

Taxation and Corporate Risk-Taking

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The Accounting Review 93 (2018), 237-266

Loss Firms

- Each year, 45-52% of U.S. corporations report a loss (Cooper/Knittel, 2010)
 - Firms can use losses to reduce prior or future tax payments (*loss carrybacks* and *carryforwards*)
 - Firms are able to use one-half of losses in this way, decreasing corporate tax revenues about 15% (Cooper/Knittel 2006, 2010)
 - How does the tax treatment of losses affect firm behavior?
 - existing studies of tax loss rules find no or very small effects on *level* of investment (Devereux et al., 1994; Edgerton, 2010)
 - firms might adjust a different margin (→ risk-taking)
- focus on *level* of investment may underestimate private sector response

Why Study Taxation and Risk-Taking?

- Corporate risk-taking fuels growth
 - a one-standard deviation increase in risk-taking is associated with a 33% increase in GDP per capita growth (John et al., 2008)
 - large, listed firms account for almost half of aggregate investment in U.S. (Asker et al., 2014)
- Little understood which policies affect corporate risk-taking
- Taxation is a good candidate
 - taxation affects entrepreneurial risk-taking (Cullen/Gordon, 2007; Djankov et al., 2010)
 - taxation influences the level of corporate investment (e.g. Hassett/Hubbard, 2002)
 - user cost elasticity of ≈ -1
 - little or no effect of tax loss rules

This Paper

Our model and empirical results show...

- 1 Tax loss rules directly affect corporate risk-taking
 - tax loss offset shifts a portion of investment risk to the government
 - firms respond by increasing their level of risk-taking
- 2 Sign of tax rate effect hinges on firm-specific expectations of future loss recovery
 - negative effect of tax rate for firms unable to use losses
 - positive effect of tax rate for firms able to use losses

Literature

Determinants of corporate risk-taking

- Managerial incentives (Coles et al., 2006), corporate governance (John et al., 2008), shareholder diversification (Faccio et al., 2011)
- Sarbanes-Oxley act (Bargeron et al., 2010)

Taxation and individual portfolio choice or entrepreneurship

- Conflicting evidence on portfolio choice (Asea/Turnovsky, 1998, Poterba/Samwick, 2002)
- Higher tax rates have a negative effect on entrepreneurship (Cullen/Gordon, 2007, Djankov et al., 2010)

Tax System

- **Loss carryback:** A loss may be offset against past profits
 - offers certainty
- **Loss carryforward:** Loss may be carried forward and offset against future profits
 - uncertainty (future profits, future tax rate), discount rate

Country	Loss Carryback	Loss Carryforward
Germany	1998: 2 years 1999-2009: 1 year	1998-2009: Infinite
Italy	none	1998-2009: 5 years
Spain	none	1999-2001: 10 years 2002-2009: 15 years
UK	1998-2009: 1 year	1998-2009: Infinite
US	1998-2009: 2 years	1998-2009: 20 years

Loss rules in selected countries, 1998-2009

Model Framework

- Firm allocates a given amount of investment I among differently risky projects
- Firm chooses the optimal riskiness of its investment, σ
- Return depends on state of the world
 - good state (probability p): profit $f_g(\sigma) > 0, f'_g > 0, f''_g < 0$
 - bad state (probability $1 - p$): loss $f_b(\sigma) < 0, f'_b < 0, f''_b < 0$
- (Potentially) “risk-averse” firm: firm maximizes $E[U(\pi)]$
 - liquidity constraints (Géczy et al., 1997), costly financial distress (Purnanandam, 2008)
 - control delegated to risk-averse manager whose pay is linked to performance (e.g. Tufano, 1996; Lewellen, 2006)
- Profits taxed at rate t ; fraction λ of losses can be offset

$$EU(\pi) = pU[(1-t)(f_g(\sigma) - I)] + (1-p)U[(1-\lambda t)(f_b(\sigma) - I)]$$

Effect of Tax Loss Offset

$$\frac{d\sigma}{d\lambda} = \frac{t(1-p)f'_b(\sigma)}{SOC} [U'(\pi_b) + U''(\pi_b)\pi_b] > 0$$

- Better loss offset increases risk-taking, as it reduces the loss in the bad state
- This effect is larger when the tax refund is higher (i.e. when the tax rate is higher)

Hypothesis 1 (loss rule effects)

- 1 Tax loss carryback and carryforward periods are positively related to corporate risk-taking.
- 2 This relation increases with the tax rate.

Effect of the Tax Rate

$$\frac{d\sigma}{dt} = \frac{pU'(\pi_g) f'_g(\sigma) [R_R(\pi_g) - 1] - \lambda(1-p)U'(\pi_b) f'_b(\sigma) [R_R(\pi_b) + 1]}{-SOC}$$

- With full loss offset ($\lambda \rightarrow 1$), higher tax rate increases risk-taking if firm is risk-averse. No effect if firm is risk-neutral.
- With no loss offset ($\lambda \rightarrow 0$), higher tax rate decreases risk-taking if the firm is moderately risk-averse ($R_R < 1$) or risk-neutral ($R_R = 0$).

Hypothesis 2 (tax rate effects)

- 1 Tax rates are positively related to risk-taking for firms that can expect to significantly offset losses ("high λ firms").
- 2 Tax rates are negatively related to risk-taking for firms that cannot expect to offset a significant amount of losses ("low λ firms").

Empirical Strategy

Effect of loss offset rules (H1)

- 1 Cross-country panel estimation
- 2 Matched sample difference-in-difference estimation
- 3 Regression discontinuity design with data from Spain

Effect of tax rates (H2)

- 1 Cross-country panel estimations

Cross-Country Study: Data

Firm-Level Data:

- Financial statement data from *Worldscope Fundamentals* (Thomson Reuters)
 - comprehensive data on all listed companies from 17 countries
 - from 1998 to 2009 (Our sample ends in 2009, as we require data for two subsequent years (2010 and 2011) to calculate the three-year risk measure.)
 - we drop cross-listed firms, financial and utilities firms, firms missing total assets or where total assets are less than zero, firms missing the requisite time-series data to calculate the three-year risk measure, and firms missing data to calculate the control variables
- final sample of 84,222 firm-year observations

Country-Level Data:

- Data on loss offset provisions from IBFD European Tax Handbooks and U.S. internal revenue code
- Statutory corporate tax rates from OECD tax database
- GDP data from IMF (World Economic Outlook Database)

Tests of Hypothesis 1 – Cross-country panel analysis

Regression Specification

$$Risk_{ijt} = \beta_0 + \beta_1 LCB_{jt} + \beta_2 LCF_{jt} + \beta_3 StdCTR_{jt} + \beta_4 LCB^* StdCTR_{jt} + \beta_5 LCF^* StdCTR_{jt} + \beta_n X_{ijt} + \theta_k + \rho_t + \epsilon_{it}$$

- $Risk_{ijt}$: measure of firm risk-taking (John et al., 2008)
 - ① construct difference of a firm's return on assets (ROA) to the average ROA of firms in same industry-country-year
 - ② take 3-year standard deviation of these differences
- LCB_{jt}, LCF_{jt} : loss carryforward/carryback period in years
- $StdCTR_{jt}$: standardized corporate tax rate
- X_{ijt} : controls (size, market-to-book-ratio, sales growth, ROA, leverage, GDP growth, inflation, risk-free rate, macroeconomic risk, rule of law, regulatory quality, control of corruption)
- θ_k, ρ_t : industry- and year-fixed effects
- Standard errors are clustered 2-ways (firm and country-year)

Tests of Hypothesis 1 – Results: Panel

	Dependent Variable: Firm Risk-Taking			
	(1)	(2)	(3)	(4)
LCB	0.052** (2.243)	0.034** (2.292)	0.045*** (3.802)	0.056*** (4.209)
LCF	0.011*** (6.501)	0.007*** (5.975)	0.009*** (7.081)	-0.001*** (-0.521)
StdCTR	0.070*** (3.138)	0.042** (2.463)	-0.037 (-1.478)	0.052 (1.550)
LCB*StdCTR			0.061** (2.570)	0.065** (2.585)
LCF*StdCTR			0.001 (0.501)	-0.003* (-1.825)
Controls?	No	Yes	Yes	Yes
Industry/Year FE?	Yes	Yes	Yes	Yes
Observations	84,222	84,222	84,222	69,274
R^2	0.058	0.359	0.362	0.371

LCB and LCF are loss carryback and carryforward periods in years. StdCTR is the standardized corporate tax rate. t-statistics in parentheses, based on standard errors clustered by firm and by country-year.

Tests of Hypothesis 1 – Size of Effect

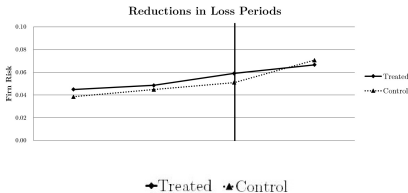
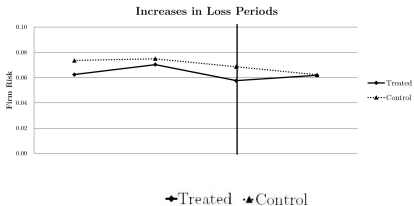
How large are these effects?

- A one year longer carryback period is associated with 11.6% higher risk-taking for the average firm
- A one year longer carryforward period is associated with 2.4% higher risk-taking for the average firm

	Mean	Median	Std. Dev.	5%	95%
Risk	0.294	0.101	0.665	0.007	1.246
LCB	1.536	2.000	0.868	0.000	3.000
LCF	17.821	20.000	5.023	5.000	20.000
CTR	0.361	0.393	0.055	0.260	0.394

Tests of Hypothesis 1 – Matched Sample DiD

- 4 increases in loss carryforward period (Denmark, France, Norway, Spain)
- 2 decreases in loss carryback period (Germany and Netherlands)
- Matching firms in treated countries with firms in control countries on firm characteristics



Tests of Hypothesis 1 – Results: Matched Sample DiD

Matching Characteristics	Mean Difference-in-Difference	
	Decrease in LCB (-) (1)	Increase in LCF (+) (2)
Size/ROA/Sales Growth/Leverage/MB (Mahalanobis match)	-0.015*** (-2.682)	0.008** (2.107)
Size/ROA/Sales Growth/Leverage/MB/Industry (Mahalanobis match)	-0.016*** (-2.854)	0.008** (2.080)
Size/ROA/Sales Growth/Leverage/MB/Industry (Propensity score match, caliper)	-0.010* (-1.820)	0.005 (0.844)

Tests of Hypothesis 1 – Within-Country Test

Background:

- In 2011, Spain limited loss carryforwards to 75% of the tax base for firms with revenues above € 20 million in 2010
- Law passed in 2011 → no selection
- No contemporaneous changes in other tax rules

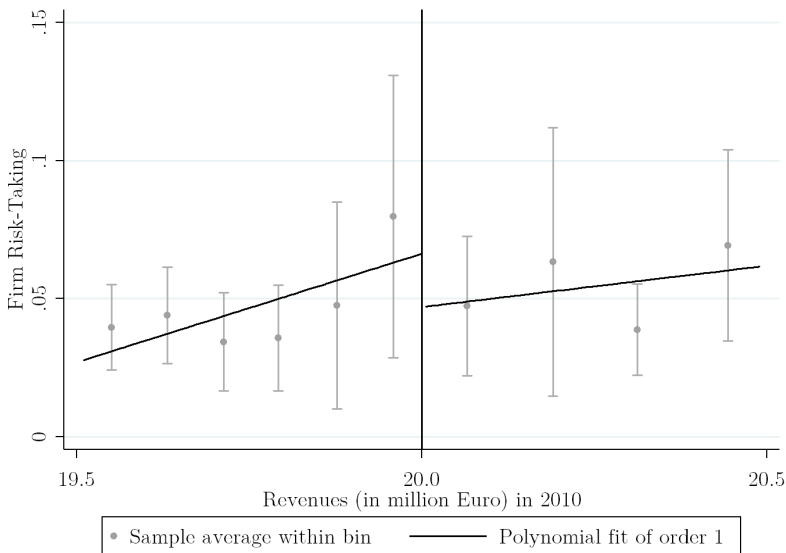
Research Design:

- Regression discontinuity design
- Prediction: Firms with revenue above € 20 million engage in less risk-taking

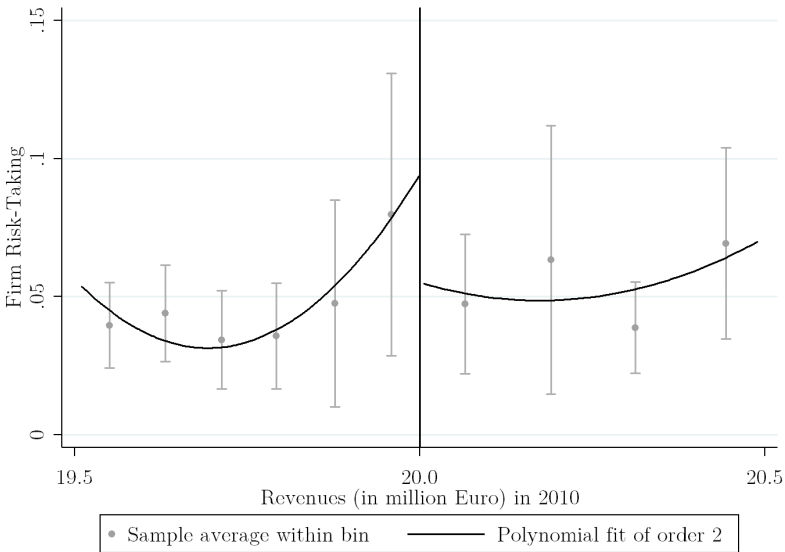
Data:

- Worldscope has few observations with revenues below € 20m
- Bureau van Dijk's Amadeus data set

Tests of Hypothesis 1 – Within-Country Test: Results



Tests of Hypothesis 1 – Within-Country Test: Results



Tests of Hypothesis 1 – Within-Country Test: Results

Dependent Variable: Firm Risk-Taking						
	Local linear regression			Quadratic polynomial regression		
	(1)	(2)	(3)	(4)	(5)	(6)
Avg. Treatm. Effect	-0.142** (-2.57)	-0.117** (-2.46)	-0.084** (-2.07)	-0.131** (-2.34)	-0.146** (-2.40)	-0.131** (-2.52)
Bandwith	139,840	279,680	419,519	139,840	279,680	419,519

Optimal bandwidth (using Imbens and Kalyanaraman (2012) algorithm) is €139,840.

Tests of Hypothesis 1 – Within-Country Test: Falsification

I. Levels of Lagged Revenues

	Dependent Variable: Firm Risk-Taking			
Average Treatment Effect	0.073 (0.77)	-0.000 (-0.02)	0.019 (0.60)	-0.013 (-0.59)
Cutoff	€15m	€19m	€21m	€25m

II. Other Years

	Dependent Variable: Firm Risk-Taking			
Average Treatment Effect	0.041* (1.90)	-0.046 (-0.79)	-0.040 (-0.53)	-0.019 (-0.79)
Year	2007	2008	2009	2010

III. Other Firm Characteristics

Dependent Variable:	Employees	Assets	EBIT	Sales Growth
Average Treatment Effect	2.212 (-0.04)	-84.49 (-0.38)	-3.353 (-0.46)	-0.212* (-1.85)

Test of Hypothesis 2

How does the tax rate affect risk taking?

- Effect is firm specific, depends on loss offset expectations
→ split sample according to loss offset expectations

Subsamples:

- ① Full loss offset expected (“high λ ” firms)
 - firm operates in country where loss carrybacks allowed
 - and reported positive earnings in carryback years
- ② Loss offset unlikely (“low λ ”)
 - firm active in a country without loss carryback
 - and unlikely to be profitable in the short term (based on historical performance)

Regression:

$$RISK_{ijt} = \gamma_0 + \gamma_1 CTR_{jt} + \gamma_n X_{it} + \theta_k + \rho_t + \epsilon_{it}$$

Test of Hypothesis 2 – Results

	(1) High λ Levels	(2) Low λ Levels	(3) High λ Changes	(4) Low λ Changes
CTR	0.913** (2.575)	-0.304** (-2.602)	1.038*** (4.686)	0.015 (0.064)
Controls	Yes	Yes	Yes	Yes
Industry/Year FE?	Yes	Yes	Yes	Yes
Observations	52,014	2,463	40,951	2,463
R^2	0.344	0.249	0.004	0.197

t-statistics in parentheses, based on standard errors clustered by firm and by country-year.

Tests of Hypothesis 2 – Size of Effects

How large are these effects?

- A three percentage point increase in the tax rate is associated with an *13.9 % increase* in risk-taking for the average high- λ firm.
- A three percentage point increase in the tax rate is associated with an *8.6 % decrease* in risk-taking for the average low- λ firm.

Alternative Risk Measures

- Idiosyncratic Volatility: market-based measure of firm risk
- Log(R&D): log of R&D expenses
- Also use standard deviation of cash flows, and risk measure over five years

Dep. Variable:	Idiosyncratic Volatility			Log(R&D)		
	(1) Risk	(2) High λ	(3) Low λ	(4) Risk	(5) High λ	(6) Low λ
LCB	0.005*** (5.410)			0.279*** (6.191)		
LCF	0.001*** (2.707)			0.002 (0.153)		
StandCTR	-0.005** (-2.296)			-0.156 (-1.338)		
CTR		0.053*** (3.366)	-0.024 (-1.096)		4.522*** (5.209)	4.047 (1.456)
LCB*StandCTR	0.005** (2.189)			0.217*** (3.161)		
LCF*StandCTR	0.000* (1.793)			0.007 (1.081)		
Controls?	Yes	Yes	Yes	Yes	Yes	Yes
Industry/Year FE?	Yes	Yes	Yes	Yes	Yes	Yes
Observations	67,287	41,031	2,070	27,206	16,329	686

Further tests

- **Alternative samples:** Dropping U.S. or using random sample of U.S. firms equivalent to the number of U.K. firms yields very similar results.
- **Interaction with firm size:** Loss offset matters more for smaller firms.
- **Nonlinear effects:** Additional years in the loss offset period have diminishing benefits.
- **Stock option expense:** Including stock options, which could affect both risk-taking (by providing incentives for managers) and tax payments (if options are tax-deductible), yields similar results.
- **No overlapping observations:** Estimates using only every third year yield similar results.

Conclusion

- Better loss offset possibilities encourage risk-taking; loss carrybacks are more effective than carryforwards
 - The tax rate has a positive effect on risk-taking if loss offset is expected; otherwise its effect is negative
- To the extent that governments want to encourage risk-taking, longer loss periods, particularly carrybacks, provide appropriate incentives
- High tax rates do not necessarily inhibit risky investments, as long as sufficient loss offset is provided

Statutory loss carryback periods

Country	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Austria	0	0	0	0	0	0	0	0	0	0	0	0
Belgium	0	0	0	0	0	0	0	0	0	0	0	0
Denmark	0	0	0	0	0	0	0	0	0	0	0	0
Finland	0	0	0	0	0	0	0	0	0	0	0	0
France	3 [◇]	3 [◇]	3 [◇]	3 [◇]	3 [◇]	3 [◇]	3 [◇]	3 [◇]	3 [◇]	3 [◇]	3 [◇]	3 [◇]
Germany	2	1	1	1	1	1	1	1	1	1	1	1
Greece	0	0	0	0	0	0	0	0	0	0	0	0
Ireland	1	1	1	1	1	1	1	1	1	1	1	1
Italy	0	0	0	0	0	0	0	0	0	0	0	0
Luxembourg	0	0	0	0	0	0	0	0	0	0	0	0
Netherlands	3	3	3	3	3	3	3	3	3	1	1	1
Norway	0	0	0	0	0	0	0	0	0	0	0 [○]	0 [○]
Portugal	0	0	0	0	0	0	0	0	0	0	0	0
Spain	0	0	0	0	0	0	0	0	0	0	0	0
Switzerland	0	0	0	0	0	0	0	0	0	0	0	0
United Kingdom	1	1	1	1	1	1	1	1	1	1	1	1
United States	2	2	2	2 [○]	2 [○]	2	2	2	2	2	2 [○]	2 [○]

[◇] indicates no immediate tax refund; a tax credit is instead paid after five years.

[○] indicates temporary rule in the U.S. and Norway. Due to the retroactive nature of these rules, we code 2008 and 2009 for Norway as no loss carryback, and 2009 as 2 years loss carryback for the U.S. in the empirical study.

Statutory loss carryforward periods

Country	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Austria	/	/	/	/	/	/	/	/	/	/	/	/
Belgium	/	/	/	/	/	/	/	/	/	/	/	/
Denmark	5	5	5	5	5	/	/	/	/	/	/	/
Finland	10	10	10	10	10	10	10	10	10	10	10	10
France	5	5	5	5	5	5	/	/	/	/	/	/
Germany	/	/	/	/	/	/	/	/	/	/	/	/
Greece	5	5	5	5	5	5	5	5	5	5	5	5
Ireland	/	/	/	/	/	/	/	/	/	/	/	/
Italy	5	5	5	5	5	5	5	5	5	5	5	5
Luxembourg	/	/	/	/	/	/	/	/	/	/	/	/
Netherlands	/	/	/	/	/	/	/	/	/	9	9	9
Norway	10	10	10	10	10	10	10	10	/	/	/	/
Portugal	6	6	6	6	6	6	6	6	6	6	6	6
Spain	7	10	10	10	15	15	15	15	15	15	15	15
Switzerland	7	7	7	7	7	7	7	7	7	7	7	7
United Kingdom	/	/	/	/	/	/	/	/	/	/	/	/
United States	20	20	20	20	20	20	20	20	20	20	20	20