of Disaster



Predicted mean returns vs. Data mean returns



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- Cross-sectional evidence is mixed

Backup

Barro's measures of disasters

- Data on **GDP per capita** in XXth century (Maddison).
- 20 OECD countries + 15 countries from Latin America and Asia.
- Defines disaster as fall in GDP greater than 15% (peak-to-trough).
- Finds 60 disasters.
- Prob of disaster $= \frac{60}{35} =$**1.7%** per year.
- Average peak-to-trough decline is **29%.**
- Mainly WWI, Great Depression, WWII, Latin America post WWII.
- Barro and Ursua (2008): measuring consumption disasters.

More dynamics

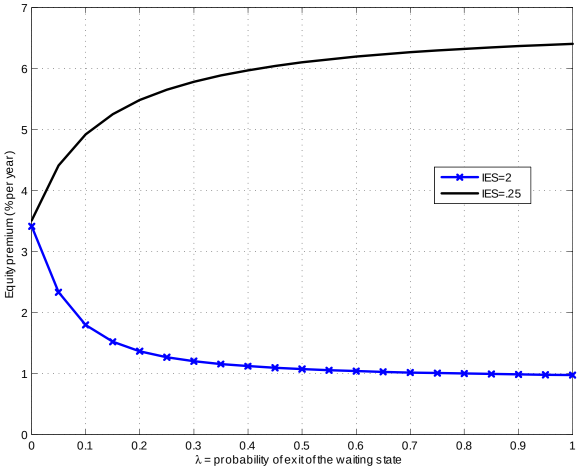

Figure: Impact of the speed of recovery on the unconditional equity premium in the model, for two elasticities of substitution parameters.

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Cross-Sectional Tests: Theory

$$\begin{aligned} \Delta \log D_{it} &= \mu_i + \lambda_i \varepsilon_t \\ &= \mu_i + \lambda_i \varepsilon_t + \eta_i \log(1-b) \end{aligned}$$

- Exposure to "business cycle shocks" λ_i.

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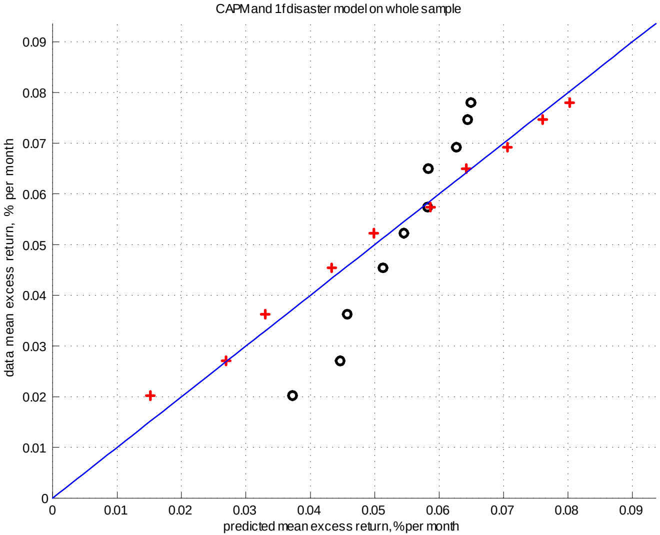
- Implied stock i excess return:

$$\log \frac{ER_i^e}{R^f} = \lambda_i \sigma \gamma + \log \left(\frac{\left(1-p+p(1-b)^{-\gamma}\right)\left(1-p+p(1-b)^{\eta_i}\right)}{1-p+p(1-b)^{\eta_i-\gamma}} \right).$$

Motivation for 1-factor disaster model



Effect of Recoveries with Epstein-Zin utility

Probability of a recovery π	0.00	0.30	0.60	0.90	1.00
IES $= 0.25$	3.31	4.62	5.91	7.19	7.64
IES $= 0.50$	3.31	3.30	3.03	2.26	1.68
IES $= 1$	3.31	2.69	1.94	1.00	0.54
IES $= 2$	3.31	2.42	1.52	0.63	0.30

Table: Equity premium, as a function of the intertemporal elasticity of substitution (IES) and the probability of a recovery.

Effect of Recoveries with Epstein-Zin utility

	ER^b	ER^e	$\sigma(R^e)$	$\sigma(R^b)$	$\sigma(D)$	$\sigma(pd)$	$\beta_{R^e R^b}$	β_{R^e}
Model	1.62	16.47	23.55	2.55	6.48	.411	3.77	2.750
Data	1.03	8.91	15.04	4.36	14.9	.415	3.83	3.39