Counterparty Risk: Implications for Network Linkages and Asset Prices

Fotis Grigoris, Yunzhi Hu, Gill Segal   2021

叶鑫   2021/07/22

Background & Motivation

- The amount of credit a lender extends to a borrower in the network depends on the risk of each agent and the macroeconomy. Consequently, credit should convey important information about firm- and aggregate-level fundamentals.

- Trade credit is among non-financial firms' largest sources of short-term financing, and consequently, plays a key macroeconomic role.

- Motivated by this intuition, we study the implications of credit provision for micro- and macro-level risks and for network linkages, using trade credit in production networks as a laboratory.

Research question

1. Does offering trade credit increase a supplier's exposure to operating and counterparty risks?

2. How does trade credit relate to macroeconomic risk?

3. Can trade credit provide information on suppliers' trade counterparties (i.e., customers), such as their quality?

4. Do changes in trade credit affect the strength of supplier-customer links, and the production network's density?

Research Contents

- First, we find that trade credit is an important determinant of firms' risk profiles. Firms that extend more trade credit, and have higher ratios of receivables-to-sales (henceforth R/S), earn a significantly lower risk premium(7% p.a.) .

- Second, trade credit impacts the dynamics of supplier-customer links. At the micro-level, high R/S firms have longer duration links to their customers. At the macro-level, aggregate trade credit positively predicts the density of the production network.

- Third, to reconcile the first two findings we establish a novel link-duration spread: firms that have longer-lived relationships with their customers command lower expected returns.

Related Literature and Innovation

- Dou, Ji, Reibstein, and Wu (2019) show that the departure of key talent affects the fragility of supplier-customer links.
  - ➢ We highlight that trade credit affects the durability of these links.

- Ahern (2013) shows that industries with a higher eigenvalue centrality earn higher expected returns, while Gofman (2020) show that upstream earn higher expected returns than downstream firms.
  - ➢ We confirm that the counterparty premium is not explained by network centrality and is positive and significant within all layers of the production network..

- Cohen and Frazzini (2008) and Menzly and Ozbas (2010) examine the predictability of stock returns using supplier-customer links.
  - ➢ We show that supplier-customer links are predictable via trade credit.

Research Data

- Our sample includes all public firms in the CRSP/Compustat universe, excluding financial firms and public utilities.
  - ➢ We focus on the years ranging from 1978 to 2016 because data on trade receivable is sparse prior to 1978.
- We obtain Fama and French 3- and 5-factor and Carhart(1997) 4- factor data from the data library of Kenneth French.

- Firm-level data on supplier-customer relationships is obtained from the FactSet Revere database which provides comprehensive coverage of inter-firm links.
  - ➢ Importantly, by reporting both the start and end date of each supplier-customer link, the FactSet data allows us to measure link duration.

Empirical Fact 1: Trade credit and risk premium

- We measure the extent of trade credit provision for firm i in year t by scaling the firm's trade receivables by its sales:

$$R/S_{i,t} = \frac{\text{Trade receivables}_{i,t}}{Sales_{i,t}} \qquad (1)$$

- At the end of each June from 1978 to 2016, we sort firms into portfolios based on the value of R/S in the fiscal year ending in calendar year t−1.

- We form three portfolios on each sort date. The low (high) R/S portfolio includes all firms whose R/S ratio is at or below (above) the 10th (90th) percentile of the R/S ratios. The low and high R/S portfolios are well-diversified, with each containing about 340 firms.

Portfolio in	Portfolio in year $t+1$		
year t	Low	Medium	High
Low	0.849	0.129	0.022
Medium	0.015	0.948	0.037
High	0.018	0.372	0.610

Empirical Fact 1: Trade credit and risk premium

- By and large, there is an inversely monotonic relation between average returns and R/S.
- Moreover, we find an economically and statistically significant spread between the returns of low and high R/S firms.

Portfolio	Value-weighted			Equal-weighted	
	Mean	SD		Mean	SD
Low R/S	1.185	5.029		1.191	6.348
Medium	1.062	4.545		1.286	6.122
High R/S	0.589	5.981		0.744	7.476
Spread (L-H)	0.597 (2.95)	4.128		0.448 (2.28)	3.439

- And our results are robust to alternative choices of portfolio breakpoints (30%，70%).

	Mean	SD
Low R/S	1.129	4.292
Medium	1.050	4.571
High R/S	0.871	5.451
Spread (L-H)	0.259 (2.09)	2.498

Empirical Fact 1 : The resource of counterparty premium

- We examine whether the counterparty premium is explained by 5 common unconditional factor models: CAPM, FM 3- and 5-factor, the Carhart (1997) 4-factor model, Hou(2015) q-factor.
- The results show that the monthly α's obtained from these projections are always greater than 0.49% per month and statistically significant.
- Common empirical asset-pricing models fail to explain the counterparty premium.

	(1)	(2)	(3)	(4)	(5)
MKTRF	-0.312	-0.308	-0.288	-0.256	-0.276
	(-6.13)	(-6.03)	(-5.45)	(-5.02)	(-5.08)
SMB		0.035	0.025	0.132	0.154
		(0.47)	(0.34)	(1.64)	(2.35)
HML		0.053	0.096	-0.050	
		(0.56)	(1.09)	(-0.51)	
MOM			0.107		
			(1.84)		
Profit.				0.367	0.322
				(3.40)	(2.88)
Invest.				0.138	0.181
				(1.06)	(1.55)
α	0.798	0.775	0.684	0.585	0.487
	(4.07)	(3.97)	(3.57)	(3.06)	(2.56)

Empirical Fact 1 : Counterparty premium: a puzzle?

- From the perspective of financial statement analysis, high R/S firms are typically perceived as having low operating efficiency, and as potentially having high exposures to shocks that deteriorate their customers' financial conditions.

- However, the fact that they command lower risk premia suggests that high R/S firms are, in fact, safer than low R/S firms.

- On the other hand, endogenously riskier firms may choose to extend less trade credit, but the source of risk (i.e., the type of systematic shock) that renders low R/S firms riskier remains unclear.

- In particular, we show that the counterparty premium is not explained by common macroeconomic pricing factors.

Empirical Fact 1 : Trade credit and macroeconomic factors

- Consequently, counterparty risk may be a distinct determinant for investors' stochastic discount factor (SDF) and stock prices.

- We examine this possibility by evaluating whether a counterparty risk factor is priced in the cross-section of stock returns.

$$M_t = 1 - b' f_t - b_{CPR} CPR_t \quad (2)$$

- We measure the counterparty risk factor using the spread between the value-weighted returns of the portfolio that buys high R/S firms and sells low R/S firms.

- f is a k*1 column vector that contains either the excess market return only, or the Fama and French (1993) three factors. All factors underlying the equation are demeaned.

- We estimate the risk factor loadings in equation (2) by generalized method of moments(GMM) using the following set of moment conditions:

$$E[M_t r_{i,t}^e] = 0$$

- $r_{i,t}^e$ denotes the excess return of test asset i at time t.

Empirical Fact 1 : Trade credit and macroeconomic factors

- First, we estimate the risk factor loadings using 25 value-weighted portfolios double sorted on size and book-to-market.
- We then add the test assets with the Fama-French 17 value-weighted industry portfolios (42).
- Third, We add the test assets with 10 portfolios sorted on each of investment and momentum (62).

- The GMM evidence suggests that a counterparty risk factor is priced in the cross-section of returns, and carries a negative market price of risk.

	Panel B: Four-factor model					
	25 portfolios		42 portfolios		62 portfolios	
	FF3F	+CPR	FF3F	+CPR	FF3F	+CPR
b_M	3.988	9.313	4.042	5.022	3.952	5.481
$t(b_M)$	(3.14)	(4.74)	(3.29)	(3.79)	(3.36)	(4.34)
b_S	1.489	1.190	0.372	0.673	0.181	0.534
$t(b_S)$	(0.87)	(0.61)	(0.22)	(0.40)	(0.11)	(0.32)
b_H	6.375	4.777	4.991	4.992	4.385	4.138
$t(b_H)$	(3.62)	(2.18)	(2.85)	(2.75)	(2.52)	(2.36)
b_{CPR}		-17.803		-3.589		-5.331
$t(b_{CPR})$		(-4.08)		(-2.27)		(-3.52)
MAE	0.608	0.478	0.728	0.708	0.775	0.737

Empirical Fact 2 : Network characteristics

We check whether high and low R/S firms differ in terms of key network-based characteristics：

- Prior papers have established that network (eigenvalue) centrality, upstreamness customer concentration and volatility are associated with risk premia.
- In addition, we also consider another overlooked characteristic: the average duration (in months) of a suppliers' links with its existing customers.

High R/S firms are typically more upstream producers than low R/S firms. However, this cannot explain the counterparty premium as Gofman et al. (2020) show that more upstream firms earn higher returns.

	Low (L)	Medium	High (H)	Diff(L-H)	t(Diff)
Centrality	0.31	0.44	0.42	-0.11	(-0.91)
Upstreamness	1.65	2.74	3.03	-1.38	(-15.34)
HHI (Customer)	0.17	0.35	0.24	-0.07	(-1.03)
IVOL (Customer)	1.47	1.49	1.24	0.24	(1.15)
Duration	39.60	46.69	47.98	-8.38	(-2.68)

Empirical Fact 2 : Link duration and trade credit

- We estimate Fama-MacBeth regressions utilize supplier-level characteristics to predict (1) the expected duration of a supplier's links with its customers, and (2) the probability that supplier-customer links break.

$$D_{s,t} = const + \beta X'_{s,t} + \epsilon_{s,t} \quad \forall\, t \in \{2003, \ldots, 2016\} \;\; (4)$$

- We use two measures for $D_{s,t}$:
  - ➢ (1) the average life of a supplier's existing links going forward (in months).
  - ➢ (2) an indicator variable that identifies the event in which the links between the supplier and its current customers break in the future. Specifically, the indicator takes on a value of one if 50% of the supplier's links that exist in year t do not survive until year t+3.

- $X'_{s,t}$ include the R/S ratio, the natural logarithm of the supplier's market value, investment rate, and profitability. Each predictor is scaled by its unconditional standard deviation for ease of interpretation.

Empirical Fact 2 : Link duration and trade credit

- The left side of the table shows that increases in the amount of trade credit offered are associated with longer lived supplier-customer relationships.

- A one standard deviation increase in R/S extends the expected link duration by about five months.

- The right side of the table yields similar results, showing that increases in R/S reduce the probability of supplier-customer links breaking.

- A one standard deviation increase in a supplier's R/S reduces the likelihood of links breaking by 9%.

	Future duration		Pr (Break = 1)	
Constant	55.62	56.70	0.58	0.57
	(11.49)	(11.38)	(23.32)	(25.76)
R/S	4.69	5.86	-0.09	-0.09
	(3.59)	(3.66)	(-3.11)	(-3.98)
SIZE		-2.20		-0.01
		(-5.15)		(-0.34)
I/K		-2.84		0.01
		(-1.94)		(0.88)
ROA		2.82		-0.04
		(3.61)		(-3.36)

Empirical Fact 2 : Production network analysis

- The aggregation of equation (4) across all firms implies that the average level of trade credit should positively predict the density of the production network.

- To test this conjecture we project the future density of the production network on the average level of R/S across all firms:
$$Density_{t+k} = const + \beta_{rs}\,\overline{R/S_t} + \beta_{IP}\Delta IP_t + \beta_d Density_t + \eta_t$$

- $Density_t$ is the density of the production network at quarter t, defined as the ratio of observed-to-potential links in the network.

- ΔIP_t is the quarterly log-growth rate of industrial production.

- Each independent variable is normalized by its standard deviation and, for ease of interpretation, we divide each slope coefficient by the unconditional mean of network density.

Empirical Fact 2 : Production network analysis

- Consistent with the above conjecture, a one standard deviation increase in aggregate R/S predicts the one-quarter ahead network density will rise by about 4% relative to density's mean.

- The predictive power of the aggregate R/S ratio is economically sizable and statistically significant up to five-quarters ahead.

- Furthermore, the economic significance of trade credit is of the same magnitude as that of lagged density.

	1Q ahead		3Q ahead		5Q ahead		7Q ahead	
R/S	0.06	0.04	0.05	0.03	0.06	0.05	0.04	0.04
	(3.25)	(4.25)	(2.53)	(2.50)	(2.67)	(2.75)	(1.42)	(1.48)
Density		0.07		0.06		0.03		0.01
		(13.82)		(5.29)		(1.98)		(0.34)
IP		0.00		-0.02		-0.01		0.01
		(0.28)		(-1.85)		(-0.53)		(0.37)
R^2	0.17	0.83	0.09	0.51	0.13	0.20	0.03	-0.01

Reconciling facts 1 and 2: the link duration premium

- Our empirical results have shown that low R/S firms have higher expected return (Fact 1) and lower duration links with their customers (Fact 2).

- We reconcile these two facts jointly to see whether the differences in link duration can explain the counterparty premium by establishing a novel "link duration" premium.

- We conduct a univariate portfolio sort using the link duration characteristic:
    - ➤ First, the sorts begin in April 2003 instead of June 1978, given the availability of FactSet data.
    - ➤ Second, we rebalance the portfolios monthly.

Reconciling facts 1 and 2: the link duration premium

- Suppliers that maintain shorter-lived links with their customers earn average value-weighted returns that are 0.98% per month higher than those earned by suppliers that maintain longer-lived links.

- This link duration premium is aligned with the R/S spread, as low R/S firms maintain low duration links.

- This suggests that the economic origin of the counterparty premium is potentially related to the duration of supplier-customer links.

|	Panel A: Univariate sort on link duration	
Portfolio	Mean	SD
Low (L)	2.005	2.005
Medium	0.860	3.795
High (H)	1.021	1.021
Spread	0.984	2.533
(L-H)	(4.26)	

Reconciling facts 1 and 2: the link duration premium

- We examine this possibility by conducting a conditional portfolio double sort analysis.

- The R/S spread is close to 1% per month among low link duration suppliers, but is insignificant at the 10% level. The R/S spread is qualitatively negative within the medium link duration portfolio, and is statistically indistinguishable from zero among high link duration suppliers.

- These results show the link duration effect crowds out the counterparty premium.

Panel B: Controlling for duration				
	Low Dur.	Medium	High Dur.	
Low R/S	2.28	0.82	1.49	
Medium	1.97	0.84	0.98	
High R/S	1.30	0.83	1.02	
Spread	0.98	-0.02	0.47	Joint test
(L-H)	$(p = 0.11)$	$(p = 0.52)$	$(p = 0.20)$	$(p = 0.61)$

Mechanism: Lower R/S firms are riskier

- First, low R/S firms are more likely to search for a new customer next period, and therefore have a larger exposure (in absolute value) to systematic shocks that govern the cost of searching for a new counterparty.

- Second, low R/S firms are matched with lower quality customers. Consequently, low R/S firms have higher operating risks than high R/S firms that are typically matched to more productive customers.
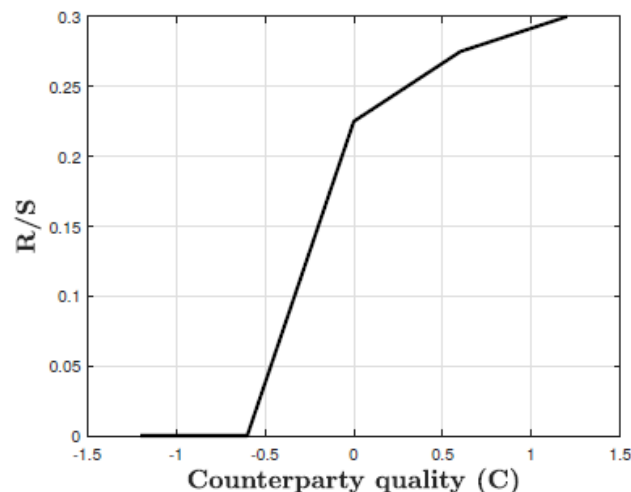
Conclusion

- We document three novel facts: First, low R/S firms earn a higher risk premium. Second, R/S is an economically important and statistically significant predictor of the average duration of supplier-customers links. Third, low link duration firms earn a higher risk premium.

- Consequently, low R/S firms have higher operating risks than high R/S firms that are typically matched to more productive customers. The model delivers the prediction that low R/S firms have lower link duration with their counterparty.

- In all, the empirical and theoretical evidence suggests that trade credit contains valuable information for both risk and for the dynamics of the production network.

Summary

- This paper studies the relation between trade credit, risk, and the dynamics of production network linkages. We find that firms that extend more trade credit earn 7% p.a. lower risk premia, and maintain longer relationships with their customers. Moreover, suppliers with longer-duration links to their customers command lower expected returns.

- Using a production-based model, we quantitatively explain these facts. Trade credit helps to hedge customers against liquidity risks, thereby reducing suppliers' exposures to costs incurred in finding new customers.

- Overall, trade credit is informative about the lifespan of supplier-customer links, the production network's density, and macroeconomic risk.

2021/7/22