

Economic and Financial Determinants of Firm Bankruptcy:

Evidence from the French Food Industry

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Firm bankruptcies in the French Food Industry

- ▶ On average, 1,100 firms file for bankruptcy every year.
- ▶ Resilience during the recent crisis.
- ▶ Dramatic increase of firm bankruptcies in recent period.

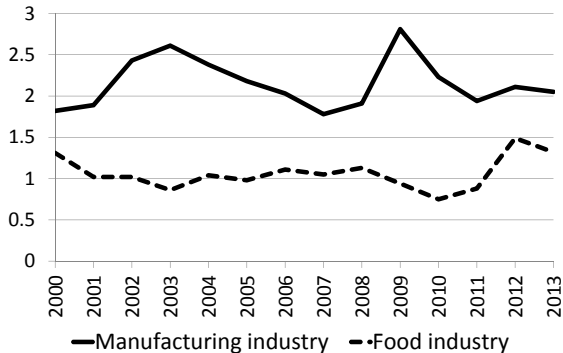


Figure: Bankruptcy rate, %

Firm bankruptcies in the French Food Industry

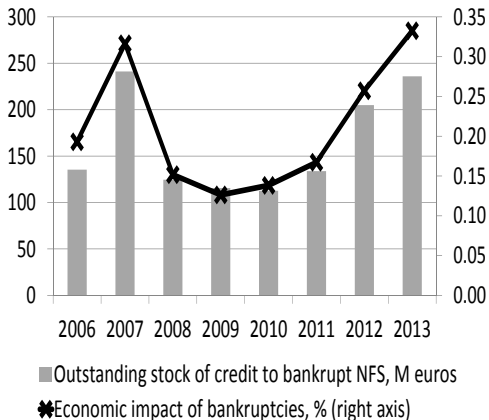
- ▶ Each year, on average, nearly 2,700 jobs are concerned.
 - ▶ In 2012, more than 4,000 jobs!



Figure: "GAD group: dead or alive, we'll fight till the end"

Firm bankruptcies in the French Food Industry

- ▶ The economic impact of bankruptcies in terms of firms' outstanding debt doubled between 2010 and 2013.



This paper

- ▶ To understand firms' bankruptcy risk evolution and to identify the determinants of exits due to bankruptcy.
 - ▶ Firm size, age
 - ▶ Productivity
 - ▶ Financing conditions
- ▶ To identify the role of financing conditions in bankruptcy risk, particularly relevant after the recent crisis.
- ▶ To reveal the differences of bankruptcy patterns in the food industry and other manufacturing industries.
- ▶ Very rich firm-level data covering the period 2001-2013.
- ▶ Binary dependent variable econometric modeling for the occurrence of the failure. .

This paper: Results

- ▶ Higher productivity reduces bankruptcy risk, whereas a higher cost of credit increases bankruptcy risk.
- ▶ Compared to the productivity, we observe smaller effects of firm financial characteristics (credit cost, indebtedness) on firms' bankruptcy risk.
- ▶ Productivity appears to have an important beneficial effect on bankruptcy risk reduction.

A brief literature review

Firm efficiency and exit

- ▶ Heterogeneity in firms' behavior concerning the decision to exit the market.
(Roberts and Tybout 1997, Caves 1998, Bartelsman and Doms 2000)
- ▶ Endogeneous exit decision
(the learning model of Jovanovic 1982, Hopenhayn 1992 etc.)
- ▶ Ericson and Pakes 1995 model on firm exit decision and efficiency level;
- ▶ The probability of exit depends on firm efficiency
(e.g. Olley and Pakes 1996, Dwyer 1997, Farinas and Ruano 2005, Bellone et al. 2006, Blanchard et al. 2012)

A brief literature review

Firm financing constraints and exit

- ▶ The market selection process can be distorted by credit market imperfections.
- ▶ The financial frictions impact on firms' exit.
- ▶ Firms' exit due to credit rationing.
(e.g. Cooley and Quadrini 2001, Osotimehin and Pappada 2013, Arellano et al. 2009, Albuquerque and Hopenhayn 2004 etc.)

The economic model: endogenous exit model

Based on Ericson and Pakes 1995, Olley and Pakes 1996, Blanchard et al. 2012.

- ▶ The exit decision on the basis of a Bellman equation:

$$\begin{aligned} V(K_{it}, a_{it}, \omega_{it}, r_{Bit}, B_{it}, \gamma_t) \\ = \max\{\phi, \max_{i_{it}}\{R(K_{it}, a_{it}, \omega_{it}, \gamma_t) - (1 + r_{Bit})B_{it} \\ + \beta E[V(K_{it+1}, a_{it+1}, \omega_{it+1}, r_{Bit+1}, B_{it+1}, \gamma_{t+1})|\Theta_t]\}\}\} \end{aligned} \quad (1)$$

- ▶ The exit rule:

$$\chi_{it} = \begin{cases} 1 \text{ (stay)}, & \text{if } \omega_{it} \geq \underline{\omega}(K_{it}, a_{it}, r_{Bit}, B_{it}, \gamma_t) \\ 0 \text{ (exit)}, & \text{otherwise} \end{cases} \quad (2)$$

- ▶ In words, a firm decides to exit if
 - ▶ Given its capital stock K_{it} , its productivity shock ω_{it} , its debt level B_{it} , its cost of credit r_{Bit} and its environment at $t...$
 - ▶ it is more profitable to go bankrupt and get the value of bankruptcy, ϕ , than to keep going and obtain the expected discounted profits from continued operations.

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- ▶ Two sub-samples: the food industry and manufacturing industry excluding the food industry.

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- ▶ On average, about 35,000 manufacturing companies per year.
- ▶ Two sub-samples: the food industry and manufacturing industry excluding the food industry.
- ▶ Scarce data on bankrupt firms!
2001-2012: 50,000 bankruptcies of manufacturing business units.
Fewer than 3,500 observed the year of the failure.
Nearly 14,000 observed at most 3 years before the failure.

- ▶ Bankruptcy definition: judicial reorganization or liquidation proceedings.
- ▶ Firm characteristics:
 - ▶ *Total factor productivity* estimated at firm level using Olley and Pakes 1996 and Levinsohn and Petrin 2003 approach.
 - ▶ *Cost of credit*
 - ▶ *Bank debt on total assets*
 - ▶ Age, Size, Sector etc.

Descriptive statistics

Food industry, 2001-2012

	No failure	Failure	% <i>in total obs.</i>
Number of firm-year obs.	74,913	650	0,8
SMEs	0.89	0.98	0.9
of which independent SMEs	0.45	0.59	1.1
Intermediate-size and large firm	0.11	0.02	0.2
Very small firm	0.28	0.44	1.3
Small firm	0.18	0.24	1.2
Medium firm	0.20	0.19	0.8
Large firm	0.34	0.13	0.3
Food products and beverages	1	1	0.8
of which Meat industry	0.24	0.40	1.4

Descriptive statistics (3)

Food industry, 2001-2012

	Mean	Q1	Median	Q3
TFP				
Year of the failure	3.59	3.37	3.62	3.86
1 year before	3.70	3.45	3.71	3.99
2 years before	3.81	3.56	3.82	4.08
3 years before	3.89	3.64	3.87	4.13
No failure	4.19	3.84	4.14	4.48
Cost of credit				
Year of the failure	0.07	0.03	0.06	0.07
1 year before	0.07	0.04	0.06	0.08
2 years before	0.07	0.04	0.06	0.08
3 years before	0.07	0.04	0.06	0.08
No failure	0.05	0.03	0.05	0.07

Descriptive statistics (4)

Food industry, 2001-2012

	Mean	Q1	Median	Q3
Bank debt/total assets				
Year of the failure	0.27	0.08	0.23	0.43
1 year before	0.33	0.14	0.30	0.48
2 years before	0.29	0.12	0.27	0.43
3 years before	0.29	0.13	0.25	0.42
No failure	0.21	0.06	0.17	0.32

▶ Other manufacturing industries

Descriptive statistics (5)

Food industry, 2001-2012

	Mean	Q1	Median	Q3
Short-term bank debt/total assets				
Year of the failure	0.06	0.00	0.03	0.10
1 year before	0.08	0.00	0.05	0.14
2 years before	0.08	0.00	0.05	0.13
3 years before	0.08	0.00	0.05	0.12
No failure	0.03	0.00	0.00	0.04
Profitability				
Year of the failure	-0.06	-0.18	-0.05	0.05
1 year before	-0.03	-0.13	-0.01	0.07
2 years before	0.02	-0.05	0.03	0.10
3 years before	0.06	0.00	0.06	0.12
No failure	0.13	0.05	0.11	0.19

Econometric modeling

- ▶ Binary dependent variable model for the occurrence of the failure.
- ▶ We have:

$$Bankruptcy_{it} = \begin{cases} 1, & \text{if } Bankruptcy_{it}^* \geq 0 \\ 0, & \text{otherwise} \end{cases} \quad (3)$$

and

$$Bankruptcy_{it}^* = X'_{it}\beta + \alpha_i + \epsilon_{it} \quad (4)$$

where α_i is individual unobserved effect, ϵ_{it} is the model error term.

- ▶ Our model:

$$Prob(Bankruptcy_{it}|X_{i,past}, \beta, \alpha_i) = F(\alpha_i + X'_{i,past}\beta) \quad (5)$$

where $X'_{i,past}$ is the mean of past values of X over at most three years ($X_{i,t-1}, X_{i,t-2}, X_{i,t-3}$).

Econometric modeling (2)

- ▶ The proportion of bankruptcy observations is very low!
Endogenous stratification choice-based sampling (Manski and Lerman 1977).

Weighted endogenous sampling maximum likelihood method:

$$\log L = \sum_{i=1}^N w_i \log F(q_i(\alpha_i + X_i' \beta)) \quad (6)$$

with $w_i = \text{Bankruptcy} \frac{Q_1}{H_1} + (1 - \text{Bankruptcy}) \frac{Q_0}{H_0}$ and
 $q_i = 2\text{Bankruptcy} - 1$.

- ▶ Endogeneity of the cost of credit: the average cost of credit in other sectors than the sector of the firm (controlling for size and debt level for each year).

Two-step approach based on a control function (Rivers and Vuong 1988)

Results

Probit regression of bankruptcy using WEML on choice-based samples, 2001-2013

$mean(X_{i,t-1}, X_{i,t-2}, X_{i,t-3})$	Food industry (1)	Manuf. Ind. (excl. Food ind.) (2)	Manuf. industry (3)
TFP	-0.452*** (0.039)	-0.334*** (0.011)	-0.339*** (0.010)
Cost of credit	0.034*** (0.010)	0.012*** (0.003)	0.013*** (0.003)
Bank credit / total assets	0.006*** (0.001)	0.009*** (0.000)	0.008*** (0.000)
Annual dummies	Yes	Yes	Yes
IV Avg credit cost in other sectors	Yes	Yes	Yes
Number of obs.	31,961	191,707	223,668
Number of firms	3,582	23,428	27,010
LogL	-1538.5	-17540.2	-19101.0
WEML weight non bankruptcy obs.	1.348	1.350	1.350
WEML weight bankruptcy obs.	0.067	0.068	0.068

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Standard errors in parentheses. Panel-robust standard errors.

Results (2)

Probit regression of bankruptcy using WEML on choice-based samples, 2001-2013

$mean(X_{i,t-1}, X_{i,t-2}, X_{i,t-3})$	Food industry (1)	Manuf. Ind. (excl. Food ind.) (2)	Manuf. industry (3)
Age (less than 5 years)	ref.	ref.	ref.
Age (5-10 years)	-0.068 (0.064)	-0.129*** (0.020)	-0.123*** (0.019)
Age (more than 10 years)	-0.191*** (0.057)	-0.343*** (0.017)	-0.330*** (0.016)
Very small firm	ref.	ref.	ref.
Small firm	-0.009 (0.041)	-0.149*** (0.013)	-0.138*** (0.012)
Medium firm	-0.058 (0.044)	-0.189*** (0.013)	-0.179*** (0.013)
Large firm	-0.200*** (0.050)	-0.209*** (0.015)	-0.213*** (0.015)
Constant	-0.849*** (0.178)	-0.699*** (0.056)	-0.695*** (0.054)
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Results (3)

Predicted probability of bankruptcy, %

	Food industry	Meat industry	Food ind. (excl. Meat industry)	Manuf. ind. (excl. Food ind.)	Manuf. industry (all sectors)
Full sample	0.930	1.488	0.773	1.943	1.795
Very small firm	1.566	2.161	1.371	3.031	2.833
Small firm	1.306	1.913	1.099	1.922	1.853
Medium firm	0.826	1.167	0.756	1.586	1.486
Large firm	0.344	0.598	0.287	1.073	0.929
Age (less than 5 years)	1.962	2.832	1.747	3.835	3.589
Age (5-10 years)	1.504	2.320	1.377	2.899	2.705
Age (more than 10 years)	0.773	1.276	0.626	1.64	1.512
2008	0.925	1.503	0.773	1.542	1.453
2009	0.724	1.200	0.598	2.316	2.073
2010	0.668	1.086	0.568	1.749	1.582
2011	0.786	1.309	0.665	1.678	1.537
2012	1.182	1.783	1.030	1.706	1.624
2013	1.079	1.645	0.939	1.747	1.635

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Results (4)

Predicted probability of bankruptcy, %

	Food industry		Manufacturing ind. (excl. Food ind.)		Manufacturing industry	
	TFP Quantile	Predicted prob.	TFP Quantile	Predicted prob.	TFP Quantile	Predicted prob.
p1	2.907	2.804	2.641	4.679	2.665	4.359
p10	3.557	1.402	3.337	2.854	3.364	2.619
p25	3.780	1.087	3.645	2.261	3.667	2.069
p50	4.072	0.769	3.958	1.770	3.973	1.617
p75	4.423	0.498	4.266	1.378	4.288	1.244
p90	4.788	0.309	4.601	1.038	4.629	0.926
p99	5.713	0.083	5.523	0.452	5.562	0.389

Results (4)

Predicted probability of bankruptcy, %

- ▶ The bankruptcy risk decreases considerably for firms in the upper part of productivity distribution.

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Results (4)

Predicted probability of bankruptcy, %

- ▶ The bankruptcy risk decreases considerably for firms in the upper part of productivity distribution.
- ▶ The productivity effect is lower for food industry firms compared to other manufacturing firms.

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Results (5)

Predicted probability of bankruptcy, %

	Food industry		Manufacturing ind. (excl. Food ind.)		Manufacturing industry	
	Cost of credit Quantile	Predicted prob.	Cost of credit Quantile	Predicted prob.	Cost of credit Quantile	Predicted prob.
p1	0.000	0.523	0.000	1.557	0.000	1.403
p10	0.021	0.636	0.027	1.680	0.026	1.525
p25	0.036	0.724	0.043	1.759	0.042	1.604
p50	0.051	0.824	0.063	1.857	0.061	1.701
p75	0.072	0.989	0.096	2.036	0.093	1.877
p90	0.106	1.313	0.148	2.342	0.143	2.188
p99	0.222	3.208	0.275	3.254	0.270	3.170

Results (5)

Predicted probability of bankruptcy, %

- ▶ The effect of cost of credit on bankruptcy risk appears to be less important than that of productivity.

	Food industry		Manufacturing ind. (excl. Food ind.)		Manufacturing industry	
	Cost of credit Quantile	Predicted prob.	Cost of credit Quantile	Predicted prob.	Cost of credit Quantile	Predicted prob.
p1	0.000	0.523	0.000	1.557	0.000	1.403
p10	0.021	0.636	0.027	1.680	0.026	1.525
p25	0.036	0.724	0.043	1.759	0.042	1.604
p50	0.051	0.824	0.063	1.857	0.061	1.701
p75	0.072	0.989	0.096	2.036	0.093	1.877
p90	0.106	1.313	0.148	2.342	0.143	2.188
p99	0.222	3.208	0.275	3.254	0.270	3.170

Results (5)

Predicted probability of bankruptcy, %

- ▶ The effect of cost of credit on bankruptcy risk appears to be less important than that of productivity.
- ▶ The probability of bankruptcy increases almost equally for food industry and other manufacturing industries.

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- ▶ Among manufacturing sub-sectors, food industry seems to be more resilient towards bankruptcy risks.
- ▶ Bankruptcy predictions based on our model confirm the observed dramatic increase of bankruptcy risk in the French food industry on the recent period.
- ▶ Meat industry was mostly responsible for bankruptcy risk evolution between 2010 and 2012.

Conclusions (2)

- ▶ Higher productivity reduces the bankruptcy risk and, on the contrary, higher cost of credit increases the probability to go bankrupt.

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- ▶ We find lower effects of firms' financial characteristics (credit cost, bank debt level) on their bankruptcy risk.
- ▶ On contrary, productivity appears having more important beneficial effect on bankruptcy risk reduction.

Thank you for your attention!

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Descriptive statistics

Manufacturing ind. (excl. Food ind., 2001-2012)

	No failure	Failure	% <i>in total obs.</i>
Number of firm-year obs.	417,575	8,402	2,0
SMEs	0,94	0,98	2,1
of which independent SMEs*	0,39	0,53	2,7
Intermediate-size and large firm	0,06	0,02	0,8
Very small firm	0,29	0,44	3,0
Small firm	0,23	0,23	2,0
Medium firm	0,22	0,19	1,7
Large firm	0,25	0,14	1,1

Descriptive statistics (2)

Manufacturing ind. (excl. Food ind., 2001-2012)

	No failure	Failure	% <i>in total obs.</i>
Number of firm-year obs.	417,575	8,402	2,0
Young firm (less than 5 years)	0,05	0,08	3,0
Age (5-10 years)	0,14	0,2	2,9
Age (more than 10 years)	0,81	0,72	1,8
Bad BDF rating	0,05	0,17	7,0
Textiles, wearing apparel, etc.	0,07	0,14	3,6
Wood, paper, coke and refined petrol.	0,15	0,16	2,1
Chemicals ; other non-metallic prod.	0,18	0,1	1,2
Basic, fabricated metals	0,24	0,24	2,0
Comp.; machinery, other transport	0,19	0,18	2,0
Furniture, machinery, other manuf.	0,17	0,18	2,2

Descriptive statistics (3)

Manufacturing ind. (excl. Food ind., 2001-2012)

	Mean	Q1	Median	Q3
TFP				
Year of the failure	3,42	3,07	3,49	3,85
1 year before	3,64	3,32	3,69	4,02
2 years before	3,74	3,42	3,78	4,09
3 years before	3,78	3,46	3,81	4,12
No failure	4,04	3,70	4,02	4,34
Cost of credit				
Year of the failure	0,09	0,04	0,07	0,12
1 year before	0,09	0,05	0,07	0,11
2 years before	0,09	0,05	0,07	0,11
3 years before	0,09	0,05	0,07	0,11
No failure	0,07	0,04	0,05	0,08

Descriptive statistics (4)

Manufacturing ind. (excl. Food ind., 2001-2012)

	Mean	Q1	Median	Q3
Bank debt/total assets				
Year of the failure	0,28	0,09	0,23	0,42
1 year before	0,28	0,11	0,24	0,41
2 years before	0,26	0,1	0,22	0,38
3 years before	0,24	0,08	0,20	0,35
No failure	0,17	0,03	0,11	0,25

▶ Food industry

Descriptive statistics (5)

Manufacturing ind. (excl. Food ind., 2001-2012)

	Mean	Q1	Median	Q3
Short-term bank debt/total assets				
Year of the failure	0.08	0.00	0.04	0.12
1 year before	0.10	0.01	0.07	0.16
2 years before	0.10	0.00	0.06	0.15
3 years before	0.08	0.00	0.04	0.13
No failure	0.03	0.00	0.00	0.03
Profitability				
Year of the failure	-0.10	-0.23	-0.07	0.04
1 year before	-0.02	-0.12	0.00	0.09
2 years before	0.04	-0.05	0.05	0.14
3 years before	0.08	-0.01	0.08	0.16
No failure	0.18	0.06	0.14	0.25