Section 3: Intermediary Asset Pricing

Ralph S.J. Koijen   Stijn Van Nieuwerburgh*

March 22, 2024

*Koijen: University of Chicago, Booth School of Business, NBER, and CEPR. Van Nieuwerburgh: Columbia Business School, CEPR, and NBER. If you find typos, or have any comments or suggestions, then please let us know via ralph.koijen@chicagobooth.edu or svnieuwe@gsb.columbia.edu.

1. Basic structure of the notes

- High-level summary of theoretical frameworks to interpret empirical facts.
- Per asset class, we will discuss:
  1. Key empirical facts in terms of prices (unconditional and conditional risk premia) and asset ownership.
  2. Interpret the facts using the theoretical frameworks.
  3. Facts and theories linking financial markets and the real economy.
  4. Active areas of research and some potentially interesting directions for future research.
- The notes cover the following asset classes:
  1. Equities (weeks 1-5).
     - Discount rates and the term structure of risk (week 1)
     - The Cross-section and the factor zoo (week 2)
     - Intermediary-based Asset Pricing (week 3)
     - Production-based asset pricing (week 4)
     - Demand-based asset pricing (week 5)
  2. Mutual funds and hedge funds (week 6).
  3. Volatility (week 7).
  4. Government bonds (week 8).
  5. Corporate bonds and CDS (week 9).
  6. Currencies and international finance (week 10).
  7. Commodities (week 11).
  8. Real estate (week 12).

2. Intermediary-based Asset Pricing

- Intermediary-based asset pricing is an active line of research, both theoretical and empirical, which emphasizes the central role of financial intermediaries for asset prices and real outcomes

- Builds on old idea of the *financial accelerator* of Bernanke and Gertler (1989) and Bernanke, Gertler, Gilchrist (1999): creating amplification and persistence in standard business cycle models

- It starts from the premise that the marginal agent, whose SDF prices assets, is a financial intermediary.

- Maybe this is because households delegate their investments to financial intermediaries, possibly because they lack the financial sophistication to invest directly in complex asset markets.

- Before we get into the details, we start by briefly reviewing an older and more traditional view, which is that it is the consumers that are the marginal agents.

- The consumption-based asset pricing literature goes back to Lucas (1978), Breeden (1979), and Rubinstein (1976).

- It is important to remember that intermediary-based AP models are ultimately also consumption-based AP models; the consumption (share) of the owners of the financial intermediaries is what matters for pricing. Bankers need to eat too!

2.1. *SDFs based on consumers as "the" marginal investor*

- The consumption-based asset pricing model based on aggregate consumption data does not perform well, as exemplified by the many puzzles it generates (see your previous AP classes).

- If a consumer does not hold stocks, the Euler equation with that consumer's IMRS does not need to hold for the stock market.

- Limited stock market participation: Only about 50% of American households hold stocks directly or through mutual funds. Even among stock-holders, equity ownership is very concentrated (Gomez, 2018).

- Vissing-Jorgensen (2002) and Malloy, Moskowitz, and Vissing-Jorgensen (2009, MMVJ) study the Euler equation of stockholders, whose consumption is more volatile and more highly correlated with the stock market.

- MMVJ focus on pricing the cross-section of returns using long-horizon consumption risk of stock holders. Hence, their Euler condition tends to hold at longer horizons.

- Consumption-based models tend to work better at longer horizons. This makes sense as nobody thinks that the consumption CAPM should hold at daily frequency.

- The pricing model in MMVJ assumes that each investor has recursive preferences Epstein-Zin (1989)

$$V_t = \left[(1-\beta)C_t^{1-\frac{1}{\sigma}} + \beta\left[E_t\left(V_{t+1}^{1-\gamma}\right)^{\frac{1-\frac{1}{\sigma}}{1-\gamma}}\right]\right]^{\frac{1}{1-\frac{1}{\sigma}}},$$

where σ is the elasticity of intertemporal substitution (EIS) and γ the coefficient of relative risk aversion.

- They assume the dynamics of consumption growth to have a persistent component x_t as in the long-run risk literature:

$$\begin{aligned}\Delta c_{t+1} &= \mu_c + Ax_t + Bw_{t+1},\\ x_{t+1} &= Cx_t + Dw_{t+1}.\end{aligned}$$

- In the limiting case of EIS $\sigma = 1$, the log stochastic discount factor of a household is m_t:

$$m_{t+1} \simeq const. + (1-\gamma)\left[(E_{t+1}-E_t)\sum_{s=1}^{\infty}\beta^{s-1}\Delta c_{t+s}\right]$$

The approximation drops the contemporaneous consumption growth term, $(1-\gamma)\Delta c_{t+1}$, which does not matter empirically.

- The standard first-order condition can now be written as

$$E(r_{t+1}^i - r_{t+1}^f) + \frac{1}{2}V(r_{t+1}^i - r_{t+1}^f) \simeq (\gamma-1)Cov\left(\sum_{s=1}^{\infty}\beta^{s-1}\Delta c_{t+s}, r_{t+1}^i - r_{t+1}^f\right)$$
$$-(\gamma-1)Cov\left(E_t\left[\sum_{s=1}^{\infty}\beta^{s-1}\Delta c_{t+s}\right], E_t\left[r_{t+1}^i - r_{t+1}^f\right]\right).$$

- Empirically, the second term is hard to estimate. Although they provide conditional estimates, we'll focus on the results that ignore the second term.

- The final test is then

$$E(r^i_{t+1} - r^f_{t+1}) + \frac{1}{2}V(r^i_{t+1} - r^f_{t+1}) \simeq$$
$$(\gamma - 1)Cov\left(\sum_{s=1}^{\infty}\beta^{s-1}\left[\frac{1}{H^g_{t+s-1}}\sum_{h=1}^{H^g_{t+s-1}}\Delta c^{h,g}_{t+s}\right], r^i_{t+1} - r^f_{t+1}\right).$$

  where $\Delta c^{h,g}_{t+1}$ is quarterly consumption growth for household h in group g (e.g., stock holders or top 1/3 wealthiest stockholders) and H^g_t is the number of members of the group in quarter t

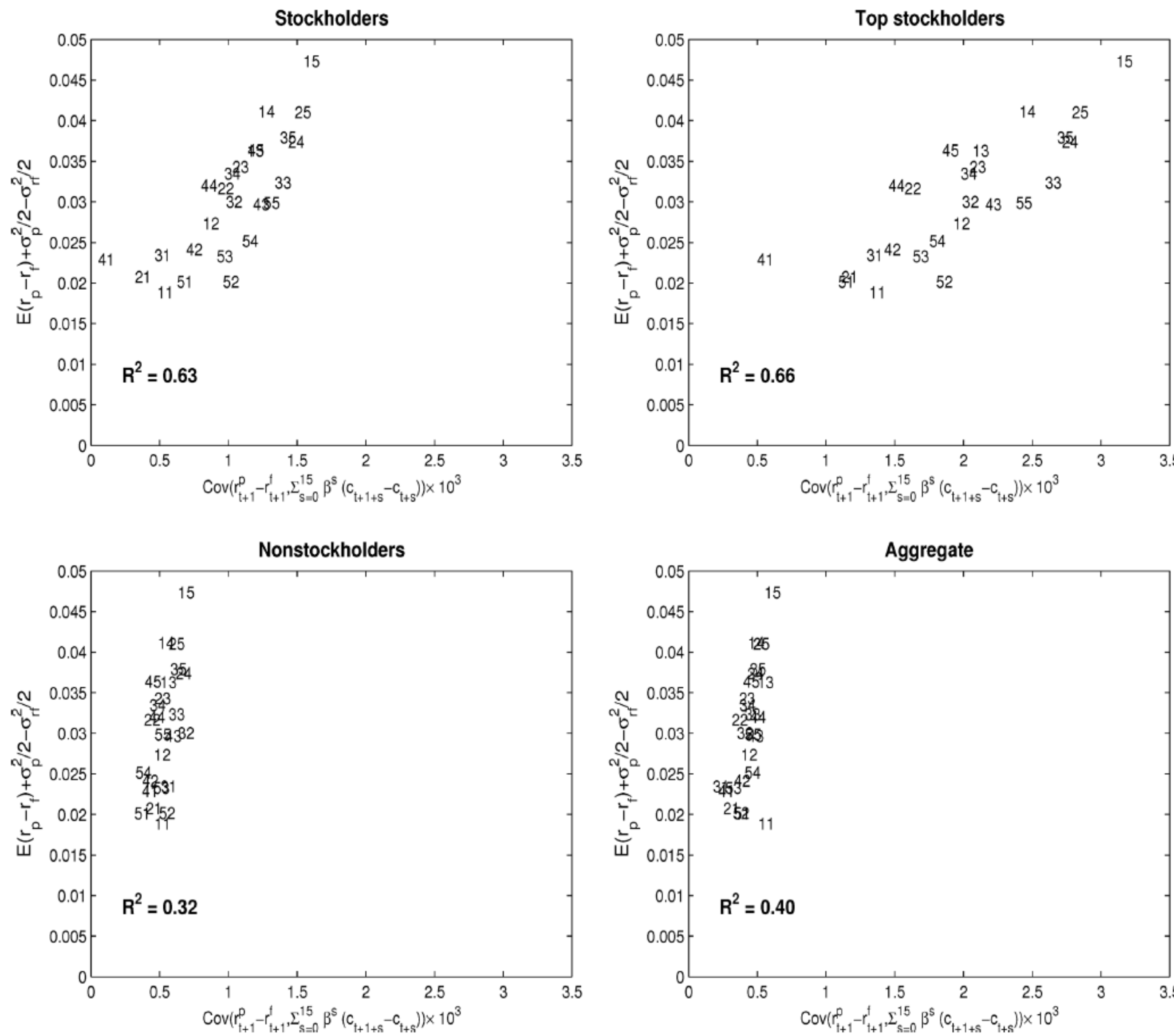
- Note that this is different from a representative agent where we would use

$$\ln\left(\frac{1}{H^g_t}\sum_{h=1}^{H^g_t}C^{h,g}_{t+1}\right) - \ln\left(\frac{1}{H^g_t}\sum_{h=1}^{H^g_t}C^{h,g}_{t}\right),$$

  where we first average and then take logs. The difference between the average of the growth rate and the growth rate of the average depends on the amount of consumption inequality.

- Test assets are 25 size and BM portfolios and 8 maturity-sorted Treasury bond portfolios for the sample period 1926-2004.

Panel A: Mean returns versus consumption covariances



Panel B: Pricing errors

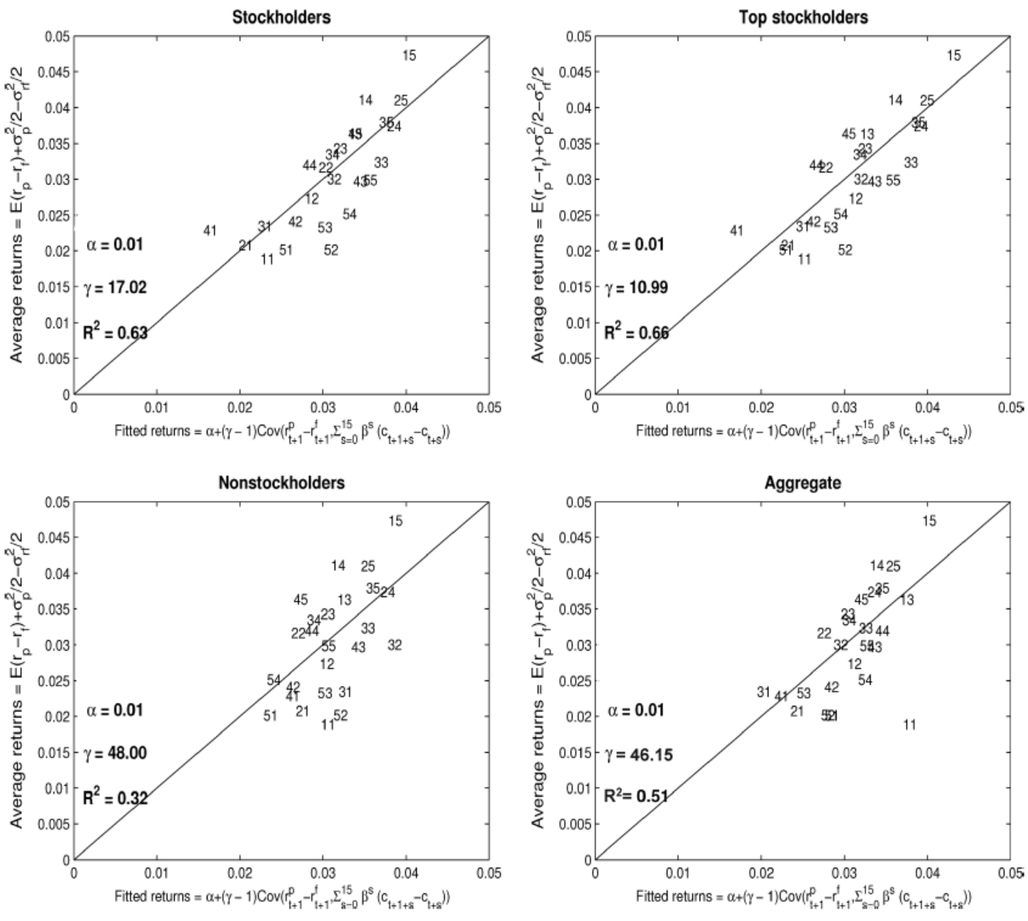


Figure 1. *Continued*

- Risk aversion γ, which is driven by the comovement between consumption growth and returns, is much lower for stockholders (17) and even lower for the top-third of stockholders (11) than for non-stockholders (48) or an estimate based on aggregate consumption (46).

- There is generally a stronger link between long-run consumption risk and the cross-section of stocks, see Parker and Julliard (2005), Bansal, Dittmar, and Lundblad (2005), and Hansen, Heaton, and Li (2008), but there is also less power.

- Related theoretical work on consumption inequality as a priced risk factor by Constantinides and Duffie (1996), Storesletten, Telmer, and Yaron (2007), Lustig and Van Nieuwerburgh (2010), Guvenen (2010), Herskovic, Kelly, Lustig, and Van Nieuwerburgh (2016), Constantinides and Ghosh (2016), and Schmidt (2022).

- This work is motivated by early evidence that the cross-sectional variance of labor income growth is counter-cyclical by Storesletten, Telmer, and Yaron (2004).

- This evidence was revisited with better (Social Security Administration) data by Guvenen, Ozkan, and Song (2014), who show that it is the cross-sectional *skewness* of labor income growth which is counter-cyclical. Large negative income drops become more likely in recessions.

- Before this evidence was known, Brav, Constantinides, and Geczy (2002) already used the second and third cross-sectional moments of the *consumption growth* distribution as asset pricing factors. They showed that adding the cross-sectional skewness to the cross-sectional mean (Lucas/Breeden) and cross-sectional variance (Constantinides & Duffie) helps to price assets better.

- Another branch of the literature shows that the consumption-CAPM works better when consumption is measured more accurately. There is large measurement error in consumption; see Koijen, Van Nieuwerburgh, and Vestman (2014)
  - Q4-Q4 consumption: Jagannathan and Wang (2007).
  - Garbage: Savov (2011) and Kroencke (2017).
  - Initial versus revised estimates of consumption growth: Borup and Schutte 2022)
  - Luxury consumption: Ait-Sahalia, Parker, and Yogo (2004).
  - Durable consumption: Yogo (2006).

2.2. *SDFs based on intermediaries as "the" marginal investor*

2.2.1. Adrian, Ettula, and Muir (AEM)

- Adrian, Etula, and Muir (2014) propose an empirical implementation of the model of Brunnermeier and Pedersen (2009).
- Key equation in their 2-period model:

$$E_0[R^e_{1j}] = -\frac{Cov_0(R^e_{1j}, \phi_1)}{E[\phi_1]}, \tag{1}$$

  where R^e_{1j} is the excess return on risky security j and ϕ_1 is the Lagrange multiplier on the time-1 margin constraint.
- A binding margin constraint (high multiplier) is a bad state of nature, i.e., a high SDF realization. Assets that have low returns when margin constraints bind are risky and should command a high risk premium.
- Empirical implementation: Lagrange multiplier on the margin constraint is monotonically decreasing in leverage:

$$\phi_t = a - b \times Leverage_t, \tag{2}$$

  where $Leverage$ is taken to be broker-dealer leverage.
- To obtain innovations, they take first-differences of broker-dealer leverage and remove seasonal effects.

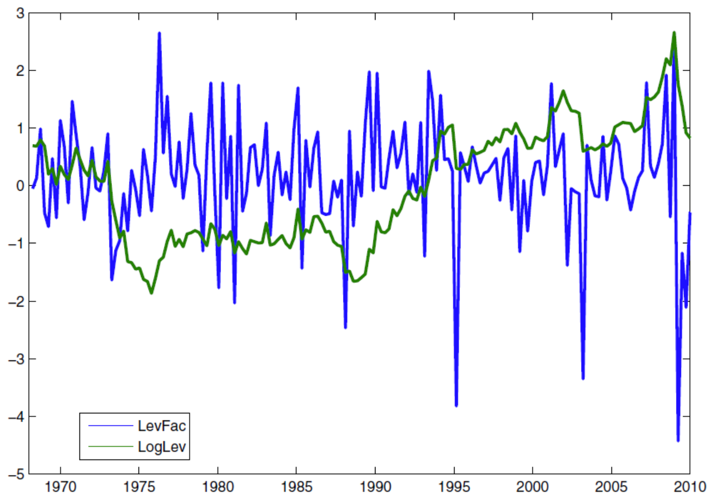


Figure 2. Log-leverage and leverage factor. We plot the log-leverage and the leverage factor (changes in log-leverage) of security broker-dealers, 1968Q1 to 2009Q4. We standardize each series to have zero mean and unit variance for convenience.

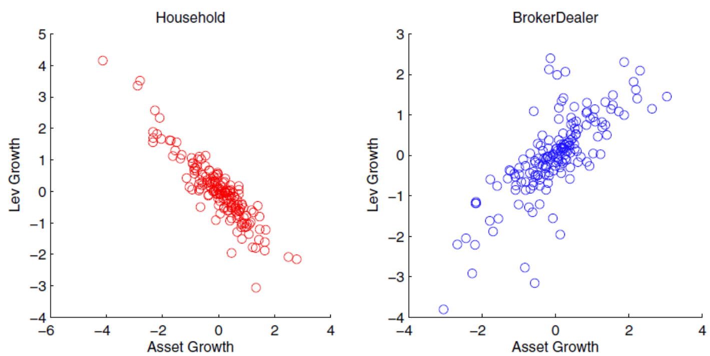


Figure 3. Cyclicality of leverage. We plot leverage growth versus asset growth for households and broker-dealers. In both cases, leverage is defined as (Total Assets)/(Total Assets − Total Liabilities). A downward-sloping line (households) indicates passive balance sheet management, as increasing asset values mechanically decrease leverage and vice versa. An upward-sloping line (broker-dealers) indicates active balance sheet management, whereby increases in asset values are associated with increases in leverage. Data are quarterly, 1968 to 2009, from the *Flow of Funds*.

– Broker-dealer leverage and household leverage move in opposite directions, suggesting broker-dealer leverage is procyclical. Broker-dealers actively increase leverage when asset values rise.

– In AEM, increases in financial intermediary leverage are good news (since they make binding margin constraints less likely). Thus, leverage shocks should carry a positive market price of risk.

- The model does a good job pricing stocks (size, value, momentum) and Treasury bonds jointly for 1968.Q1-2009.Q4
- Leverage factor has a positive market price of risk

Table III

Pricing the Size, Book-to-Market, Momentum, and Bond Portfolios

This table presents pricing results for the 25 size and book-to-market, 10 momentum, and 6 Treasury bond portfolios sorted by maturity. Each model is estimated as $E[R^e] = \lambda_0 + \beta_{\text{fac}}\lambda_{\text{fac}}$. FF denotes the Fama-French three factors, Mom the momentum factor, PC1 the first principal component of the yield curve, and LevFac our leverage factor. Panel A reports the prices of risk with Fama-MacBeth and Shanken t-statistics. Panel B reports test diagnostics, including mean absolute pricing errors (MAPEs) by portfolio group, adjusted R^2s with corresponding confidence intervals (C.I.), and a χ^2 statistic that tests whether the pricing errors are jointly zero. $E[R^e]$ gives the average excess return to be explained. Data are quarterly, 1968Q1 to 2009Q4. Returns and risk premia are reported in percent per year (quarterly percentages multiplied by four).

Panel A: Prices of Risk

	CAPM	FF	FF, Mom	FF, Mom, PC1	LevFac	LevMkt
Intercept	3.39	3.16	1.06	0.66	0.12	−0.19
t-FM	3.55	4.09	1.51	1.14	0.06	−0.21
t-Shanken	3.54	4.03	1.34	1.01	0.04	−0.14
LevFac					62.21	60.97
t-FM					4.62	5.29
t-Shanken					3.12	3.65
Mkt	3.06	2.30	4.54	4.89		5.46
t-FM	0.99	0.80	1.59	1.71		1.75
t-Shanken	0.99	0.80	1.58	1.70		1.55
SMB		1.76	1.57	1.63		
t-FM		0.93	0.83	0.87		
t-Shanken		0.93	0.82	0.86		
HML		3.33	4.37	4.34		
t-FM		1.45	1.90	1.89		
t-Shanken		1.45	1.86	1.85		
MOM			7.82	7.75		
t-FM			2.94	2.91		
t-Shanken			2.92	2.89		
PC1				14.99		
t-FM				1.03		
t-Shanken				0.93		

Panel B: Test Diagnostics

MAPE	$E[R^e]$	CAPM	FF	FF, Mom	FF, Mom, PC1	LevFac	LevMkt
Size B/M	7.86	2.62	1.81	1.05	1.01	1.16	1.11
MOM	5.80	3.05	3.75	1.47	1.48	1.79	1.85
Bond	1.65	1.83	1.59	0.17	0.17	0.37	0.26
Intercept		3.39	3.16	1.06	0.66	0.12	0.12
Total	6.45	6.00	5.41	2.08	1.66	1.31	1.36
AdjR^2		0.10	0.16	0.81	0.81	0.77	0.78
C.I.AdjR^2		[0.02, 0.30]	[0.02, 0.36]	[0.74, 0.88]	[0.72, 0.88]	[0.82, 1]	[0.76, 1]
$T^2(\chi^2_{N-K})$		174.48	167.46	111.45	110.19	67.87	68.86
p-value		0.0%	0.0%	0.0%	0.0%	0.3%	0.0%

– Or graphically:

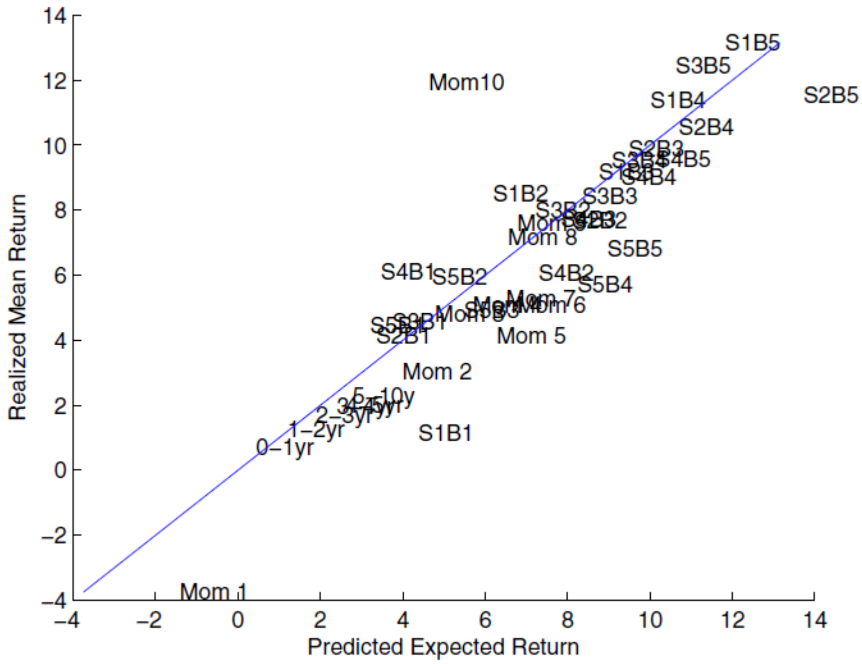


Figure 1. Realized versus predicted mean returns: leverage factor. We plot the realized mean excess returns of 35 equity portfolios (25 size- and book-to-market-sorted portfolios and 10 momentum-sorted portfolios) and six Treasury bond portfolios (sorted by maturity) against the mean excess returns predicted by our single-factor financial intermediary leverage model, estimated without an intercept ($E[R^e] = \beta_{lev}\lambda_{lev}$). The sample period is 1968Q1 to 2009Q4. Data are quarterly, but returns are expressed in percent per year.

2.2.2. He, Kelly, and Manela (HKM)

- He, Kelly, and Manela (2017) is the second key empirical paper in this literature.
- They expand the focus to asset classes beyond stocks and government bonds: credit default swaps (CDS), corporate bonds, options, commodities, foreign exchange (FX), and sovereign bonds.
    * The share of equities owned by broker-dealers is only 0.5%. Hence, is it not more reasonable to think of these investors as price takers in the equity market?
    * Similar argument holds for U.S. Treasuries
    * But, intermediaries are much more central in the other markets since trade is usually over the counter.
- Finding significant and equally large risk prices in all these markets would imply that financial intermediaries are marginal agents in every asset market.
- HKM define intermediaries as the (holding companies of the) primary dealers, a subset of about 25 broker-dealers that are the counterparties of the NY Fed in open market operations, rather than *all* broker-dealers as in AEM
- They focus on shocks to intermediary net worth = equity capital

$$\eta_t = \frac{\sum_i MktEquity_{i,t}}{\sum_i (MktEquity_{i,t} + BookDebt_{i,t}}$$

- Intuition: When the intermediaries' net worth falls, their risk-bearing capacity is impaired and they require higher compensation to take on risk.
- This is consistent with the model of He and Krishnamurty (2013).

- Periods in which intermediary net worth increases ($\Delta\eta_{t+1} > 0$) are good states of the world. The risk price on the $\Delta\eta$ factor, λ_η, is positive.

$$E_t[R^{i,e}_{t+1}] - r^f_t = \beta^i_{m,t}\lambda^m + \beta^i_{\eta,t}\lambda_\eta$$

- Note how an increase in intermediary equity ratio (E/A) implies a decrease in intermediary leverage (A/E) and vice versa. A positive price of risk for the intermediary equity capital factor implies a negative price of risk for the intermediary leverage factor, the *opposite sign* as what AEM postulate and estimate.
- Put differently, in HKM, high intermediary equity capital periods are good states of the world. In AEM, in contrast, they are periods of intermediary distress, bad states of the world.

– Here is the main result in HKM, quarterly data 1970.Q1-2012.Q4 (updated intermediary capital factor time series available on the authors' web site)

Table 5
Cross-sectional asset pricing tests by asset class.
Risk price estimates for shocks to the intermediary capital ratio and the excess return on the market. The capital ratio is defined as the ratio of total market equity to total market assets (book debt plus market equity) of primary dealer holding companies. Risk prices are the mean slopes of period-by-period cross-sectional regressions of portfolio excess returns on risk exposures (betas), reported in percentage terms. Betas are estimated in a first-stage time-series regression. The quarterly sample is 1970Q1–2012Q4. Mean absolute pricing error (MAPE) is in percentage terms. MAPE-R uses a restricted model which restricts the risk prices (λs) to be the same in all asset classes, as in the last column. Relative risk aversion (RRA) is implied by the price of intermediary capital risk factor and the factors covariance matrix. GMM t-statistics in parentheses adjust for cross-asset correlation in the residuals and for estimation error of the time-series betas.

	FF25	US bonds	Sov. bonds	Options	CDS	Commod.	FX	All
Capital	6.88	7.56	7.04	22.41	11.08	7.31	19.37	9.35
	(2.16)	(2.58)	(1.66)	(2.02)	(3.44)	(1.90)	(3.12)	(2.52)
Market	1.19	1.42	1.24	2.82	1.11	−0.55	10.14	1.49
	(0.78)	(0.82)	(0.32)	(0.67)	(0.41)	(−0.25)	(2.17)	(0.80)
Intercept	0.48	0.41	0.34	−1.11	−0.39	1.15	−0.94	−0.00
	(0.36)	(1.44)	(0.33)	(−0.31)	(−2.77)	(0.83)	(−0.83)	(−0.00)
R^2	0.53	0.84	0.81	0.99	0.67	0.25	0.53	0.71
MAPE, %	0.34	0.13	0.32	0.14	0.18	1.15	0.44	0.63
MAPE-R, %	0.40	0.26	0.45	0.68	0.39	1.40	0.62	0.63
RRA	2.71	3.09	2.52	8.90	3.61	2.88	8.26	3.69
Assets	25	20	6	18	20	23	12	124
Quarters	172	148	65	103	47	105	135	172

– Risk prices on intermediary capital factor are positive in all 7 asset classes and significant in 5; best fit is for options and worst for commodities

– Last column combines 124 portfolios from 7 markets and has R^2 of 71%, MAPE of 63 bp per quarter

– Risk price of 9.35% per quarter is large: one st.dev. increase in beta (0.11) results in $0.11\times9.35\times4=4.11$ percentage point increase in annual risk premium

– Cannot reject null that risk price is 9 in every asset class

2.2.3. How to reconcile AEM and HKM?

- Compare-and-contrast of AEM and HKM raises two questions
  1. Which financial intermediaries matter more for asset pricing?
  2. What does theory predict about the sign of the market price of risk on the leverage/equity capital factor?
- HKM show that looking at the equity capital shocks for broker-dealers that are *non-primary dealers* does not work nearly as well as for primary dealers; only equity and CDS show a significantly positive risk price. Thus, there is **important heterogeneity** within broker-dealer sector.
  * Non-bank equity capital shocks do not price these assets at all, a useful placebo test
- AEM's leverage factor has a negative risk price for options, CDS, FX (consistent with HKM), but positive risk price for stocks and Treasuries (consistent with AEM), zero for sov. bonds and commodities. Risk price across all assets combined is positive; but 60% smaller than the HKM factor. AEM's factor works better for stocks, esp. momentum stocks.
- AEM use *book* equity in the construction of their leverage factor while HKM use *market* equity in their capital ratio factor. Market and book capital ratios have positive correlation of 50% in levels and 30% in first differences. Only partially explains the difference. Even book leverage of primary dealers is *counter*-cyclical. (Recall AEM find overall broker-dealer leverage to be pro-cyclical.)

- HKM's results still (mostly) hold when using a book capital ratio factor instead of the market capital ratio factor, but timely information in market prices is important.

Fig. 4. Intermediary capital measures comparison. Panel A compares our main state variable of interest, the aggregate market-based capital ratio of NY Fed primary dealers with other measures of intermediary capital. Market capital ratio at t is defined as $\frac{\Sigma_i marketequity_{it}}{\Sigma_i (marketequity_{it} + bookdebt_{it})}$, where market equity is outstanding shares multiplying stock price, and book debt is total assets minus common equity $AT - CEQ$. Book capital ratio simply replaces $marketequity_t$ with $bookequity_t$ in this calculation. AEM leverage ratio is the leverage ratio of the broker–dealer sector used by Adrian et al. (2014a), constructed from Federal Reserve Z.1 security brokers and dealers series: Total Financial Assets (FL664090005) divided by Total Financial Assets (FL664090005) less Total Liabilities (FL664190005). In Panel A, the capital ratios are in the scale of percentage points (i.e., 5 means 5%). Panel B draws a similar comparison for the risk factors (innovations in the state variables). Our main asset pricing factor is AR(1) innovations to the market-based capital ratio of primary dealers, scaled by the lagged capital ratio. The quarterly sample is 1970Q1–2012Q4. The AEM leverage factor is defined as the seasonally adjusted growth rate in broker–dealer book leverage level from Flow of Funds. Shaded regions indicate NBER recessions.

- A more important difference than market vs. book leverage is that HKM measure leverage at the parent-level (holding company) while AEM use broker-dealer subsidiary-level information, aggregated by the Flow of Funds.
  * AEM-implied capital ratio and HKM (primary dealer) capital ratio have correlation of -59%!
  * Correlation of AEM capital ratio and *non-primary* dealer capital ratio is +12%, a 72% difference with the primary dealer one.
  * Broker-dealer sector is dominated by primary dealers (96% of assets, 91% of market equity)
  * Parent company raises outside equity and (short-term) debt, and allocates capital to subsidiaries via internal capital markets. Lehman Brothers' bankruptcy is instructive.
  * Parent company can shift risky assets from broker-dealer arm to commercial banking arm with more stable deposit funding in a downturn (Hanson, Schleifer, Stein, Vishny, 2015)

2.2.4. Long-run and international evidence

- Barron and Muir (2022) study long-run data from 1870-2016 for U.S., U.K., and Japan to
  - improve inference
  - allay concerns that the post-1975 period may not be representative
  - or even that all results are driven by the financial crisis of 2008-09.
- Construct **asset growth** for (i) commercial banks and (ii) for securities dealers.
- Test assets are stocks, long-term government bonds, currencies, housing, and corporate bonds.
- High asset growth = good times when risk bearing capacity of the intermediary sector increases; positive price of risk. Asset growth can arise from changes in equity or from increases in leverage. This side-steps the debate on whether to use equity shocks or leverage shocks.
- Rather than focusing on contemporaneous covariances between asset growth and returns, they look at the predictive relationship. A negative predictive relationship means that high asset growth lowers expected returns. The lower risk premia indicate that high-asset growth periods are good states of the world.

- Over 140-year period, in all three countries, for both types of institutions, and for all asset classes, intermediary asset growth *predicts* asset returns negatively
  - after controlling for macro-economic risk factors
  - stronger in asset classes where intermediaries participate more
  - Also show that effects are stronger for Japanse stocks that are disproportionately held directly by fin. intermediaries.

Table 3: Predicted returns conditional on intermediary asset growth

This table reports estimates from Equation 1, which regresses log future returns (i.e. *stock index real total returns* or *10-year government bond real total returns* at 1-, 2-, or 3-year ahead cumulative horizons) on past-year *asset growth* of commercial banks. The regression is estimated on a panel of three countries with country fixed effects. Panel A is estimated from a univariate regression without control variables, Panel B adds in three macroeconomic control variables; and Panel C adds in additional control variables (estimates on control variables and constant not reported to save space). T-statistics, reported in brackets, are based on standard errors double-clustered on country and year. *, **, and *** correspond to p-values less than 10%, 5%, and 1%, respectively.

Panel A: Predictability regressions without control variables

	Commercial Banks						*Securities Firms*					
	Stock total real returns			*Bond total real returns*			*Stock total real returns*			*Bond total real returns*		
	1yr ahead	2yrs	3yrs	1yr	2yrs	3yrs	1yr ahead	2yrs	3yrs	1yr	2yrs	3yrs
Asset growth	-0.037***	-0.058**	-0.053*	-0.040***	-0.062***	-0.063***	-0.010	-0.023*	-0.055***	-0.019***	-0.051*	-0.075**
	[-4.282]	[-2.418]	[-1.778]	[-6.156]	[-3.749]	[-2.789]	[-1.120]	[-1.746]	[-3.921]	[-2.824]	[-1.870]	[-2.496]
Constant	0.055**	0.103***	0.141***	0.031***	0.051**	0.060	0.051*	0.101**	0.156**	0.033**	0.064**	0.103***
	[2.231]	[2.611]	[2.657]	[2.646]	[2.184]	[1.519]	[1.920]	[2.181]	[2.576]	[2.341]	[2.571]	[3.105]
Adj. R^2	0.029	0.043	0.031	0.118	0.110	0.059	0.004	0.008	0.032	0.028	0.071	0.097
N	371	371	371	377	377	377	263	263	263	265	265	265

Panel B: Controlling for main macroeconomic variables

	Stock total real returns						*Bond total real returns*					
Commercial Banks	*1yr ahead*		*2yrs ahead*		*3yrs ahead*		*1yr ahead*		*2yrs ahead*		*3yrs ahead*	
Asset growth	-0.034***	-0.027*	-0.072***	-0.077***	-0.091***	-0.104***	-0.041***	-0.046***	-0.073***	-0.084**	-0.087***	-0.094*
	[-8.069]	[-1.783]	[-12.480]	[-4.359]	[-15.453]	[-15.366]	[-3.854]	[-3.761]	[-2.882]	[-2.076]	[-2.790]	[-1.954]
Log consumption growth		-0.049**		-0.050		-0.050		-0.015		-0.004		0.031
		[-2.381]		[-1.412]		[-1.198]		[-1.359]		[-0.105]		[0.605]
Log GDP growth		0.010		0.023		0.024		0.025***		0.020***		-0.033
		[0.391]		[0.541]		[0.794]		[13.341]		[9.680]		[-1.427]
Δ(Nonfin. Assets / Book Eq)		0.009**		0.036***		0.063***		-0.007		0.014		0.052
		[2.510]		[5.925]		[4.369]		[-1.098]		[0.730]		[1.463]
Constant	0.046*	0.052**	0.089*	0.097**	0.134**	0.147**	0.036***	0.032**	0.060**	0.060**	0.076	0.088**
	[1.762]	[1.999]	[1.876]	[2.137]	[2.103]	[2.480]	[2.719]	[2.231]	[2.161]	[2.192]	[1.618]	[2.216]
Adj. R^2	0.021	0.021	0.060	0.063	0.078	0.093	0.138	0.148	0.155	0.154	0.100	0.114
N	170	170	170	170	170	170	170	170	170	170	170	170
Securities Firms												
Asset growth	-0.011	-0.005	-0.030**	-0.023*	-0.062***	-0.059***	-0.018**	-0.018**	-0.059**	-0.059**	-0.077**	-0.077**
	[-1.306]	[-0.621]	[-1.989]	[-1.670]	[-40.006]	[-11.103]	[-2.148]	[-2.270]	[-2.177]	[-2.093]	[-2.427]	[-2.267]
Log consumption growth		-0.022*		-0.034		-0.023		-0.024***		-0.015		0.008
		[-1.755]		[-0.791]		[-0.663]		[-7.970]		[-1.296]		[0.505]
Log GDP growth		-0.037***		-0.040***		-0.019**		0.015***		0.018**		-0.009
		[-8.495]		[-2.699]		[-1.963]		[5.169]		[2.358]		[-0.856]
Δ(Nonfin. Assets / Book Eq)		0.004		0.019*		0.036*		-0.016***		-0.012		0.007
		[0.966]		[1.939]		[1.891]		[-2.685]		[-1.082]		[0.580]
Constant	0.051*	0.066**	0.103**	0.122***	0.158***	0.170***	0.032**	0.032**	0.066***	0.064**	0.104***	0.105***
	[1.929]	[2.574]	[2.202]	[2.623]	[2.600]	[2.879]	[2.338]	[2.082]	[2.694]	[2.297]	[3.140]	[3.009]
Adj. R^2	-0.010	-0.006	0.001	-0.003	0.036	0.024	0.021	0.028	0.128	0.114	0.154	0.136
N	141	141	141	141	141	141	141	141	141	141	141	141

2.2.5. Theory to the rescue?

- Two strands of the theoretical intermediary-AP literature with **opposite implications** for the market price of leverage risk:

  1. Intermediaries face constraints on debt such as margin (haircut, collateral) constraints or value-at-risk constraints
     - In bad times, debt constraint binds, forcing de-leveraging and fire sales of assets to agents with lower valuation: forced debt $\downarrow\downarrow$, market value of equity $\downarrow$.
     - Leverage falls in downturn, leverage is pro-cyclical, the market price of leverage shocks is positive.
     - E.g., Geanokoplos and Fostel (2008), Brunnermeier and Pedersen (2008), Garleanu and Pedersen (2011), Adrian and Shin (2014), Moreira and Savov (2017), Elenev, Landvoigt, and Van Nieuwerburgh (2021)
  2. Intermediaries face constraints on equity, a skin-in-the-game constraint due to moral hazard
     - In bad times, a fall in asset prices reduces intermediary's equity capital and its risk absorption capacity. Binding equity constraint prevents intermediaries from raising outside equity. Risk premia rise to induce intermediaries to invest more in risky assets. Intermediary debt falls by less than equity or may even have to rise to absorb the increased desire to save by households.
     - Leverage increases in downturns, leverage is countercyclical, the market price of leverage risk is negative
     - E.g., Bernanke and Gertler (1989), He and Krishnamurty (2012, 2013), Brunnermeier and Sannikov (2014)

- These views are not necessarily mutually inconsistent

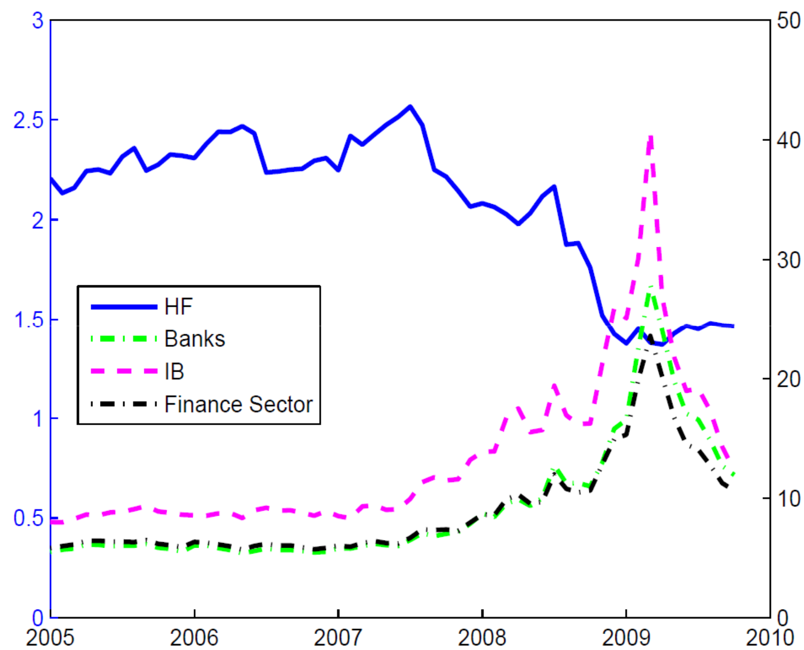
  1. One type of constraint may be relevant for one type of intermediary and the other type of constraint for different intermediaries.
     - E.g., equity constraints for banks and debt constraints for hedge funds.
  2. Both constraints may be relevant for many intermediaries, but bind at different times or in different states of the world.
     - Large banks have to satisfy at least 10 different constraints per post-financial crisis regulation
  3. Intermediaries interact in equilibrium: hedge funds may sell their assets to commercial banks in a downturn, causing bank leverage to increase and hedge fund leverage to decrease.

- The appendix of He, Kelly, and Manela (2016) provides a simple (static) model with households and two types of intermediaries to reconcile the properties of leverage.

  - Banks are risk averse (mean-variance) investors not subject to constraints $\Rightarrow$ Leverage is counter-cyclical.
  - Hedge funds are risk-neutral and subject to a Value-at-Risk constraint $\Rightarrow$ Leverage is pro-cyclical as the constraint binds more in recessions (when return volatility rises).
  - After negative shock, hedge funds sell their assets to banks

- Evidence consistent with these opposite leverage dynamics between hedge funds and banks

Sector	Q4 2007	Q1 2009
Hedge fund equity capital	$1,975bn	$1,002bn
Top 19 Commercial bank equity capital	827bn	285 bn
Top 19 Commercial bank debt liabilities	6,360bn	6,845bn
Top 19 Commercial bank leverage (D/E)	7.7	24



- As Barron and Muir (2021) point out, both classes of models imply that periods of low intermediary asset growth are bad times, times of high risk premia. Negative asset growth predicts higher future returns.

- Intermediary debt and equity are choice variables, subject to (occasionally binding) constraints; they are endogenous outcomes of the intermediaries' optimization process.

- Leverage shocks or equity capital shocks are not structural shocks. The empirical intermediary-AP literature sometimes creates the impression that they are.

- The shocks could be arising from the non-financial corporate sector or from the household sector. For example, productivity shocks affecting non-financial firms' future investment opportunities may have deteriorated in 2008. Or demand for new mortgages from households may have waned. Or firm shocks may have resulted from lack of demand from households with under-water mortgages.

- Defaults on non-financial corporate loans and household loans (mortgages) may be the source of the reduction in net worth of the intermediary sector.

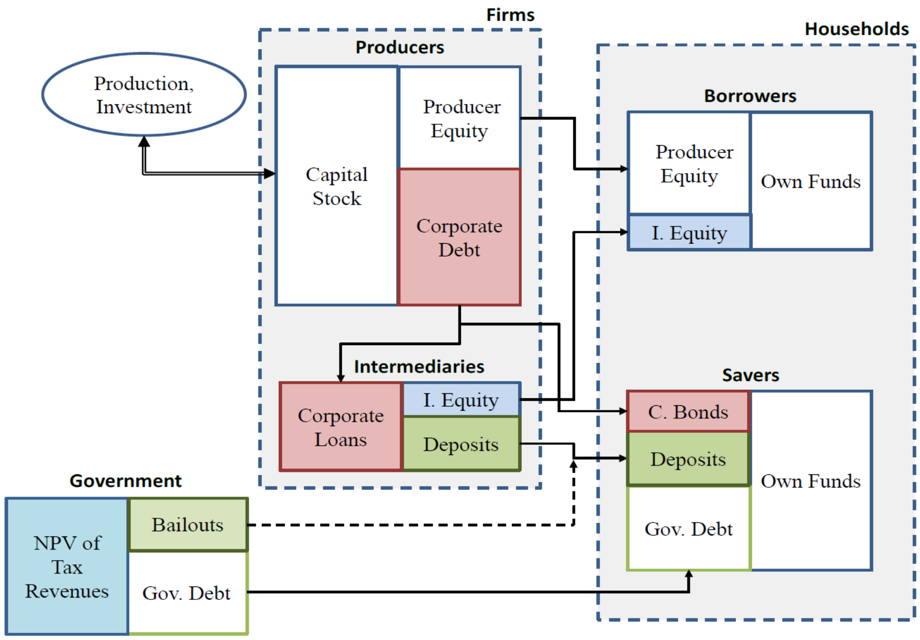
- See Santos and Veronesi (2021) for a habit preferences model with frictionless trading among heterogeneous agents that delivers a SDF that looks like that in an intermediary-AP model, but without shocks to the financial sector.

2.3. Intermediary-based asset pricing with production

- Elenev, Landvoigt, and Van Nieuwerburgh (2021) solve a full-fledged general equilibrium model that embeds an intermediary sector into a macro-economic model with firms and households. Useful to think about *real implications* of intermediation frictions.

- Setup

  - One leveraged financial sector, call them "banks"
  - Banks are owned by risk-averse shareholders
  - Banks face Basel-style regulatory capital constraints, limiting their debt to a certain fraction of the market value of their assets = minimum bank equity capital requirement
  - Banks enjoy government bailout guarantees (deposit insurance, state insurance fund guarantees, too-big-to-fail guarantees). The moral hazard that government guarantees create necessitates regulation on minimum bank equity capital .
  - Banks can raise new equity from their owners but that is costly
  - Leverage and bank equity capital are endogenous objects
  - All shocks originate in the non-financial corporate sector



- Fully calibrated model that generates
  - observed amount of corporate default risk
  - observed credit spread (see credit spread puzzle discussion later in course)
  - observed avg. corporate sector leverage (35%)
  - observed avg. financial sector leverage (90%)
  - realistic macro-economic dynamics
  - rare, severe financial crises with substantial bank bankruptcies and government bailouts

- Financial sector leverage falls in downturns, esp. in financial crises
  - In *financial crises*, banks suffer large credit losses and are forced to shrink, delever, and raise equity to satisfy their regulatory capital constraint. Going forward, banks earn high credit spreads and enjoy cheap costs of debt (deposit rates are ultra low), so they would like to lend. But they are held back by their regulatory capital constraint and by the cost of raising outside equity.
  - In *regular recessions* (not accompanied by a financial crisis), banks are also constrained but the reason for the constraint binding is fundamentally different. Productivity and labor income are temporarily low, and investment opportunities are weak. This reduces corporate loan demand. Savers reduce their demand for safe assets to smooth consumption, and supply of govt debt goes up due to low tax revenue and increased govt spending. Deposit rates are fairly high, making intermediation unprofitable. Low profitability depletes equity capital, and to avoid raising costly external equity banks exhaust their debt capacity.

- Model is used to think about macro-prudential policy. Admati and Hellwig (2015) advocate 30% equity capital requirements for banks, a dramatic increase from the pre-crisis 7%. BIS and Minneapolis Fed reports endorse this proposal. ELVN shows this may not be a good idea.
  - There is a fundamental trade-off between *financial sector stability*, which increases with higher equity capital requirements, and the *size of the economy*, which decreases with higher capital requirements
  - Welfare is maximized around current capital requirements. Depending on how agents are weighted, slightly higher or slightly lower requirements are optimal. Macro-prudential policies redistribute wealth between savers and borrowers.
  - Counter-cyclical capital requirements make savers better off and allow for a Pareto improvement (after transfers)

Figure 5: Effect of tighter capital requirement on size, fragility, and volatility of the economy

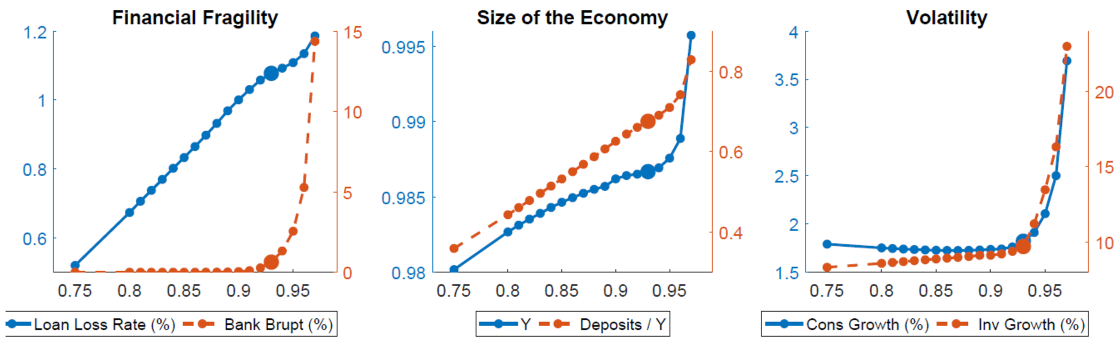
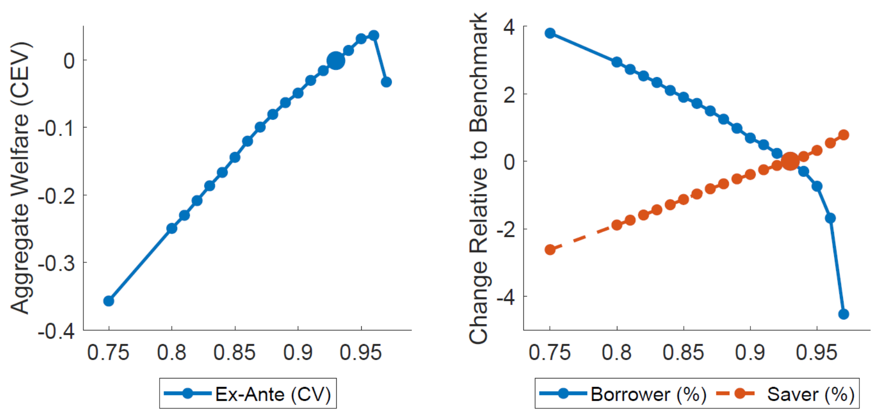


Figure 6: Welfare Across Macro-Prudential Policy Experiments



- Elenev, Landvoigt, and Van Nieuwerburgh (2016) consider a similar setup but with mortgage borrowers instead of non-financial corporate borrowers.
  - Study the role of the underpriced default insurance that Fannie Mae and Freddie Mac sold to the banking sector.
  - Find that this created moral hazard: banks increase mortgage lending, the risk of the mortgages they originate, and their leverage ratios
  - Overall financial system ends up more fragile than without the government guarantees
  - Analyze policy proposals to phase out the GSEs
  - Credit Risk Transfer bonds are a way of getting private sector involved in the residential mortgage credit risk market again
- Greenwald, Landvoigt, and Van Nieuwerburgh (2020) study alternative mortgage design in equilibrium model with borrower and financial intermediary default
  - Interested in *Shared Appreciation Mortgages* that lower mortgage payments for borrowers when house prices fall
  - Have been proposed as a better way of sharing risk in mortgage market and shielding borrowers from adverse effects of financial crises, e.g., Mian and Sufi (2015)
  - Indexing mortgage payments to aggregate/national house prices may wreak financial havoc, reducing welfare
  - Indexing mortgage payments to local/regional prices is welfare-improving for borrowers and savers, but hurts banks