Discussion of "Uncertainty, Risk, and Capital Growth" by Segal and Shaliastovich

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USC Macro Finance Conference | August 2022

Summary

- Stylized facts: Uncertainty ↑ →
  - Investment rate I/K ↓
  - Capital stock growth K'/K ↑ -- puzzle?
  - Depreciation rate D/K ↓↓ -- resolution. But why?
  - Utilization ↓↓
- Macro Model
  - Challenge: difficult to rationalize endogenous ↓↓ in utilization and hence depreciation in response to uncertainty ↑
  - Solution: EZ preferences + persistent effect of utilization on depreciation
  - Utilization replaces investment as agents' preferred precautionary savings tool
- Asset Pricing Implications
  - Aggregate: long-lived depreciation effects flip price of uncertainty risk (from + to -)
  - Cross-sectional: more elastic utilization adjustments → more negative exposure to uncertainty risk

Model Mechanism

- Uncertainty ↑ → Precautionary Saving Motive ↑
- With fixed utilization (standard macro model)
  - Macro: Precautionary Saving Motive ↑ → Investment ↑
    - Capital is the unique saving technology
    - Only way to create more capital is to invest
  - Finance: Investment ↑ → Tobin’s q ↑
    - Cov[uncertainty, returns] > 0 i.e. equity is a hedge against uncertainty

Model Mechanism

- Uncertainty ↑ → Precautionary Saving Motive ↑
- With fixed utilization (standard macro model)
- With flexible utilization
  - New way to “create” more capital: prevent depreciation by not using it
  - Utilization ↓ → Output ↓: if large enough, can decrease both C and I
    - Investment and under-utilization are substitute technologies
  - Static utilization choice (feature in some med-scale NK models):
    - Only today’s depreciation reduced by letting the machine idle
    - Not much extra capital created (alternatively, δ-u elasticity would need to be huge)
    - Not a very good saving technology. Investment still way better. So looks like the fixed case.

Model Mechanism

- Uncertainty ↑ → Precautionary Saving Motive ↑
- With fixed utilization (standard macro model)
- With flexible utilization
  - Dynamic utilization choice (new to this paper)
    - Idling the machine today makes it depreciate slower for a long while (AR coefficient > 0.99)
    - Large gains in capital stock distributed over time
    - Idling today and tomorrow both increase tomorrow's depreciation → consumption smoothing incentive to distribute under-utilization over time
    - Future utilization ↓ → Future MPK ↓ : another reason not to invest → greater substitutability between investment and under-utilization
    - Investment ↓ → Tobin's q ↓: Cov[uncertainty, returns]<0 and shocks now raise risk premia

Overall Impression

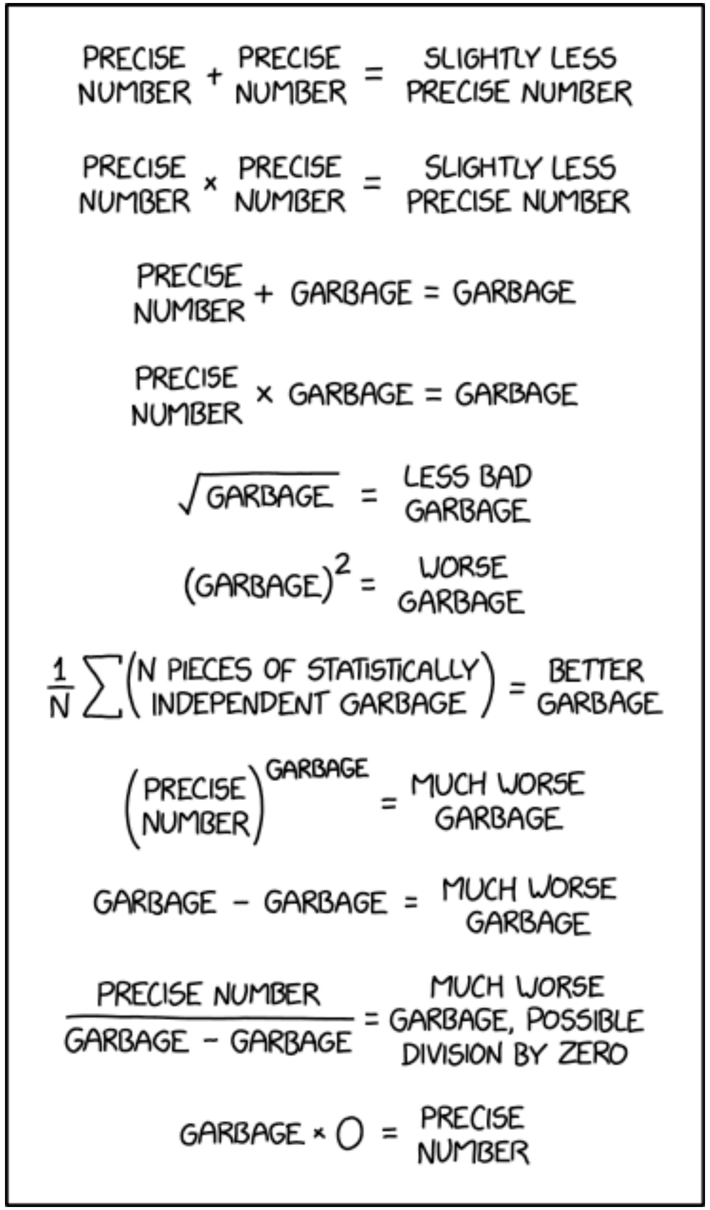
- Very cool paper!
  - Documents novel macro stylized facts
  - Explains large variations in utilization without relying on nominal frictions!
  - Proposes a macro-at-its-heart resolution to the equity premium puzzle in a production-based asset pricing model
    - Channel accounts for >50% of the ERP
- A few comments on empirics
  - Not a critique of the authors' work, just limitations of the data
  - "You go to war with the data you have" -- but maybe can adjust tactics accordingly?
- A few comments on the model

Fixed Asset Tables: a primer

- What the BEA does to produce Fixed Asset quantities
  - Collect data on nominal investment by asset type
  - Deflate using asset-specific deflators to get real cost
  - Estimate depreciation for type of asset
  - Use it to depreciate each vintage of each asset type investment
  - Add up vintages to get asset stocks for each asset
  - Each asset's total (across vintage) depreciation = Investment – Δ Asset Stock
  - Aggregate changes in asset stocks and depreciation using Fisher Ideal Index

$$\frac{Q_t}{Q_{t-1}} = \sqrt{\frac{\sum_j K_{tj} P_{tj}}{\sum_j K_{t-1,j} P_{tj}} \times \frac{\sum_j K_{tj} P_{t-1,j}}{\sum_j K_{t-1,j} P_{t-1,j}}}$$

- Typical uses of BEA Fixed Asset Tables: E[K/Y], E[D/K]
  - Pretty robust to many types of measurement error
- This paper's use of BEA Fixed Asset Tables
  - $\rho(\Delta K, Uncertainty), \rho\left(\Delta[\frac{D}{K}], Uncertainty\right)$
  - Places a higher demand on BEA to get right
    - Individual capital type depreciation rates
    - Fisher Ideal Index Aggregation



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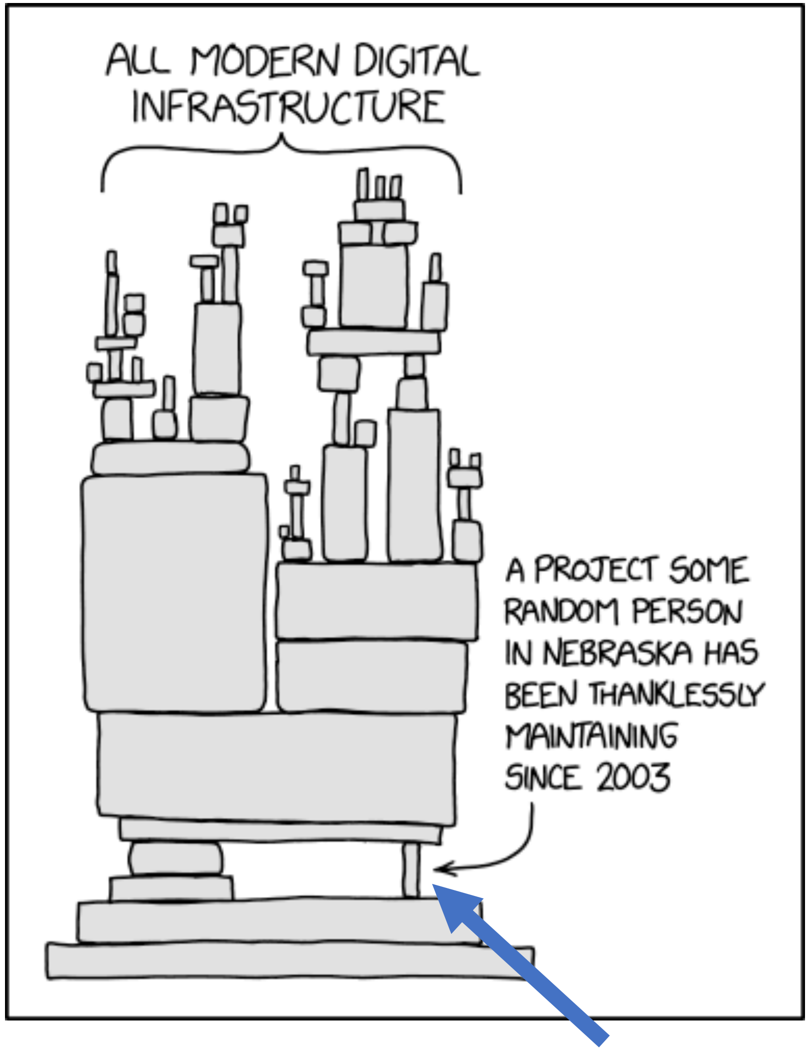

BEA's depreciation estimates

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    - Individual capital type depreciation rates
    - Fisher Ideal Index Aggregation
  - Is there a "capital controversy" here?

Quality of Depreciation Rate Data

- Depreciation Rate = (“True” first-year depreciation / Straight-line depreciation) / Average Life
- Five quality tiers for the first term
  - BEA: direct estimates from new & used prices
  - A/B/C tiers from Hulten Wykoff
    - A: “extensive data available”
    - B: “case by case basis”
    - C: “no data available”

Table 1: **Growth, Uncertainty, and Capital: Correlations**

y	Panel A: $\rho(\Delta y, v_t)$		Panel B: $\rho(\Delta y, g_t)$
	$v_t = E_t[RV_{t+1}]$	$v_t = RV_t$	
I/K	-0.27	-0.19	0.51
δ	-0.27	-0.26	0.27
K	0.17	0.08	0.49
u	-0.30	-0.51	0.44

2018 Share of K	Correlatior	Asset Type	Type	Std. Dev.
100.0%	-0.410	Nonresidential equipment		1.86%
22.5%	-0.379	Information processing equipment		3.63%
3.7%	-0.418	Computers and peripheral equipment	C	10.81%
8.1%	-0.118	Communication equipment	C	0.13%
6.7%	-0.280	Medical equipment and instruments	C	0.73%
3.3%	-0.254	Nonmedical instruments	C	0.23%
0.6%	-0.271	Photocopy and related equipment	C	0.67%
0.1%	-0.497	Office and accounting equipment	B	3.35%
31.5%	0.155	Industrial equipment		0.17%
2.5%	-0.489	Fabricated metal products	C	1.07%
2.1%	0.156	Engines and turbines	C	0.32%
4.3%	-0.184	Metalworking machinery	A	0.30%
4.9%	-0.463	Special industry machinery, n.e.c.	C	0.27%
9.9%	-0.386	General industrial, including materials handling, equipment	A	0.16%
7.8%	-0.531	Electrical transmission, distribution, and industrial apparatus	C	0.06%
23.3%	-0.282	Transportation equipment		0.93%
10.1%	0.234	Trucks, buses, and truck trailers		0.52%
6.7%	0.283	Light trucks (including utility vehicles)	BEA	0.66%
3.4%	0.241	Other trucks, buses, and truck trailers	A	0.46%
2.5%	0.601	Autos	BEA	4.31%
6.8%	0.470	Aircraft	BEA	1.18%
1.4%	-0.229	Ships and boats	B	0.08%
2.4%	0.030	Railroad equipment	C	0.07%
22.8%	-0.281	Other equipment		0.21%
5.1%	-0.021	Furniture and fixtures	C	0.13%
3.5%	-0.101	Agricultural machinery	C	0.22%
3.5%	-0.094	Construction machinery	A	0.29%
2.1%	-0.056	Mining and oilfield machinery	C	0.53%
2.8%	-0.030	Service industry machinery	C	0.17%
0.5%	-0.329	Electrical equipment, n.e.c.	C	0.52%
5.3%	-0.186	Other nonresidential equipment	C	0.19%

Quality of Depreciation Rate Data

- Depreciation Rate = ("True" first-year depreciation / Straight-line depreciation) / Average Life
- Five quality tiers for the first term
  - BEA: direct estimates from new & used prices
  - A/B/C tiers from Hulten Wykoff
    - A: "extensive data available"
    - B: "case by case basis"
    - C: "no data available"
  - IP handled separately
- The better the data, the less negative/more positive the correlation
  - Is it systematic measurement error?
  - Does the stylized fact fit some industries better than others?

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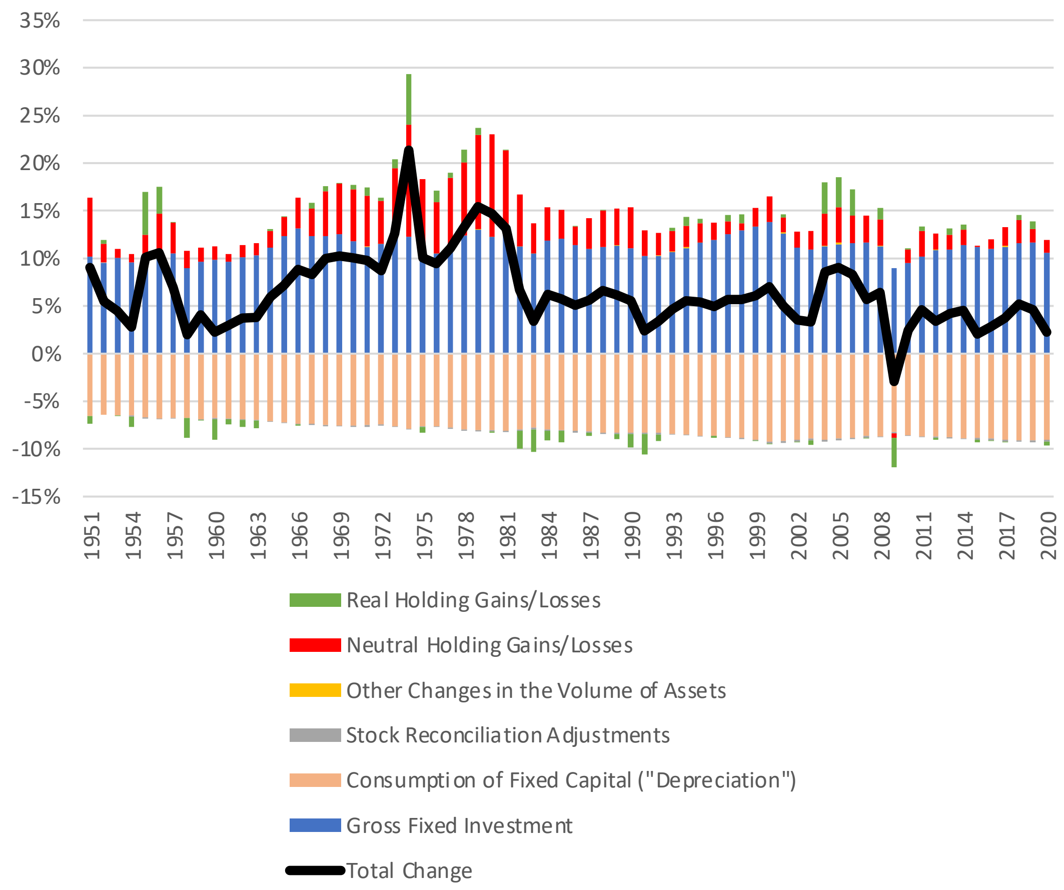
K	0.17	0.08	0.49
u	-0.30	-0.51	0.44

Asset Type	Variance-Weighted Avg Correlation
BEA	0.5853
A	0.1534
B	-0.4889
C	-0.2587
IP	-0.0582

Are there prices in quantities?

- BEA's challenge:
  - We want $\frac{K_t}{K_{t-1}} = 1 + \frac{I_t}{K_{t-1}} - \frac{D_t}{K_{t-1}}$
  - But we have data only on $P_t K_t$, $P_{t-1} K_{t-1}$, $P_t I_t$, and $P_t D_t$
  - Relying on good method to strip out both nominal and real prices
  - What if it's imperfect e.g. some real price changes remain?
- Uncertainty ↑ → Safe rate ↓
  - Capital price ↑
  - Capital stock seemingly ↑, depreciation ↓
  - Like the paper finds



Link Between Depreciation and Utilization

- Claim: utilization speeds up depreciation
  - "Wear and tear"
  - This paper: persistently so!
  - Support in aggregate data
- Evidence for the mechanism in the cross-section?
  - E.g. using a milling cutter to make a metal part depreciates it faster than using a computer to lay out a magazine

Table 3: **Depreciation and Utilization**

Horizon K	β_δ	t-stat	β_u	t-stat
1			0.52	[4.78]
1	0.60	[5.61]	0.45	[5.65]
3	0.31	[1.82]	0.38	[3.02]
5	0.28	[1.69]	0.23	[1.52]

The table shows the results of the regression: $\frac{1}{K}\Delta\delta_{t-1\to t+k-1} = const + \beta_\delta \Delta\delta_{t-1} + \beta_u u_t + error$. δ_t is private nonresidential depreciation rate. u_t is the capacity utilization rate. $\Delta\delta_{t-1}$ refers to the log growth rate between δ_{t-1} and δ_{t-2}. Brackets report t-statistics. Both the dependent variable and the independent variables are normalized. In the first row, the control $\Delta\delta_{t-1}$ is omitted, and the reported β_u is equal to the correlation between $\Delta\delta_t$ and u_t. Standard errors are robust and Newey West adjusted. Annual growth data on depreciation and utilization are from 1967-2018.

Depreciation and Utilization: Cross-Section

- Significant heterogeneity in "wear and tear"
  - Does the pattern make sense? I don't have enough engineering intuition to judge, but
  - No relationship for rubber
  - Moderate for computers?

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Industry	beta_delta	t-stat	beta_u	t_stat	R-squared
Plastics and rubber products	0.011	2.736	-0.002	-0.010	0.143
Oil and gas extraction	0.023	0.758	0.062	0.413	-0.027
Miscellaneous manufacturing	0.006	1.645	0.111	0.791	0.057
Mining	0.008	0.191	0.211	1.510	0.006
Petroleum and coal products	-0.008	-0.632	0.211	1.436	0.017
Electrical equipment, appliances, and components	0.032	3.356	0.222	1.617	0.323
Paper products	-0.004	-0.473	0.283	1.930	0.041
Printing and related support activities	0.013	1.902	0.319	2.249	0.226
Furniture and related products	0.018	1.814	0.335	2.234	0.263
Computer and electronic products	0.001	1.145	0.352	2.492	0.143
Support activities for mining	0.007	0.636	0.386	2.719	0.130
Primary metals	0.016	2.473	0.441	3.637	0.292
Fabricated metal products	-0.001	-0.120	0.470	3.599	0.192
Wood products	0.026	2.362	0.502	4.072	0.446
Chemical products	-0.001	-0.227	0.509	4.045	0.238
Nonmetallic mineral products	0.002	0.199	0.540	4.288	0.265
Machinery	-0.006	-0.708	0.656	5.858	0.418
Mining, except oil and gas	0.000	0.014	0.664	6.022	0.428

Depreciation and Utilization: Persistence

- Key equation: $\delta_t = (1 - \rho_\delta)\delta_0 + \rho_\delta \delta_{t-1} + \sigma_u \frac{u_t^{1+\zeta} - 1}{1+\zeta}$
  - Innovation relative to macro literature is the $\rho_\delta > 0$ case
  - u_t affects not just δ_t but also $\delta_{t+1}, \delta_{t+2}, \ldots$
- Authors propose multiple micro-foundations that can qualitatively explain this pattern.
  - Which ones are quantitatively important?
  - Which ones deliver a constant $\rho_\delta = 0.9908$ in response to all shocks?

Depreciation and Utilization: Persistence in CX

- Empirical evidence for the persistent effect
  - *"Notably, the lagged depreciation rate remains a positive and significant predictor of its future growth controlling for the current utilization rate. Indeed, β_δ is positive and significant at least at the 10% confidence level across all the horizons. This suggests that the utilization rate alone does not fully capture persistent fluctuations in the depreciation rate dynamics, a feature that we incorporate into our economic framework."*
- But little to no persistence in depreciation **within industry**
  - Evidence for the reallocation channel?
  - Evidence against stale data?

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Petroleum and coal products	-0.008	-0.632	0.211	1.436	0.017
Electrical equipment, appliances, and components	0.032	3.356	0.222	1.617	0.323
Paper products	-0.004	-0.473	0.283	1.930	0.041
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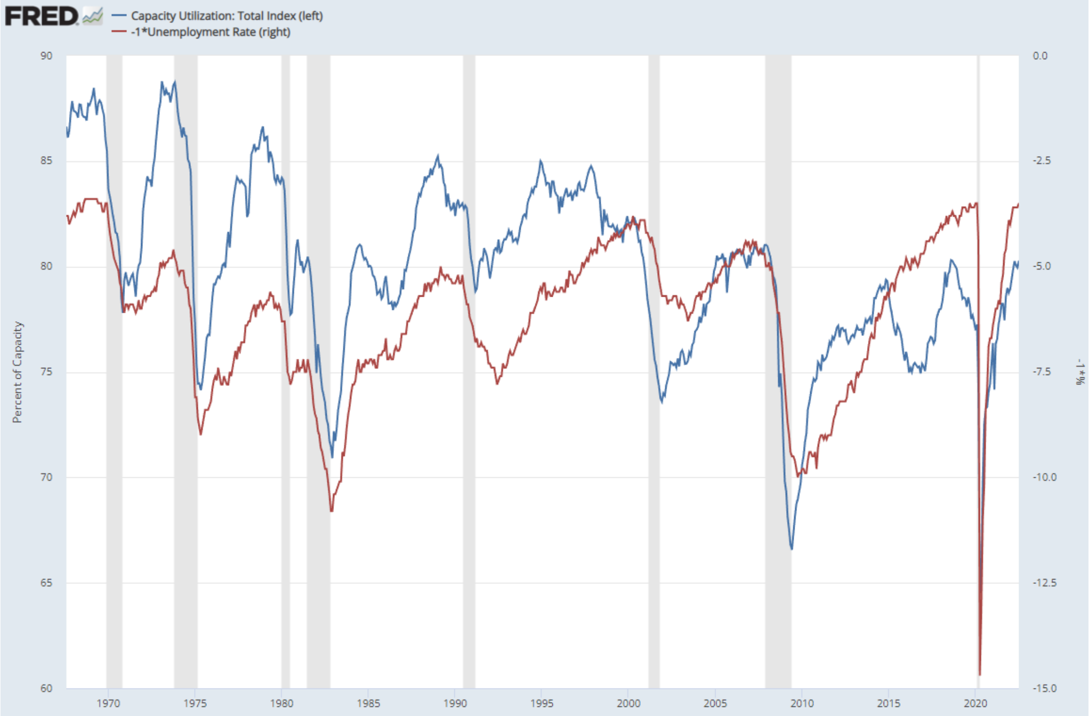
Discount Rate ≠ Risk-Free Rate

- Uncertainty ↑ → Precautionary Saving Motive ↑
  - Risk-free rate ↓
  - But quantity of risk ↑ → | risk premium | ↑
  - If risk premium > 0, net effect on the rate at which future MPKs are discounted is ambiguous. If λ_g is the price of growth risk:
    - Term in risk-free rate: $-\frac{1}{2}\lambda_g\sigma_t^2$
    - Term in risk premium: $\beta_{k,g}\lambda_g\sigma_t^2$
- Quantitatively, the risk-free rate effect must dominate to such an extent that the RP effect isn't even worth mentioning. Why?
  - Must be that $\beta_{k,g} << \frac{1}{2}$ but then how does the model get a high ERP with ¾ of it coming from the growth shocks (as opposed to uncertainty shocks)?
  - How does the model do here? Excess return predictability?

Which adjustment margin? K or L?

- Model has inelastic labor supply
  - Utilization is **the only way** agents can change current output in response to an uncertainty shock
  - Authors point out that elastic labor has opposite impulse than utilization in response to an uncertainty shock
  - But their estimation targets uncond. vols, not impulses
  - In estimation, high-frequency changes in macro aggregates must show up in utilization.
- If labor supply was elastic, how different would the estimate of utilization-depreciation elasticity ζ be?
  - Not an abstract concern. Labor adjustment frequency not that much lower in the data. B-cycle main factor for both.
  - Appendix has NK model but it's not re-estimated. Worth it.
  - Related exercise: how much of currently estimated negative output gaps are actually first-best under-utilization?



Role of EZ preferences

- Paper shows that depreciation persistence $\rho_\delta > 0$ key to generate quantitatively meaningful effects of uncertainty. When $\rho_\delta = 0$, utilization, output, and consumption barely change
- Intuition: persistent effect needed to generate large PV cost of utilization
- How crucial is EIS >> 1/CRRA (strong preference for early resolution of uncertainty) to generating this high PV?
    - Or is any mechanism that generates a strong precautionary savings motive enough?
    - E.g. heterogeneous agent model with undiversifiable labor risk & CRRA preferences
- Would be cool to have a “pure macro” rationale for EZ preferences!

Conclusion

- Paper should be read by both macro and asset pricing folks
- Advances our understanding of the effects of uncertainty shocks on the real economy and stock prices
- Are we meant to trust BEA data *this much?*
  - Can we get confidence from disaggregated data? Maybe some individual industries where quantities are more readily observable?
- Next steps
  - Why is the effect of utilization on depreciation persistent? Which of the stories is best?
  - Kick the tires a bit more with respect to EZ, labor elasticity
- Can't wait for the next version!