

What Drives Repo Haircuts? Evidence from the UK Market

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The views expressed in this paper are those of the authors, and not necessarily those of the Bank of England.



Motivation

- Understanding the repo market. Total size of the market: more than 15 trillion Euro (ICMA, 2013)
 - Institutions
 - Funding patterns
 - Pricing
- Importance of the repo market and its contribution to the systemic risk of the financial system
 - 2008 crisis
 - Little is known about haircuts, collaterals and counterparties due to the OTC nature of repo transactions

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Repo as Collateralised Borrowing

Collateralised borrowing

- is an ancient financial institution.
 - Pawnshop loan records from China circa 662-689 A.D with silk garments as collateral (Goetzmann and Rouwenhorst (2005), The Origin of Wealth).
- serves an important economic function.
 - has been used for a long time, and under very different institutions
 - One rationale: Collateral helps to mitigate information frictions.
- Repo haircut: $h = 1 - F/C$ with collateral value C and notional amount F . E.g., if a borrower receives \$98 against \$100 value of collateral, the haircut is 2%.

Relation to the Literature

- Theoretical studies
 - Difference of opinion approach: Geanakoplos (1997), Fostel and Geanakoplos (2012), Simsek (2013)
 - Contractual and/or information frictions: Dang et al. (2013), Gottardi et al. (2017), Ozdenoren (2018)
 - Runs in the repo market: Acharya et al. (2011), Martin et al. (2014), Gorton and Orodneez (2014)
- Empirical studies
 - US: Adrian and Shin (2010), Copeland (2010), Gorton and Metrick (2012), Adrian et al. (2013), Krishnamurthy et al. (2014). Mostly tri-party market
 - Europe: Mancini et al. (2016)
- Our paper is the only one that covers a significant part of a bilateral repo market

Outline

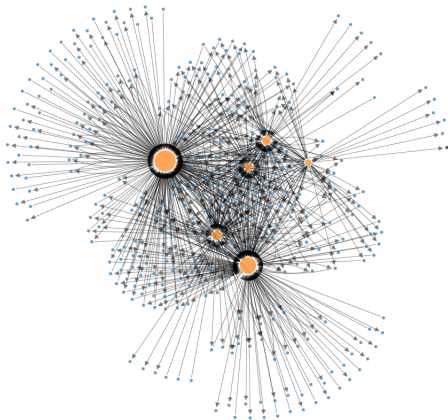
- 1 Introduction
- 2 Data
- 3 Hypotheses
- 4 Determinants of haircuts
- 5 Conclusion

Regulatory Data

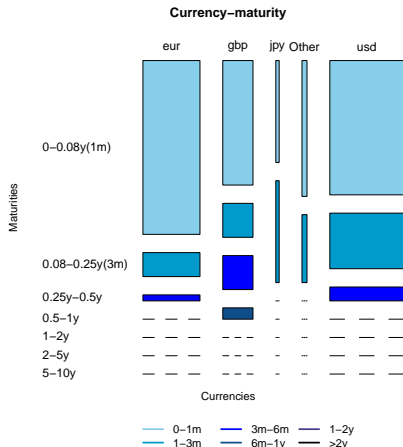
Repo books of 6 banks at the end of 2012. Major players in the UK repo market

- £511 billion which is about 24% of the total reported repo activities (£2.1 trillion)
- gross notional, maturity, currency, and counter-party
- haircuts and collaterals
- reverse repo (REVR) – the 6 banks lend; and repo (REPO) – the 6 banks borrow
- 27,886 transactions.

Network Flows



Maturity-currency split (Number of contracts)



Maturity

	REVR		REPO		Net (bn £)
	Value (bn £)	Percent	Value (bn £)	Percent	
A. Maturity					
Overnight	23.5	9.6%	-39.1	14.7%	-15.6
<3m	140.7	60.0%	-130.7	48.6%	10.0
3m-1y	65.8	26.9%	-78.1	29.2%	-12.3
1y-5y	8.0	3.3%	-18.5	6.9%	-10.5
5y+	0.0	0.0%	-1.7	0.6%	-1.6
Total	244.2	100.0%	-267.0	100.0%	-22.8

Counterparty

	REVR		REPO		Net
	Value	Percent	Value	Percent	
Reporting bank	8.2	3.4%	-10.2	3.8%	-2.0
Other banks	29.3	12.0%	-43.6	16.3%	-14.3
Broker-Dealers	15.0	6.1%	-15.8	5.9%	-0.8
Hedge Fund	15.1	6.2%	-15.5	5.8%	-0.4
MMFs	0.0	0.0%	-1.9	0.7%	-1.9
Asset Managers	11.5	4.7%	-8.3	3.1%	3.2
CCP	145.5	59.6%	-131.3	49.3%	10.4
Insu and Pension	9.5	3.9%	-8.5	3.2%	1.0
Gen. bank and Govt	5.5	2.3%	-28.6	10.7%	-23.0
Other	4.4	1.8%	-2.8	1.0%	1.6

Collateral

	REVR		REPO		Net
	Value	Percent	Value	Percent	
US govt	10.9	6.0%	-5.4	2.9%	5.5
UK govt	83.1	45.8%	-111.7	59.1%	-28.6
Germany govt	25.5	14.0%	-19.1	10.1%	6.4
France govt	16.9	9.3%	-7.2	3.8%	9.7
GIIPS	4.1	2.2%	-4.4	2.3%	-0.3
Other sovereign	31.6	17.4%	-16.0	8.4%	15.7
Corporate	7.5	4.1%	-11.7	6.2%	-4.2
Securitisation	2.0	1.1%	-13.5	7.1%	-11.5
Other	0.0	0.0%	0.0	0.0%	0.0

Currency

	REVR		REPO		Net
	Value	Percent	Value	Percent	
GBP	110.2	45.1%	-149.8	56.1%	-39.6
EUR	90.6	37.1%	-86.7	32.5%	4.0
USD	30.5	12.5%	-26.8	10.0%	3.7
JPY	6.0	2.5%	-1.6	0.6%	4.4
Other	6.9	2.8%	-2.1	0.8%	4.8

Average (Value-Weighted) Haircut

	REVR	REPO
US govt	0.4%	0.0%
UK govt	1.0%	0.4%
Germany govt	0.1%	0.1%
France govt	0.1%	0.1%
GIIPS	0.2%	0.1%
Other sovereign	1.1%	0.2%
Corporate debt	1.1%	0.6%
Securitisation	0.5%	0.8%
Overall average	1.2%	0.7%

Summary stats of the data

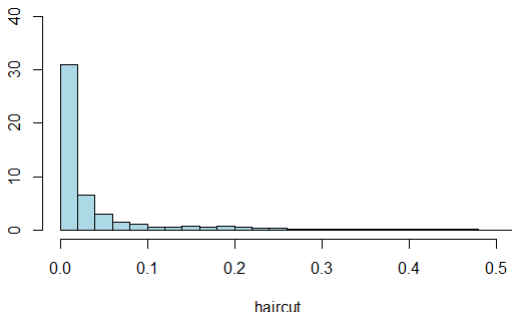
- Over 69% less than 3m and 27% at 3m-1yr maturity
- The 6 banks are net borrowers. They are able to borrow at a lower haircut compared to the one they charge for the same type of collateral
- Borrow
 - from central banks and governments, other banks, money-market funds
 - overnight, and longer than 3 months
 - using UK govt debt, securitisation
- Lend
 - to CCPs, other asset managers, insurance companies and pension funds
 - less than 3m
 - using non-UK sovereign bonds (mostly Others, French, US)

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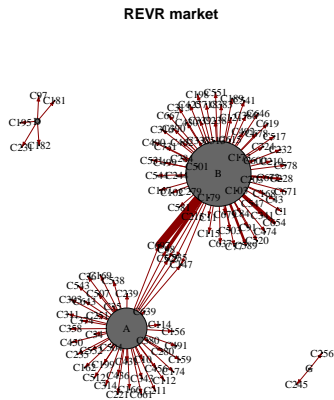
Zero Haircuts

- 35% of the whole sample are 0 haircuts
- most contracts are overnight (more than 70%)
- vast majority of contracts are with other banks and are denominated in EUR. Important borrower-lender relationships



Zero-haircut network for REVR

Edge thickness – number of zero-haircut trades between two given nodes. Node size – number of zero-haircut deals involving the node



Hypotheses

- 1 Hypothesis 1 (collateral quality): The repo haircut is larger when the collateral is of lower quality and/or illiquid
- 2 Hypothesis 2 (counterparty types): The repo haircut is larger when the counterparties in the contracts are from different lines of business.
- 3 Hypothesis 3 (counterparty's quality): The repo haircut is larger when the default probability (credit quality) of borrower is higher (lower), or when the borrower is better privately informed about the quality of the collateral.

Hypotheses

- 4 Hypothesis 4 (lender's quality and liquidity): The repo haircut is larger when the default probability and/or liquidity need of the lender is higher.
- 5 Hypothesis 5 (bilateral relationship): Haircuts are lower for bilateral parties with banking relationship.
- 6 Hypothesis 6 (portfolio repos): Risky assets in a portfolio repo with safe assets have lower haircut than purely risky asset repos.

Empirical Specifications of Haircut Regressions

- OLS
- Tobit
- Logistic transformation:

$$\log \left(\frac{0.01 + \text{haircut}}{1 - 0.01 - \text{haircut}} \right)$$

- Excluding CCPs versus including CCP
- Independent variables: Deal specific, collateral, counter-party, network variables
- Currency FE
- Bank FE (when network variables are not used)
- Bank-Counterparty FE to capture special relationships

Test 1 (collateral quality)

Hypothesis: haircut is larger when the collateral is of lower quality and or illiquid. Collateral quality measured using:

- VaR. 1 sd increase raises the haircut by 5-9 bps
- collateral rating. One unit decrease in rating increases the haircut by 8-12 bps
- asset types. Securitised collateral increases haircut by 20-64 bps
- transaction maturity. 1 sd increase raises the haircut by 83-103 bps
- collateral concentration increases the haircut by 6-8 bps but is less significant

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Test 2 (counterparty types)

Hypothesis: haircut is larger when the counterparties in the contract are from different lines of business

- define a dummy variable for all non-bank counterparties (broker-dealers, hedge funds, etc.)
- all these counterparties are from different lines of business compared to the six reporting banks
- haircut increases by 9-13 bps in the reverse repo market and by 6-7 bps in the repo market
- this evidence supports the difference in opinion framework as well as the adverse selection framework

OLS REVR



Test 3 (counterparty's quality)

Hypothesis: haircut is larger when the default probability of borrower is higher

- riskier counterparties are charged a higher haircut
 - one unit decrease in borrower rating leads to 8-21 bps increase in haircut
 - 1 sd increase in leverage leads to 53-79 bps increase in haircut
 - hedge funds are charged massively higher haircuts (99-157 bps more)
 - higher counterparty CDS increases the haircut but the effect is less significant
- collateral quality can overshadow counterparty characteristics

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OLS REVR

Test 4 (lender's quality and liquidity)

Hypothesis: haircut is larger when the default probability and/or liquidity need of lenders is higher

- mixed evidence
 - estimates for lender's rating are marginally significant but positive (higher rating–higher haircut), which goes against the hypothesis
 - estimates for lender's cash ratio are insignificant

OLS REVR

Test 5 (bilateral relationship)

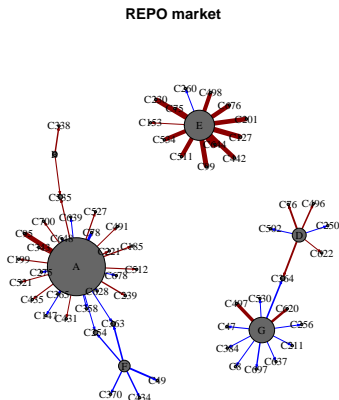
Hypothesis: haircut is lower for bilateral parties with banking relationship

- use bank-counterparty interaction dummies to proxy for special relationships
- percentage of significant interaction dummies:

Significance level	REVR	REPO
10%	68.1%	57.0%
5%	60.6%	50.6%
1%	49.7%	34.2%

Test 5 (bilateral relationship). REPO, 1% significance level

Red—negative estimate, blue—positive. Edge thickness—magnitude of the estimate. Node size—number of significant interactions involving the node



Test 6 (portfolio repos)

Hypothesis: Risky assets in a portfolio repo with safe assets have lower haircut than purely risky asset repos

- lower-rated assets in a portfolio with a safe asset (AAA) have a lower haircut compared to the same assets in a standalone arrangement
- combining a risky asset with a safe one reduces the haircut on average by 5-16 bps
- lower-rated counterparties and hedge funds are more likely to bundle assets in such portfolios

OLS REVR

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OLS REVR

Network Effects

- use principal component of the unweighted and weighted centrality measures
- banks with higher centrality measures ask for lower haircuts as lenders and pay lower haircuts on repos

OLS REVR

Conclusion

- We study what variables determine repo haircuts
- Collateral quality measured by VaR, asset type, and transaction maturity has a first order importance in setting haircuts
- Banks charge higher haircuts when they transact with non-bank institutions (particularly, hedge funds)
- Riskier counterparties are charged a higher haircut
- Combining a risky asset with a safe one reduces the haircut
- Important network effects and special relationships

Regression Table – OLS REVR

OLS REVR		back					
Category	Variable	(1)	(2)	(3)	(4)	(5)	(6)
Deal var	notional	0.003	0.004**	0.006**	0.007**	0.009**	0.009***
	maturity	0.095***	0.103***	0.090***	0.083***	0.097***	0.091***
Collateral var	collrating	-0.008***	-0.012***	-0.008***	-0.007***	-0.011***	-0.011***
	collmaturity	-0.001	0.002	-0.0004	0.001	0.002	0.004**
	corpdebt	-0.008*	-0.009*	-0.013*	-0.011*	-0.015*	-0.012*
	securitisation	0.036***	0.020**	0.064***	0.057***	0.052***	0.046***
	VaR	0.005**	0.005***	0.005**	0.005*	0.005**	0.005**
	asset in safe portf	-0.005*	-0.006**	-0.015***	-0.015***	-0.016***	-0.016***
Cpty type	brokerdealers	0.003	0.007	-0.020***	-0.024***	-0.014**	-0.027***
	hedgefund	0.139***	0.099***	0.157***	0.134***	0.140***	0.111***
	othermanager	0.022**	0.009	0.028**	0.023**	0.031**	0.022**
	insur&pension	0.006	-0.003	-0.026***	-0.032***	-0.023***	-0.033***
	cb&govt	0.008	0.019**	-0.024***	-0.023***	-0.017***	-0.012*
	other	0.017***	0.005	-0.009*	-0.003	-0.009	-0.006
Cpty var	cptysize		-0.093**			-0.139**	-0.134**
	cptyroa		-0.003			-0.017***	-0.010***
	cptyrating		-0.021***			-0.008***	-0.011***
	cptyleverage		0.079***			0.065***	0.053***
	cptycnds		-0.003			0.006**	0.006**
	cptycashratio		0.006**			0.001	0.007***
	nocptydata		-0.164***			-0.129***	-0.195***
Network var	pcu			-0.021***		-0.023***	
	pcw				-0.028***		-0.028***
	Bank FE	Yes	Yes	No	No	No	No
	Bank-Cty FE	Yes	Yes	Yes	Yes	Yes	Yes
	Currency FE	Yes	Yes	Yes	Yes	Yes	Yes
	Obs	3,925	3,907	3,925	3,925	3,907	3,907
	R ²	0.615	0.650	0.637	0.633	0.664	0.658

Regression Table – OLS REPO

Category	Variable	(1)	(2)	(3)	(4)	(5)	(6)
Deal var	notional	0.005***	0.004***	0.005***	0.006***	0.004***	0.005***
	maturity	0.047***	0.029***	0.043***	0.049***	0.024***	0.033***
Collateral var	collrating	-0.001	0.001	-0.0001	-0.0002	0.001*	0.001*
	collmaturity	0.002	0.002	0.003*	0.003**	0.003**	0.003**
	corpdebt	0.004	0.008***	0.006**	0.007**	0.009***	0.009***
	securitisation	0.002	0.004	0.009**	0.012***	0.012***	0.014***
	VaR	0.009**	0.009***	0.007*	0.008**	0.007**	0.007**
	asset in safe portf	0.003	0.003	0.003	0.003	0.003	0.003
Cpty type	brokerdealers	-0.012***	-0.005	-0.014***	-0.018***	-0.006	-0.011***
	hedgefund	-0.005	-0.001	0.0004	-0.003	-0.0004	-0.002
	othermanager	-0.009	-0.015*	-0.045***	-0.039***	-0.049***	-0.042***
	insur&pension	0.096***	0.099***	0.099***	0.090***	0.103***	0.097***
	cb&govt	-0.009	-0.016*	-0.023***	-0.023***	-0.028***	-0.028***
	other	0.003	-0.005	-0.046	-0.034	-0.050	-0.037
Cpty var	cptysize		0.023**			0.024**	0.017
	cptyroa		0.002			0.001	0.001
	cptyrating		0.006***			0.006***	0.006***
	cptyleverage		-0.025***			-0.004	0.003
	cptycdds		0.0001			0.005	0.007**
	cptycashratio		0.001			-0.006*	-0.005
	nocptydata		0.041			0.123***	0.109***
Network var	pcu			-0.013***		-0.014***	
	pcw				-0.017***		-0.016***
	Bank FE	Yes	Yes	No	No	No	No
	Bank-Cty FE	Yes	Yes	Yes	Yes	Yes	Yes
	Currency FE	Yes	Yes	Yes	Yes	Yes	Yes
	Obs	3028	2915	2915	3028	2915	2915
	R ²	0.572	0.589	0.572	0.572	0.589	0.589