Determinants of cross-border acquisitions in the EU*

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Abstract
This study empirically investigates the determinants of the probability that a EU firm received and completed a takeover bid. Our identification strategy relies on the logit methodology, using cross-border acquisitions and firm level balance sheet data for the years 2008-2018. We find that higher productivity increases the probability of acquisition, except for large firms. Higher firm liquidity, and listing status also increase the probability of a cross-border acquisition.
JEL Codes: D24; F23; F60; G34.
Keywords: FDI, Cross-border M&As, TFP, European Union, Logit.

Le determinanti delle acquisizioni trasfrontaliere nell'UE

Sommario
Questo studio analizza empiricamente le determinanti della probabilità che un'impresa UE riceva e porti a termine un'offerta pubblica di acquisto. La nostra strategia di identificazione si basa sulla metodologia logit, utilizzando acquisizioni transfrontaliere e dati di bilancio a livello aziendale per gli anni 2008-2018. Scopriamo che una maggiore produttività aumenta la probabilità di acquisizione, ad eccezione delle grandi imprese. Anche una maggiore liquidità dell'impresa e lo status di società quotata in borsa aumentano la probabilità di un'acquisizione transfrontaliera.

Parole chiave: IDE, fusioni-acquisizioni transfrontaliere, TFP, UE, logit

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* Responsibility for any errors lies solely with the authors. The views ex-pressed are those of the authors and may not in any circumstances be regarded as an official position of the European Commission

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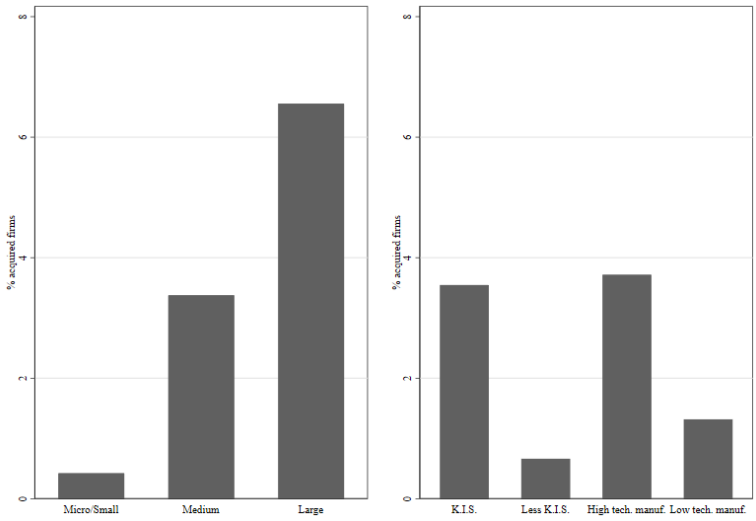
Introduction

Financial constraints faced by firms may constitute a major limit for business growth and development. Due to cash limits or inability to access external credit sources, investment opportunities could be postponed or lost, and in the worst cases a financial shortage leads to bankruptcy. In this context, foreign direct investment (FDI) may improve firms' access to capital markets and funding, and firms facing financial constraints could be more willing to be acquired by foreign investors to guarantee business continuity (Stein, 2003; Hericourt and Poncet, 2009), particularly during economic crises. In addition, when a target firm has a comparative advantage in terms of access to bank finance compared to the investor, its attractiveness, from the point view of the acquirer, increases. In fact, a foreign investor may acquire firms to improve overall bank credit supply reducing financial costs (Cornaggia and Li, 2019).

The aim of this study is to empirically investigate cross-border (CB) acquisitions' determinants in the post-2008 financial crisis. Our identification strategy relies on a binary logit estimation, in order to model financial factors affecting acquisition likelihood. Since the work by Palepu (1986), acquisition likelihood models have been implemented in several empirical analyses. The original model included financial variables, and has been subsequently extended to include aspects such as insider and institutional shareholdings or takeover defences (Ambrose and Megginson, 1992), or measures of a technical nature and market sentiment (Brar et al., 2009). In our analysis, we pay particular attention to the relationship between productivity and capital structure of the firm and the likelihood of acquisition, during this period. Therefore, we contribute to improve the understanding of the firms' characteristics subject to foreign takeovers during the 2008 financial crisis period in the EU. Thanks to a European-level granular dataset, we contribute to the literature by improving past analyses that focused on single EU countries or data corresponding to the 90s-00s, extending the coverage of countries included and focusing on recent years (for example, Powell, 1997; Brar et al., 2009; Weche-Gelübcke, 2012; Tunyi, 2019; or de Jong and Fliers, 2020; Gregori et al., 2021).

Figure 1 displays the percentages of EU firms acquired by foreign investors in different size and sector categories (details regarding these classifications are provided in section 2.3) between 2008 and 2018.

Figure 1. – Percentage of EU acquired over total firms by size and sector category (2008-2018)



Notes: K.I.S. refers to Knowledge Intensive Activities. Authors' elaboration based on Orbis database.

It suggests that the amount of foreign takeovers is unevenly distributed across firm size, with the majority of CB acquisitions[1] targeting large firms. Less than 40% of CB investments were directed toward small and medium EU companies in this period of time. Furthermore, the majority of CB investors targeted firms in high-tech manufacturing and knowledge-intensive services (75% overall), leaving only about 20% of takeovers to low-tech manufacturing and less knowledge intensive services. Following this descriptive evidence and findings from previous literature (see, among others, Antras et al., 2009), we replicate our baseline analysis for each of the size and sector categories displayed, in order to disentangle potential differing patterns across these categories. Our results suggest that there is some heterogeneity in the estimates depending on firms' size and sector. Our baseline specification indicates that firm performance (defined in terms of productivity) was

[1] In our study, acquisitions refer to control, i.e. majority acquisitions, therefore with an investment that allows the investor to control the acquired company (see footnote 3 and 6 for more details).

an important factor determining firm takeover between 2008 and 2018, except for large firms. Capital structure was also an important factor, with firms characterized by higher liquidity and lower short-term debt rations being more likely to become targets of CB acquisitions. The marginal effects show some magnitude variation depending on the sector where targeted firms operate.

The remainder of this study is divided as follows. Section 1 illustrates the econometric dataset, model, and variables used. Section 2 shows the results and a series of robustness checks, while section 3 concludes.

1. Methodology and Dataset

1.1 Dataset

We obtain information regarding CB acquisition deals that took place between 2008 and 2018 from the Zephyr database, provided by Bureau van Dijk (BvD). The timespan of our analysis starts in 2008 and includes the financial crisis period and recovery years up to 2018. The Zephyr extraction includes data for completed and confirmed CB majority acquisitions only,[2] where the target firm is located in a EU27 country plus United Kingdom.[3] We include both EU and non-EU investors in our sample. After the cleaning process, Zephyr acquisitions data are included in the Orbis financial database, in which there are information of both acquired and not acquired firms. We use Orbis balance sheet data, also compiled by BvD, for the same time period 2008-2018. Through this merging, the acquired and not acquired firms in each country are identified.

Once the Zephyr acquisitions and Orbis financial data are merged, the resulting combined dataset is further completed with historical Orbis ownership information. The historic ownership data allows to reconstruct ownership changes (or lack of them) for firms in our sample. The use of historical ownership information is important because it allows overcoming a common

[2] We exclude mergers, avoiding the problem of the treated firm collapsing into the balance sheet of the parent company, which would create identification of the effects of mergers difficult and lead to potential confounding effects.

[3] We carried out several additional selection and cleaning steps: (i) we selected unconsolidated accounts, except for firms which only reported consolidated accounts; (ii) we removed duplicate observations; and (iii) excluded from the analysis firms with less than €1m total assets value and 5 employees.

drawback faced by previous related analysis, which relied on the ownership status recorded in the last year of the sample (for example, Carril-Caccia, 2020). We use this information to remove not acquired firms from the sample if there is a change in the GUO (Global Ultimate Owner) or the DUO (Domestic Ultimate Owner)[4] in the period analysed, and also if the GUO country of origin is located in EU27 plus UK.[5]

1.2 Methodology

To empirically study the probability of firms' acquisitions, we need an identification strategy able to deal with categorical data. Therefore, we implement a binary Logit model,[6] considering that our dependent variable is binary and takes value 1 since the year in which a firm is acquired, 0 in the period before the acquisition, and also if a firm has never been acquired. The baseline model is specified as follows:

$$A_{i,t} = \alpha + \beta P_{i,t-1} + \boldsymbol{\gamma B_{i,t-1}} + \delta L_{i,t} + \varphi_c + \sigma_t + \omega_s + \varepsilon_{i,t} \qquad (1)$$

where $A_{i,t}$ is the acquisition dummy equal to one when a firm i is acquired at time t, zero otherwise. $P_{i,t-1}$ is the TFP computed at the firm-level using balance sheet information, as described in the next section. $\boldsymbol{B_{i,t-1}}$ is a vector of independent variables of interest, based on firm level balance sheet data, which are described in detail in the next section. All balance sheet independent variables and productivity variable are lagged by one year to lower endogeneity issues, and are expressed in logarithm form. We also add a dummy to control for listed firms, namely $L_{i,t}$, equal to one when a firm is listed in a specific year, zero otherwise. The estimated model also includes country (φ_c), sector (ω_s), defined at the two-digit NACE Rev. 2 classification, and year (σ_t) fixed effects, to control for time-invariant firm- and sector-level characteristics and yearly exogenous shocks. Finally, $\varepsilon_{i,t}$ is the error term.

[4] The Global Ultimate Owner refers to the company owner at the global level (i.e. beyond national borders) with at least 50.01% of company's shares. The Domestic Ultimate Owner refers to the company owner within the same country.

[5] Additionally, we also remove from our sample domestically acquired firms, firms that were part of a minority acquisition, in order to avoid potential confounding effects.

[6] See, among others, Wooldridge (2010) and Gregori and Marattin (2019).

1.3 Variable description

The firm level characteristics included as in the logit model are based on Orbis balance sheet data. One of the main independent variables of interest is the measure of firm level productivity. Previous papers have use proxies for firm performance mostly based on financial data, however productivity constitutes a more reliable and complete indicator of medium to long-term firm performance and competitiveness. TFP is our preferred measure of productivity, as it takes into account all factors of production (provided that there is enough data available for its computation). A widely used measure of TFP is obtained through the estimation of a production function, and the resulting Solow's residuals:

$$\ln (y)_{i,t} = \beta_0 + \beta_l \ln (l)_{i,t} + \beta_k \ln (k)_{i,t} + \ln (\alpha)_{i,t} + \gamma_{i,t} \quad (2)$$

Equation (2) displays a Cobb-Douglas production function, where $y_{i,t}$ is firm value added,[7] $l_{i,t}$ is the labour (variable) input, [8] and $k_{i,t}$ is the capital (fixed) input,[9] $\alpha_{i,t}$ is the productivity shock, and $\gamma_{i,t}$ is an error term that captures other shocks that are not known by the researcher or the producer. A well-known problem that affects the estimation of production functions is the presence of simultaneity and selection issues. These would bias the estimates obtained using standard econometric estimation techniques, such as OLS, due to the simultaneity of the unobserved productivity shock $\alpha_{i,t}$ (which is unknown to the econometrician, but known to the firm) and input choices made by the firm (Van Biesebroeck, 2007). Control function approaches have been widely implemented in the empirical literature in order to remove this bias. In this paper, we use the estimation strategy proposed in Levinsohn and Petrin (2003), which we refer the reader to for further details. This approach uses intermediate inputs as proxy for the productivity shock.[10]

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[7] Value added is available in Orbis; however, it has a large number of missing values in some countries. Following Gal (2013) and Bajgar et al. (2020) we impute missing value added observations internally using the sum of the cost of employees and the EBITDA.

[8] Measured as the number of employees, variable available in Orbis.

[9] In order to measure capital, we build a variable capturing firms' capital stock, based on firms' annual value of fixed assets and depreciation available in Orbis. This approach uses the Perpetual Inventory Method (see Gal (2013) or Andrews et al. (2016) for specific details).

[10] Intermediate inputs are not directly available in Orbis, but can be computed as: operating revenue minus (imputed) value added.

All monetary values are deflated using sector and country specific price indices taken from the Klems database.

In addition to productivity, our logit specification also includes a group of firm financing related variables. This way we attempt to provide some evidence regarding the financial motivations underlying the selection of targets during the financial crisis and posterior years. We explore the capital structure of the target firms in order to see whether financial distress during the period 2008-2018 had any importance in relation to the probability of a firm being acquired. We proxy this through the use of four financial ratios: i) short-term debt over total assets, which refers to part of long term financial debts payable within a year or bonds, and takes into account the level of short-term indebtedness; ii) medium- and long-term debt over total assets, related to loans with a maturity above one year and credits, to consider medium/long-term indebtedness; iii) cash and cash equivalents (i.e. only the amounts of cash in the bank or in hand) over total assets, to consider firms' liquidity as a measure of good financial health; iv) equity (approximated through the amount of shareholders' funds available, such as capital and other shareholders finds not linked to issued capital such as undistributed profits) over total assets, so as to control for firms' capitalization. Besides these ratios, we include an additional set of firm level independent variables: i) total assets, in linear and quadratic forms, to control for the size and related non-linearities of each firm; ii) value of the firms' operating profits over total assets, to include a measure of firm's ability to produce wealth for its shareholders; iii) age and age squared, to take into account the firms' seniority and related non-linearities; and iv) the aforementioned listed status dummy variable.

We use two alternative firm classifications to further exploring whether the relationship between productivity and firm capital structure and the probability of acquisition differ depending on firm size or the sector of operation. First, we use the European Commission classification to divide firms in our sample in three categories: i) *Micro/Small*,[11] defined as those with less than 50 employees and an annual turnover, or an annual balance sheet total, equal or lower than 10 million Euro; ii) *Medium*, grouping firms with less than 250 employees and an annual turnover equal or lower to 50 million Euro, or an annual balance sheet total, equal or lower than 43 million Euro; and iii) *Large* firms, including those with more than or equal to 250 employees, and annual

[11] The small number of deals in the Micro firm category prevented the estimation of the logit model for this size category separately.

turnover or balance sheet total higher than 50, or 43, million Euro respectively (European Commission, 2003). Second, we exploit Eurostat classification based on technological intensity and Research and Development, for manufacturing production, and on the share of tertiary educated labour, for services activities (in both cases defined at the NACE Rev. 2 two-digit classification).[12] We build four sectoral classifications according to the degree of technological development or knowledge intensity of the activities carried out by manufacturing and services firms,[13] respectively, in our sample: i) we group firms in the manufacturing sector according to the technological level, or intensity (based on R&D expenditure/value added) in two categories, being *high/medium-high technology* and *medium-low/low technology manufacturing*; ii) we group firms in the services sectors according to knowledge intensity (based on tertiary educated persons employed) in two categories, being *knowledge intensive services* (K.I.S.) and *less knowledge intensive services* (less K.I.S.).[14]

Our final sample includes acquired and not acquired firms located in 14 EU countries.[15] Table 1 displays descriptive statistics for the main variables included in the empirical model, for the different firm categories we consider separately.[16] Medians are displayed (except for dummy variables) since these are considered more informative due to the skewed distribution of most financial ratios.[17] Large firms are more productive when compared with the other two size categories, while no clear pattern is uncovered for the sector categories. Large firms also have higher median profit and equity ratios, while medium firms have higher median leverage and liquidity ratios. Both

[12] https://ec.europa.eu/eurostat/cache/metadata/en/htec_esms.htm#annex1580829488131.

[13] We focus on these two sectors as they group the majority of acquisitions in our sample (95 percent, combined).

[14] For details on the definition of high and low technology manufacturing and knowledge/less knowledge-intensive services see https://ec.europa.eu/eurostat/cache/metadata/Annexes/htec_esms_an3.pdf.

[15] Austria, Belgium, Germany, Denmark, Spain, Finland, France, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Sweden and the UK. Although previously included in the cleaned Zephyr extraction, Greece did not have enough observations to compute TFP.

[16] A matrix with the correlation coefficients of the independent variables included in our model is provided in Table A1 in Appendix A, which shows correlations are rather low.

[17] We perform a series of Kruskal–Wallis tests to identify differences across the subsamples. These tests indicated in all cases that all continuous variables are different across size and sector categories. Results and further explanations are provided in Table A2 in Appendix A.

high technology and knowledge intensive firms have higher median profit, cash and equity ratios, and also group larger firms.

Table 1. – Descriptive statistics (2008-2018), by size and sector categories

		Firm size			Manufacturing and Services sectors			
		Small/Micro	Medium	Large	High techn. manufacturing	Low techn. manufacturing	Knowledge intensive serv.	Less knowledge intensive serv.
ln(TFP)	*Median*	10.984	11.467	12.068	11.131	10.867	11.462	11.469
	Min.	-0.609	-3.821	3.814	0.352	1.630	-1.117	-3.821
	Max.	18.412	16.084	19.235	19.235	15.646	20.349	18.412
Total assets	*Median*	2.273	11.939	81.43	5.925	3.804	4.260	3.363
	Min.	1	1	1.97	1	1	1	1
	Max.	383.606	383.737	384.022	383.916	384.022	384.038	384.041
Loans/Total assets	*Median*	0.027	0.048	0.016	0.032	0.053	0.005	0.031
	Min.	0	0	0	0	0	0	0
	Max.	13.966	16.968	5.594	20.004	10.531	13.966	33.932
Long term debt/Total assets	*Median*	0.047	0.054	0.028	0.027	0.053	0.007	0.044
	Min.	0	0	0	0	0	0	0
	Max.	24.031	45.099	6.485	5.723	24.031	45.099	15.877
Profits/Total Assets	*Median*	0.031	0.040	0.052	0.046	0.036	0.039	0.034
	Min.	-3.988	-7.890	-2.260	-4.742	-3.988	-7.890	-16.624
	Max.	5.698	5.011	21.558	8.96	12.079	1681.542	5.698
Cash/Total assets	*Median*	0.037	0.042	0.036	0.046	0.033	0.072	0.042
	Min.	-1.060	-0.403	-0.212	-0.684	-1.06	-0.571	-0.91
	Max.	0.995	0.996	0.990	1.609	0.979	1.127	1.093
Equity/Total assets	*Median*	0.303	0.324	0.326	0.341	0.323	0.348	0.287
	Min.	-33.199	-57.458	-8.309	-20.653	-33.199	-57.458	-77.527
	Max.	1.864	1.014	2.820	1.095	2.143	2.820	1.569
Age	*Median*	19	23	27	23	22	16	20
	Min.	0	0	0	0	0	0	0
	Max.	421	640	735	190	735	334	284
Listed firm dummy	*Mean*	0.001	0.003	0.01	0.005	0.002	0.004	0.001
	Min.	0	0	0	0	0	0	0
	Max.	1	1	1	1	1	1	1
Observations		1,215,792	331,813	77,449	194,078	546,036	268,335	973,058

Notes: The value of total assets is expressed in €1m.

2. Results

We estimate the logit model described in section 1.1 using the pooled sample (which we refer to as the baseline model), and for three size categories. In addition, we focus on the four sector categories described in section 1.3 separately. We compute marginal effects of each variable at the

median sample values (mean for the case of dummy variables), which are displayed in Table 2.[18]

Table 2. – Marginal effects. Baseline, size and sector analysis

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
			Firm size			Manufacturing and Services sectors		
	All	Small/Micro	Medium	Large	High techn. Manufacturing	Low techn. Manufacturing	Knowledge intensive serv.	Less knowledge intensive serv.
ln(TFP)	0.0010***	0.0007***	0.0065***	0.0038	0.0035***	0.0004*	0.0022***	0.0008***
	(0.0001)	(0.0001)	(0.0014)	(0.0039)	(0.0011)	(0.0003)	(0.0008)	(0.0002)
ln(Total assets)	0.0039***	0.0013***	0.0089***	0.0087***	0.0116***	0.0035***	0.0111***	0.0018***
	(0.0001)	(0.0001)	(0.0009)	(0.0028)	(0.0011)	(0.0003)	(0.0009)	(0.0001)
ln(Loans/Total assets)	-0.0036***	-0.0013**	-0.0170***	-0.0395***	-0.0131***	-0.0045***	-0.0052	-0.0019***
	(0.0006)	(0.0005)	(0.0044)	(0.0150)	(0.0047)	(0.0011)	(0.0036)	(0.0005)
ln(Long term debt/Total assets)	-0.0007	-0.0008**	-0.0043	0.0213*	-0.0006	-0.0010	-0.0012	-0.0004
	(0.0004)	(0.0003)	(0.0037)	(0.0109)	(0.0036)	(0.0007)	(0.0027)	(0.0004)
ln(Profits/Total Assets)	-0.0056***	-0.0021***	-0.0392***	-0.0608***	-0.0285***	-0.0034**	-0.0204***	-0.0024**
	(0.0008)	(0.0006)	(0.0054)	(0.0215)	(0.0058)	(0.0015)	(0.0041)	(0.0010)
ln(Cash/Total assets)	0.0014***	0.0009***	-0.0024	0.0622***	0.0007	-0.0004	0.0063**	0.0015***
	(0.0004)	(0.0003)	(0.0038)	(0.0118)	(0.0034)	(0.0008)	(0.0026)	(0.0004)
ln(Equity/Total assets)	-0.0017***	-0.0012***	-0.0029	-0.0122	-0.0036	-0.0022***	-0.0021	-0.0014***
	(0.0003)	(0.0003)	(0.0024)	(0.0087)	(0.0024)	(0.0006)	(0.0021)	(0.0003)
ln(Age)	-0.0009***	-0.0006***	-0.0055***	-0.0117***	-0.0032***	-0.0002	-0.0064***	-0.0004***
	(0.0001)	(0.0001)	(0.0011)	(0.0031)	(0.0009)	(0.0002)	(0.0011)	(0.0001)
Listed firm dummy	0.0125***	0.0027*	0.0225***	0.1880***	0.0165**	0.0117***	0.0486***	0.0353***
	(0.0023)	(0.0016)	(0.0084)	(0.0469)	(0.0078)	(0.0040)	(0.0148)	(0.0122)

Notes: Marginal effects calculated at the median values for continuous variables. Standard errors in parentheses, computed using the delta method. *** p<0.01, ** p<0.05, * p<0.1. Continuous variables are lagged one year.

The marginal effects represent the change in the probability (of a CB acquisition) to a change in an independent (continuous) variable, holding the rest of regressors at their median values. For dummy independent variables, the marginal effects describe the magnitude of change in the dependent

[18] The estimated logit coefficients are provided in Table A3 in Appendix A. All models presented include country, year, and sector fixed effects. This proved to be a superior specification when compared to models without dummies, based on a higher McFadden (1974) Pseudo-R^2 computations.

variable after a change from 0 to 1 of the regressors, again holding the rest of regressors at median values. The interpretation of the marginal effects of continuous variables in non-linear models is not as straightforward as for the case of dummy or categorical independent variables. For continuous variables, the marginal effects represent the instantaneous rate of change, given that the 'unit' change may be very small (i.e. not necessarily one). It often provides a good approximation to the amount of change in the probability that will be produced by one unit change in the independent variable, but this is not ensured as the model is non-linear (Long and Freese, 2006). Despite these notes of caution regarding the interpretation of marginal effects, we still can infer the relative importance (i.e. magnitude) of the change they induce in the probability of the firm being the target of a CB acquisition.

According to Table 2, one instant change in firms' TFP changes the probability of being acquired by between 0.1 and 0.6 percentage points (p.p.). TFP appears to be a more important factor in the probability of firms in the medium size category being a target of a CB acquisition. The marginal effects are statistically significant and positive in all cases, except for firms in the large size category. Evidence regarding foreign acquirers choosing more productive firms (i.e. "cherry picking" target firms) has been uncovered in past related analyses (for example, Harris and Robinson, 2002; Salis, 2008; Balsvik and Haller, 2010; Bandick, 2011). This behaviour is typically linked to acquiring firms' motivation of achieving greater market access and power, or acquiring superior managerial knowledge, production techniques or intellectual property (Weche-Gelübcke, 2012).

Focusing on the leverage ratios, the marginal effects of short-term debt are negative and statistically significant for firms in all categories, except for firms operating in K.I.S., indicating that firms with higher short term debt are less likely to be targeted by CB acquisitions. More leveraged firms, likely to be in more financial distress during the period following the 2008 financial crisis, have been typically found to be targets of takeovers in related literature (Brar et al., 2009; Åstebro and Winter, 2012). The negative link is particularly meaningful for medium and large firms, for which an instant change in short term ratio decreases the probability of being acquired by 1.7 and 4 p.p., respectively; and for firms in the high technology manufacturing sector, with a probability decrease of 1.3 p.p. Long term debt, on the other hand, has a mostly statistically insignificant relationship with the probability of acquisition. A noticeable exception is for large firms, for which one instant change in long term debt ratio increases the probability of being acquired by 2.1 p.p., possibly because a higher long term debt can be related to lower

refinancing risks (Harford et al. 2014). Finally, the liquidity and equity ratios are linked to an increase, and a decrease, respectively, of the probability of being acquired for certain categories of firms. An instant change in liquidity is linked to an increase in the probability of acquisition of 6.2 p.p. for large firms and of 0.6 p.p. for firms operating in the K.I.S. sectors. Firms with more cash reserves were also identified as more likely targets by De Jong and Fliers (2020), who linked this result to the appeal of more financial flexibility these target firms which higher cash reserved might have and potential coinsurance to potential acquirers. The relation between liquidity and acquisition likelihood is no statistically significant for manufacturing and small and medium firms. The impact of the equity ratio is negative and statistically significant for micro/small firms and for firms operating in the low technology manufacturing and less K.I.S. sectors, although the magnitude of the p.p. decrease in probability is very small in all cases.

In terms of the rest of independent variables, firm profitability and listing status display the largest overall economic importance in terms of the magnitude of the marginal effects, besides being statistically significant. Profitability is liked with a reduction in the probability of being acquired in all cases. This reduction in the likelihood of acquisition has been attributed to acquirers targeting under-performing firms, which are typically valued less, in order to re-structure them (Weche-Gelübcke, 2012; De Jong and Fliers, 2020). The opposing impacts of profitability and productivity were also reported in Weche-Gelübcke (2012), and attributed to a coexistence of the "cherry picking" and "lemon grabbing" (i.e. picking firms lower-performing firms) hypotheses. An instant change in profitability of medium and large firms changes the probability of being acquired by 3.9 and 6.1 p.p. for firms in each category. This decline is of 2.9 p.p. for firms in the high technology manufacturing sector. For two otherwise-median firms, the listed firms' probability of being acquired is 2.3 and18.8 p.p higher for medium and large firms, respectively; and 4.8 and 3.5 p.p. higher for firms in K.I.S and less K.I.S., respectively. The impact of age is overall negative and statistically significant, indicating older firms are less likely to experience a takeover (Åstebro and Winter, 2012). Finally, larger firms appear to be more likely targets of a CB acquisition across all firm categories. Although a significant portion of related literature postposes that smaller firms are more likely targets of takeovers, more recent papers have identified non-linear relationship of size such as the ones we identify (Tunyi, 2019), indicating that foreign acquirers might have targeted larger firms, but only up to a certain level of acceptable transaction costs.

3.1 Robustness checks

In this section we assess the robustness of the estimates obtained from the baseline model (i.e. specification 1, Table 2) to alternative model and sample specifications. More specifically, we carry out the following changes: i) estimate a probit, instead of logit, model;, ii) we narrow our down sample to include only Euro Area member states, iii) we include only foreign acquirers (defined as investors located outside the EU27, plus UK), iv) we exclude firms operating in the insurance and financial sectors (corresponding to the NACE Rev. 2 category *"K - Financial and insurance activities"*), and lastly we perform separated estimations in v) the pre-2013 time period and vi) the post-2013 time period. Again, the marginal effects calculated at the medians are displayed in Table 3 for each of the six re-estimations performed.

Table 3. – Marginal effects. Robustness checks, pooled baseline model

	(1) Probit regression	(2) EA countries	(3) Foreign acquirors	(4) No fin./ insurance firms	(5) Pre-2013	(6) Post-2013
ln(TFP)	0.0012***	0.0008***	0.0003***	0.0010***	0.0004***	0.0015***
	(0.0002)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0002)
ln(Total assets)	0.0039***	0.0031***	0.0015***	0.0038***	0.0022***	0.0057***
	(0.0002)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0002)
ln(Loans/Total assets)	-0.0044***	-0.0033***	-0.0008***	-0.0037***	-0.0016***	-0.0058***
	(0.0007)	(0.0006)	(0.0003)	(0.0006)	(0.0005)	(0.0010)
ln(Long term debt/Total assets)	-0.0012**	-0.0005	-0.0000	-0.0007	-0.0006	-0.0007
	(0.0005)	(0.0004)	(0.0002)	(0.0004)	(0.0004)	(0.0007)
ln(Profits/Total Assets)	-0.0065***	-0.0051***	-0.0024***	-0.0058***	-0.0035***	-0.0079***
	(0.0009)	(0.0007)	(0.0004)	(0.0008)	(0.0006)	(0.0014)
ln(Cash/Total assets)	0.0017***	0.0009**	0.0010***	0.0011**	0.0014***	0.0014**
	(0.0005)	(0.0004)	(0.0002)	(0.0004)	(0.0003)	(0.0007)
ln(Equity/Total assets)	-0.0022***	-0.0014***	-0.0004**	-0.0016***	-0.0007***	-0.0028***
	(0.0004)	(0.0003)	(0.0002)	(0.0003)	(0.0003)	(0.0005)
ln(Age)	-0.0011***	-0.0008***	-0.0005***	-0.0009***	-0.0006***	-0.0013***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0002)
Listed firm dummy	0.0245***	0.0099***	0.0037***	0.0114***	0.0105***	0.0164***
	(0.0048)	(0.0020)	(0.0009)	(0.0022)	(0.0022)	(0.0032)

Notes: Marginal effects calculated at the median values for continuous variables. Standard errors in parentheses, computed using the delta method. *** p<0.01, ** p<0.05, * p<0.1. Continuous variables are lagged one year.

Overall, the estimated marginal effects and significance levels are confirmed regardless of the model or sample changes. Following Palepu

(1986), most related papers have implemented logit regressions, however analyses using probit regressions instead can also be found (Weche-Gelübcke, 2012). Specification (1) in Table 3 shows the marginal effects (at the medians) obtained from a probit regression. The only noticeable change is the statistical significance of the long-term debt ratio, together with overall slightly larger magnitude of the marginal effects. In specification (2), we include only Euro Area countries, with the purpose of exploring whether these group of countries present specificities that could be arising from the weaknesses faced by the Euro in the years after the crisis. In both cases the liquidity ratio appears to have reduced statistical significance, but overall the results are robust. In specification (3) we include only acquiring firms which have a GUO originating outside of the EU27 plus UK, to explore potential differences in motivations between EU and non-EU acquiring firms. We do not find noticeable differences to the baseline specification. In specification (4), we exclude firms operating in the financial and insurance industries, since these are highly regulated activities, which could affect the likelihood of being the target of a CB acquisition. Again, the results are not affected. Finally, in specifications (5) and (6), we separate the first six years of data (2008-2013), and the last five years (2014-2018) in order to assess whether the determinants of CB acquisitions present any differences before and during the 2008 crisis "recovery" period. Overall, the relationships between our independent variables and the probability of a firm being acquired in each of the two sub-periods remains stable (no sign changes are observed).

3. Conclusions

In this paper we model CB acquisition likelihood of EU target firms in order to provide empirical evidence regarding the characteristics of firms' subject to CB acquisitions during the years following the 2008 financial crisis. The estimates obtained can provide some evidence regarding potential motives underlying foreign takeover activity in the EU during those economically challenging times. We use Zephyr acquisitions data and Orbis balance sheet information for the years 2008 to 2018, and estimate a logit model to assess the likelihood of a firm becoming the target of a CB acquisition.

We find that the likelihood of acquisition is linked to firm performance (i.e. TFP) and financial characteristics, and that these links vary depending on the size and sector of operation. The evidence suggests that takeover targets are productive albeit relatively unprofitable (i.e. undervalued), compar-

atively larger (than acquirers), are young, and have substantial liquidity ratios and are less leveraged, especially in terms of short term debt. Moreover, we find some heterogeneity regarding the significance and magnitudes of some of the CB acquisition determinants depending on the size of the target firm, and the sector where they operate. Firm performance did not have a statistically significant relationship with the acquisition likelihood of large firms. Liquidity did not have a statically significant impact on the acquisition likelihood of medium and manufacturing firms, while the short-term debt ratio was not statistically significant for firms operating in the Knowledge Intensive Services category. Mixed results were also obtained for the long-term debt and equity ratios.

Some limitations of our analysis can be pointed out. We do not include in our model other potentially important information such as the probability of firm failure and survival (Åstebro and Winter, 2012) or information regarding target firms' takeover defences (Ambrose and Megginson, 1992), due to this information not being available in the dataset we use. Finally, some ideas for future research include a comparison to domestic acquisitions, and also potential distinction between hostile and friendly takeovers.

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APPENDIX A

Table A1. – Correlation matrix

	ln(TFP)	Total assets	Loans/ Total assets	Long term debt/ Total assets	Profits/ Total Assets	Cash/ Total assets	Equity/ Total assets	Age	Listed firm dummy
ln(TFP)	1								
Total assets	0.392	1							
Loans/Total assets	-0.031	-0.004	1						
Long term debt/Total assets	-0.083	0.048	0.005	1					
Profits/Total Assets	0.041	-0.001	-0.012	-0.011	1				
Cash/Total assets	0.125	-0.055	-0.228	-0.167	0.023	1			
Equity/Total assets	0.146	0.048	-0.351	-0.333	0.024	0.22	1		
Age	0.111	0.179	-0.014	-0.028	-0.003	0.014	0.157	1	
Listed firm dummy	0.029	0.079	-0.003	-0.001	-0.001	0.006	0.02	0.032	1

Table A2. – Kruskal–Wallis equality-of-populations rank tests

The Kruskal-Wallis test is a rank-based test typically used to determine if there are statistically significant differences between the medians of a continuous variable for more than two groups (it is an extension of the Mann-Whitney test, which only allows the comparison of two groups). It is considered the non-parametric alternative to the one-way ANOVA. The homogeneity of variance assumption necessary to perform ANOVA tests was checked in our data using Levene's tests, which rejected the null hypothesis of equal variances in all cases, therefore ANOVA tests are not suitable for comparisons across groups in our case. If the p-value obtained from the Kruskal-Wallis test is statistically significant, we can reject the null hypothesis and conclude that not all the group medians are equal.

The following Kruskal-Wallis tests were carried out in order to determine if the continuous variables in our regression analysis were different:

- for the three size groups: (i) micro/small; (ii) medium; and (iii) large. The test statistics shown in the table below indicate that there are statistically significant differences in the median of all independent variables between the three groups (all p-values are lower than the 0.001 significance level).
- for the four sector groups: (i) high-techn. manufacturing; (ii) low-techn. manufacturing; (iii) Knowledge Intensive Services; and (iv) Less Knowledge Intensive Services. The test statistics in the table below indicate

that there are statistically significant differences in the median of all independent variables between the four groups (all p-values are lower than the 0.001 significance level).

	SME 3-categories	Sector 4-categories
ln(TFP)	293,184.58	333,799.83
	(0.000)	(0.000)
Total assets	638,992.74	24,203.36
	(0.000)	(0.000)
Loans/Total assets	13,126.91	32,836.20
	(0.000)	(0.000)
Long term debt/Total assets	1,060.63	17,963.12
	(0.000)	(0.000)
Profits/Total Assets	10,805.21	7,573.21
	(0.000)	(0.000)
Cash/Total assets	792.71	25,126.21
	(0.000)	(0.000)
Equity/Total assets	848.91	9,831.81
	(0.000)	(0.000)
Age	39,361.04	36,511.63
	(0.000)	(0.000)

Notes: Chi^2 statistic and p-values (in parenthesis) reported.

Table A3. – Logit coefficients

	(1) All	(2) Small/Micro firms	(3) Medium firms	(4) Large firms	(5) High techn. Manufacturing	(6) Low techn. Manufacturing	(7) Knowledge intensive serv.	(8) Less knowledge intensive serv.
ln(TFP)	0.257***	0.471***	0.336***	0.098	0.272***	0.177*	0.142***	0.518***
	(0.034)	(0.086)	(0.070)	(0.099)	(0.085)	(0.099)	(0.049)	(0.079)
ln(Total assets)	5.286***	4.659***	1.742**	8.629***	5.604***	6.742***	3.858***	6.240***
	(0.322)	(0.991)	(0.762)	(2.463)	(0.745)	(0.796)	(0.504)	(0.714)
$\ln(\text{Total assets})^2$	-0.141***	-0.127***	-0.039*	-0.231***	-0.151***	-0.177***	-0.103***	-0.170***
	(0.010)	(0.031)	(0.023)	(0.068)	(0.022)	(0.023)	(0.015)	(0.021)
ln(Loans/Total assets)	-0.944***	-0.906***	-0.888***	-1.019***	-1.025***	-1.797***	-0.332	-1.173***
	(0.146)	(0.345)	(0.214)	(0.357)	(0.338)	(0.356)	(0.222)	(0.286)
ln(Long term debt/Total assets)	-0.177	-0.556**	-0.223	0.549*	-0.048	-0.406	-0.075	-0.219
	(0.114)	(0.228)	(0.189)	(0.293)	(0.280)	(0.263)	(0.171)	(0.252)
ln(Profits/Total Assets)	-1.478***	-1.491***	-2.044***	-1.566***	-2.227***	-1.342**	-1.293***	-1.499***
	(0.196)	(0.419)	(0.265)	(0.548)	(0.422)	(0.581)	(0.243)	(0.559)
ln(Cash/Total assets)	0.370***	0.637***	-0.123	1.602***	0.053	-0.148	0.403**	0.959***
	(0.115)	(0.220)	(0.195)	(0.315)	(0.269)	(0.323)	(0.170)	(0.247)
ln(Equity/Total assets)	-0.454***	-0.888***	-0.153	-0.314	-0.285	-0.888***	-0.132	-0.891***
	(0.082)	(0.169)	(0.127)	(0.219)	(0.184)	(0.204)	(0.132)	(0.176)
ln(Age)	0.945***	1.534***	1.140***	0.854***	0.679***	0.055	2.418***	1.149***
	(0.121)	(0.360)	(0.196)	(0.244)	(0.241)	(0.204)	(0.306)	(0.297)
$\ln(\text{Age})^2$	-0.161***	-0.267***	-0.186***	-0.145***	-0.121***	-0.019	-0.407***	-0.189***
	(0.019)	(0.057)	(0.030)	(0.037)	(0.036)	(0.031)	(0.050)	(0.044)
Listed firm dummy	1.836***	1.706***	1.282***	2.229***	1.001***	1.938***	1.667***	3.414***
	(0.156)	(0.453)	(0.272)	(0.271)	(0.307)	(0.292)	(0.260)	(0.335)
Observations	1,893,771	974,822	277,063	62,970	160,962	449,689	209,368	779,107
Pseudo R-squared	0.246	0.241	0.179	0.136	0.196	0.235	0.208	0.216
Log-likelihood	-61,528	-10,082	-21,027	-8,956	-12,315	-13,847	-16,446	-14,149
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Robust standard errors (clustered by firm) are displayed in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Independent variables are lagged one year. Pseudo-R-squared is calculated as suggested by McFadden (1974).