Risk Exposure to Investment Shocks: A New Approach Based on Investment Data (*Garlappi & Song*)

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Research question

What drives the Value Premium: Kogan & Papanikolaou

- Growth opportunities are exposed positively to investment shocks
  - IST or embodied technical change
- Growth firms are composed of growth opportunities
- If growth firms have lower returns then the price of risk for IST shocks is negative

This paper: measuring firm exposure to investment upends the current literature

- Firms with higher investment opportunities are more exposed to IST
- Firms with low book to market also have lower future investment over market value
- If growth firms (low B/M) have lower returns then the of risk for IST shocks is positive

This paper

New approach to estimate exposure to IST shock

- (Now) standard approach of Kogan & Papanikolaou
  - Based on Berk, Green & Naik or Gomes, Kogan & Zhang.
  - Firms are collection of projects
  - Accumulated projects vs. prospective projects determines the ratio of PVGO to VAP
  - Valuation of each component of the firm determines the value premium

- Kogan & Papanikolaou: PVGOs are more exposed to IST shocks
  - To ground the shock from outside (identification) use ImC portfolio
  - Inv. firms have higher (more positive) IST exposure than Cons. firms
- Garlappi & Song:
  - Use a factor mimicking portfolio to ground the shock
  - Model predicts ratio of PVGO over value is also *investment over value*

Summary

- Kogan & Papanikolaou

$$\beta^z_{f,t} = \frac{\alpha}{1-\alpha}\beta_{0,t} \cdot \beta^{IMC}_{f,t}$$

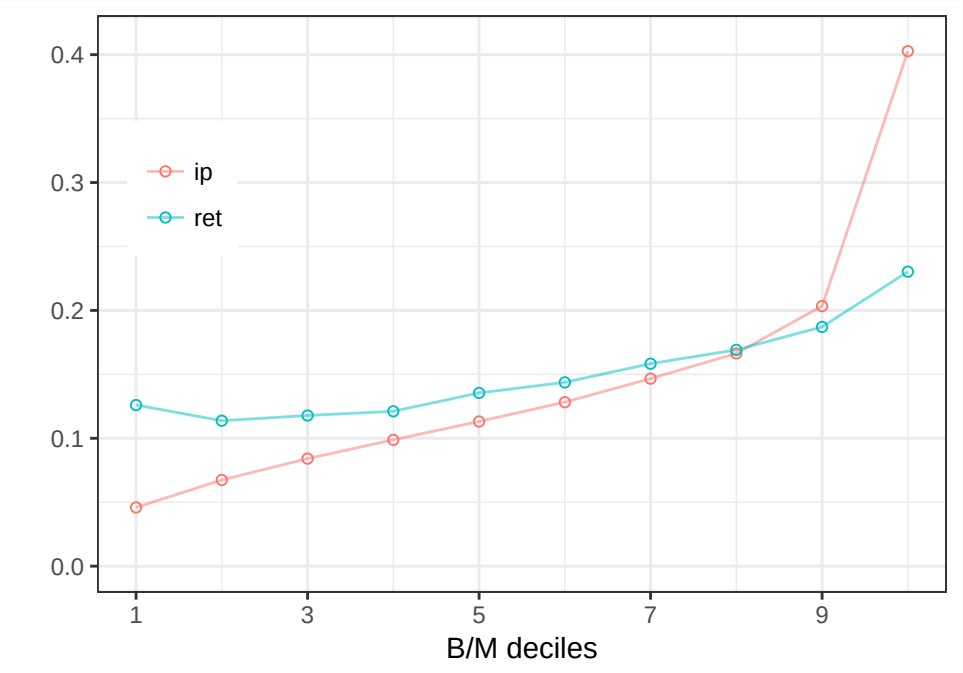
- Garlappi & Song

$$\beta^z_{f,t} = \rho^{-1} \cdot \frac{I_{f,t}}{V_{f,t}}$$

New testable implications

- Firms with high exposure to IST shocks have higher investment over market equity ratio

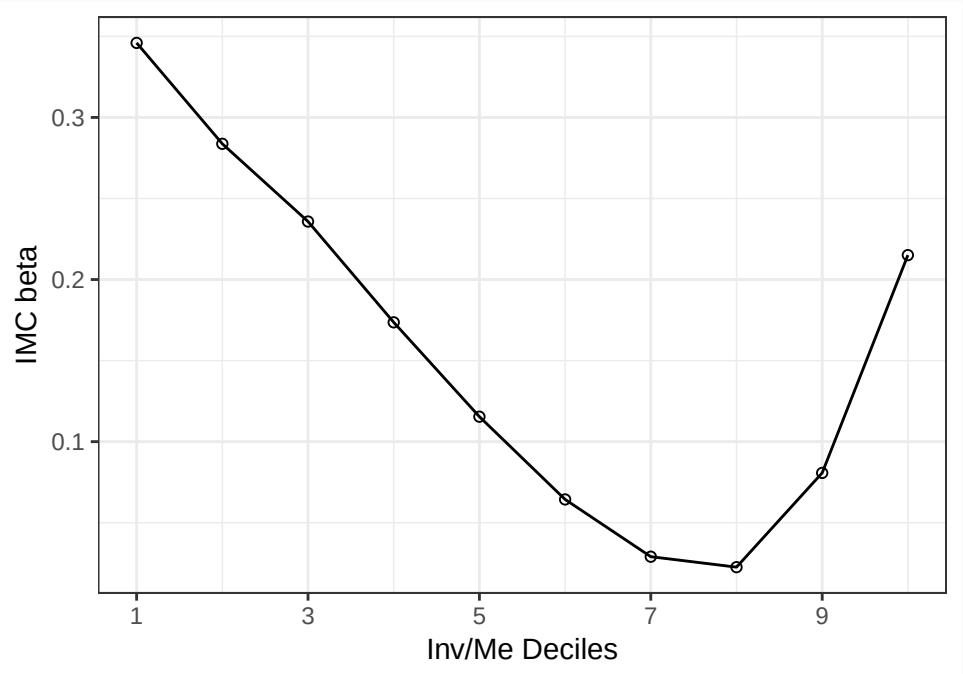
New testable implications



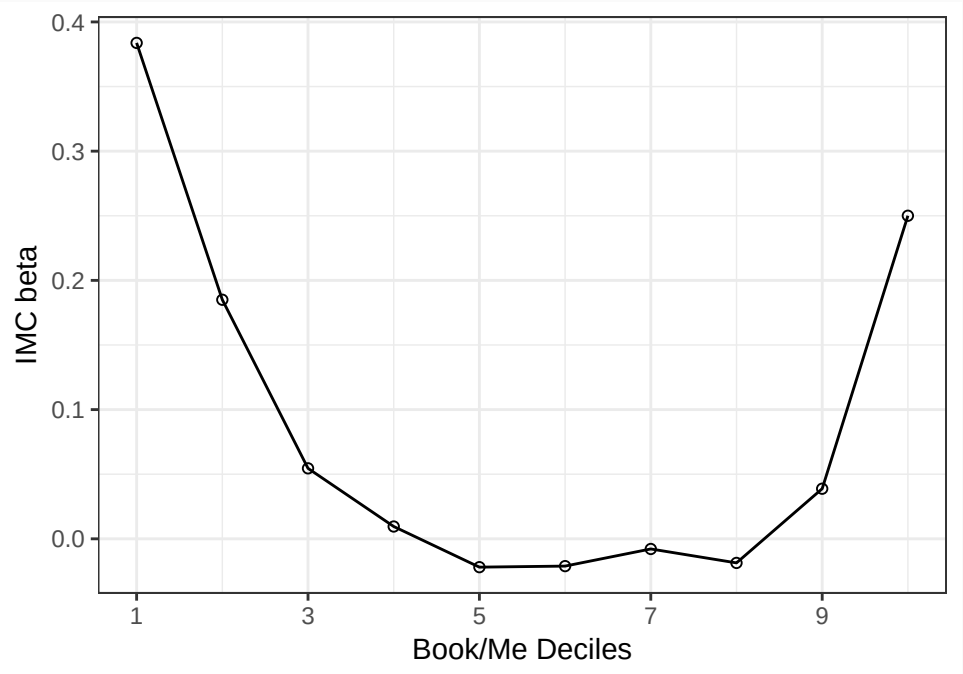
New testable implications

- Firms with high exposure to IST shocks have higher investment over market equity ratio
- If the investment to market ratio predicts IST beta then the price of risk is positive

How different is this from IMC Beta



How different is this from IMC Beta



How different is this from IMC Beta

- IMC beta seems to decline with B/M or I/M ratios
- Negative price of risk

Two different interpretations of the data

Can we reconcile the two approaches?

- Opposite predictions on the price of risk for IST shocks
  - so probably not
- But they use the same model...

Can we make sense of the differences?

G&S. IST shocks favors firms with better investment opportunities (high I/V)

- lowers the cost of investment
- increases the NPV of projects
- favors firms with better investment opportunities (more projects)
- firms with relatively lower valuations

K&P. IST shocks favors firms with few already installed assets

- PVGO tilted firms benefit a lot relative to VAP tilted firms from IST
- direct mapping into growth firms have higher loadings than value firms
- value premium yield negative price of risk

Looking at the model

$$\beta^z_{f,t} = \frac{\partial V_{f,t}}{\partial z_t} = \frac{\alpha}{1-\alpha}\frac{1}{V_{f,t}} \cdot \text{PVGO}_{f,t}$$
$$= \frac{1}{V_{f,t}} \cdot \mathbf{E}_t \int_t^\infty e^{-\eta(s-t)} I_{f,s} ds$$

K&P. Mapping to the data: Book to Market

- Direct evidence of the mechanism: firms with higher M/B respond more to IST shocks

G&S. Mapping to the data: Future investment

- Under assumption of constant project rate: $\beta^z_{f,t} = \rho^{-1} I_{f,t} / V_t$
- Direct evidence of firms with higher investment to market ratio respond more positively to IST shocks

What drives the differences in firms between the results

- Under the constant project assumption β^z depends on I_t / V_t
- Investment depends on aggregate but especially on idiosyncratic opportunities $A(\varepsilon, 1)$:

$$I_t = \lambda \cdot x_t z_t^{\frac{\alpha}{1-\alpha}} \left(\alpha A(\varepsilon_t, 1)\right)^{\frac{1}{1-\alpha}}$$

- Is it true that firms with higher productivity (higher I_t) also have higher returns?

What drives the differences in firms between the results

$$\beta^z \propto I_t / V_t$$

$$I_t = \lambda \cdot x_t z_t^{\frac{\alpha}{1-\alpha}} \left(\alpha A(\varepsilon_t, 1)\right)^{\frac{1}{1-\alpha}}$$

- Estimate a translog production function (see Eeckhout & de Loecker)
  - Extract firm level productivity (and idiosyncratic productivity)
- Productivity and returns

Idiosyncratic productivity quintiles	1	2	3	4	5
Idiosyncractic productivity	0.87	0.97	1.01	1.05	1.24
Productivity	0.97	0.99	1.03	1.09	1.39
Inv / Me	0.17	0.15	0.15	0.14	0.15
returns	20.48	18.24	16.37	13.45	10.19

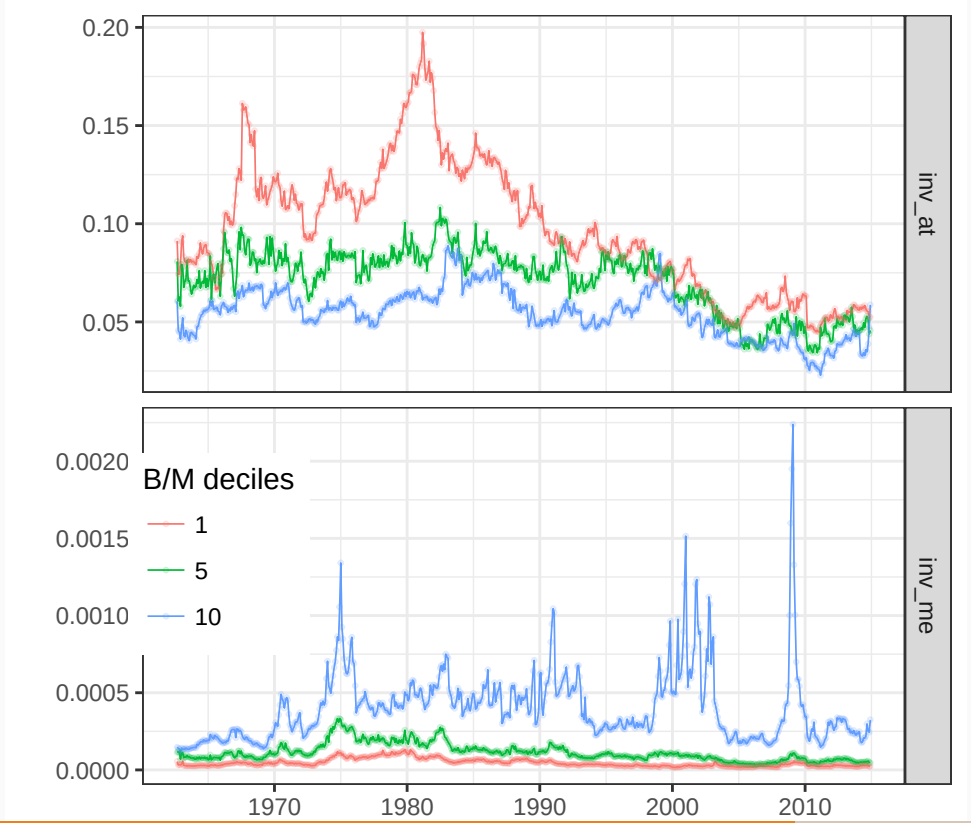
- Productivity across investment to market ratios:

Inv / Me quintiles	1	2	3	4	5
Inv / Me	0.02	0.04	0.08	0.14	0.45
firm productivity	1.35	1.18	1.07	0.99	0.95
idiosyncratic firm productivity	1.06	1.03	1.01	1.01	1.01
returns	14.26	14.78	15.73	16.55	17.37

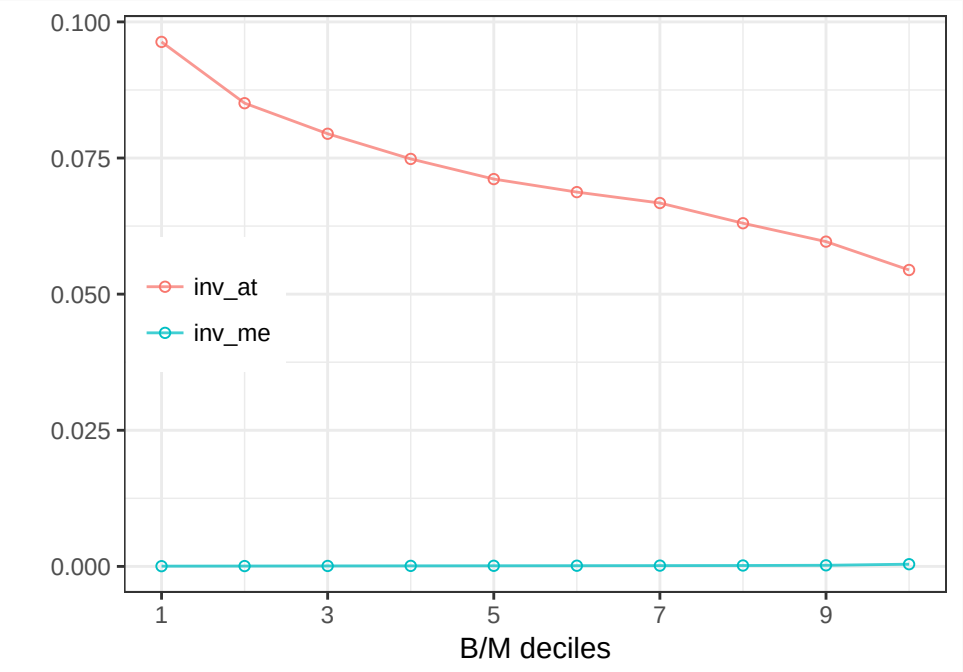
What drives the differences in firms between the results

- Probably not investment opportunities

What drives the differences in firms between the results



What drives the differences in firms between the results



Movements in PVGO: portfolio churn

	1	2	3	4	5	6	7	8	9	10
1	0.59	0.17	0.05	0.02	0.01	0.01	0.00	0.00	0.00	0.00
2	0.22	0.36	0.19	0.08	0.04	0.02	0.01	0.01	0.01	0.00
3	0.08	0.22	0.28	0.19	0.10	0.05	0.03	0.02	0.01	0.01
4	0.04	0.11	0.21	0.24	0.18	0.10	0.06	0.03	0.02	0.01
5	0.02	0.05	0.11	0.20	0.23	0.18	0.10	0.05	0.03	0.01
6	0.02	0.03	0.06	0.12	0.19	0.23	0.18	0.10	0.05	0.02
7	0.01	0.02	0.04	0.07	0.12	0.20	0.24	0.19	0.10	0.04
8	0.01	0.01	0.02	0.04	0.07	0.12	0.20	0.27	0.20	0.07
9	0.01	0.01	0.02	0.03	0.04	0.06	0.12	0.23	0.35	0.19
10	0.00	0.01	0.01	0.01	0.02	0.03	0.05	0.09	0.24	0.65

Response of Investment to Shocks

- Direct measure of the elasticity

$$\log(I_t/K_t) = \text{IMC}_t + Q(\text{PVGO}) \cdot \text{IMC}_t + \dots$$

Quintile	Interact with I/V	Interact with B/M
1 (baseline)	0.83	0.29
2 (relative to baseline)	-0.29	0.09
3	-0.43	0.009
4	-0.48	0.11
5	-0.73	0.20

Response of Investment to Shocks

- Direct measure of the elasticity

$$\log(I_t/V_t) = \text{IMC}_t + Q(\text{PVGO}) \cdot \text{IMC}_t + \ldots$$

Quintile	Interact with I/V
1 (baseline, low I/V)	0.44
2 (relative to baseline)	0.43
3	0.76
4	0.94
5 (high I/V)	0.85

Make sure not only driven by impact of imc shock on valuation

Conclusion

- Evidence of direct mechanism driven by investment opportunity set
- My take: markups!
- Make sure cross-section is not entirely drive by movement in valuations