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Outward FDI, performance and group affiliation: evidence from French matched firms

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Abstract

This paper investigates whether group affiliation and stakeholder's nationality affect both the propensity of engaging in outward FDI and its effects on home performance. Using a sample of French manufacturers, we combine propensity-score matching with a Difference-In-Difference estimator in order to estimate the impact of outward FDI on home activities, and distinguish our results for three subsamples: independent firms, firms which belong to a French business group and foreign-owned affiliates. We find that firms which are part of a French business group are more likely to engage in outward FDI and to enjoy positive effects from their investment decision than independent firms. This suggests that independent firms face more obstacles in their internationalization process and that group affiliation might increase the ability of handling international development. Reversely, foreign-owned firms appear less likely to engage in outward FDI and do not enjoy any significant effect on their home performance ex-post. One explanation for this result might be that foreign-owned firms do not invest abroad in order to increase their own performance, but the performance of their own group.

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INTRODUCTION

Using French firm-level data, we assess whether engaging in outward FDI for the first time has similar effects for independent firms, firms which are part of a French business group and foreign-owned firms. We argue that group affiliation and stakeholder's nationality both determine the propensity of investing abroad and the gains associated to this strategy.

First, the literature establishes a strong link between firms' performance and ownership. Chang and Hong (2000) show that affiliated firms benefit from the internal resources of their group and internal markets for capital and intermediate goods. Several papers also show that foreign-owned firms enjoy a productivity premium (Doms and Jensen, 1998; Griffith *et al*., 2004; Criscuolo and Martin, 2009). Belonging to a business group seems to provide unobservable advantages, related to technology, organization or resources' pooling. This productivity advantage should increase the propensity of engaging in outward FDI.

Besides, affiliated firms might enjoy a specific advantage when investing abroad, which is related to the existence of costs for coordinating and managing foreign affiliates: developing information systems and reporting procedures, visiting regularly the affiliate, giving incentives to the local workforce etc. Affiliated firms might have a greater capacity of pooling these costs (especially those which correspond to auxiliary functions) and are expected to manage their new affiliate more easily than independent firms, given that they already belong to a group.

Finally, we see three reasons for separating foreign-owned firms. First, despite their productivity premium, these firms should have a lower propensity to engage in outward FDI, since they essentially aim at exploiting their location advantages (Dunning, 1977). Second, foreign-owned firms have a lower degree of autonomy for strategic decisions and their investments might aim at improving the performance of their whole group, rather than their own performance. In that case, foreign-owned firms might not enjoy any effect of outward FDI. Third, foreign-owned firms are less likely to enjoy learning effects from outward FDI because they already belong to a multinational group.

Therefore, this paper empirically tests the two following hypothesis:

- firms which belong to a French business group have a greater propensity to invest abroad and enjoy higher gains from this strategy than independent firms.
- reversely, foreign-owned firms are less likely to engage in outward FDI than domestic firms, and their first investment abroad has a neutral effect on home activities.

This paper is organized as follows. Section 1 details the methodology. Section 2 presents the data. We compute the probability of investing abroad in order to match first-time investors ("switchers") with similar domestic firms in section 3. Finally, we estimate the impact of outward FDI according to group affiliation in section 4.

1. METHODOLOGY

Following other studies which evaluate the impact of outward FDI on home performance (Barba Navaretti and Castellani, 2007; Barba Navaretti *et al.*, 2010), we use propensity-score matching in order to compare first-time investors ("switchers") with similar domestic firms (full explanation of the methodology is given in appendix I). First, we estimate the probability of "switching" in year *t* according to firms' observable characteristics in *t-1* (vector *X*), using a probit model:

$$P\left(SWITCH_{it} = 1 | X_{i,t-1}\right) \qquad (1)$$

We retrieve the predicted scores for each firm and use them to match switchers with firms which show similar observable characteristics *ex-ante* but choose to remain domestic. This way, we construct a "control group", which allows us to tackle the endogeneity issue between outward FDI and firms' performance, provided that switchers and control firms effectively have similar characteristics in *t-1*.

However, switchers and the control group might not only differ in terms of quantifiable variables, but also in terms of unobservable and time-invariant characteristics, such as organization or technology. This is why we use a "Difference-In-Difference" (DID) estimator, which measures the evolution of the mean gap between switchers and control firms. Denote Y the firm's performance, we have:

$$DID = (\bar{Y}_{i1} - \bar{Y}_{i0}) - (\bar{Y}_{j1} - \bar{Y}_{j0}) \qquad (2)$$

Where 0 corresponds to the *ex-ante* period (1 to the *ex-post* period), and switchers are denoted by i (domestic firms by j). $\bar{Y}_{i1}$ represents the mean level of switchers' performance *ex-post*. Therefore, if the DID estimator is positive, this means that the average gap between switchers and domestic firms increases *ex-post*.

2. THE DATA

We match three databases over the period 1999 – 2007 (which are fully detailed in appendix II).

First, the French manufacturing census (known as "EAE") provides income statements of all manufacturers with more than 20 employees[1]. It gives information about sales, employment, industry[2], tangible assets, value-added and investment. Let's mention that we only describe the performance of the parent company in France.

Second, individual data from the French customs provides individual exports and imports.

Finally, the French survey on financial linkages (known as "LiFi") allows us to identify which firms engage in outward FDI. It also tells us whether one firm is independent, is a parent company or is controlled by another firm. In the latter case, we can identify and locate the parent company, allowing us to distinguish French affiliates from foreign-owned ones.

We organize our data around cohorts: we define a cohort as a four-year window centered on T, where T is the year in which domestic firms choose whether to invest abroad or not. We construct six cohorts, centered on the years 2000 to 2005. Cohorts are balanced, so results cannot be affected by a change in the number of observations. Then we focus on two categories of firms:

- switchers, *i.e.* firms which stay domestic for at least two years, invest abroad in T and keep their foreign affiliates for at least two years[3] ;
- firms which do not invest abroad until T+1. Therefore, we might compare switchers with firms which invest abroad later (in T+1 or T+2). Indeed, engaging in FDI always remains an open choice for one company: the relevant question is whether it should invest now or later, rather than whether it should invest now or never[4].

[1] Our data does not cover the sector of services, where many firms also engage in outward FDI (see Hijzen *et al.*, 2010). We acknowledge that omitting this sector certainly reduces the generality of our results.

[2] Industry is broken down into 36 two digits ("Nomenclature Economique de Synthèse" (NES) categories).

[3] Switchers which own more than three foreign affiliates in T are also dropped from the sample: these firms might be longtime multinationals which are suddenly surveyed by LiFi.

[4] Only 18 switchers are matched with firms which invest abroad in T+1 or T+2.

Table I: Cohort composition

Year of investment	2000	2001	2002	2003	2004	2005	TOTAL
Domestic firms	14,022	13,747	13,553	13,402	13,246	12,855	80,825
Switchers	25	55	63	15	65	41	264
- Independent firms	2	9	15	1	21	9	57
- Firms part of a French business group	15	34	37	9	34	22	151
- Foreign-owned firms	8	12	11	5	10	10	56
TOTAL	14,047	13,802	13,616	13,417	13,311	12,896	81,089

Reading : 63 firms switched in 2002. Among these, 37 belonged to a French business group.

Sample : Manufacturers with more than 20 employees.

Source : EAE for the manufacturing sector, LiFi - Authors' calculation.

Table II: Switchers' characteristics in T-1 according to ownership

CHARACTERISTICS IN T-1	INDEPENDENT FIRMS		FIRMS PART OF A FRENCH GROUP		FOREIGN-OWNED FIRMS		ALL FIRMS	
	Domestic firms	Switchers	Domestic firms	Switchers	Domestic firms	Switchers	Domestic firms	Switchers
Number of observations	34,814	57	34,362	151	11,649	56	80,825	264
Industry (%)								
Clothing and leather	7%	14%	4%	9%	2%	0%	5%	8%
Publishing, printing and reproduction	7%	2%	10%	7%	5%	2%	8%	5%
Pharmacy, perfumes, maintenance	1%	2%	2%	3%	5%	9%	2%	4%
Household equipment	7%	7%	6%	8%	4%	2%	6%	6%
Manufacture of motor vehicles	2%	2%	2%	1%	4%	7%	3%	3%
Shipbuilding, aeronautics and rail construction	1%	5%	1%	1%	1%	0%	1%	2%
Mechanical equipment	19%	21%	16%	17%	18%	11%	18%	16%
Electrical and electronic equipment	5%	16%	5%	9%	6%	13%	5%	11%
Mineral products	5%	4%	7%	2%	6%	2%	6%	2%
Textiles	5%	5%	6%	5%	4%	0%	5%	4%
Wood and paper	6%	2%	6%	6%	8%	9%	6%	6%
Chemicals, rubber and plastics	8%	4%	11%	15%	18%	34%	10%	17%
Metal and transformation of metal	22%	14%	19%	13%	15%	7%	20%	12%
Electrical and electronic components	3%	4%	4%	5%	5%	5%	4%	5%
	100%	100%	100%	100%	100%	100%	100%	100%
International activities (%)								
Domestic	27%	3%	17%	2%	3%	0%	20%	2%
Exporters only	13%	4%	9%	4%	3%	0%	9%	3%
Importers only	11%	0%	10%	0%	6%	0%	10%	0%
Exporters and importers	49%	93%	64%	94%	88%	100%	61%	95%
	100%	100%	100%	100%	100%	100%	100%	100%
Mean performance								
Sales	5,381	13,539	13,284	33,630	34,700	66,934	12,966	36,357
Workforce	50	88	94	180	175	263	86	177
log(TFP)	47	62	52	88	64	95	51	84
Export intensity	11%	37%	12%	31%	31%	40%	14%	34%
Median performance								
Sales	3,663	9,778	7,041	21,023	17,535	45,260	5,600	19,504
Workforce	38	48	53	128	107	231	47	119
log(TFP)	3.91	4.21	4	4.32	4.17	4.45	3.98	4.33
Export intensity	1%	38%	2%	26%	19%	34%	2%	28%

Reading : 93% of independent switchers are exporters and importers in T-1. In average, independent switchers have 88 employees.

Sample : Manufacturers with more than 20 employees.

Source : EAE for the manufacturing sector, LiFi - Authors' calculation.

We count 264 switchers, 207 of which are part of a business group. These 207 switchers correspond to 202 different groups, so our results are not biased by switchers belonging to the same group. Importantly, switchers are more likely to invest in high-income countries, regardless of ownership: these gather 74% of all FDIs, between 66% and 75% according to ownership. Therefore, the distinction between high-income and low-income locations is not likely to drive our results. We will distinguish our results according to group affiliation and nationality in T-1 (changes of ownership over the period are reported in appendix II).

Interestingly, switcher's performance in T-1 greatly depends on ownership (see table II): in average, switchers that belong to a French group are larger and more productive than independent switchers. Foreign-owned switchers exhibit the greatest performance and export/import experience *ex-ante*.

3. PROPENSITY-SCORE MATCHING

We now estimate the probability of switching. Regressors (all in logarithm) are lagged and include: number of plants, sales, value added, number of employees, total factor productivity (computed following Olley and Pakes (1996) – see appendix III), capital intensity (tangible assets over the number of employees), labour costs per employee, exports and imports. Scores are estimated separately for each ownership category, allowing us to improve the quality of the matching procedure. We also introduce year and industry fixed effects.

Table III shows that the probability of switching increases with size (captured by the number of plants) and export/import experience. When all firms are included in the regression, we are able to assess the specific effect of ownership on the propensity to invest abroad (first column of table III): as expected, we find that firms which belong to a French group are more likely to invest abroad than independent firms. This suggests that belonging to a French group might help to overcome the sunk costs of FDI more easily. Reversely, foreign-owned firms are less likely to switch, probably because they only aim at exploiting their location advantages.

Using the predicted scores, we now match switchers with similar domestic firms, with the "nearest neighbor" technique. We require that two matched firms belong to the same industry, the same cohort, have the same ownership status (independent, part of a French business group, foreign-owned), but do not belong to the same group. Indeed, comparing two firms within the same group may bias our results, since their performance levels and internationalization strategies are probably correlated. We only consider one "neighbor" for each switcher: beyond, the number of similar domestic firms within the same industry-year-ownership combination falls dramatically. We obtain 263 pairs, each containing one switcher and one control firm, after eliminating the pair with the highest difference between the two scores. We run Kolmogorov-Smirnov (KS) tests in order to ensure that switchers and control firms have the same characteristics *ex-ante*. Table IV shows that the null hypothesis of distribution equality is accepted for each regressor of the probit model. This means we corrected for the selection bias on observable characteristics.

Table III: The propensity of investing abroad

Regressors in T-1 (logarithm)	Group affiliation			
	All firms	Independent firms	Firms part of a French business group	Foreign-owned firms
Number of plants	0.175***	0.202***	0.192***	0.146*
	(0.0339)	(0.0763)	(0.0448)	(0.0751)
Sales	-0.0008	0.0879	-0.0198	-0.0143
	(0.0636)	(0.116)	(0.0880)	(0.132)
Value added	0.134	0.324	-0.0724	0.521**
	(0.162)	(0.329)	(0.205)	(0.243)
Workforce	-0.0670	-0.244	0.149	-0.431**
	(0.125)	(0.264)	(0.151)	(0.175)
Total Factor Productivity	0.0611	-0.300	0.270	-0.196
	(0.146)	(0.314)	(0.176)	(0.220)
Capital Intensity	-0.0596**	-0.101*	-0.0213	-0.147***
	(0.0278)	(0.0596)	(0.0382)	(0.0466)
Labour costs per employee	0.215**	0.193	0.428***	-0.238
	(0.105)	(0.241)	(0.130)	(0.203)
Exports	0.112***	0.112***	0.125***	0.0791***
	(0.0127)	(0.0231)	(0.0176)	(0.0296)
Imports	0.0264**	0.0573**	0.0109	0.0283
	(0.0131)	(0.0224)	(0.0179)	(0.0314)
Part of a French business group	0.126**			
	(0.0587)			
Foreign-owned	-0.250***			
	(0.0818)			
R^2	0.1535	0.2125	0.1622	0.0945
Number of observations	81,089	34,871	34,513	11,127
Number of switchers	264	57	151	56

*Reading : *** means significativity at 1%, ** at 5%, * at 10%. Standard errors, in parenthesis, are clustered at the firm level.*

Sample : Manufacturers with more than 20 employees.

Source : EAE for the manufacturing sector, LiFi - Authors' calculation.

Table IV: Quality of the matching procedure

REGRESSOR	AVERAGE PERFORMANCE BEFORE			AVERAGE PERFORMANCE AFTER MATCHING			
	Switchers	Domestic firms	Bias (%)	Switchers	Domestic firms	Bias (%)	KS test : p value
log (number of plants)	0.668	0.322	51.8%	0.657	0.596	9.1%	0.997
log (sales)	9.922	8.781	11.5%	9.917	9.846	0.7%	0.602
log (value added)	8.874	7.867	11.3%	8.87	8.773	1.1%	0.332
log (workforce)	4.667	3.988	14.6%	4.662	4.592	1.5%	0.527
log (TFP)	4.373	4.026	7.9%	4.370	4.326	1%	0.527
ln (capital intensity)	3.517	3.287	6.6%	3.519	3.5	0.5%	0.105
ln (labour costs per employee)	3.591	3.431	4.4%	3.59	3.59	0%	0.678
ln (exports)	8.038	4.344	46%	8.029	7.943	1.1%	0.457
ln (imports)	7.36	4.420	39.9%	7.353	7.152	2.7%	0.391

Source : EAE for the manufacturing sector, LiFi - Authors' calculation.

4. THE IMPACT OF OUTWARD FDI ACCORDING TO OWNERSHIP

We finally evaluate the impact of outward FDI on home performance using the DID estimator (see appendix I for details about the econometric specification and table V for results). Our results are consistent with the main conclusions of Barba Navaretti *et al.* (2010), which apply a similar methodology using French data[5] : outward FDI strengthens home activities. Indeed, switchers exhibit a higher growth of their sales, their value added, their productivity, their workforce and their exports *ex-post*. However, the contribution of our analysis is to show that this positive effect is specific to switchers which belong to a French group. Non-affiliated switchers enjoy relatively modest effects, only on their sales, value added and capital intensity, whereas foreign-owned firms do not enjoy any effect (except on their imports two years after switching). Therefore, we confirm that the effect of outward FDI on home performance significantly depends on group affiliation and stakeholders' nationality.

Table V: Impact of outward FDI on home performance using a DID estimator

SAMPLE	YEAR	SALES	VALUE ADDED	WORKFORCE	MEAN WAGE	CAPITAL INTENSITY	TFP	EXPORTS	IMPORTS
All switchers (263 pairs)	T	0.0393	0.0434	0.0310**	0.0059	-0.0177	0.0249	0.0849	0.0020
		(0.0309)	(0.0356)	(0.0155)	(0.0191)	(0.0487)	(0.0309)	(0.0573)	(0.0614)
	T+2	0.125***	0.115***	0.0661**	0.0112	-0.0080	0.0684**	0.269***	0.237**
		(0.0352)	(0.0421)	(0.0306)	(0.0240)	(0.0522)	(0.0329)	(0.0979)	(0.108)
Independent switchers (57 pairs)	T	-0.0083	-0.0101	-0.0048	-0.0127	0.0523	0.0010	0.128	0.126
		(0.0668)	(0.0602)	(0.0252)	(0.0438)	(0.0628)	(0.0571)	(0.130)	(0.148)
	T+2	0.184**	0.141*	0.0677	0.0397	0.169**	0.0799	0.127	-0.0315
		(0.0779)	(0.0793)	(0.0685)	(0.0414)	(0.0698)	(0.0626)	(0.184)	(0.232)
Switchers that belong to a French business group (150 pairs)	T	0.0619**	0.0859**	0.0590**	0.0076	-0.0506	0.0487	0.0886	-0.0371
		(0.0301)	(0.0411)	(0.0235)	(0.0283)	(0.0725)	(0.0382)	(0.0769)	(0.0846)
	T+2	0.146***	0.186***	0.0937***	0.0139	-0.0786	0.119***	0.354**	0.332**
		(0.0443)	(0.0509)	(0.0341)	(0.0313)	(0.0780)	(0.0431)	(0.141)	(0.155)
Foreign-owned switchers (56 pairs)	T	0.0295	-0.0162	-0.0085	0.0180	-0.0043	-0.0133	0.0113	-0.0263
		(0.0341)	(0.0528)	(0.0244)	(0.0297)	(0.0253)	(0.0506)	(0.0879)	(0.0751)
	T+2	0.0400	-0.0646	0.0236	-0.0274	-0.0075	-0.0682	0.198	0.309*
		(0.0587)	(0.0744)	(0.0530)	(0.0603)	(0.0555)	(0.0812)	(0.279)	(0.176)

*Legend : * means significativity at 10%, ** at 5%, and *** at 1%. Standard errors are bootstrapped with 100 replications.*

Reading : In T+2, switchers that belong to a French business group employ 9% more than they would have if they had delayed their investment decision.

Sample : Manufacturers with more than 20 employees.

Source : EAE for the manufacturing sector, LiFi - Authors' calculation.

CONCLUSION

Using French individual data, this paper shows that firms which belong to a French business group are more likely to invest abroad and to enjoy positive effects from outward FDI than independent firms. Reversely, foreign-owned affiliates are less likely to invest abroad and do not enjoy any significant effect on their home performance.

We can draw two conclusions from these results. First, since independent firms seem to face more obstacles in their internationalization process, they should get additional attention from policy makers in order to boost their internationalization process. Second, our results suggest that the acquisition of domestic firms by foreign business groups may hamper their internationalization process on the long-run.

[5] The authors do not use the LiFi survey but the "Enquêtes filiales" in order to identify French multinationals and their data covers the period 1993 – 2000. They find positive effect of outward FDI on home output and employment (not productivity).

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APPENDIX I: PROPENSITY-SCORE MATCHING AND DIFFERENCE IN DIFFERENCE ESTIMATOR

We want to compare the performance trajectory of French firms under two different scenarii: engaging in outward FDI or staying domestic. We write the impact of outward FDI (noted *DELTA*) on performance (noted *Y*) as following:

$$DELTA = E(Y|SWITCH = 1) - E(Y|SWITCH = 0) \qquad (3)$$

With *SWITCH*= $\begin{cases} 1 \text{ if the firm engages in outward FDI} \\ 0 \text{ instead} \end{cases}$

We cannot directly observe this counterfactual scenario $(Y|SWITCH = 0)$, but we can implement matching techniques in order to reconstruct it. These techniques consist in matching switchers with firms which did not choose to engage in FDI but show similar performance *ex-ante*. Since this implies comparing switchers and domestic firms over a large number of criteria (size, productivity, exports, workforce, capital stock, industry, ownership), we follow Rosenbaum and Rubin (1983) and their recommendation to use "propensity scores": in our case, these scores correspond to the probability of engaging in outward FDI according to lagged observable characteristics. We compute these individual scores with a probit model, using lagged regressors (see equation (1)).

We then match switchers with domestic firms which have the closest score. This propensity-score matching procedure is robust only if scores control for all variables which determine outward FDI. If this condition is met, the performance gap between switchers and control firms only comes from different international strategies. Moreover, we have to ensure that switchers and control firms exhibit the same observable characteristics after the matching procedure, for each variable considered in the scores. To this end, we use Kolmogorov Smirnov (KS) tests in order to assess whether the distribution of *X* for switchers is statistically similar to the distribution of *X* for control firms. If all these conditions hold, we can compute the impact of outward FDI all things being equal.

However, switchers might not only differ from domestic firms in terms of size, productivity or exports, but also in terms of unobservable characteristics, such as organization, technology or specific skills. If these characteristics are supposed time-invariant, one can control their influence by using a Difference-In-Difference (DID) estimator. This estimator measures the evolution of the mean gap between switchers and control firms, between the period preceding the investment and the period following it (see equation (2)). However, this estimator requires more data, since we need information about firms' performance *ex-ante* and *ex-post*.

In section 4, we compute the DID estimator using the following regression:

$$lnX = C + \beta\ SWITCH + \sum_t \delta_t LAG_t + \sum_t \gamma_t\ SWITCH \times LAG_t\ +\ \varepsilon \qquad (4)$$

SWITCH equals 1 if the firm is investing abroad and 0 otherwise. *LAG* controls for the year of observation, with t={T-1, T, T+1, T+2}, T-1 being the reference year. We obtain the *DID* estimator with the coefficient associated to the interaction term $SWITCH \times LAG$. This term measures the evolution of the gap of performance between switchers and domestic firms, between T-1 and the years following the investment (see table VI for a decomposition of equation 3). The regression is first estimated using all switchers, then using separately our different sub-samples (switchers according to ownership in T-1).

Table VI: Difference-In-Difference (DID) estimator

	Before switching	After switching	Difference
Switchers	$C + \beta$	$C + \beta + \delta + \gamma$	$\delta + \gamma$
Domestic firms	C	$C + \delta$	δ
Difference between domestic firms and switchers	β	$\beta + \gamma$	γ

APPENDIX II: DETAILS ABOUT THE DATABASE

THE DATA

The French manufacturing census ("Enquête Annuelle Entreprises" or EAE)

The French manufacturing census ("EAE") provides income statements for all manufacturers with more than 20 employees (representing about 20,000 companies each year). The survey covers all NACE codes from 10 to 41, excluding food and tobacco industries. We choose to exclude energy from our analysis, which represents 320 firms in 2007. The survey provides information about the number of plants, sales, value-added, employment, tangible and intangible assets, investment and wages. All amounts are deflated using series from the French office of statistics (INSEE).

Given that only manufacturers with more than 20 employees are surveyed, exporters and multinational firms are over-represented in the sample: in 2007, they respectively gather 70% and 6% of all firms. Using a different database which surveys all manufacturers regardless of their size ("Bénéfice Normaux Réels" or BRN), Crozet *et al.* (2008) find that the share of exporters equals 37% in 2001.

It is important to precise that the survey does not provide consolidated accounts for companies which belong to a business group. Indeed, the EAE only provides information about the activity of the legal entity itself: figures reported in the EAE do not include the sales and employment of the affiliates the company might own. This data is well suited to our research's objective, since we want to estimate the impact of outward FDI on the French perimeter of firms only.

The LiFi survey ("Financial Linkages")

Information about ownership and FDI is given by the LiFi survey ("Financial linkages"). LiFi covers all industries and surveys firms which meet at least one of the following criteria:

- Amount of equity superior to 1.2 million euros;
- Sales reaching 60 million euros;
- More than 500 employees;
- Parent companies identified in the precedent survey;
- Companies directly owned by a foreign one.

Moreover, since 1999, the LiFi survey is completed by the "DIANE" database, which provides information for business groups with less than 500 employees.

The first contribution of LiFi is to identify and locate the parent company of each firm. This allows us to distinguish independent firms (which gather firms stating that they have no parent company and firms which are not surveyed by LiFi) and affiliated firms. Under the assumption that the location of the parent company determines the group's nationality, we are able to separate firms which belong to a French business group and foreign-owned companies. Moreover, since each parent has its own identification number, we can gather all French companies which belong to the same business group. This information is very useful in this study, since we do not want to match switchers with domestic firms which belong to the same group, since their strategies might be interdependent.

Second, firms surveyed by LiFi have to provide information about all stakes in other companies (name, location and identification number of the invested company, controlling share). This way, we can identify all firms which own at least 10% of the capital of a foreign company, therefore engaging in outward FDI following the IMF definition.

Individual data from the French customs

Individual information about exported and imported amounts is provided by the French customs ("Direction Générale des Douanes et des Droits Indirects"). Firms exporting to countries inside the European Union (EU) do not have to declare their transactions unless the annual exported amount reaches a certain threshold (same for imports). This threshold was 38,100 euros until 2000, then 99,100 euros in 2001, then 100,000 euros between 2002 and 2005 and 150,000 euros afterwards. All transactions with a country outside the EU are reported when the amount exceeds 1,000 euros. Given that most switchers already export a significant share of their sales one year before investing abroad (see table II), changes in the threshold of declaration are not likely to change the conclusions of our work. Again, exports and imports are deflated using series from the INSEE.

Matching the three databases

We are able to match the three databases using the SIREN number, which is the identification number of each legal entity in France. Each survey (EAE, LiFi and French customs) provides this SIREN number.

Using LiFi and data from the French customs, we are able to set five categories of firms according to their internationalization status:

- Domestic firms, which have no exports, no imports and no FDI;
- Firms which only export;
- Firms which only import;
- Firms which export and import but have no foreign affiliate;
- Multinational firms, which nearly all happen to be exporters and importers in the sample (97%).

COHORTS' CLEANING

Since we intend to match switchers with similar domestic firms, we must ensure that such similar firms actually exist. Given the concentration of some industries, matching switchers with firms within the same industry/cohort/ownership status might be difficult beyond a certain size threshold. This is why we drop all firms with sales exceeding 500 million euros or with more than 1000 employees. Following the same logic, we drop ten switchers because of the very abrupt dynamic of their workforce between T and T+2 (often related to Mergers or Acquisitions (M&A)). Three others are dropped because we count less than 30 firms in the same industry-cohort-ownership combination: given the number of parameters considered in the propensity scores, the probability of finding a good match is too low.

CHANGES OF OWNERSHIP OVER THE PERIOD

We cannot systematically detect changes in group affiliation over the period, because a change of the parent company might also come from the creation of a new holding company, not related to M&A. However, we check that each change in the parent company does not involve a big change in the firm's size, limiting the impact of M&A on the results. Moreover, switchers hardly change of nationality over the period: only one foreign-owned affiliate becomes French-owned afterwards, and only 11 independent or French-owned firms get acquired by a foreign group. These changes are too marginal to deserve a special treatment.

APPENDIX III: COMPUTATION OF TOTAL FACTOR PRODUCTIVITY

Total Factor Productivity (TFP) is defined as the ratio between output and an aggregate measure of inputs. Let's consider a Cobb-Douglas production function, using two inputs, labor (*L*) and capital (*K*). We write TFP of firm *i* at time *t* as following:

$$TFP_{it} = \frac{Y_{it}}{L_{it}^{\alpha} K_{it}^{\beta}}$$

Taking the logarithm, we have:

$lnTFP_{it} = y_{it} - (\beta_l l_{it} + \beta_k k_{it})$, where y, l and k represent the logarithm of output, labor and capital.

Following this approach, TFP is defined as the part of output which is not explained by inputs. Several methods exist in order to compute TFP, among which the semi-parametric approach of Olley and Pakes (1996). They compute TFP by using the estimates of the production function's coefficients:

$$lnPTF_{it} = y_{it} - \hat{\beta}_l l_{it} - \hat{\beta}_k k_{it}$$

In this production function, the error term ε_{it} is decomposed into a productivity shock ω_{it} and an error term η_{it} :

$$y_{it} = \beta_0 + \beta_l l_{it} + \beta_k k_{it} + \omega_{it} + \eta_{it}$$

Olley and Pakes (OP henceforth) try to correct for two issues that arise from the term ω_{it} : the simultaneity bias and the selection bias.

THE SIMULTANEITY BIAS

The simultaneity bias arises from the fact that only the firm (and not the statistician) can observe the productivity shock ω_{it}. These shocks arise when the firm chooses the level of its inputs: therefore, inputs and these unobservable productivity shocks are positively correlated. OP correct for this bias by assuming a positive correlation between unobservable productivity shocks and investment, for a given capital stock. By inversing this function, unobservable productivity shocks become a function of investment and capital[6]:

$$y_{it} = \beta_l l_{it} + \varphi(i_{it}, k_{it}) + \eta_{it}, \quad \text{with } \varphi(i_{it}, k_{it}) = \beta_0 + \beta_k k + h(i_{it}, k_{it})$$

Once φ is estimated with a fourth order Taylor expansion, they use an OLS regression in order to estimate the coefficient for labor.

THE SELECTION BIAS

The selection bias arises from the fact that we estimate the production function using only firms that stay on the market. In this approach, firms decide whether to produce or not according to their level of productivity. If the productivity level reaches a certain threshold, the firm stays on the market and chooses the level of inputs. Otherwise, the firm exits the market. Since profits increase with capital stock and productivity level, firms with a high stock of capital are more likely to stay with a low productivity level. The selection bias then results in a negative correlation between productivity and capital in the sample.

[6] Therefore, this method requires that few observations have no investment. In our case, only 4% of firms in the manufacturing census do not invest in 2006.

In order to correct for this bias, OP estimate the probability of survival at t according to capital stock and investment in t-1. They estimate this probability of survival with a probit model. Then they estimate the coefficient for capital using the coefficient for labor, function φ and the probability of survival.