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The impact of FDI on firms' survival in Italy: evidence on horizontal and vertical spillovers

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Abstract

The aim of this paper is to explore a new issue in the literature on the "indirect effects" of FDI: the impact on firm survival. This is done by checking both *within* industry (horizontal) and *between* industry (vertical) spillovers through forward and backward linkages and also testing whether there is a difference in the patterns of FDI spillovers experienced in high and low technology industries. The empirical analysis is conducted using a firm level database for the period 2002-2009 resulting from the intersection of three different sources: IXth Survey 2001-2003 on Manufacturing Firms, by Capitalia/Unicredit, AIDA (Analisi Informatizzata delle Aziende) and Mint-Italy, by Bureau Van Dyck. This original database provides a rich micro evidence on a stratified and randomly selected sample of more than 4,000 Italian manufacturing firms. The econometric analysis relies on Probit and Cox proportional hazard estimates of the relationship between firm survival and horizontal and vertical FDI, measured respectively as output share of sales of foreign firms in the market and as a share of foreign firms sales in supplier (upstream) and buyer (downstream) industries, and controlling for a rich set of firm and industry specific variables following the survival literature. The study contributes to a very restricted and recent strand of research which estimates the role of horizontal and vertical FDI spillovers on survival (Girma and Gong, 2008; Wang, 2010). Our findings reveal that within the same industry survival of firms in Italy is unaffected by the increased presence of foreign-owned firms. On the other hand, at intra- industry level, firms experience less exits if they benefit from more intense upstream inter-industry linkages with foreign firms (positive vertical upstream spillovers) while tend to have shorter lives if affected by affiliates operating in downstream industries (negative vertical downstream spillovers). Furthermore, a different impact is observed in high and low technology sectors and the technology gap between local and foreign firms matters for spillover effects. These results are broadly consistent with the evidence that competition from sectoral FDI does not help firm survival while this is affected positively by inter-industry spillovers (Wang, 2010). The result is also in line with the analyses of spillover effects of FDI on productivity of Italian manufacturing firms which also found no evidence of intra-industry FDI spillovers but consistent positive vertical spillovers.

JEL classification*: F21, F23, F29, O3, L25, C41, J31*

Keywords *: FDI, Survival Analysis, Economic Linkages, Productivity Spillovers, Backward Linkages, Forward Linkages, Italian productive system.*

1. Introduction

Multinational firms can have both *direct* and *indirect* effects on host economies. The direct effects are related to the fact that foreign multinationals enterprises (FMNEs) are usually more productive than domestic-owned firms. Therefore, by attracting FMNEs a country can increase its aggregate productivity by a pure *composition effect* (Doms and Jensen, B., 1998). However, foreign multinationals also have an indirect impact on domestic firms and this may be compounded of a negative competition crowding out effect and a positive spillover effect through pecuniary and knowledge externalities.[1]

The large and overwhelming strand of literature on the effect of FDI on local contexts has focused primarily on examining the spillovers effects on *firms productivity* (see Görg and Greenaway, 2004a, Hanousek, Kočendab and Maurel, 2010, and Havranek and Irsovà, 2010, for a survey of this large literature). Within this framework, the empirical literature has identified three main channels through which FDI impact on domestic-owned plants: horizontal intra-industry economic linkages, vertical upstream and vertical downstream inter-industry linkages.[2] Building on this research, recent empirical works (Görg and Strobl, 2003; De Backer and Sleuwaegen, 2003; Görg and Strobl, 2004b; Burke, Görg and Hanley, 2008; Girma and Gong, 2008; Bandick, 2010; Wang, 2010; Kosovà, 2010) have introduced the issue of the transmission of technological and pecuniary FDI externalities to *firms survival*.

There are two main advantages stemming from this new approach which deserve some consideration. Firstly, the research on FDI spillovers has neglected the possibility that domestic firms may exit as a result of foreign competition. Therefore, the positive evidence on FDI productivity spillovers might be overestimated. Secondly, while the measurements of productivity spillovers entails the problem of input measurement, and therefore face the input endogeneity problem typical of productivity estimations, the estimate of firm exit largely avoids measurement problems.

The aim of our paper is to follow this promising approach i.e. to investigate upon the impact of foreign multinationals firms located in Italy on firms exit behaviour disaggregating through intra-

[1] The literature has mainly focused on testing the indirect impact of FDI due to the fact that estimating the direct effect is complicated by several issues as foreign firms and domestic firms are heterogeneous enterprises and contrasting the former with the latter entail building a counterfactual to avoid the selection bias due to the different size, productivity and performance of foreign and domestic firms.

[2] Horizontal intra-industry linkages refer to the economic relationships between domestic- and foreign-controlled affiliates within the same industry, mainly through competition for market shares. Upstream inter-industry linkage is the economic relationships of a local firm with foreign firms in forward industries through purchasing intermediate inputs from them, downstream inter-industry linkage is the economic relationships of a local firm with foreign firms in backward industries through selling products to them.

and inter-industry economic linkages. Hence, we explicitly differentiate the economic linkages between FDI affiliates and domestic-owned plants as competitors, input suppliers, and customers.

More precisely the paper tackles the following questions: how foreign presence affects survival of firms in Italy within the same 2-digit sector? do pecuniary and knowledge externalities or crowding out effects prevail at intra-industry level? are there vertical inter-industry spillovers of FDI on firm exit, i.e. do domestic firms benefit from FDI affiliates operating in upstream and downstream industries as input suppliers and customers? is the effect different in high and low tech industries? how relevant is firm absorptive capacity?

How foreign firms contribute to domestic firm dynamics and to what extent achieving a stronger degree of foreign investment might imply a displacement impact or a positive spillover effect on firms in the economy are issues of great interest to both policy makers and academics. In the Italian case these policy issues have become quite relevant over the last years. In the last decade (before the 2008 crisis), Italy has received increasing flows of inward FDI, whose value passed from 6,918 million dollars in 1999 to 40,202 million dollars in 2007 (Unctad, 2010). In 2007, the number of foreign-controlled firms amounted at 14,401 (from 11.396 in 2000) with 1,230,427 workers employed (they were 950.038 in 2001). Although less than 1 per cent of the population of firms in Italy are foreign owned, foreign multinationals accounted for about 12 per cent of net value added in 2007. Moreover, MNEs performed better than their Italian counterparts since they have been more productive, have employed more workers, and are more profitable (ISTAT, 2010). Therefore, it is worth exploring whether Italian firms were able to gain positive externalities from the increasing presence of MNEs.

To the best of our knowledge, to-date the effects of foreign MNEs on the entry-exit dynamics of firms have not yet received any answer in the literature with respect to Italy. There are a few studies which have examined the different pattern of survival of domestic and foreign owned firms in Italy (Colombo and Delmastro, 2000; Santarelli and Vivarelli, 2007; Giovannetti *et al.*, 2009; Ferragina *et al.*, 2010 a and b), but no previous study focused on the impact of FDI on domestic firms' survival.

Hence, our paper brings three important contributions: first, it develops for the first time the analysis of the "indirect effects" of foreign and domestic multinationals in terms of spillovers on firm survival in Italy; secondly, it decomposes the impacts of FDI into supplier effects (vertical linkages) and competitive effects (horizontal linkages) respectively, adding to a quite restricted international literature which has estimated so far the role of horizontal and vertical FDI spillovers on survival (Girma and Gong, 2008; Wang, 2010); third, it brings relevant information to policy makers.

In order to purge out the effects on firms' survival due to the presence of FDI, in addition to measurements of the importance of FDI in the same region and industry and in upstream and downstream sectors, we also control for several firm and industry factors which are known by the literature to be related to life durations. At firm level we include variables such as size, age, productivity, export status, ownership status, wage, capital intensity, financial health. At industry level, we control for the R&D industry intensity, import and export shares as measures of industry exposure to trade, entry rate, output growth rate, index of industry concentration and of scale economies.

The empirical analysis is conducted using a firm level database for the period 2002-2009 resulting from the intersection of three different sources: IXth Survey 2001-2003 on Manufacturing Firms, by Capitalia/Unicredit, AIDA (Analisi Informatizzata delle Aziende) and Mint-Italy, by Bureau Van Dyck. This original database provides a rich micro evidence on a stratified and randomly selected sample of more than 4,000 Italian manufacturing firms. The econometric analysis relies on Probit and Cox proportional hazard estimates of the relationship between firm survival and horizontal and vertical FDI, measured respectively as output share of sales of foreign firms in the market and as share of foreign firms sales in supplier (upstream) and buyer (downstream) industries, controlling for a rich set of firm and industry specific variables following the survival literature.

Our findings reveal that within the same industry survival of firms in Italy is unaffected by the increased presence of foreign-owned firms. On the other hand, at intra-industry level, firms experience less exits if they benefit from more intense upstream inter-industry linkages with foreign firms (positive vertical upstream spillovers) while tend to have shorter lives if affected by affiliates operating in downstream industries (negative vertical downstream spillovers). Furthermore, a different impact is observed in high and low technology sectors and the technology gap between local and foreign firms play an important role in the spillover effect. These results are broadly consistent with the evidence that competition from sectoral FDI does not help firm survival while this is affected positively by inter-industry spillovers (Wang, 2010). The result is also in line with the analyses of spillover effects of FDI on productivity of Italian manufacturing firms which found a weak presence of intra-industry FDI spillovers in manufacturing (Reganati and Sica, 2007; Castellani and Zanfei, 2007) while positive vertical spillovers (Reganati and Sica, 2007; Imbriani, Pittiglio, Reganati and Sica, 2011).

The paper is organised as follows. Section 2 presents the review of the theoretical models underlying the FDI impact on firm survival and main empirical results. Section 3 describes the data and provides some descriptive statistics. Section 4 presents the model used in the paper and the estimation results. Finally, section 5 summarises and concludes.

2. The impact of foreign ownership on domestic and foreign firm survival: theoretical and empirical literature review

2.1. FDI effects: a theoretical overview of key hypotheses

Little attention has been paid in the literature on how foreign presence affects the host country firm survival. As discussed in Görg and Strobl (2003) the theoretical a priori behind this question are ambiguous. Foreign establishments are likely to intensify competition and may force domestic establishments go out of the market. Multinationals may also have negative effects on firm survival via their higher output and often higher wages which may push up domestic firms average costs of production and produce a selection effect as described in the prominent work by Aitken and Harrison (1999). They argue that foreign firms producing at lower marginal costs than indigenous firms have an incentive to increase output and attract demand away from indigenous firms. This will cause host country rivals to cut production which, if they face fixed costs of production, will raise their average cost and, therefore, reduce their probability of survival.[3]

On the other hand, domestic firms may benefit from *technological and pecuniary spillovers* from foreign establishments.[4] Multinationals are generally assumed to have some sort of firm specific asset or efficiency advantage that enables them to operate abroad successfully (Markusen, 2002; Helpman, Melitz, Yeaple, 2003). A common assumption made in the literature is that there is a potential *technology gap* between domestic firms and MNCs (due to MNCs' firm-specific assets), and this creates the opportunity for *technology spillovers* between the two groups of firms, provided that domestic firms are endowed with a certain *absorptive capacity*.[5] An increase in productivity through technology spillovers will reduce a host country firm's average cost of production, so increasing their price-cost-margins with a positive effect on firm survival (see e.g. Audretsch, 1991

[3] A different competition effect is also described in the literature: multinationals, due to their advantages, may use foreign acquisitions in order to gain market access taking over a rival and closing it down afterwards.

[4] FDI pecuniary spillovers are captured by prices while FDI knowledge and technology spillovers occur when the benefit from FDI are not completely captured by monetary transactions due to the public good nature of knowledge transmission.

[5] The theoretical and empirical literature on the relation between the level of technology gap and the absorptive capacity of firms is split among two opposite views. The first put forward first by Findlay (1978) , later on followed by Wang and Blomstrom (1992), Blomstrom and Wolff (1994), and more recently, enriched by Jordaan (2008) and Jabbour and Mucchielli (2007) find that the potential for positive spillovers is higher when the technology gap between domestic firms and MNEs is large. This argument is based on the idea that firms with lower stocks of technology have a greater scope for technological accumulation in that they have a larger stock of established knowledge to assimilate. The opposite view argues that when the technology gap is too large the domestic firms are unable to follow and adapt the technological developments and the superior features of MNEs as they do not have internal knowledge resources to absorb them (Cantwell, 1989; Kokko, 1994; Takii, 2005; Dimelis, 2005; Hamida and Gugler, 2009).

and 1995).[6] When FDI affiliates are input suppliers there will be vertical FDI *upstream spillovers*, as they are able to provide domestic plants with more varieties and better quality intermediate inputs. In addition, foreign multinationals also have the resource to provide better customer services. On the other hand, when FDI affiliates are customers of domestically-owned firms there might be vertical FDI *downstream spillovers* as they will often provide technical assistance to them, in order to have a high-standard and stable stream of input suppliers. This may lead to increased productivity and lower prices in upstream industries (Blalock and Gertler, 2008).

The channel of impact on firm survival via *pecuniary externalities* is described by Markusen and Venables (1999). According to this model, the presence of multinationals has three effects on the host economy. First, there is a *competition effect* as multinationals compete with domestic final good producers. The increase in total output due to multinationals production decreases the market price, which leads to the exit of some domestic firms. Hence, there is a *demand effect* as multinationals create additional demand for domestically produced intermediate goods through linkages with indigenous suppliers inducing the entrance of new intermediate producers. Then, a derived third effect takes place through a *fall in the price of intermediates* which induce the entry of domestic final good producing firms. The latter two positive effects may outweigh or not the potential negative competition effect.[7]

To sum up, we may conclude that the effect of MNCs on the survival of host and foreign country firms is ambiguous on a theoretical ground.

2.2. The empirical evidence on the impact of FDI on survival

The most investigated issue in the literature the impact of FDI on host economies is the FDI spillover on firm productivity. The empirical evidence is quite mixed. Early case studies and industry-level findings (Caves, 1974; Blomström, 1986) emphasize that activities of MNCs generate knowledge externalities. Macroeconomic studies (Borensztein, Gregorio & Lee, 1998; Alfaro *et al.*, 2004) provide supporting evidence, but firm-level panel studies have generally found no clear-cut findings. Several studies find that FDI generates positive spillovers on the productivity of domestic-owned firms—Chuang and Lin (1999) for Taiwan, and Branstetter (2005) and Keller and Yeaple (2009) for the US, among others. But others find significant and negative effects of FDI on local firms‘ productivity, see Haddad and Harrison (1993) for Morocco, Aitken and Harrison

[6] As far as the effect of MNCs' presence on other foreign-owned firms in the host country is concerned, the potential for positive spillovers is less important since all MNCs may be expected to use a similarly high level of technology.

[7] See also Rodriguez-Clare (1996) which sets up a theoretical model in which multinationals benefit a host country by expanding the set of intermediate inputs available there.

(1999) in the case of Venezuela. Studies in transitional economies show negative FDI spillovers in the Czech Republic and in Bulgaria and Romania (Djankov and Hoekman, 2000; Kinoshita, 2000; Sabirianova et al., 2005),) and no spillovers in Poland (Konings, 2001). Using data for seventeen emerging markets, Gorodnichenko Svejnar, and Terrell (2007) suggest that the presence of spillovers may depend on various firm, industry, and institutional characteristics. The mixed results reflect the theoretical arguments that intra-industry FDI effects are jointly determined by (positive) spillover effects and (negative) competition effects. However, the overwhelming evidence show that intra-industry effects of FDI tend to be negative when other controls are present.

Gorg and Greenaway (2004a) in their review of the literature on the impact of FDI on productivity conclude that the net effects of FDI are often found negative: competition effects generally dominate spillover ones as FDI affiliates try to safeguard their technology as tightly as possible.

However, the picture is quite different as far as the effects of FDI through upstream inter-industry linkages are concerned. Studies on inter-industry FDI productivity effects mainly focus on developing or transition economies and on the channel where domestic-owned firms provide inputs to downstream FDI affiliates (downstream inter-industry linkages). For instance, at the firm level, Javorcik (2004) finds substantial FDI spillover effects to Lithuanian-owned firms through these economic linkages (termed backward linkages). Similar findings are in Bwalya (2006) for Zambia, Blalock and Gertler (2008) for Indonesia, Marcin (2008) for Poland, Javorcik and Spatareanu (2008) for Romania and Jordaan (2008) for Mexico. Referred to developed countries, both upstream and downstream economic linkages between FDI affiliates and domestic-owned plants are found to be important channels. Lileeva (2010) find significant FDI spillover effects on Canadian-owned manufacturing plants as input suppliers. Jabbour and Mucchielli (2007) find positive and significant FDI spillovers through both forward and backward inter-industry linkages in Spain, and so is Wang (2010) which studies the productivity effects of FDI for Canadian manufacturing industries.

Thus far as much as the literature on the effect of FDI on productivity. But what are the results as far as the literature which investigated in detail the effect of inward FDI on survival of domestic entrants and/or incumbents firms is concerned? The empirical evidence on this matter is rather more limited. The majority of studies focus on intra-industry spillovers. De Backer and Sleuwaegen (2003) analyze firm entry and exit across Belgian manufacturing industries and find evidence that foreign direct investment discourage entry and stimulate exit of domestic entrepreneurs.[8] However, the crowding out effect is moderated or even reversed in the long-run and a long term positive effects of FDI on domestic entrepreneurship emerges as a result of learning, demonstration, networking and linkages effects. Görg and Strobl (2003 and 2004) distinguish between the impact

[8] These results are in line with theoretical occupational choice models in open economy (Grossman, 1994), that predict foreign direct investment would crowd out domestic entrepreneurs through their selections in product and labour markets.

of foreign MNCs on Irish-owned (indigenous) firms and on foreign-owned ones (i.e., other FMNCs) located in the host country confirming positive spillover effects rather than competition/crowding out. However, this only holds for plants in high tech industries, which suggests that firms in low tech industries have not enough absorptive capacity to profit of the spillovers from technological gap. Burke, Görg and Hanley (2008) using U.K. single-plant firms also document net positive effects from FDI. However they find a negative effect of foreign presence on survival of firms in dynamic industries, alongside a net positive effect in static industries.[9] Bandick (2010) investigates how survival of domestic plants is determined by the presence of foreign ownership (measured by the share of foreign employment at the industry level) disentangling between domestic MNEs, export active plants and purely domestic oriented plants. The results reveal that foreign presence has negative effects on the survival of purely domestic firms while does not impact on the exit rate of Swedish MNEs and Swedish non multinationals exporting plants. Kosová (2010) using 1994–2001 firm-level data for Czech R. find evidence of both technology spillovers and crowding out as a short term phenomenon. Nevertheless, domestic firms in technologically advanced industries are the main beneficiaries of technology spillovers.

Two recent studies extend upon this scant literature investigating across technology transfer through vertical linkages and differentiating the effects of FDI on domestic plants‘ survival across three channels: *intra-industry* economic linkages, *upstream inter-industry linkages*, *downstream inter-industry linkages*. Girma and Gong (2008) using Chinese state-owned enterprises (SOEs) data find that competition from sectoral FDI has a deleterious impact on growth and survival probability of SOEs, export-oriented FDI in downstream sectors have negative spillovers on performance while there are no discernible spillover effects that can be attributed to FDI in upstream sectors. Wang (2010) examines Canadian indigenous plants‘ survival though their economic linkages with FDI affiliates as competitors, input suppliers and customers. The study finds that indigenous plants tend to have shorter lives due to competition with FDI affiliates operating in the same industry, but benefit from FDI affiliates operating both in upstream and downstream industries as input suppliers and customers. The positive benefits of FDI outweigh the negative competition effects, resulting in net positive impact on survival.[10]

[9] The explanation the authors provide for this result is that dynamic markets are typically characterised by high rates of churn (firm entry plus exit relative to the stock of firms) as they are at earlier stages of the diffusion of innovation. In these types of markets, new ventures are often innovative and tend to introduce new technology (Audretsch and Mahomood 1995, Geroski, 1995). By contrast lower churn (more static) industries are associated with later stages of innovation diffusion where price competition become more prevalent. In dynamic industries the relationship between them is more likely to be competitive hence, has a greater chance of being negative for survival. By contrast, in static industries new ventures are more imitative and hence have more scope to benefit from knowledge spillovers from foreign firms.

[10] Ayyagari, M. Kosová, R. (2010) also investigate the role of horizontal and vertical entry in the Czech Republic during 1994–2000 on firm entry. They find that larger foreign presence stimulates the entry of domestic firms within the

3. Data and preliminary statistics

In this section we present the dataset (section 3.1), the variables specifications, the theoretical *a priori* with respect to the signs and some descriptive statistics (section 3.2).

3.1. Dataset construction

The empirical analysis has been conducted using a firm level database for the period 2002-2010 resulting from the intersection of three different sources: IXth Survey on Manufacturing Firms, by Capitalia[11], AIDA (Analisi Informatizzata delle Aziende) and Mint-Italy, both by Bureau Van Dyck.[12] We use the IXth Capitalia survey, i.e. the wave 2001-2003 of the survey which has been run in 2004 through questionnaires distributed to a sample of 4289 firms with more than 10 employees. In order to have a long panel we build up a "catch-up" panel, where the Capitalia dataset units of analysis are located in the present by subsequent observations drawn from another dataset, AIDA, which collects annual accounts of Italian corporate enterprises and contains information on a wide set of economic and financial variables, such as sales, costs and number of employees, value added, fixed tangible assets, start-up year, leverage, indebtedness, as well as legal and ownership status.[13] By matching all firms in the 2001-2003 Capitalia dataset with AIDA information we have obtained a sample of 4066 firms (that is 94,8 per cent of the Capitalia sample) which were followed over 2004-2010.[14]

Variables about internationalization activity of firms are drawn from AIDA, Capitalia and Mint-Italy. In particular, using the ownership status variable in AIDA, we define *domestic multinationals* (DMNEs) as non foreign-owned firms with a share of direct ownership greater/equal to 10 percent in firms located in countries other than Italy; *foreign multinationals* (FMNEs) are defined as Italian

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same industry, indicating the existence of positive horizontal spillovers from FDI. Their results also show that entry spillovers through vertical linkages are stronger than horizontal spillovers and that while service industries benefit from both horizontal and vertical spillovers, manufacturing industries do not experience significant positive entry spillovers at all.

[11] The Capitalia database was a survey in 3-years waves which provided micro evidence about manufacturing companies on a sample of more than 4,000 firms drawn from Italian manufacturing. The samples were stratified and randomly selected (it reflected sector's geographical and dimensional distribution of Italian firms) for firms with 11 to 50 employees and by census for firms with more than 50 employees

[12] The firm level dataset AIDA is supplied at the University of Salerno by the commercial data provider Bureau Van Dyck, while access to the Bureau Van Dyck Mint-Italy dataset and to the Capitalia 2001-2003 database were given confidentially and exceptionally to the authors. Questions related to how access the firm level data used can be forwarded to the authors.

13 AIDA data set reports the unconsolidated balance sheets of corporate firms with a value added of more than 800.000 euro.

[14] Firms which did not have complete records on some of the variables fundamental for our analysis were dropped, Moreover, the dataset was carefully cleaned excluding firms with abnormal values.

firms whose ultimate beneficial owner is foreign. Information related to the export activity of the firms is drawn from a merge between Capitalia and Mint-Italy. This latter is a firm level database of Italian companies, banks and insurance companies with variables on export and import activities. The merge between Capitalia and Mint-Italy allowed us to identify the firms in the sample that were exporters over the entire period 2002-2010. Each variable included in the database was deflated through the price index provided by ISTAT (Italian Institute of Statitsics)

To identify the exit of firms we followed this procedure. We consider as exited firms whose legal status variable in AIDA dataset was failure, liquidation, bankruptcy. We consider when a firm enters a liquidation or bankruptcy process, whichever started earlier. We rely on the start (rather than the end) of these processes, since when a firm enters any such process, it no longer freely operates in the market. In order to identify with accuracy the timing of any legal cessation of a firm's activity we complement this variables by checking for the balance sheet data. If a firm is out of the register, it must have already been liquidated and its record deleted from the register. So we assign firm exit in the year in which it reports the last sales or the last balance sheet if sales are missing. Also, we allow for a two-year prior exit window to incorporate the reporting delays or mismatch between calendar and fiscal years. For example, if a firm started a liquidation process in 2009 but the last reported sales are in 2007, we assume that a firm exits in 2007. Then $Exit_{it} = 1$ in the year when a firm exits, 0 in all prior years and missing in the years following exit. We further control firm status by also considering AIDA information on the type of procedure a firm is undergoing.[15] This information allows us to not consider as exited firms which change denomination due to a process of Merger and Acquisition or to change of location or sector. Most importantly, we do not consider as exited firms which change denomination due to a process of Merger and Acquisition or to change of location or sector, hence we catch the "true exit".[16] By using this detailed information on exit, we avoid to a great extent the problem of "the catch-all meaning of the exit events recorded in business registries" (Bottazzi *et al.* 2011) i.e. the fact that these events are often associated with a simple relabelling of the economic subject, following changes of ownership, incorporations, change of sector or province.

Omitting all observations that do not fit the definition of exit, as well as firm for which data needed in the empirical analysis are incomplete we end up with an unbalanced sample of 32.131 observations.

[15] Failure, Voluntary liquidation, Administrative/juridic. Liquidation, Liquidation, Extraordinary administration, Cancellation from business registry, Closing due to failure/liquidation, Insolvency, End of activity, Closure agreement.

[16] This might still correspond to both negative (bankruptcy) and positive (voluntary liquidation) outcomes. However, liquidation and bankruptcy represent the most common legal status we observe. Therefore, we can say that our main focus is on the firms' death as a consequence of firm business failure, not voluntary exit.

3.2. Variables specification and expected signs

In this section we describe the specification and the expected sign for the set of variables which we use in our empirical analysis distinguishing between industry level and firm level covariates (a full list is provided in table 1).

3.2.1. Industry level covariates

Let's start by describing our key variables of interest: the FDI measurements variables.

- $FDI\_OWN\_INDUSTRY_{j,t} = Y_{j,t}^{FOR}/Y_{j,t}^{Total}$ where $Y_{j,t}^{FOR}$ is foreign firms turnover and $Y_{j,t}^{Total}$ is turnover of all firms in sector j at time t.[17] It is a measure of the importance of foreign presence in the host industry in the same firm's sector.
- $FDI\_UP_{j,t} = \sum_{k \neq j} FDI\_OWN\_INDUSTRY_{k,t} \times \frac{USEi_{k,t}^{j}}{\sum USEi_{k,t}^{j}}$

  is constructed as a weighted average of *FDI _OWN_INDUSTRY* in all upstream industries *k* of industry *j*, where the weights are input-shares that industry *j* purchases from all its upstream industries (including non-manufacturing industries).[18] It is a measure of FDI in upstream industries *k* which affect plant or firm *i* in industry *j* through providing intermediate inputs to industry *j* (see Langer and Taymaz, 1996 and Wang, 2010).[19]
- $FDI\_DOWN_{j,t} = \sum_{l \neq j} FDI\_OWN\_INDUSTRY_{k,t} \times \frac{BUY_{j,t}^{k}}{\sum BUY_{j,t}^{k}}$

  is constructed as a weighted average of FDI _OWN_INDUSTRY in all downstream industries of industry j, where the weights are output-shares that industry *j* sell to all of its downstream industries (including non-manufacturing industries). [20] It is a measure of FDI in downstream industries affecting plant *i* in industry *j*, through foreign firms purchasing inputs produced by plant *i*.

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[17] Source: Eurostat, http://appsso.eurostat.ec.europa.eu/nui/setupModifyTableLayout.do)

[18] The formula excludes inputs supplied within each sector since they are already captured through the variable *FDI _OWN_INDUSTRY*.

[19] Source: Istat, input-output Tables. The information on the proportion of sector j's inputs purchased from upstream sectors k ($\sum_{k \neq j} \frac{USEi_{k,t}^{j}}{\sum USEi_{k,t}^{j}}$ is) available for 2 digit sectors and for 1995, 2000 and 2005, Ateco91 classification. We used the coefficients related to 2005.

[20] Source: Istat, input-output tables. The information on the proportion of sector j's inputs supplied to using downstream sectors ($\sum_{k \neq j} \frac{BUYi_{k,t}^{j}}{\sum BUYi_{k,t}^{j}}$) is available for 2 digit sectors and for 1995, 2000 and 2005, Ateco91 classification. We used the coefficients related to 2005..

The amount purchased from foreign-owned firms or sold to foreign-owned firms for each industry is inferred from the industry input-output tables. This is common practice in literature given that it is generally unknown how much each firm (plant) sold to foreign-owned buyers or purchased from foreign suppliers. Implicit in the construction of Upstream and Downstream FDI is also the assumption that the interindustry input-output shares for each plant/firm in an industry are identical, and are the same as the one at the industry level.

Blalock and Gertler (2008) argue that this measure, although not perfect, also avoids certain endogeneity problems regarding domestic firms‘ decision to supply foreign firms and to adopt the more advanced foreign technology into their production process

- *FDI _SHARE_ REGION=* $Y_{r,t}^{FOR}/Y_{r,t}^{Totali}$ where $Y_{k,t}^{FOR}$ is the production of foreign firms in region r at time t and $Y_{r,t}^{Totali}$ is the production of all firms in region r at time t. It is a measure of the importance of FDI in the region in which the firm is located. It is constructed as the ratio between the
- *IMPORT SHARE* is the ratio of 3 digit Ateco 2007 industry j's total imports over its output at year t. Imports could spur technology spillover effects—as often found in the trade literature—and the spillover effects can lead to higher productivity and thus higher survival rates. [21]
- *EXPORT SHARE* is the ratio of 3 digit Ateco 2007 industry j's total exports over its output at year t. Exporting to foreign markets not only allows firms to access foreign knowledge, but also an expanded customer base. Accordingly, these industries are expected to generate some positive effects on firm survival.[22]
- *OUTPUT GROWTH RATE* is the 2 digit ATECO annual output growth rate.[23]
- ENTRY RATE in the sector is the ratio between the number of firms which enter the business registry each year and the total number of active firms operating in industry *j* at year *t*. [24] Entry rate captures the dynamics of an industry. High levels of entry are associated with conditions that make entry less costly. *Ceteris paribus*, industries with higher entry rates should experience higher level of competition, and higher rates of churning, and thus higher exit rates.

[21] Data come from ISTAT. Imports are found to be an important channel for productivity growth (Frankel and Romer, 1999). Grossman and Helpman (1991) argue that imports embed the technology level of the producing countries, and a country can get access to other countries‘ technology through imports. Coe and Helpman (1995) find that imports promote technology diffusion among OECD countries. That finding is confirmed by later studies using data on OECD or developing countries, such as Keller (2002), Schiff and Wang (2006) and Schiff and Wang (2008).

[22] Data come from ISTAT. Exports are also argued to improve productivity performance of the domestic economy (Falvey, Foster and Greenaway, 2004).

[23] Data come from ISTAT.

[24] Data come from ISTAT.

- MES is measured as the ratio between firms' sales above the average sales for the industry, divided by total industry sales. It is is the minimum efficient scale of the industry and is employed as a proxy for economies of scale (Comanor and Wilson, 1967);
- HERF is constructed as $\sum_{i=1}^{N}\left[\frac{sales_{ijt}}{sales_{jt}}\right]^2$ and is bound between 0 and 1. It is the Herfindahl index of turnover and is used as a proxy for the level of concentration and thus of competition within the sector and year.
- *PAVITT* are four macrosector dummies which indicate Pavitt taxonomy for clusters of innovation at industry level.
- *TECH* are technology macrosector dummies *(tech_class=1,..,4*) for firms belonging to low, medium-low, medium high and high technology (OECD taxonomy**).**[25]

Previous work examining survival conditions of new entrants at the industry level (Audretsch and Mahmood, 1995; Audretsch *et al.*, 2000) have found exit rates to be greater in R&D intensive industries given that the competition environment is tougher.

3.2.2. Firm level covariates

1) Firm structure and performance variables.

- *SIZE* is given by the number of employees. It is a stylized fact from many empirical studies that the likelihood of firm exit declines with firm size measured by the number of employees (Dunne *et al*., 1989; Mata and Portugal, 1994). There are several reasons suggesting a negative relationship between firm size and the probability of exit. A small size can be interpreted as a proxy variable for a number of unobserved firm characteristics, including disadvantages of scale, higher restrictions on the capital market and labour market access, leading to a higher risk of insolvency and illiquidity for small firms, competition for highly qualified employees and lower talent of management.
- *AGE* is defined as the difference between year *t* and the official year of incorporation of the firm. Since older firms are more likely to possess a bundle of characteristics that have helped them to prevent exit in the past, we expect they have a lower chance to exit. This is coherent with selection models (Jovanovic, 1982), where firms go through a process of learning about their relative efficiency and market competitiveness, and in line with a large number of

[25] The classification of sectors into high tech and low tech is based on an OECD classification as used by Keans and Ruane (2001). We aggregated the OECD's medium and high-sectors to define the high tech group. Accordingly, high-tech sectors are: 24 Manufacture of chemical and chemicals products; 29-35 Manufacture of machinery and equipment n.e.c.; Manufacture of electrical and optical equipment; Manufacture of motor vehicles, trailers and semi-trailers; Manufacture of other transport equipment.

empirical papers which have shown that younger firms are more likely to fail (e.g., Mata and Portugal, 1994; Audretsch and Mahmood, 1995; Disney *et al.*, 2003).

- *PROD* is labour productivity, namely net value added per employee. Several theoretical models describing the dynamics of industries with heterogeneous firms (Jovanovic, 1982; Hopenhayn, 1992) predict that the exit of firms is motivated to a large extent by productivity differences at the firm level. Hence, we expect that the exit rates are lower for more productive firms.
- *CAPINTENSITY* represents a firm's capital intensity and is given by the fixed assets over total employment. Theoretically, we would expect that more capital-intensive firms would be more likely to survive. In fact, firms with higher capital-labour ratios may have a lower ratio of variable to fixed costs and be more likely to withstand negative shocks than high variable-cost production producers (Doms *et al.*, 1995). In addition, if capital is firm-specific, it may involve sunk costs and become a barrier to exit (Dixit, 1989).
- WAGE is the real wage and is obtained by dividing the total personnel cost by the total employment.

2) Internationalisation

- *EXPORT* is the export dummy variable that takes a value of 1 if firm *i* is an exporter and 0 otherwise;
- *OUTFDI* is the domestic multinational ownership dummy that takes a value of 1 if firm *i* is an Italian owned MNE and 0 otherwise-Domestic multinationals are non foreign-owned firms with a share of direct ownership greater/equal to 10 percent in firms located in countries other than Italy; [26]
- *INWFDI* is the foreign multinational ownership dummy that takes a value of 1 if firm *i* is foreign owned and the value 0 otherwise. Foreign multinationals (FMNEs) are defined as Italian firms whose ultimate beneficial owner is foreign. Multinationals are expected to have a negative effect on the probability of firm failure as they are likely to have better access to capital markets and to have better information processing.

3) Financial variables.[27]

- *PROFIT* is the operating margin on total sales. We expect more profitable firms to be less likely to fail (Bunn and Redwood, 2003). Higher profits reduce exiting, while lower profits stimulate the decision to exit; so we expect a negative impact of the operating profit ratio on the likelihood of exit.

[26] The data is built using the ownership status variable in AIDA.
[27] All financial variables were converted into constant 2000 Euros using two-digit industry price level deflators.

- *SOLVENCY* defines the solvency ratio (shareholder's funds/total assets), which is an indicator of the liquid assets of the firm. We expect to find that more solvent firms face a lower likelihood of failure.
- *COLLATERAL*, given by the ratio of firm tangible assets to its total assets, is expected to have an important impact in terms of lowering failure probabilities.
- *DEBT WITH BANKS OVER TURNOVER* can be associated with a worse balance sheet situation, increasing moral hazard and adverse selection problems. Hence, we should expect a positive relationship between higher leverage and the probability of exit as some empirical studies have found (Becchetti and Trovato, 2002; Bunn and Redwood, 2003; Fotopoulos and Louri, 2000; Vartia, 2004; Bridges and Guariglia, 2008). On the other hand, as a high rate of leverage can also be seen as an indicator of a good credit standing and high borrowing capacity of firms, we expect an ambiguous sign between leverage and the exit probability.

4) Innovation

- *RD* (research & development intensity) is defined as the ratio of R&D expenditure on sales. According to the resource-based literature (Barney *et al.*, 2001), the chances of survival greatly depend on the ability of firms to develop specific capabilities, which in turn may be improved by investing in R&D. Kimura and Fujii (2003) have found that R&D activities raise firms' survival probabilities. However, R&D activities are usually associated with uncertainty and so firms investing in research may suffer a higher failure risk. Audretsch and Mahmood (1995), Audretsch, Houweling and Thurik (2000) and Segarra and Callejon (2002) all find that exit rates are greater in R&D intensive industries since the competitive environment is more intense. The expected sign is therefore ambiguous.
- GAP is the difference between the mean productivity of foreign firms in the sector and the productivity of each firm in the same sector and is used as a proxy for domestic technological gap. We have ambiguous expectations on this variable since the literature on the relation between the level of technology gap and the firm absorptive capacity is split among two opposite views (see note 4). [28]

Table 1 around here

[28] It is quite common in the literature to proxy the 'technology gap' through measures of 'productivity gap': the general idea is that a more productive foreign firm is a reflection of the technological gap between the foreign and the domestic firm. However, the technology gap can be defined as the difference in the *techniques* available for production, whereas productivity gap represents the difference in *productivity* when the same technology is used (Kathuria, 2010).

In table 2 we describe the mean characteristics of firms disaggregated according to different types of global engagement (exporting, non exporting, foreign multinationals, domestic multinationals, purely domestic firms). We observe several superior characteristics of globally engaged firms but particularly what is worth underlining is that foreign firms outperform national firms, even domestic multinationals, in productivity levels and in many other dimensions (higher size, age, productivity and profit margin, lower collateral and indebtedness and higher solvency). This justifies our investigation of FDI spillovers.

Table 2 around here

4. Modelling and estimation results

The focus of our work is to examine whether foreign firms affects domestic firms' probability of survival.

$$exit_{i,j,t}=f\,(FDI\_OWN\_INDUSTRY, FDI\_SHARE\_REGION, FDI\_UP_{j,t}, FDI\_DOWN_{j,t}, Xijt, Yjt, \varepsilon it)$$

where exit of firm *i* in industry *j* at time *t* is related to FDI within the sector and region, which captures the competition and knowledge spillover effects of FDI (horizontal spillover), and is also related to upstream and downstream FDI, which in turn capture the forward and backward vertical linkages effects; *Xi,j,t* is a vector of firm characteristics; *Yj,t* is a vector of industry characteristics (see sections 3.2 and table 1 for the full list of the firm and industry covariates), $e_{it} \sim N\,(0, \sigma^2)$ is the error term accounting for stochastic shocks at a firm level.

All models include time dummies to capture business cycle effects and a full set of 2 digit Ateco 2002 industry dummies to control for specific industry characteristics that may affect the survival rates. Standard errors are adjusted for clusters at firm level.

Following the literature we treat the level of FDI as exogenous and we do not try to correct for possible endogeneity (see Jovarcik, 2004; Blalock and Gertler, 2008). Only Lileeva (2010) tests for endogeneity of industry level FDI but reject the hypothesis. Wang (2010) argues that although FDI tend to be endogenous at the aggregate level (Wang, 2010), when the effects of industry-level FDI are examined at the firm level, the potential endogeneity tends to disappear for two reasons: 1) plants/firms operating in a certain industry tend to take the industry-level FDI as given and exogenous; 2) the inclusion of other industry covariates along with those at the firm level, already

controlled the possible endogeneity of FDI. So the potential endogeneity issue of FDI at the aggregate level is not a problem at the micro-level.

We analyze firm exit using two approaches. First, we use continuous survival analyses: a nonparametric Cox model, because firm survival is a continuous variable (a firm can exit after two and a half years). However, since data are grouped by years due to balance sheet reporting, we also estimate firm exit by a discrete method: probit.

4.1. Exit hazard rates by Cox model

We use a semi-parametric Cox proportional hazard model (CPHM).[29] The estimation of the hazard of exit using a Cox proportional hazard specification models both the event of failure and the time it takes a firm to fail.

We estimate the following hazard model where the hazard function [$\lambda(t)$] of a firm *i* – i.e., the rate at which firms exit at age *t* given that they have survived up to age *t*-1-, is given by:

$$\lambda(t) = \lambda_0(t) H(\beta' x) \qquad [1]$$

The hazard function depends multiplicatively on the vector of explanatory variables X for the *i-th* firm (which measure firm and industry specific characteristics affecting firm survivability), with the corresponding vector of unknown parameters β to be estimated and an (arbitrary and unspecified) baseline hazard, $\lambda_0(t)$, which is the hazard corresponding to $H(\beta' x_i)$ =1 when all the covariates are set to zero.

Following the CPHM, the functional form adopted to specify the effect of the covariates on the base hazard is exponential. So, the hazard a firm *i* faces may be written in the following form:

$$\lambda_i(t) = \lambda_0(t) \exp(\beta' x_i) \qquad [2]$$

We estimate the parameter λt by the CPHM to measure the effect of different regressors on the survival probability of firms and estimate the coefficients. The coefficients in (2) can be expressed as hazard rates in which case a value of β=1 represents a covariate that does not affect the hazard

[29] Because we are not interested in investigating the underlying shape of the baseline hazard, but in understanding the effect financial and global engagement variables have on the firm's hazard of exit, Cox's (1972) partial likelihood approach provides a convenient way of estimating the parameters β without having to specify a functional form for the baseline hazard, $\lambda_0(t)$. This estimation method has been widely used in the literature on firm survival. It should be noted that, in this case, age could not be entered in the model directly, as it is collinear with the baseline hazard.

ratio; a coefficient of β >1 implies that the variable increases the risk of exit, while a value of β <1 reduces the hazard of failure or increases survival time. In the case of a dummy variable covariate, the hazard ratio can be interpreted as the increase in the overall hazard rate for the firm when the dummy is equal to 1 while holding all other variables constant.

Equation (2) is the proportional hazard model, and its logarithmic expression gives us a linear model that can be estimated by maximum likelihood method:

$$\ln \lambda_i(t) = \ln \lambda_0(t) + \beta' x_i \qquad [3]$$

In this specification, the effect of a unit change of the independent variables is a constant parallel shift of the baseline function, which is estimated for all of those firms that survive until a particular period.

4.2. Discrete regression analysis of hazard rates: the probit model

We also estimate domestic firm exit by a probit model. Controlling for survival time (age), it approximates the exit hazard rates.

We observe the company status variable (y_{it}), which is either failure (y_i = 1) or survival (y_i = 0), but we define the dependent variable as a latent variable y^*, the underlying response variable, which is the probability of failure as a function of the vector of the determinants of failure:

$$y_i = 1 \; if \; y_i^* > 0$$
$$y_i = 0 \; if \; y_i^* = 0.$$

The response variable y^* is defined by the following regression relationship, in which y is exit in 2002-2010, the slope parameters are given by the vector β and ε_{it} is a normally distributed error term.

$$y_i^* = \alpha_i + \alpha_t + x_{it}^{'}\beta + \delta_s + \varepsilon_{it} \qquad [1]$$

where $\varepsilon_{it} \sim N(0, \sigma^2)$.

The probability that a firm fails (y_i=1) can therefore be written as:

$$\Pr(y_{it}=1) = F(X'_{it}, \beta)$$

Because the rate of firm failure in our analysis is small (7% in the full sample, see table A.1 in the Appendix), it could potentially be classified as a rare event. In the application of the standard Probit model this rare events nature of exits is ignored. One consequence of this is that our Probit regression may underestimate the probability of this rare event. Therefore, we further check whether our results are robust to correcting for this bias, using the procedures suggested in King and Zeng (2001a, b). This method, called Rare Events Logistic Regression or ReLogit, estimates the same logit model as the standard logit procedure, but it uses an estimator that gives lower mean square errors in the presence of rare events data for coefficients and probabilities.[30] This gives approximately unbiased and lower-variance estimates of Logit coefficients and their variance–covariance matrix allowing correcting for rare events.

4.3. Estimation results

Results of the Probit and the CPHM estimates for foreign MNE, domestic MNEs and domestic non-MNEs are reported in tab. 3. We found that firm survival is unaffected by the increased presence of foreign MNEs within the same industry (absence of horizontal intra-industry spillovers). However, we do find evidence of vertical inter-industry spillovers. More specifically, higher shares of foreign investors in upstream industries acting as input suppliers significantly decreases the exit risk of firms located in Italy suggesting a positive survivor premium of FDI upstream. Conversely, the downstream inter-industry linkages do not favour firm survival: higher shares of foreign investors in downstream industries acting as customers significantly increases the exit risk of firms located in Italy. In other words, our findings point to the fact that the Italian companies are able to improve their survival once they are offered products and services from MNEs from upstream sectors. These results are robust to different specifications of both the Probit and the Cox model and also to the estimate of a Rare Event Logit model.[31]

[30] We used the Stata ado-file relogit.ado available from Gary King's website (see http://gking.harvard.edu/software/)..

[31] Our corrected results, not shown here but available upon request are similar to those outlined for the Probit specification. This suggests that having a small rate of firm failure is not a significant source of bias.

Our result point to a sensible economic interpretation. We may interpret our findings as due to the fact that if foreign firms act as input suppliers of Italian local firms they will help them to reduce their average cost and will, ceteris paribus, increase their probability of survival. There are various explanations for this: MNEs in upstream industries may provide inputs to domestic firms that were previously unavailable in the country, or make them technologically more advanced or less expensive, or ensure that they are accompanied by the provision of complementary services (see Smarzynska 2004). On the contrary, if foreign firms act as customers of Italian local firms they will be probably quite selective and this will make competition among local suppliers more fierce. Besides, MNEs have an incentive to prevent technology leakage to their competitors which reduce horizontal spillovers

Comparison of our results with previous studies on the issue of the impact of FDI on survival is not easy as the conclusions are not so clear cut. Our results are in line with Girma and Gong (2008) and Ayyagari and Kosová (2010), which found no evidence of spillovers in the same industry in manufacturing. However, these studies for China and Czch R. show that manufacturing industries do not experience significant positive vertical spillovers of any kind. On the other hand, Wang (2010) for a developed country (Canada) found benefits from FDI affiliates operating in upstream industries, like in the present study. Finally, our finding of a not significant impact of the foreign presence within the same industry differs from both Görg (2004), Burke *et al.* (2007), Kosovà (2010) findings of positive intra-industry spillovers for manufacturing firms survival. However, they further disaggregate for technology and for static and dynamic sectors.

More generally, our results are in line with the most recent studies on FDI spillovers which argue that it is more likely that FDI spillovers would take place through vertical linkages (i.e. backward and/or forward spillovers) than through horizontal ones and also with the literature on FDI spillovers on productivity in Italy, which has found a weak presence of intra-industry FDI spillovers in manufacturing (Imbriani and Reganati, 2002; Reganati and Sica, 2007; Castellani and Zanfei, 2007) while positive forward spillovers (Imbriani, Pittiglio, Reganati and Sica, 2011), while we do not find the positive vertical spillovers of a downstream type found in Reganati and Sica (2007).

Further relevant results worth underlining are related to firm global activities via exports (export dummy) and also to international competition at industry level (export and import shares) which are very significant determinant of firm survival. In particular export intensity reduces exit while import competition increases it. These variables adds to another further relevant one: firm productivity which consistently reduces firm exit. Conversely, once controlling for several firm and industry

covariates, size and age do not appear significant determinants of exit. Finally, firms with higher solvency and indebtedness experience longer life duration.

Conclusions

FDI affiliates in a host country interact with its indigenous plants in many ways—as competitors, input suppliers and customers. FDI affiliates compete for market shares with domestic-owned plants in the same industry (intra-industry economic linkages), they supply intermediate inputs to domestic-owned plants (the upstream inter-industry linkages), and they purchase products produced by domestic-owned plants (the downstream inter-industry linkages). Through these intra- and inter-industry economic linkages, FDI generates significant impact to indigenous plants. The impact can be shown through productivity changes, employment changes and through plant /firm death/survival. This paper examines the effects of FDI on the survival of manufacturing firms located in Italy.

The study finds that the presence of FDI in Italy exerts contrasting effects on manufacturing firms. These tend not to be affected by competition from FDI affiliates operating in the same industry, but benefit from FDI affiliates operating in upstream industries through inter-industry economic linkages while end up with shorter lives (and more deaths) due to FDI in downstream industries. This suggests that significant knowledge spillovers occur through backward linkages from foreign firms in upstream sectors to local firms in downstream sectors, a result consistent with the vertical technology spillover hypothesis. We may conclude that the effects of FDI overwhelmingly come from those industries with which plants closely interact as input suppliers. Conversely there is no evidence that foreign firms facilitate knowledge transfer to local firms to enable them to produce intermediate inputs more efficiently, thereby making them available to foreign firms upstream at a lower cost.

There is scope to enhance the results of this investigation. This study had to use quite aggregated input-output data but it would be useful to get firm level data able to catch the firm-to firm exchanges, and therefore also foreign and local firms linkages within and across industries and sectors. This would greatly improve our understanding of horizontal and vertical spillover on firm survival. Furthermore, in the more immediate reach is the extension of our study to test for three relevant conditions investigated in literature as related to FDI spillovers on survival and likely to affect our results. First, we are going to check for the technology of the sector (following Görg (2004), Burke *et al.* (2007), Kosovà (2010). Secondly, we wish to investigate upon the interaction between FDI variables and firm exporting status (Bandick, 2010). Thirdly, we are going to

investigate whether firm technology gap (a proxy for firm absorptive capacity) matters, following a large literature on the link between technology gap and productivity spillover (see Cantwell, 1989; Kokko, 1994; Takii, 2005; Dimelis, 2005; Hamida and Gugler, 2009 for a positive relationship; Jordaan, 2008; Jabbour and Mucchielli, 2007 for a negative one).

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Table 1. Definition of variables, data sources and expected relationships with firm exit

Category	Variables	Description	Source	Exp. Sign
		FIRM LEVEL COVARIATES		
FIRM STRUCTURE AND PERFORMANCE VARIABLES	SIZE	Firm size measured by the number of employees.	AIDA	-
	RELATIVE SIZE	Ratio between firm employment relative to mean employment at 2 digit Ateco level.	AIDA	
	CLASS41, CLASS42, CLASS43, CLASS$$	Dummies for size groups: Class41=small firms (<20) Class42=medium firms (between 20 and 50), Class43= large firms (50-100); Class44=.		
	AGE	Firm age measured by the number of years since establishment.	AIDA	-
	PRODUCTIVITY	Firm productivity measured by value added per employee.	AIDA	-
	CAPINTENSITY	Real capital stock on employees.	AIDA	-
	WAGE	Ratio between total personnel cost and total employment	AIDA	
FINANCIAL VARIABLES	PROFIT MARGIN (PTPM)	Firm profits before tax over turnover (%)	AIDA	-
	SOLVENCY_RATIO	Company's post-tax net profit and depreciation divided by the quantity of long-term and short-term liabilities (%) .	AIDA	-
	COLLATERAL	Firm ratio of its tangible assets to its total assets (%,)	AIDA	-
	DEBTS WITH BANKS OVER TURNOVER	Firm short and long term debts with banks over turnover (%).	AIDA	+/-
INTERNATIONALISATION VARIABLES	INWFDI (OWN2)	Foreign ownership dummy that takes on the value 1 if the firm is foreign-owned, 0 otherwise.	AIDA	+/-
	OUTFDI (OWN3)	Domestic multinational ownership dummy that takes on the value 1 if the firm is an Italian owned-MNE, 0 otherwise.	AIDA	+/-
	EXPORT	Dummy variable equal to 1 if the firm exports over the entire period 2002-2009.	MINT-ITALY	+/-
INNOVATION VARIABLES	GAP_BYMARKET	Difference between the mean productivity of foreign firms in 2 digit Ateco and the productivity of each firm in the same sector.	AIDA	+/-
	GAP_class	Dummies for three technology gap classes: gap_1=low technology gap firms; gap_2=medium technology gap firms; gap_3=high technology gap firms;		+/-
	RANDD_AIDA	R&D intensity defined as the ratio of R&D expenditure on sales	AIDA	+/-
		INDUSTRY LEVEL COVARIATES		
FDI LINKAGES & EXPORT	FDI_OWNIND	Foreign firms turnover on total sector turnover. Proxy of FDI competitors in the same Ateco 2 digit industries.	EUROSTAT	+/-
	FDI_UP	FDI in upstream industries k which affect plant or firm i in industry j through providing intermediate inputs to industry j.	EUROSTAT AND ISTAT	+/-
	FDI_DOWN	FDI in downstream industries k which affect plant or firm i in industry j through buying intermediate inputs by industry j.	EUROSTAT AND ISTAT	+/-
	FDI SHARE BY REGION	Rratio between the production of foreign firms to the production of all firms in region r at year t.	AIDA	-
	EXPSHARE	Ratio of 3 digit Ateco 2007 industry j's total exports over total output at year t.	ISTAT	+
	IMPSHARE	Ratio of 3 digit Ateco industry j's total imports over total output at year t.	ISTAT	+
FURTHER INDICATORS	SPEC	Dummy =1 if 3 digit Ateco Lafay index of specialisation > 0, 0 otherwise.	OECD	-
	OUT_GROWTH_	Annual output growth rate by 2 digit Ateco.	ISTAT	+
	ENTRY RATE	Ratio between the number of firms which enter the business registry and the total number of active firms in industry *j* at year *t*.	ISTAT	-
	MES	Minimum efficient scale of the industry measured as the ratio between firms' sales above the average sales for the industry and total industry sales (Comanor and Wilson 1967)	AIDA	+/-
	HERF	Herfindahl index of turnover by 2 digit Ateco, proxy for the level of concentration within the sector.	AIDA	+/-
	LOCATION DUMMY	Dummy =1 if firm located in South of Italy otherwise =0		
	ATECO SECTORS	2 digit Ateco 2002 classification	ISTAT	
	TECH_clas	Technology macrosector dummies *(tech_class=1,..,4)* for firms belonging to low, medium-low, medium high and high technology (OCSE taxonomy)	OCSE	
	PAVITT	*PAVITT* macrosector dummies *(p=1,..,4)* for firms belonging to Traditional, Specialised, Scale and High-Tech industries	CAPITALIA	

Table 2. Descriptive statistics: mean statistics (all firms, exporting firms, non exporting firms, foreign multinationals, domestic multinationals, domestic firms; 2007)

	All firms	Domestic firms	Exporting firms	Non exporting firms	Foreign multinationals	Domestic multinationals
			FIRM LEVEL COVARIATES			
AGE	30	30	31	29	32	35
SIZE	154	138	169	138	563	386
Class 41 (20)	0.15	0.15	0.12	0.18	0.02	-
Class 42 (20-50)	0.28	0.29	0.27	0.29	0.14	0.10
Class 43 (50-100)	0.27	0.27	0.29	0.24	0.20	0.23
Class 44 (>100)	0.30	0.29	0.33	0.27	0.64	0.67
PRODUCTIVITY	63.176	62.636	64.255	61.948	76.622	69.301
CAPINTENSITY	61.071	61.234	57.835	64.753	57.005	44.425
RELATIVE SIZE	1.10	1.02	1.23	0.95	3.09	2.69
WAGE	36.742	36.371	36.846	36.623	45.969	38.859
PROFIT MARGIN	2.98	2.96	3.39	2.51	3.49	3.23
COLLATERAL	0.77	0.77	0.77	0.77	0.70	0.54
DEBTS WITH BANKS OVER TURNOVER	24.10	24.76	23.61	24.65	7.70	25.04
SOLVENCY RATIO	28.76	28.81	29.12	28.35	27.56	30.30
EXPORT DUMMY	0.53	0.53	-	-	0.48	0.6
INWARD FDI DUMMY	0.04	0.05	0.03	0.04	-	-
OUTWARD FDI DUMMY	0.05	-	0.05	0.04	-	-
TECHNOLOGY GAP	5.844	6018	4.608	7.251	1.507	496
R&D	0.005	0.005	0.005	0.005	0.003	0.003
			INDUSTRY LEVEL COVARIATES			
FDI_UP	10.81	10.78	10.78	10.84	11.39	10.96
FDI_DOWN	8.81	8.77	8.80	8.82	9.90	8.88
FDI_OWNIND	0.16	0.15	0.16	0.15	0.24	0.16
FDI SHARE BY REGION	0.16	0.16	0.16	0.16	0.19	0.16
EXPSHARE	0.0143	0.014	0.015	0.013	0.0116	0.02
IMPSHARE	0.0079	0.008	0.008	0.007	0.006	0.008
OUTPUT GROWTH	0.027	0.03	0.03	0.025	0.03	0.03
ENTRY RATE	4.143	4.17	4.11	4.18	3.43	4.38
MES	0.76	0.77	0.77	0.77	0.80	0.77
HERF	0.05	0.05	0.05	0.05	0.08	0.04
TECH1	0.71	0.72	0.69	0.73	0.37	0.53
TECH2	0.29	0.28	0.31	0.27	0.63	0.47
Pavitt 1	0.45	0.47	0.47	0.44	0.11	0.39
Pavitt 2	0.17	0.17	0.19	0.15	0.34	0.31
Pavitt 3	0.32	0.32	0.29	0.35	0.41	0.19
Pavitt 4	0.05	0.05	0.05	0.05	0.14	0.10
Centre-North area	0.83	0.83	0.87	0.79	0.88	0.93
Southern area	0.17	0.17	0.13	0.21	0.12	0.07

Source: Own elaborations

Table 3: Regression estimates of firm exit: Probit and Cox Proportional Hazard Model (2002-2009)

	Probit model		Cox proportional hazard model	
	(1)	(2)	(3)	(4)
SIZE	-0.000	-0.0000	0.9096	0.8537
	(0.04)	(0.13)	(0.63)	(0.96)
AGE	-0.0002	0.000	-	-
	(1.27)	(0.28)		
PROD	-0.0009	-0.0006	0.4735	0.4468
	(5.35)***	(3.48)***	(7.64)***	(5.01)***
EXPORT	-0.0033	-0.0026	0.0416	0.0564
	(4.78)***	(4.51)***	(4.35)***	(3.89)***
INWFDI	-	-	-	-
OUTFDI	-0.0005	-0.0003	0.3388	0.4794
	(0.95)	(0.64)	(1.25)	(0.85)
FDI_OWN	**0.0090**	**0.0003**	**0.0342**	**0.0103**
	(1.38)	**(0.06)**	**(0.74)**	**(0.47)**
FDIUP	**-0.0003**	**-0.0003**	**0.7947**	**0.7761**
	(1.70)*	**(1.63)***	**(1.16)**	**(1.68)***
FDIDOWN	**0.0001**	**0.0002**	**1.1128**	**1.2604**
	(1.07)	**(1.97)****	**(0.78)**	**(1.49)***
R&D	-0.0030	-0.0063	0.0100	0.0000
	(0.58)	(0.79)	(0.65)	(0.74)
IMPSHARE	0.0876	0.0560	3.2500	3.4500
	(2.28)**	(1.77)*	(1.18)	(1.45)
EXPORTSHARE	-0.0700	-0.0490	0.0000	0.0000
	(2.96)***	(2.71)***	(1.75)*	(1.9)*
COLLATERAL		-0.0003		0.5092
		(0.73)		(1.12)
PROFIT		0.0000		1.0012
		(1.04)		(0.54)
SOLVENCY		-0.0000		0.9729
		(1.61)*		(2.52)**
DEBT WITH BANKS/TURNOVER		-0.0000		0.9824
		(1.24)		(2.55)
SPECIALISATION	0.0001	0.0000	1.1039	1.0344
	(0.39)	(0.34)	(0.29)	(0.09)
PAVITT TRADITIONAL	-0.0006	-0.0005	0.3739	0.4317
	(1.11)	(1.14)	(1.34)	(1.14)
PAVITT SCALE INTENSIVE	-0.0009	-0.0005	0.2678	0.3414
	(1.88)*	(1.72)*	(1.86)**	(1.36)
PAVITT HIGH-TECH	-0.0006	-0.0004	0.2722	0.5031
	(1.15)	(0.62)	(1.01)	(0.55)
SOUTH LOCATION DUMMY	-0.0005	-0.0001	0.7629	1.0676
	(1.75)*	(0.50)*	(0.67)	(0.15)
INDUSTRY DUMMIES (2 DIGIT ATECO)	Yes	Yes	Yes	Yes
NUMBER OF OBSERVATIONS	17064	16607	17653	17193
LOG LIKELIHOOD	-281.63	-240.50	-285.46	230.78
PSEUDO R2	0.16	0.14		
PRED. P (AT X BAR)	0.0007	0.0006		
NO. OF SUBJECTS			17652	17193
NO. OF EXITS			287	287
WALD'S TEST ($\chi 2$)	101.63***	118.48***	208.46***	169.94***

Robust t-statistics are presented in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%. ***significance at the 1% level; ** significance at the 5% level; * significance at the 10% level.