

Managing moral hazard in last resort lending

Credit limits as 'contingent rules' at the Austro-Hungarian Bank

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- Definitions
 - **LLR**: elastic supply of central bank liquidity for the benefit all CB counterparties under circumstances of aggregate liquidity shock
 - **Moral hazard**: Insurance provided by LLR reduces incentives for eligible counterparties for proper liquidity management, thereby increasing the probability that LLR will be needed.
- Moral hazard is costly because
 - sorting out illiquid from insolvent institutions requires time and thus sufficient liquidity buffers.

- Last resort lending (LLR) $\rightarrow \infty$
- Fighting moral hazard by increasing (expected) costs ex post:
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 - ② **Constructive ambiguity** (Freixas 1999)

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- This paper
 - ① **Focus on liquidity**, not credit risk
 - ② Suggest **new mechanism** building on Flandreau, Ugolini (2013, 2014) and Carlson et al. (2015): Combination of monitoring/incentives + free lending in case of exogenous liquidity crisis
 - ③ Do so within historic context when **Bagehot-type free lending became standard** during the second half of 19th century
 - ④ Exploit **unique evidence** on credit limits

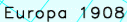
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 - ① Limits attributed as a function of good liquidity (& capital) risk management
 - ② Ceteris paribus, counterparties prefer higher limits
- Consistent with “free lending”: credit limits as **contingent rule**
 - ① Enforced in normal times
 - ② Lifted during liquidity crises perceived as exogenous
 - ③ Central bank returns to enforcing limits as soon as possible

- ① Brief overview on Austro-Hungarian Bank and its lending framework
- ② Data and qualitative evidence
- ③ Operationalize the argument on credit limits and empirical testing
- ④ Conclusion

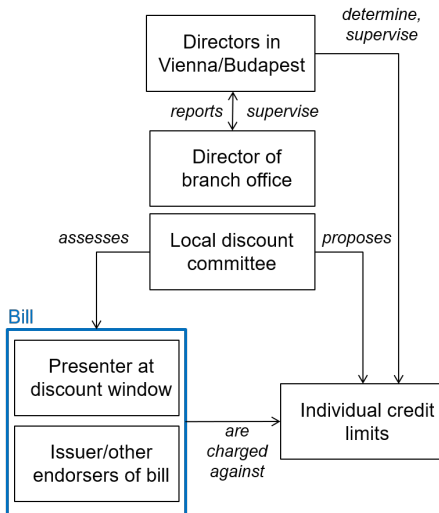
Austria-Hungary 1908



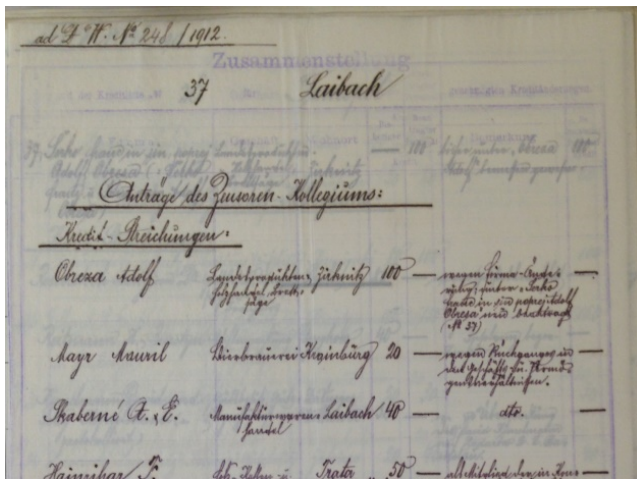
- OeUB (1878-1918)
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 - ② Monopoly of banknote issuance, **natural LLR**
- Most important liquidity providing operation: **Discount of bills** (*Wechseldiskont*)
 - ① Outright purchase of short-term paper at discount
 - ② OeUB carries credit risk, requires risk management
 - ③ Three good signatures (mutual liability) + quality of bill assessed by local discount committees
 - ④ Total exposure to CPs monitored through credit ledgers ('Kreditkonten')
 - ⑤ Credit limit defines maximum exposure for each CP

Figure: Assessments of credit limits and individual bills



- Handcollected 4,000 credit limit assessments for both NFIs and FIs
- Matched with handcollected balance sheet data for FIs
- Output: **cross-sectional and panel data sets** for 1908-1913



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 - LLR lowers incentives for proper liquidity management
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 - Liquidity shocks & transformation: moral hazard mostly problem of FIs
 - **Hypothesis: liquidity supervision more relevant for FIs than NFIs**

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 - Liquidity shocks & transformation: moral hazard mostly problem of FIs
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- **... while being compatible with last-resort lending**
 - **Hypothesis: limits lifted during liquidity crises perceived as exogenous**

Testing our hypotheses: What determines limits according to OeUB directors?

- Classify verbal reasons into categories
- Results:
 - Equity matters more for non-financial firms
 - Leverage and liquidity (asset side, refinancing) matters more for banks

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- Results:
 - Equity matters more for non-financial firms
 - Leverage and liquidity (asset side, refinancing) matters more for banks
- Run cross-sectional regressions for subset of financial firms with balance sheets

$$C_i = \alpha + \beta SIZE_i + \gamma AGE_i + \delta LEV_i + \phi LIQ_i (+\mathbf{\Lambda}'\mathbf{X}_i) + \varepsilon_i \quad (1)$$

- Robustness checks: split samples, additional controls, Panel FE regressions for levels and changes in limits

Determinants of credit limits: what does econometric evidence tell us?

Table: Cross-sectional regressions: explaining levels of credit limits (baseline)

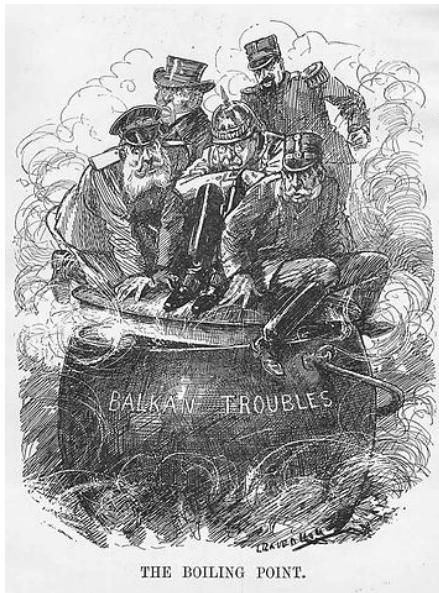
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Size	1.08*** (0.04)	1.09*** (0.04)	1.13*** (0.04)	1.19*** (0.06)	1.18*** (0.05)	1.17*** (0.05)	1.20*** (0.05)	0.98*** (0.05)	0.94*** (0.05)	0.92*** (0.05)	0.95*** (0.05)
Age		-0.03 (0.04)	-0.05 (0.04)	0.01 (0.05)	0.05 (0.05)	0.05 (0.05)	0.02 (0.05)	0.22*** (0.04)	0.24*** (0.04)	0.22*** (0.04)	0.19*** (0.04)
Leverage ratio			-0.15 (0.10)	-0.12 (0.09)	-0.11 (0.09)	-0.11 (0.09)	-0.10 (0.09)	-0.06 (0.07)	-0.06 (0.07)	-0.07 (0.07)	-0.08 (0.08)
Liquidity 1				0.10** (0.05)				0.21*** (0.05)			
Liquidity 2					0.15*** (0.04)				0.12*** (0.03)		
Liquidity 3						0.16*** (0.04)				0.11*** (0.03)	
Illiquidity							-0.18*** (0.05)				-0.20*** (0.05)
Bank dummy								1.63*** (0.15)	1.50*** (0.15)	1.50*** (0.15)	1.39*** (0.16)
Savings bank dummy								0.45*** (0.10)	0.30*** (0.09)	0.31*** (0.09)	0.48*** (0.09)
Constant	4.81*** (0.03)	4.81*** (0.04)	4.82*** (0.04)	4.83*** (0.04)	4.83*** (0.04)	4.81*** (0.04)	4.84*** (0.04)	4.52*** (0.05)	4.58*** (0.06)	4.57*** (0.05)	4.56*** (0.05)
Observations	489	471	440	400	394	423	435	400	394	423	435
R-squared	0.57	0.57	0.59	0.60	0.61	0.60	0.60	0.68	0.68	0.67	0.67
Robust SE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses; coefficients on continuous variables represent effect of 1 std.dev. increase in regressor.

*** p<0.01, ** p<0.05, * p<0.1

Credit limits during a crisis: A case study on the panic of 1912

- Classical bank runs Oct-Dec 1912
- Context: Balkan wars
- Trigger: Fear of war with Russia
- Runs concentrated at Russian border
- Central bank perceives shock as exogenous: independent of ex ante liquidity management
- Limits increased quickly by up to 100 percent and more
- 3 Dec 1912: All limits are suspended given that addition good collateral is provided
- Market interest rates stay below/at central bank discount rate: no rationing, clear case of free lending



“Contingent rules”: econometric evidence

Table: Firth logit estimates: explaining tolerations of transgressions during the crisis of 1912

VARIABLES	(1)	(2)	(3)	(4)	(5)
Distance to Russian border (linear)		-1.92*** (0.53)			
Distance to Russian border (natural log)			-0.81*** (0.20)		
Distance to Russian border (inverse)				0.36*** (0.12)	
Exposure to war threat dummy					3.05*** (0.82)
Size	0.93*** (0.30)	1.26*** (0.35)	1.14*** (0.32)	1.07*** (0.31)	0.71** (0.31)
Age	-0.78*** (0.28)	-0.66** (0.29)	-0.78*** (0.29)	-0.79*** (0.30)	-0.49 (0.35)
Leverage ratio	0.10* (0.06)	0.12** (0.06)	0.12** (0.06)	0.12** (0.06)	0.14** (0.06)
Liquidity 3	0.23 (0.18)	-0.11 (0.20)	0.03 (0.19)	0.19 (0.18)	-0.01 (0.20)
Refinancing	-0.02 (0.35)	-0.33 (0.39)	-0.24 (0.37)	-0.39 (0.59)	-0.82 (0.93)
Profitability	-0.85 (1.15)	-1.82* (1.06)	-1.38 (0.98)	-1.13 (1.09)	-1.41 (0.96)
Observations	714	714	714	714	714
Log-likelihood	-36.75	-26.42	-28.82	-31.58	-29.13
Chi-squared statistic	24.29	23.87	31.23	31.02	33.82
Number of tolerations	10	10	10	10	10

Standard errors in parentheses

Coefficients on continuous variables represent marginal effect of 1 std.dev. increase in regressor.

*** p<0.01, ** p<0.05, * p<0.1

Suspension is temporary and low liquidity sanctioned both ex ante and ex post

OeUB directorate dealings with Ústřední banka českých spořitelén

Before crisis (Sep 1912): **Request for higher limit rejected:** “The bank had **immobilized itself** in a way, so that previously granted credit lines did not appear appropriate anymore and **restrictive measures** had to be taken.” (Minutes Vienna directorate)

In the midst of the crisis (Nov 1912): “[...] we **cannot restrict credit too rapidly**, otherwise we would cause a catastrophe.” Still: “[W]e have **limited our exposure [to the bank] by strict screening of bills** so that we can hope to soon apply normal stricter standards without putting its customers at risk.”

After the crisis abated (Feb 1913): “The **management of the bank is being changed** at the moment and the new board aims at achieving a business reorganization. [...] Our future stance will have to be made **contingent on the alterations which are triggered by this change.**”

- **Our contributions**

- ① New explanation how moral hazard was tackled by 19C LLRs
- ② Wealth of qualitative evidence and unique micro-data set on credit limits (supply side of central bank lending)

- **Caveat:**

- ① We do not claim that contingent rules were effective!
- ② BUT: Credit limits operationalized in a way consistent with interpretation as micro-prudential tool to check moral hazard

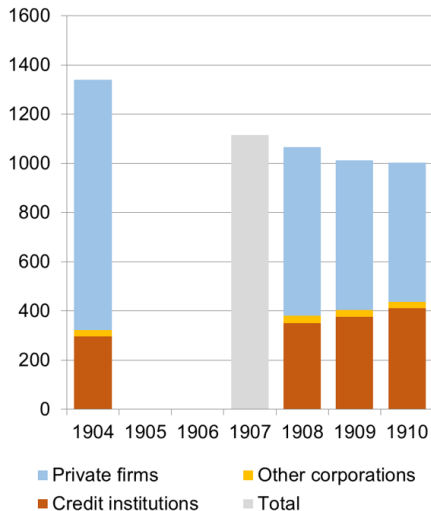
- **Main take-aways and suggestions for future research**

- ① 19C central banks very concerned about liquidity, i.e. long before introduction of explicit liquidity regulation à la Basel III
- ② Constructive ambiguity and penalty rates have theoretical appeal but might be less important empirically
- ③ Key role of information for central bank policy (see other contributions to panel today)
- ④ To understand lending of last resort have to look at what central banks do during normal times as well

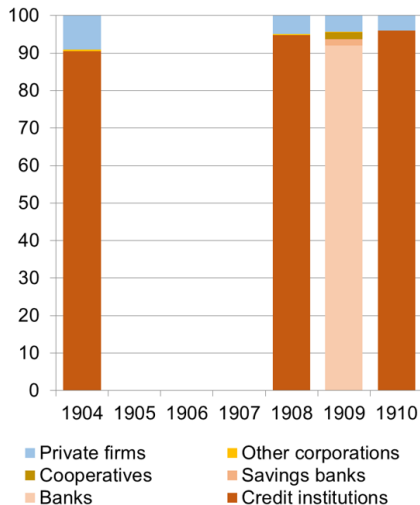
Appendix

Who discounts at the OeUB?

Who submits bills for discounting?



Share in total discount



Examples for arguments used in limit decisions

	Category	Examples
5	Equity	dem Vermögen/Eigenkapital/Reserven entsprechend, schwache Fundierung, anderseitiger niedriger Vermögensschätzung, rückgängige Verhältnisse, Vermögensverminderung durch Ableben/Austritt eines Gesellschafters, Verluste erlitten (aus einem bestimmten Geschäft), Vermögensrückgang infolge großer Konjunktur-/Spekulationsverluste, bevorstehende Verluste, unklare/komplizierte Vermögensverhältnisse, als Mitglied einer Gesellschaft unbeschränkt haftpflichtig, haftend für..., hat sein Vermögen übertragen, Kapitalerhöhung abzuwarten, Vermögensrückgang aufgrund von Erbteilung, Unklarheit hinsichtlich der Haftung der Gemeinde, hat große Spielverluste, geringe Mitgliederzahl (bei einer Genossenschaft)
9	Leverage	hohe Schuldenlasten, hohe Verbindlichkeiten, ungünstiges/angespanntes Verhältnis zwischen eigenen und fremden Mitteln, starke Belastung mit fremden Geldern, Realbesitz/Immobilienbesitz hoch belastet, hohe Hypotheken, Vermögen für den Umfang des Geschäfts unzureichend, arbeiten stark über den eigenen Mitteln, arbeiten über ihre Kräfte, überschuldet, zu schwach fundiert, unverhältnismäßig starke Kreditanspannung
10	Asset liquidity	Vermögen immobil, unzureichende Mobilität, mobile Mittel knapp/unzureichend, stark illiquide Forderungen, Vermögen in Bauspekulation gebunden, Vermögen in Realitäten investiert, Betriebsmittel gering/fehlen, bewegt sich schwer, bei einem Konkurs beteiligt dessen Liquidierung Jahre dauern kann, hohe Einzelkredite, schwere Realisierbarkeit der Anlagen, mehr als die Hälfte der Effekten belehnt
11	Refinancing risk	andauernde/hohe/zunehmende mehrseitige/vielseitige Kreditbenutzung, hohe Wechselverbindlichkeiten, hohe Giroverbindlichkeiten, Vorkommen von Geldbeschaffungswechseln, große und vielseitige Verpflichtungen, hohe Akzeptverbindlichkeiten/Akzeptobligo, starke anderwärtige Reeskomptebenutzung, starkes anderwärtiges Vorkommen

Credit limits in normal times: overview (II)

Table: Credit limit distribution (cross-section for 1911)

Business category	Unique CPs	Mean limit (in K Crowns)	P5 (in K Crowns)	Median limit (in K Crowns)	P95 (in K Crowns)
Agriculture and mining	234	82	20	50	300
Basic metals	6	768	30	275	2000
Stone, clay and glass	66	111	20	50	300
Metal working	62	273	20	150	1000
Machinebuilding	48	235	20	55	1000
Wood	50	161	20	50	600
Rubber	5	360	100	300	600
Leather	28	96	20	50	200
Textiles	263	261	20	100	1000
Wearing apparel	33	74	20	50	200
Paper	25	324	30	200	2000
Food and beverages	194	185	20	80	1000
Accommodation, food service	9	36	20	30	80
Chemicals	67	222	20	70	1000
Construction	63	86	20	50	200
Printing	11	129	20	100	300
Electricity supply	3	1347	40	2000	2000
Wholesale and retail trade	576	137	20	50	500
Finance and insurance	324	224	20	100	1000
Trade and shipping agents	53	115	20	50	500
Transportation	9	428	20	70	2000
Free professions	35	37	20	30	100
Wealthy individuals	39	157	20	80	400

Credit limits higher than 2 mill. Crowns are omitted from Table because their exact value is not known.

Source: OeUB directorate protocols (Vienna; 1911)

Table: CPs assessed for credit limits by the OeUB (cross-section for 1911)

Business category	Unique CPs	Credit limit ≤ 50K (in %)	Credit limit ≤ 100K (in %)	Credit limit ≤ 500K (in %)	Credit limit > 500K (in %)
Agriculture and mining	234	66	22	11	1
Basic metals	6	50	0	17	33
Stone, clay and glass	66	56	27	14	3
Metal working	62	27	18	44	11
Machinebuilding	48	50	19	21	10
Wood	50	56	20	18	6
Rubber	5	0	20	40	40
Leather	28	57	32	7	4
Textiles	263	32	22	34	12
Wearing apparel	33	61	24	15	0
Paper	25	12	32	48	8
Food and beverages	194	42	27	24	7
Accommodation, food service	9	89	11	0	0
Chemicals	67	42	28	19	10
Construction	63	51	38	10	2
Printing	11	27	36	36	0
Electricity supply	3	33	0	0	67
Wholesale and retail trade	576	53	26	16	5
Finance and insurance	342	31	23	32	15
Trade and shipping agents	53	53	26	17	4
Transportation	9	22	33	22	22
Free professions	35	86	14	0	0
Wealthy individuals	39	41	28	28	3
Total	2,221	46	25	22	7
	(sum)	(in % of total)	(in % of total)	(in % of total)	(in % of total)

Source: OeUB directorate protocols (Vienna; 1911)

Table: Cross sectional regressions: summary statistics

Variable	Obs	Mean	Std. Dev.	Min	Max	P1	P25	P50	P75	P99
Credit limit (in 1000 K)	423	219.67	326.09	0.00	2000.00	0.00	40.00	100.00	260.00	1500.00
Credit limit (in 1000 K, natural log)	423	4.74	1.15	3.00	7.60	3.00	3.91	4.61	5.70	7.31
Size (total assets, in 1000 K)	423	5306.46	6277.87	65.48	45663.30	209.75	1223.16	2972.96	6786.52	31152.95
Size (total assets, in 1000 K, natural log)	423	14.89	1.15	11.09	17.64	12.25	14.02	14.91	15.73	17.25
Age (in years)	423	26.91	13.4	1.00	57.00	2.00	15.00	28.00	38.00	52.00
Age (in years, natural log)	423	3.09	0.75	0.00	4.04	0.69	2.71	3.33	3.64	3.95
Leverage (total assets to equity)	423	17.35	32.27	1.33	563.02	2.48	6.11	11.70	20.05	112.65
Liquidity 1 (bills to total assets)	394	0.37	0.30	0.00	0.98	0.00	0.12	0.27	0.58	0.98
Liquidity 2 (bills to total deposits)	394	0.90	1.63	0.00	12.77	0.00	0.14	0.35	1.07	9.43
Liquidity 3 (bills and cash to total deposits)	423	0.87	1.64	0.00	13.07	0.00	0.13	0.32	1.04	8.58
Illiquidity (mortg., adv. & real est. to tot. assets)	423	0.37	0.30	0.00	0.95	0.00	0.03	0.41	0.63	0.93
Refinancing (rediscounts to total assets)	291	0.09	0.14	0.00	0.62	0.00	0.01	0.02	0.11	0.58
Profitability (return on equity)	403	0.14	1.91	-1.00	37.37	-1.00	0.05	0.09	0.16	1.37
OeUB affiliate dummy	423	0.12	0.32	0.00	1.00	0.00	0.00	0.00	0.00	1.00
Bank dummy	423	0.07	0.26	0.00	1.00	0.00	0.00	0.00	0.00	1.00
Savings bank dummy	423	0.33	0.47	0.00	1.00	0.00	0.00	0.00	1.00	1.00

Panel FE regressions: explaining levels of credit limits

$$C_{i,t} = \alpha + \beta_1 SIZE_{i,t-1} + \delta_1 LEV_{i,t-1} + \phi_1 LIQ_{i,t-1} (+\mathbf{\Lambda}_1' \mathbf{X}_{i,t-1}) + \eta_i + \kappa_t + \varepsilon_{i,t} \quad (2)$$

Panel FE regressions: explaining changes in credit limits

$$DC_{i,t} = \alpha + \beta_1 SIZE_{i,t-1} + \delta_1 LEV_{i,t-1} + \phi_1 LIQ_{i,t-1} (+\mathbf{\Lambda}_1' \mathbf{X}_{i,t-1}) \\ + \beta_2 SIZE^2_{i,t-1} + \delta_2 LEV^2_{i,t-1} + \phi_2 LIQ^2_{i,t-1} (+\mathbf{\Lambda}_2' \mathbf{X}^2_{i,t-1}) + \eta_i + \kappa_t + \varepsilon_{i,t} \quad (3)$$

Credit limits in normal times: determinants (IV)

Table: Cross-sectional regressions: explaining levels of credit limits (sample split & controls)

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Size	1.47*** (0.08)	1.49*** (0.08)	1.41*** (0.09)	1.37*** (0.08)	1.21*** (0.08)	1.37*** (0.10)	1.37*** (0.10)	0.77*** (0.06)	0.74*** (0.06)	0.92*** (0.06)	0.95*** (0.07)	0.98*** (0.07)	1.06*** (0.14)
Age		-0.05 (0.04)	-0.08** (0.04)	0.11* (0.06)	0.24*** (0.06)	0.20*** (0.06)	0.21*** (0.06)		0.09 (0.06)	0.16*** (0.05)	0.22*** (0.05)	0.27*** (0.06)	0.26*** (0.08)
Leverage ratio			-0.11 (0.09)	-0.05 (0.07)	-0.00 (0.04)	0.02 (0.04)	0.01 (0.05)			-0.97*** (0.24)	-0.94*** (0.23)	-0.91*** (0.26)	-0.99* (0.58)
Liquidity 3				0.45*** (0.14)	0.21** (0.09)	0.16** (0.08)	0.15** (0.07)				0.06* (0.03)	0.04 (0.04)	0.11** (0.05)
Bank dummy					1.04*** (0.18)	1.14*** (0.20)	1.10*** (0.22)						
Refinancing							-0.32 (0.31)						-0.14** (0.07)
Profitability							0.17 (0.38)						1.37 (1.21)
OeUB affiliate dummy							-0.01 (0.10)						0.94*** (0.36)
Constant	4.79*** (0.07)	4.77*** (0.07)	4.84*** (0.08)	4.95*** (0.08)	4.78*** (0.07)	4.41*** (0.25)	4.20*** (0.27)	4.58*** (0.05)	4.55*** (0.06)	4.43*** (0.06)	4.42*** (0.06)	4.95*** (0.18)	4.70*** (0.33)
Observations	174	174	174	168	168	168	166	315	297	266	255	255	116
R-squared	0.62	0.62	0.64	0.69	0.75	0.80	0.81	0.37	0.37	0.45	0.47	0.52	0.63
Robust SE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	No	No	No	No	No	Yes	Yes	No	No	No	No	Yes	Yes
Region FE	No	No	No	No	No	Yes	Yes	No	No	No	No	Yes	Yes
Sample	B/SB	B/SB	B/SB	B/SB	B/SB	B/SB	B/SB	Coop	Coop	Coop	Coop	Coop	Coop

Robust standard errors in parentheses; coefficients on continuous variables represent effect of 1 std.dev. increase in regressor.

*** p<0.01, ** p<0.05, * p<0.1

Table: Panel regressions: summary statistics

Variable	Obs	Mean	Std. Dev.	Min	Max	P1	P25	P50	P75	P99
Credit limit (in 1000 K)	597	294.64	400.27	0	2000	0	0	150	400	2000
Credit limit (in 1000 K, natural log)	445	5.46	1.09	3	7.6	3	4.61	5.52	6.21	7.6
Change in credit limit (in 1000 K)	597	36.11	131.61	-200	1000	0	0	0	0	800
Size (total assets, in 1000K)	597	8750.47	8136.6	385.54	47150.85	563.33	3087.52	5754.71	12532.19	43114.96
Size (total assets, in 1000K, natural log)	597	15.58	.93	12.86	17.67	13.24	14.94	15.57	16.34	17.58
Leverage ratio (total assets to equity)	494	28.97	44.02	1.33	563.02	2.11	13.78	20.11	26.59	244.55
Liquidity 3 (bills and cash to total deposits)	587	.39	1.54	0	29.9	0	.07	.13	.25	4.82
Refinancing (rediscounts to total assets)	597	.02	.05	0	.63	0	0	.01	.02	.2
Profitability (return on equity)	493	.04	1.31	-28.73	.97	-.23	.04	.07	.12	.82
OeUB affiliate dummy	597	.22	.41	0	1	0	0	0	0	1

Table: Panel regressions: explaining levels of credit limits

VARIABLES	(1)	(2)	(3)	(4)	(5)
Size	0.10 (0.08)	0.10 (0.08)	0.08 (0.09)	0.74*** (0.07)	0.23** (0.10)
Leverage ratio		-0.01 (0.16)	-0.02 (0.16)	-0.23 (0.28)	0.07 (0.20)
Liquidity 3			0.02* (0.01)	0.06 (0.08)	0.10** (0.04)
Refinancing					-0.06** (0.02)
Profitability					0.01 (0.01)
OeUB affiliate dummy					0.01 (0.05)
Constant	5.35*** (0.06)	5.35*** (0.06)	5.35*** (0.06)	5.47*** (0.09)	5.40*** (0.05)
Observations	448	447	445	445	391
R-squared	0.17	0.17	0.16	0.59	0.52
Number of panels	124	124	123	123	123
Clustered SE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
B/SB FE	Yes	Yes	Yes	No	Yes
B/SB RE	No	No	No	Yes	No

Robust standard errors in parentheses.

Coefficients on continuous variables represent effect of 1 std.dev. increase in regressor.

*** p<0.01, ** p<0.05, * p<0.1

Credit limits in normal times: determinants (Vc)

Table: Panel regressions: explaining changes in credit limits

VARIABLES	(1)	(2)	(3)	(4)	(5)
Size	119.29 (363.95)	37.63 (379.90)	-71.30 (401.92)	-291.74*** (100.60)	-365.37 (725.48)
Leverage ratio		-22.43 (18.10)	-37.55 (22.71)	-18.72* (10.28)	-213.46* (113.75)
Liquidity 3			111.78*** (39.71)	51.06*** (19.58)	179.08*** (62.62)
Refinancing					-15.56 (16.55)
Profitability					-19.76 (61.57)
Size (squared)	-199.33 (428.68)	-124.74 (441.00)	-22.96 (465.52)	314.56*** (104.07)	290.80 (794.36)
Leverage ratio (squared)		20.34 (16.69)	33.94 (20.72)	18.69* (9.94)	2,757.14** (1,202.94)
Liquidity 3 (squared)			-101.45*** (31.04)	-48.83*** (17.54)	-148.85*** (46.02)
Refinancing (squared)					-11.93 (19.08)
Profitability (squared)					-19.89 (61.05)
OeUB affiliate dummy					-44.52* (25.53)
Constant	-38.58 (35.08)	-40.74 (35.49)	-46.00 (36.84)	-22.24* (12.40)	55.49 (68.49)
Observations	604	603	597	597	493
R-squared	0.01	0.01	0.00	0.10	0.00
Number of panels	125	125	124	124	124
Clustered SE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
B/SB FE	Yes	Yes	Yes	No	Yes
B/SB RE	No	No	No	Yes	No

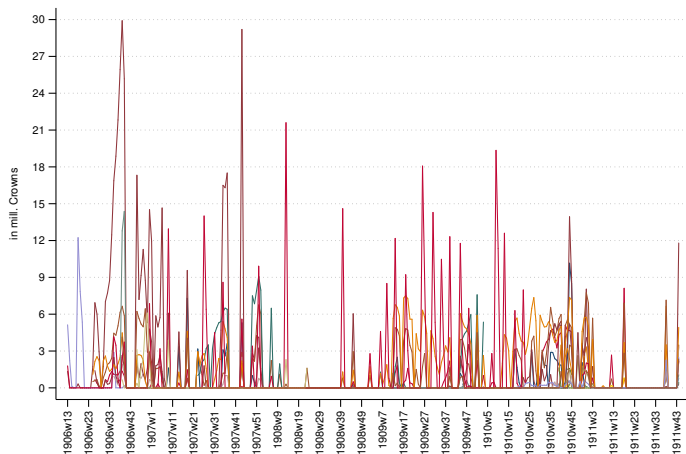
Robust standard errors in parentheses.

Coefficients on continuous variables represent effect of 1 std.dev. increase in regressor.

*** p<0.01, ** p<0.05, * p<0.1

Credit limits in normal times: transgressions (I)

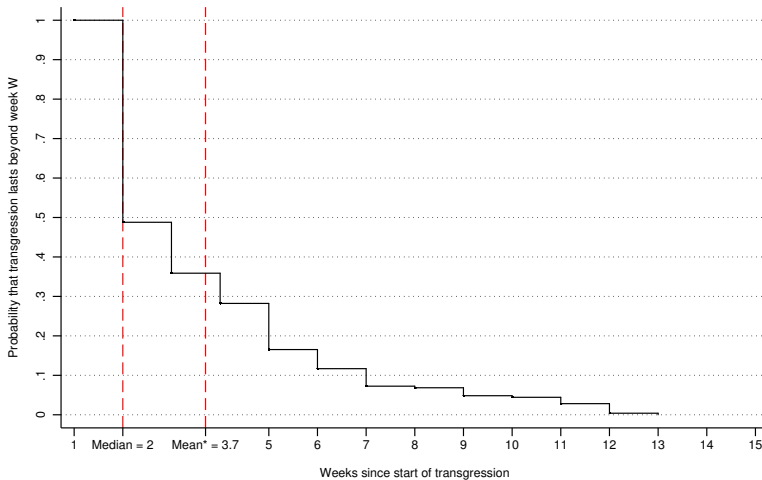
Figure: Transgressions of credit limits by CPs with limits above 2 mill. Crowns (1906-1911)



Source: OeUB directorate protocols (Vienna)

Credit limits in normal times: transgressions (II)

Figure: Duration of credit limit transgressions: non-parametric Kaplan-Meier estimator



Source: OeUB directorate protocols (Vienna)

*Mean calculated by restricting to longest follow-up time

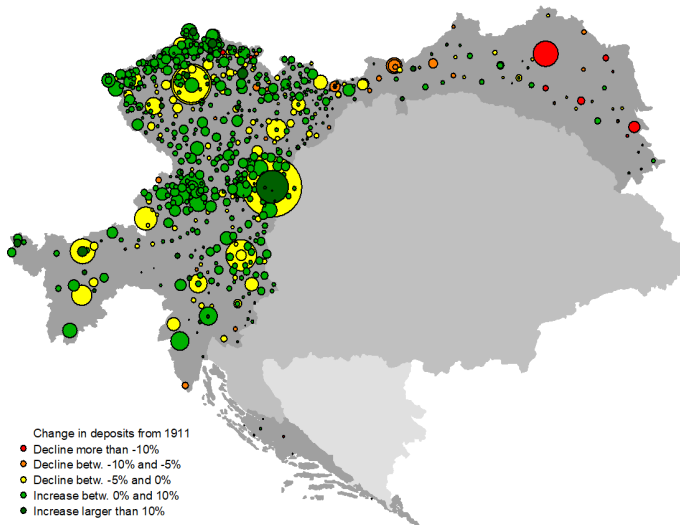
Table: Tests for equality of survivor functions ($H_0 = \text{equality}$)

City	Events observed	Events expected
Bielsko-Biała	5	5.49
Brno	11	11.01
Graz	16	21.38
Hradec Králové	9	9.8
Lviv	13	13.36
Prague	115	124.08
Vienna	79	62.87
Total	248	248

1) Log-rank test: $\text{Chi}^2(6) = 11.37$, $Pr > \text{Chi}^2 = 0.08$
 2) Cox test: $\text{LRChi}^2(6) = 6.38$, $Pr > \text{Chi}^2 = 0.38$
 3) Wilcoxon-Breslow-Gehan test: $\text{Chi}^2(6) = 7.91$, $Pr > \text{Chi}^2 = 0.24$
 4) Tarone-Ware test: $\text{Chi}^2(6) = 10.12$, $Pr > \text{Chi}^2 = 0.12$
 5) Peto-Peto-Prentice test: $\text{Chi}^2(6) = 10.12$, $Pr > \text{Chi}^2 = 0.12$

The geography of the 1912 panic

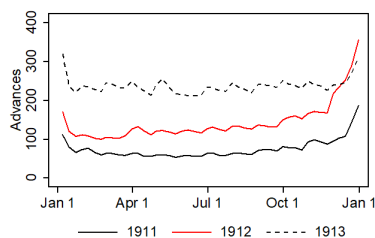
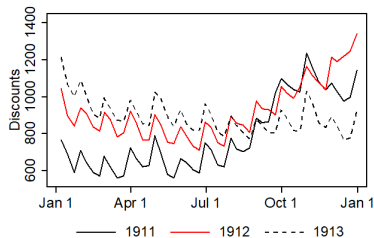
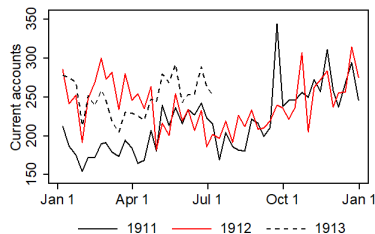
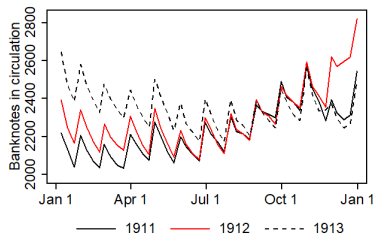
Figure: Bank runs during the panic of 1912



NOTE: Chart size proportional to deposits end of 1912

Lending freely during the panic of 1912 (I)

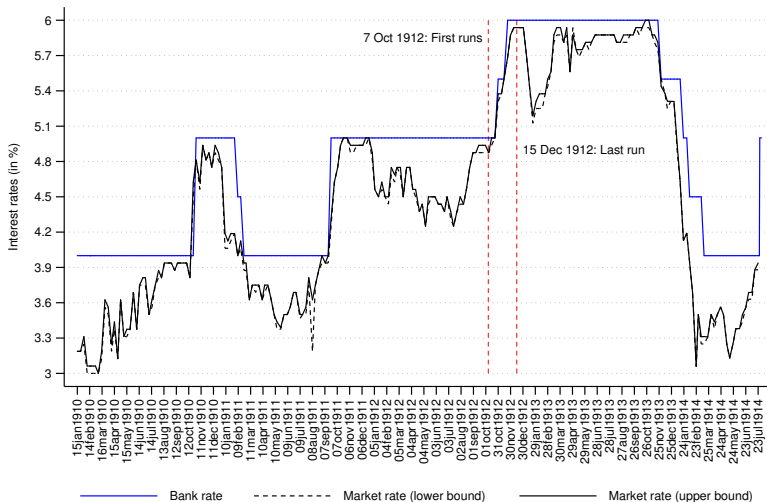
Balance sheet of the Austro-Hungarian Bank



Source: Wiener Zeitung (1911-1913)

Lending freely during the panic of 1912 (II)

Figure: Official Bank discount rate and prime market discount rates (1910-1914)



Source: Coursblatt, Der Tresor, Wiener Zeitung

“Contingent rules”: econometric evidence (II)

Firth logit estimation: predicting tolerations

$$P(T_i = 1 | S_i, \mathbf{Y}_i) = F(\beta_0 + \gamma S_i + \mathbf{\Lambda}' \mathbf{Y}_i)$$

$$\text{where } F(\beta_0 + \gamma S_i + \mathbf{\Lambda}' \mathbf{Y}_i) = F(z) = \frac{\exp(z)}{1 + \exp(z)} \quad (4)$$

Table: Summary statistics

Variable	Obs	Mean	Std. Dev.	Min	Max	P1	P25	P50	P75	P99
Toleration dummy	714	.01	.12	0	1	0	0	0	0	1
Toleration & increase dummy	714	.03	.18	0	1	0	0	0	0	1
Size (total assets, in 1000K, natural log)	714	15.39	1.42	11.68	20.88	12.3	14.46	15.26	16.17	19.68
Age (in years, natural log)	714	3.15	.84	0	4.53	.69	2.71	3.43	3.76	4.39
Leverage ratio (total assets to equity)	714	55.73	546.12	1.33	14195	3	16.24	20.62	29.57	248
Liquidity 3 (bills and cash to total deposits)	714	.24	.98	0	19.58	0	.01	.04	.15	3.55
Refinancing (rediscounts to total assets)	714	.01	.03	0	.33	0	0	0	.01	.16
Profitability (return on equity)	714	.07	.18	-1.47	1	-.29	-.01	.04	.1	.86
Distance to Russian border (in km)	714	409.92	196.78	3.45	1002.3	12.52	294.34	429.65	550.03	875.95
Distance to Russian border (in km, natural log)	714	5.8	.83	1.24	6.91	2.53	5.68	6.06	6.31	6.78
Distance to Russian border (in km, inverse)	714	.01	.02	0	.29	0	0	0	0	.08
Exposure to war threat dummy	714	.11	.31	0	1	0	0	0	0	1

“Contingent rules”: econometric evidence (III)

Table: Firth logit: explaining tolerations and increases of credit limits during the crisis of 1912

VARIABLES	(1)	(2)	(3)	(4)	(5)
Distance to Russian border (linear)		-0.82*** (0.26)			
Distance to Russian border (natural log)			-0.50*** (0.16)		
Distance to Russian border (inverse)				0.26** (0.11)	
Exposure to war threat dummy					1.89*** (0.56)
Size	0.67*** (0.23)	0.75*** (0.23)	0.76*** (0.23)	0.72*** (0.23)	0.58** (0.23)
Age	-0.66*** (0.23)	-0.55** (0.25)	-0.62** (0.25)	-0.65*** (0.24)	-0.51** (0.26)
Leverage ratio	0.06 (0.05)	0.05 (0.05)	0.06 (0.05)	0.06 (0.05)	0.07 (0.05)
Liquidity 3	0.17 (0.17)	-0.02 (0.19)	0.02 (0.18)	0.13 (0.17)	-0.03 (0.19)
Refinancing	-0.15 (0.34)	-0.47 (0.52)	-0.41 (0.47)	-0.41 (0.48)	-0.82 (0.71)
Profitability	-0.32 (0.92)	-0.23 (1.27)	-0.23 (1.18)	-0.20 (1.09)	-0.28 (1.13)
Observations	714	714	714	714	714
Log-likelihood	-84.06	-77.04	-77.45	-80.00	-78.27
Chi-squared statistic	22.32	29.44	30.03	27.89	33.03
Number of tolerations & increases	23	23	23	23	23

Standard errors in parentheses

Coefficients on continuous variables represent marginal effect of 1 std.dev. increase in regressor.

*** p<0.01, ** p<0.05, * p<0.1