Is Risk Mispriced in a Credit Boom?

Tyler Muir
UCLA Anderson
NBER

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Credit Booms: Increase in Credit to GDP

- Associated with increased fragility, higher chance of crisis (Jordà *et al.*, 2011, Schularick and Taylor, 2012)
- Associated with high asset prices
- Risk mispriced in credit booms? View through asset pricing lens.

Credit Booms and Asset Pricing Literature

- Associated with increased fragility (Jordà *et al.*, 2011, Schularick and Taylor, 2012)
- Associated with high asset prices / low returns / low risk premium
- Results are most similar to Baron and Xiong (2017) who focus on bank equity return mispricing in credit booms (also Baron Muir 2018)
- Broader literature: Krishnamurthy and Muir (2018) Baron and Xiong (2017) Brunnermeier *et al.* (2019) López-Salido *et al.* (2017), many others!

Outline

(Summarize) three facts

1. Credit booms: high asset prices, low future returns
2. Credit booms associated with elevated risk
3. 2+3 $\Rightarrow$ price of risk must be very low in credit booms

Interpretation of facts

- Not driven by standard stories for price of risk (e.g., Campbell Cochrane)
- Consistent with mispricing, though no definitive proof

Past risk as an explanation

- Suggestive: low past risk predicts credit boom, forecasts higher future risk
- One story: agents view world as safe, endogenously take leverage / extend credit, leads to fragility, not reflected in asset prices

Mispricing: Why It's Hard

- Joint hypothesis problem (Fama 1970). Need a model for asset prices. (1) Risks agents should care about (quantity of risk), (2) effective risk aversion in the economy (price of risk)
- Mispricing always relative to a model
- How far can we go? What can we say with weakest assumptions? Stronger assumptions?
- Weakest assumptions: Risk Premium should not be reliably negative (Fama: bubble is a "predictable strong decline" in prices). Risk premium < 0 is mispricing or "bubble"

Asset Pricing Framework

$$(Risk\ Premium)_t = (Price\ of\ Risk)_t \times (Quantity\ of\ Risk)_t$$

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E.g., Merton (1980)

$$E_t[R_{t+1}] - r_{f,t} = \gamma \times \sigma_t^2$$

Is Risk Mispriced in a Credit Boom?

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Findings: in a credit boom,

- $Risk\ Premium_t \downarrow$
- $Quantity\ of\ Risk_t \uparrow$
- Main conclusion: Need $Price\ of\ Risk_t \downarrow\downarrow$

Is Risk Mispriced in a Credit Boom?

$$(Risk\ Premium)_t = (Price\ of\ Risk)_t \times (Quantity\ of\ Risk)_t$$

- $Risk\ Premium_t \downarrow$
  - Credit growth negatively forecasts excess returns for equities, credit, and housing

Is Risk Mispriced in a Credit Boom?

$$(Risk\ Premium)_t = (Price\ of\ Risk)_t \times (Quantity\ of\ Risk)_t$$

- $Quantity\ of\ Risk_t \uparrow$
  - High credit growth positively predicts financial crises, crash in equities, crash in real estate, drop in consumption and GDP

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- $Risk\ Premium_t \downarrow$
- $Quantity\ of\ Risk_t \uparrow$
- $Price\ of\ Risk_t \downarrow\downarrow$
  - Rational? Behavioral? How much can we say?

Data

- Jorda Schularick and Taylor data: 17 advanced economies since 1870, augment with data on credit spreads (Krishnamurthy Muir 2018)
  - Macro: credit, GDP, consumption, financial crisis dates
  - Asset pricing: equities, housing, also add credit spreads (Krishnamurthy Muir 2018)
  - Drop WWI, WWII for this analysis

Fact 1: Low Risk Premiums in Credit Booms

Panel regressions of future 3 year excess returns (above t-bill rate) on lags of credit growth

Country fixed effects, dummy for post war data. Standard errors clustered by country and year. [Follow for all regressions]

Fact 1: Low Risk Premiums in Credit Booms

Panel A: Predicting Equity Excess Returns						
	(1)	(2)	(3)	(4)	(5)	(6)
credit/gdp	-2.01			-1.40		
	(0.98)			(0.91)		
Δ_3(credit/gdp)		-2.26			-2.47	
		(0.71)			(0.80)	
Δ_5(credit/gdp)			-1.99			-2.41
			(0.68)			(0.77)
dividend yield				1.93	2.07	2.13
				(0.37)	(0.41)	(0.40)
N	1,614	1,588	1,561	1,546	1,521	1,496
R-squared	0.05	0.07	0.07	0.10	0.13	0.13

Panel B: Predicting Housing Excess Returns						
	(1)	(2)	(3)	(4)	(5)	(6)
credit/gdp	-1.60			-0.45		
	(0.38)			(0.30)		
Δ_3(credit/gdp)		-0.98			-0.49	
		(0.29)			(0.27)	
Δ_5(credit/gdp)			-1.26			-0.66
			(0.34)			(0.31)
rental yield				1.54	1.54	1.53
				(0.19)	(0.19)	(0.19)
N	1,401	1,384	1,367	1,394	1,377	1,361
R-squared	0.17	0.16	0.17	0.31	0.31	0.31

Fact 1: Low Credit Spreads in Booms
Source: Krishnamurthy and Muir (2018)

	Spreads before a crisis		
	(1)	(2)	(3)
$1_{t-5,t-1}$	-0.23		
	(0.11)		
$1_{t-5,t-1}$ × Severe		-0.43	
		(0.20)	
$1_{t-5,t-1}$ × Mild		-0.18	
		(0.11)	
$1_{t-5,t-1} \times \Delta Credit_{t-1}$			-1.58
			(0.72)
$\Delta Credit_{t-1}$	0.98	0.92	1.18
	(0.58)	(0.52)	(0.70)
ΔGDP_{t-1}	-0.16	-0.18	-0.22
	(1.68)	(1.68)	(1.54)
Observations	621	621	621
R-squared	0.40	0.40	0.40
Country FE	Y	Y	Y
Year FE	Y	Y	Y

Spreads before financial crises 23% lower than normal (non-crisis) periods. Especially low when credit grows.

Fact 2: Higher Quantity of Risk in Credit Booms

Measuring risk:

- Financial crisis dummies
- Use “crash” or “left tail event” as indicator for risk
- Equity return $< -20\%$, real estate return $< -5\%$
- GDP growth $< -2.5\%$, consumption growth $< -2.5\%$
- “Crashes” occur about 10% of time for each series
- Regression of crash over next 3 years on credit growth

Panel A: Predicting Financial Crises						
	(1)	(2)	(3)	(4)	(5)	(6)
credit/gdp	4.94			4.32		
	(1.95)			(2.28)		
Δ_3(credit/gdp)		5.58			6.45	
		(1.26)			(1.24)	
Δ_5(credit/gdp)			4.58			5.51
			(1.16)			(1.22)
dividend yield				0.10	-0.31	-0.25
				(1.05)	(1.04)	(1.07)
rental yield				-1.55	-1.96	-1.94
				(0.82)	(0.83)	(0.82)
N	2,114	2,030	1,978	1,531	1,499	1,481
R-squared	0.06	0.08	0.07	0.07	0.10	0.09
Panel B: Predicting Equity Crashes						
credit/gdp	10.00			7.11		
	(4.87)			(4.78)		
Δ_3(credit/gdp)		7.23			8.41	
		(2.68)			(2.87)	
Δ_5(credit/gdp)			4.65			5.84
			(2.03)			(2.39)
dividend yield				-7.56	-8.14	-8.35
				(1.63)	(1.81)	(1.80)
N	1,671	1,645	1,618	1,598	1,573	1,548
R-squared	0.08	0.08	0.08	0.12	0.12	0.12
Panel C: Predicting Housing Crashes						
credit/gdp	9.16			0.85		
	(4.51)			(4.75)		
Δ_3(credit/gdp)		12.11			8.71	
		(3.37)			(3.63)	
Δ_5(credit/gdp)			13.77			9.63
			(3.75)			(4.06)
rental yield				-11.37	-10.72	-10.89
				(3.27)	(3.29)	(3.33)
N	1,445	1,428	1,411	1,438	1,421	1,405

Panel A: Predicting GDP Declines						
	(1)	(2)	(3)	(4)	(5)	(6)
credit/gdp	3.50			1.28		
	(3.73)			(4.04)		
Δ_3(credit/gdp)		5.41			4.51	
		(2.54)			(2.73)	
Δ_5(credit/gdp)			5.02			3.97
			(2.35)			(2.72)
dividend yield				0.47	0.27	0.20
				(1.74)	(1.71)	(1.86)
rental yield				-2.94	-2.75	-3.09
				(1.75)	(1.82)	(1.82)
N	1,882	1,853	1,824	1,412	1,396	1,382
R-squared	0.16	0.17	0.18	0.14	0.15	0.16
Panel B: Predicting Consumption Declines						
	(1)	(2)	(3)	(4)	(5)	(6)
credit/gdp	4.67			0.90		
	(3.86)			(4.50)		
Δ_3(credit/gdp)		6.70			6.09	
		(3.09)			(3.46)	
Δ_5(credit/gdp)			6.32			4.77
			(3.97)			(4.77)
dividend yield				3.27	3.35	3.12
				(1.51)	(1.41)	(1.48)
rental yield				-5.41	-4.94	-5.22
				(2.51)	(2.31)	(2.33)
N	1,825	1,799	1,772	1,389	1,373	1,359
R-squared	0.23	0.23	0.23	0.23	0.24	0.24

Fact 3 = Fact 1 + Fact 2: Price of Risk Very Low in Credit Booms

$$(Risk\ Premium)_t = (Price\ of\ Risk)_t \times (Quantity\ of\ Risk)_t$$

- $Risk\ Premium_t \downarrow$: Credit growth $\uparrow$ 1 std dev $\Rightarrow$ risk premium about half of normal

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- $Quantity\ of\ Risk_t \uparrow$: Crash prob about double normal

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- $Quantity\ of\ Risk_t \uparrow$: Crash prob about double normal
- $\Rightarrow Price\ of\ Risk_t \downarrow\downarrow$
  - Price of risk very low in credit booms. Rational or mispricing?

Smoking Gun?

Fama: bubble is a "predictable strong decline" in prices.
Idea: under rational model price of risk ≥ 0, so risk premium < 0 is a mispricing or "bubble"

Are risk premiums *negative* in credit booms?

Average excess returns on equities and housing conditional on credit growth > 90th percentile

Equities: -1.0% ($t = -0.60$)
Housing: 1.5% ($t = 1.80$)

Credit spread: about 75% of normal times

Fact 3: Price of Risk Low in Credit Booms

Explained by rational models?

Campbell and Cochrane (1999): time-varying risk aversion based on past consumption. Empirical results unchanged if control for many lags past GDP and/or consumption in predictive regressions.

Not changed if control for consumption volatility, etc. Previous results suggest a rational rare disaster or long run risk model will not easily explain evidence.

Hence no evidence standard rational models easily explain

Fact 4: Sharp Reversal of Risk Premium in a Crisis

	(1) Dividend Yield	(2) Rental Yield	(3) Credit Spread
Crisis Past 5 Years	0.28	0.15	0.31
	(0.10)	(0.13)	(0.13)
Observations	1,628	1,437	682
R-squared	0.31	0.57	0.14

Not easily explained by consumption / GDP behavior: other episodes where Cons/GDP fall (e.g. wars) and risk premium doesn't rise nearly as much

What Explains the Low Price of Risk?

Behavioral: past returns, e.g., extrapolation. See high returns, expected future returns to be high, leads to low price of risk due to bias.
Barberis et al (2015), Malmendier and Nagel (2011)

Behavioral: past risk. See world as safe, view quantity of risk low, demand low risk premium, take leverage and extend credit $\Rightarrow$ fragility going forward so that quantity of risk rises

Drivers of Credit Boom: LHS = future credit growth

	(1)	(2)	(3)	(4)
Past GDP growth	0.58		0.73	0.49
	(0.46)		(0.48)	(0.46)
Past Equity Returns	0.10		0.08	0.11
	(0.07)		(0.08)	(0.07)
Past Housing Returns	-0.14		-0.11	-0.10
	(0.19)		(0.18)	(0.18)
Past GDP Volatility		0.08	-0.39	
		(0.39)	(0.41)	
Past Equity Volatility		-1.91	-1.63	
		(0.79)	(0.75)	
Past Housing Volatility		-13.52	-3.75	
		(20.11)	(21.34)	
Past Equity Crash				-0.03
				(0.02)
Past Housing Crash				-0.06
				(0.02)
Past Financial Crisis				-0.09
				(0.02)
Observations	1,275	1,275	1,275	1,275
R-squared	0.09	0.09	0.10	0.13

Story Based on Past Risk

- Agents see low past risk, view world as safe
- Extend credit, take leverage, $\Rightarrow$ credit boom
- *Ignore* equilibrium effects on quantity of risk (more fragility due to more leverage)
- $\Rightarrow$ Low past risk implies low risk premium, but *higher* quantity of risk going forward through endogenous risk taking. Agents ignore, think risk low. $\Rightarrow$ Price of risk appears low due to mistake. Conditional on crisis, realize quantity of risk is high, price of risk jumps.

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- Extend credit, take leverage, ⇒ credit boom
- *Ignore* equilibrium effects on quantity of risk (more fragility due to more leverage)
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Gennaioli *et al.* (2012), Moreira and Savov (2014), Minsky (1977), Kindleberger and Aliber (2011), and Reinhart and Rogoff (2009)

Caveat: nothing here causal, see Gomes *et al.* (2018), Santos and Veronesi (2018) for frictionless views

Conclusions

Credit booms: low risk premium, higher risk

- Credit growth *negatively* forecasts returns, *positively* forecasts risk. Major reversal in crises.
- No smoking gun of mispricing a la Fama
- But, not easily explained in rational model
- Need a model which fits these facts
- One possibility: extrapolating from past risk, generates endogenous fragility through risk taking, high chance of future crash despite low risk premium

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