Turmoil over the crisis: entry and exit of Italian firms

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Main focus

- How firms could affect their probability of survival and growth over the recent economic and financial crises

- How and to what extent, innovation activities are able, in addition to standard performance variables, to shape the demographic dynamics at the firm level

  ⇒ We identify "involuntary" exits

  ⇒ Granted patents and registered trademarks as proxied for firms' innovative activity

Empirical literature related to firms' survival

- Many empirical works consider both "voluntary" and "involuntary" exits as homogeneous events
  - Cefis and Marsili (2005); Jensen et al. (2008); Carreira and Teixeira (2016)

- Some studies do not consider mergers and acquisitions and changes in legal form among causes of firms' exit
  - Pérez et al. (2004); Esteve-Pérez and Mañez-Castillejo (2008); Helmers and Rogers (2010); Tsoukas (2011); Delmar et al. (2013); Fackler et al. (2013); Colantone et al. (2014)

- Other researches only focus on some modes of exit
  - Helmers and Rogers (2010); Giovannetti et al. (2011); Godart et al. (2012); Amendola et al. (2012); Ferragina et al. (2012)
  or analyze determinants for different types of exit
  - Cefis and Marsili (2007); Wagner and Cockburn (2010); Esteve-Pérez et al. (2010); Balcaen et al. (2012)

- Only few studies focus on the analysis of "involuntary" exits
  - Bottazzi et al. (2011); Mueller and Stegmaier (2015)

Firm Level Data

- Analisi Informatizzata delle Aziende (AIDA data, 2005-2014)

    - The dataset virtually covers the universe of Italian limited liability firms independently of their size

- AMADEUS dataset (2005-2014)

    - The dataset include information on the stock of granted patents and registered trademarks

Firms' entry and "involuntary" exit

- Entry: it is based on firms' incorporation year

- "Involuntary" exit: it is based on the type of administrative procedures firms underwent
  - We account for administrative procedures that unambiguously lead to "involuntary" exit
  - We do not consider as causes of exit: "voluntary" exit, merger and acquisition, procedures that do not unequivocally lead to "involuntary" exit

Examples of admin. procedures leading to involuntary exit

Bankruptcy
Cancellation due to communication of allocation plan
Cancellation ex officio of registration with register of companies
Cancellation from the register of companies
Cancelled ex officio pursuant to Article 2490 of the Italian Civil Code
Cancelled ex officio pursuant to Italian Presidential Decree no. 247 of 23 July 2004
Closure due to bankruptcy
Composition with creditors
Compulsory administrative liquidation
Conclusion of bankruptcy procedures
Court order of cancellation
Failure to meet prerequisites
Impossibility of fulfillment of the company object
Initial failure to meet the prerequisites for a company
Initiation of cancellation procedure
No longer meets requirements specified for companies
Post-bankruptcy composition with creditors
Removal ex officio
State of insolvency (list keeps going)

Other admin. procedures leading to other forms of exit

(A hint about our ignorance about *true* firm demography)

Annulment of entry
Cancellation ex officio following creation of Chamber of Commerce in Fermo (and similar)
Cessation of business within the province
Closure of local branch
Conclusion of liquidation
Contribution
Controlled administration
Debt restructuring agreements
Demerger
Duplication
Extraordinary administration
Failure to re-establish multiple partners
Following expiry of time limits
Fulfilment of company object
Lease of company
Merger by incorporation into another company
Merger by incorporation of new company (list keeps going)

Entry & exit according to our definition of involuntary exit

Year	Entries	Exits	Active	% Entries	% Exits
2010	40,458	18,706	547,877	7.385	3.414
2011	38,678	17,990	568,565	6.803	3.164
2012	39,480	17,190	590,855	6.682	2.909
2013	46,988	8,428	629,415	7.465	1.339
2014	55,746	7,606	677,555	8.228	1.123

Note. We only consider limited liability companies operating in manufacturing or service sectors with information on both their entry and exit/survival (we exclude firms operating in the following 2-digit ATECO 2007 code: 12, 33, 64, 65, 66 and 68).

- Data on firms' exit are available for the post-crisis period (2010-2014)
- The share of entrants is generally larger than the share of exiting firms. Puzzlingly during the crisis. Might be due to considering subset of limited liabilities

Innovative activity

- Stock (+ yearly flow) of granted patents applied to United States Patent and Trademark Office (USPTO), European Patent Office (EPO), or Italian Patent and Trademark Office (IPTO)

  - We do not account for patents applied more than 20 years before the year of interest

- Stock (+ yearly flow) of registered trademarks filed at the United States Patent and Trademark Office (USPTO) or at the Office for Harmonization in the Internal Market (OHIM)

  - We consider trademarks applied before or in the year of interest, that expire after the referred year

- At present, we use two dummy variables which indicate if a firm, in each year, own granted patents or registered trademarks, respectively

Descriptive statistics

	2010	2011	2012	2013	2014
Empl	12.781	14.877	14.229	13.701	12.855
	(280.232)	(254.939)	(238.525)	(233.798)	(220.313)
Value Added	755.626	727.700	665.447	635.439	604.841
	(22667.64)	(21107.43)	(19203.59)	(17165.49)	(15747.72)
ROS	3.226	3.362	2.671	2.652	2.787
	(10.692)	(10.732)	(11.150)	(11.224)	(11.423)
SolvRatio	27.970	27.949	28.385	28.410	28.435
	(27.717)	(27.759)	(28.035)	(28.321)	(28.715)
Age	13.521	13.693	13.849	13.816	13.689
	(12.749)	(12.828)	(12.904)	(12.933)	(12.965)
Val_trade_d	0.021	0.022	0.024	0.024	0.022
	(0.143)	(0.148)	(0.152)	(0.153)	(0.148)
Val_pat_d	0.017	0.016	0.015	0.013	0.012
	(0.128)	(0.125)	(0.121)	(0.115)	(0.108)

Note. We consider in each year active firms (entrants+incumbent) with information on the relevant variable. For each variable and year we have a different number of observations.

Fligner-Policello test of stochastic equality

- Let F_A and F_E be the distributions of the relevant variables of "active" continuing firms and exiting firms. Denote with $\mathbf{X}_A \sim F_A$ and $\mathbf{X}_E \sim F_E$ the associated random variables, and with X_A and X_E two respective realizations

- The distribution F_A is said to have stochastic dominance over F_E if Prob $\{X_A > X_E\} > 1/2$

- That is, if one randomly selects one "active" continuing firm and one exiting firm, the former has a higher probability of having a greater value

Fligner-Policello test of stochastic equality

The Fligner-Policello test is useful to compare the relevant variable distributions of "active" continuing firms and exiting firms because it allows for:

- comparison of uneven samples

- non-normalities of the distributions

- unequal variances among distributions

- asymmetry and unequal shapes

Fligner-Policello test: continuing firms in 2012 vs. exiting firms in 2012

	2011	2010	2009	2008	2007	2006	2005
ln(Empl)	3.795***	1.512	1.860*	1.330	2.416**	-1.384	-0.410
	376044	303585	289981	265124	178251	135163	75861
	7390	5647	5334	4647	3130	2137	1224
ln(LP)	25.544***	11.183***	10.423***	13.239***	9.967***	7.606***	7.823***
	376044	285774	269160	246176	162709	131249	72517
	7390	5117	4760	4157	2731	2055	1159
ROS	30.824***	22.355***	17.709***	15.083***	14.048***	12.624***	10.764***
	376044	331261	300938	276751	254291	216899	197543
	7390	6344	5547	4971	4400	3571	3218
SolvRatio	42.134***	36.631***	32.503***	27.077***	22.202***	28.170***	24.921***
	376044	352299	325624	302485	279381	225621	204831
	7390	6788	6093	5462	4904	3697	3313
ln(Age)	25.075***	24.572***	22.539***	19.654***	17.656***	15.124***	12.018***
	376044	362465	339945	318603	297419	276833	258252
	7390	7036	6389	5751	5193	4647	4146

Note. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

- "Active" continuing firms perform better than exiting firms
- No clearcut evidence on size (again... is it due to limited liability)
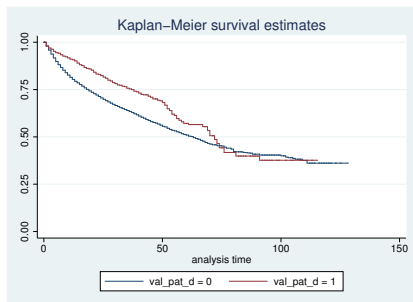
Kaplan-Meier estimator for survival function

The estimated probability to survive at least up to age of t years is given by:

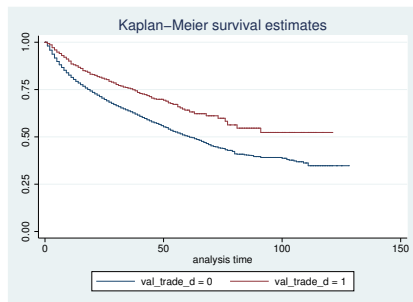$$\widehat{S}(t) = \prod_{t_i \leq t} \left(1 - \frac{e_i}{n_i} \right) \tag{1}$$

e_i, number of exiting firms of age t_i

n_i, number of firms suvived up to the age of t_i

Kaplan–Maier estimator: innovative *vs.* non-innovative firms

(a) K-M survival estimates, firms with patents *vs.* firms without patents. Log-Rank test: $\chi2 =39.12(0.0000)$; Wilcoxon-Breslow-Gehan test: $\chi2 =57.12(0.0000)$.

(b) K-M survival estimates, firms with trademarks *vs.* firms without trademarks. Log-Rank test: $\chi2 =93.14(0.0000)$; Wilcoxon-Breslow-Gehan test: $\chi2 =76.33(0.0000)$.

Model specifications

- Dependent variable: the binary variable $exit_{i,t}$ is equal to 1 if firm i exits the market in year t (where t varies between 2010 and 2014) and 0 otherwise

- Explanatory variables: firms' size, productivity, profitability, financial stability, age and its square (baseline specification); two dummies equal to 1 if firms own at least one granted patent or one registered trademark, respectively, and 0 otherwise (extended specification)

- Control variables: 2-digit industry dummy variables (ATECO 2007), geographical area dummy variables (North, Centre and South of Italy)

Probit models

$$Prob(exit_{i,t} = 1|X_{i,t-1}) = \Phi(X_{i,t-1}\beta) \tag{2}$$

Φ (.), cumulative distribution function of a standard normal variable, with associated density $\phi(.)$

for both the baseline (without) and the extended (with innovation proxies) specifications, we estimate five Probit models, each predicting the firms probability of exit in 2010, 2011, 2012, 2013 and 2014, respectively.

Probit estimates: with innov. proxies

	2010	2011	2012	2013	2014
L.ln(Empl)	-0.00230***	-0.00151***	0.0000406	0.000336**	-0.000417***
	(0.000233)	(0.000214)	(0.000228)	(0.000148)	(0.000128)
L.ln(LP)	-0.00326***	-0.00273***	-0.00380***	-0.00198***	-0.00148***
	(0.000234)	(0.000200)	(0.000275)	(0.000174)	(0.000138)
L.ROS	-0.000409***	-0.000436***	-0.000519***	-0.000248***	-0.000181***
	(0.0000288)	(0.0000283)	(0.0000259)	(0.0000150)	(0.0000133)
L.SolvRatio	-0.000306***	-0.000267***	-0.000284***	-0.000131***	-0.0000762***
	(0.0000151)	(0.0000142)	(0.0000132)	(0.00000845)	(0.00000671)
L.val_pat_d	-0.0104***	-0.00663***	-0.00311	0.00113	0.00109
	(0.00279)	(0.00237)	(0.00192)	(0.00105)	(0.00103)
L.val_trade_d	-0.0106***	-0.00906***	-0.00480***	-0.000366	0.000904
	(0.00254)	(0.00212)	(0.00164)	(0.000905)	(0.000779)
Age	-0.000612***	-0.000492***	-0.000328***	-0.0000262*	-0.0000507***
	(0.0000342)	(0.0000308)	(0.0000250)	(0.0000137)	(0.0000128)
Age_sq	0.000000727***	0.000000601***	0.000000408***	5.20e-08**	7.44e-08***
	(6.52e-08)	(6.32e-08)	(5.30e-08)	(2.24e-08)	(1.98e-08)
N	320420	328433	383434	407654	430818
Brier score	0.0218	0.0203	0.0187	0.0078	0.0064

Notes. Dummies for 2-digit sectors and geographical location included. Average marginal effects and standard errors.
Independent variables are lagged one year.

Complementary log-log models

The probability that a firm exit in interval t, conditional on its survival up to the beginning of this interval and given the independent variables, is given by the following equation:

$$h_t(X_{i,t-1}) = 1 - exp\Big(- exp(X'_{i,t-1}\beta + \theta(t))\Big)$$

t, firms' age

$\theta(t)$, baseline hazard function

$X_{i,t-1}$, vector of regressors and controls

Complementary log-log estimates

	baseline spec.	extended spec.
L.ln(Empl)	-0.0552***	-0.0494***
	(0.00560)	(0.00569)
L.ln(LP)	-0.146***	-0.145***
	(0.00585)	(0.00587)
L.ROS	-0.0240***	-0.0241***
	(0.000613)	(0.000613)
L.SolvRatio	-0.0153***	-0.0152***
	(0.000384)	(0.000384)
L.Val_pat_d		-0.210***
		(0.0591)
L.Val_trade_d		-0.249***
		(0.0502)
Age	-0.0187***	-0.0185***
	(0.000752)	(0.000751)
Age_sq	0.0000222***	0.0000220***
	(0.000000974)	(0.000000973)
_cost	-3.210***	-3.215***
	(0.0628)	(0.0628)
N	1874997	1874997

*Notes. Dummies for years, 2-digit sectors and geographical location included. Coefficients and robust standard errors. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$*

Conclusions

- Bigger and older firms, as well as companies with higher economic and financial performance (measured i terms of productivity, profitability and solvency ratio) face a lower probability of exit from the market

- Non-linear relationship between age and firms' survival

- Firms' IPRs activities help to explain the lower probability of firms' death

  - Trademarks ownership has a higher impact, in absolute terms, on firms' probability of exit than patents ownership