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Corporate Acquisitions and Firm-level Uncertainty: Domestic Versus Cross-Border Deals*

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Abstract

This paper studies the impact of corporate acquisitions on the uncertainty faced by acquiring firms. We use data for UK public companies from 2004 to 2017 and employ a matching estimator combined with difference-in-differences to control for the endogenous selection of firms into acquiring status. Acquisitions exert a large and persistent effect on the volatility of stock returns of acquirers and is characterized by a pecking order: domestic takeovers lead to a reduction in the uncertainty faced by the acquirer, while cross-border acquisitions—particularly those involving target firms in emerging markets—engender a positive response in acquirers' volatility.

Keywords: Mergers and Acquisitions; Uncertainty; Volatility; Globalization; Stock Returns; UK.

JEL classification: G32; G34; F23; F36.

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1 Introduction

Corporate acquisitions are one of the largest investments that a company will ever undertake. They also enable firms to grow much faster than internal investment would. Both their scale and swiftness makes them a risky strategy for acquiring firms to grow. While the question of whether acquisitions create or not value for shareholders has been studied extensively (see e.g. Jarrell et al., 1988; Andrade et al., 2001; Betton et al., 2008, to name some of the most prominent surveys on the topic), to the best of our knowledge, the impact that acquisitions have on the uncertainty faced by acquiring firms has yet to be investigated.

In this paper we attempt to fill this gap in the literature. Using data for listed firms in the UK between 2004 and 2017, we estimate the impact that the announcement of acquisitions has on the uncertainty faced by acquiring firms. Following an extensive literature in macroeconomics and finance, we use the realized volatility of acquirers' stock returns to measure firm-level uncertainty (see e.g. Duffee, 1995; Leahy and Whited, 1996; Bloom et al., 2007; Grullon et al., 2012). Stock returns capture changes in investors' perceptions about the expected future profitability of a firm and therefore their volatility offers a readily available indicator to gauge the uncertainty perceived by financial markets about firms' future prospects. Furthermore, as Bloom et al. (2018) show, the volatility of stock returns is tightly linked to shocks shaping firms' 'real' performance outcomes such as total factor productivity.

Acquisitions can affect the uncertainty that financial markets perceive about a firm announcing a takeover through several channels. As we noted above, takeovers are very large investments from the perspective of the acquirer, and while there is consensus that—on average—they create value for shareholders, there is also ample anecdotal evidence that they often fail dramatically.[1] As the post-acquisition process unfolds and new information

[1]Firms buy other firms for a wide range of reasons. Acquirers might expect to increase their efficiency by realizing economies of scale; achieve synergies by exploiting assets owned by the target firm that are not easily replicable through internal investment; or by reallocating resources within the combined firm. They could also intend to engage in tax or regulatory arbitrage or take advantage of short-term fluctuations in asset prices that lead to the undervaluation of targets. Managers of acquiring firms could also simply be seeking to increase their own compensation and prestige. There is great uncertainty surrounding the realization of these expected benefits. Bruner (2005) offers an in-depth case-study analysis of some of the most prominent

becomes available regarding whether the objectives of a deal have been achieved, this should be reflected in the volatility of stock returns of acquirers. Acquisitions can also change firms' exposure to shocks in different industries and countries. To fix ideas, consider an acquirer that takes over a foreign company with the aim of reaching costumers abroad. Doing so could increase the uncertainty faced by the acquirer if the investment is largely irreversible (e.g. if the assets owned by the target have limited value to other buyers), because it would increase its willingness to bear negative shocks rather than exiting the market. Alternatively, if the acquisition facilitates the diversification of revenue streams, it would then result in a reduction in the uncertainty perceived by the buyer. Since economic theory does not provide an unequivocal indication about how acquisitions affect the uncertainty faced by acquirers and the magnitude of this effect, these are ultimately empirical questions which we tackle in this paper.

We use a matching estimator combined with difference-in-differences to control for the endogenous self-selection of firms into acquiring other firms as well as for time-invariant unobserved firm heterogeneity. More specifically, we employ a 'doubly robust' estimator which uses propensity score weighting combined with covariate adjustment to estimate the counterfactual volatility that acquirers would have experienced had they not pursued a takeover. Our identification strategy differs from the event-study methodology used most frequently in the aforementioned literature investigating the impact of acquisitions on shareholders' wealth. We calculate the realized volatility of acquirers as the standard deviation of daily stock returns within a given quarter and investigate the impact of acquisitions exert on volatility one to three quarters after a deal's announcement. We do so to take into account the the well-documented persistence of the volatility of stock returns (Schwert, 1989; Andersen et al., 2001), and the fact that the mechanisms through which different types of acquisitions affect firm-level uncertainty are likely to take some time to realize.

Uncertainty plays a crucial role in shaping firms' real and financial decisions. For instance,

acquisition failures—or "Deals from Hell" as he refers to them.

investment projects often entail large sunk costs, which makes them at least partially irreversible and creates an option value of waiting. When uncertainty rises, this real option mechanism causes firms to postpone investment until conditions improve and makes them less responsive to policy stimuli (see e.g. Leahy and Whited, 1996; Bloom et al., 2007; Bloom, 2009, among others). Higher uncertainty has also been shown to increase the cost of external finance, risk premia and the likelihood of default (Froot et al., 1993; Adrian and Rosenberg, 2008; Arellano et al., 2019).

Our first key result is that the internationalization margin plays a key role in determining the impact of acquisitions on the volatility of stock returns of acquirers. More precisely, we find that this relationship is characterized by a pecking order: domestic acquisitions lead to a substantial reduction in volatility while cross-border deals produce the opposite effect. Within the latter group, deals involving the takeover of target firms located in emerging markets have a large and positive impact on the volatility of the acquirer while cross-border transactions targeting firms in developed markets do not appear to affect the volatility of the acquirer.

A second novel result from our analysis is that acquisitions exert a long-lasting impact on firm-level uncertainty. This resonates with the 'capabilities view' of acquisitions, which argues that the success of an acquisition is determined by the way in which acquired capabilities are integrated into the acquiring firm in the aftermath of a deal—a difficult, uncertain, and time-consuming process (Haspelagh and Jemison, 1991; Child et al., 2001). Our findings suggest that the complexities involved in applying and transferring capabilities to newly acquired targets are strongly influenced by whether firms extend their boundaries across borders and the level of development of the markets they expand to. This, in turn, is manifested in large and persistent differentials in the response of stock returns volatility to different types of acquisitions.

To explore the forces that give rise to the differential response of volatility to acquisitions, we investigate how these responses are affected by different characteristics of acquisition

transactions such as deal size, whether the target firm operates in the same industry as the acquirer or not and the extent of ownership control achieved. Our analysis indicates that acquirers face greater uncertainty in the process of extending their boundaries across borders than domestically—particularly when acquisitions involve taking over target firms in markets that are less developed and more dissimilar to their own. The positive effect that cross-border acquisitions in emerging markets exert on the volatility of acquirers is most notable for large deals and those that only deliver minority control of the target. The former effect is consistent with these transactions being characterized by a higher degree of irreversibility.

The stronger positive effect we find in minority transactions indicates that there is greater uncertainty surrounding the successful integration of the acquirer and the target when the former faces more limitations in shaping this process. In sharp contrast, we find that the negative impact of domestic acquisitions on volatility arises only in majority transactions. Overall, our results do not indicate that the extent of diversification produced by an acquisition, either across countries or industries, contributes systematically to reduce the uncertainty faced by acquirers.

Our focus on UK acquirers is interesting to a wide audience for two main reasons. Firstly, the UK has long been one of the world's major players in terms of domestic and cross-border acquisitions—this makes our findings highly relevant for firms based in other main major financial centers from which a large share of the world's acquisitions originate. Secondly, our results have important implications for the UK in the aftermath of the decision to leave the European Union. Brexit has been a major source of uncertainty for UK businesses (Bloom et al., 2019). Our results suggest that if UK firms reorient their cross-border acquisitions (the most important component of foreign direct investment) away from the European Union towards emerging markets, this could further increase the uncertainty they face.

Related Literature

Our paper lies at the intersection of the literature on finance and international economics. Globalization plays a central role in determining outcomes in the market for corporate control. Moeller and Schlingemann (2005) report substantial differences across a wide range of characteristics such as deal size, market-to-book ratios and method of payment between domestic and cross-border acquisitions carried out by US acquirers; they also find that domestic deals systematically elicit higher announcement returns than cross-border ones. Denis et al. (2002) find that firms that expand across countries—increasing the extent of their global diversification—see an increase in the discount in value they face relative to a comparable portfolio of undiversified firms.

The geographic pattern of firms' expansion also affects the response of stock returns to acquisitions. Doukas and Travlos (1988) find that abnormal returns of US acquirers are higher when they expand into new and less developed markets; using data from acquirers and targets from a large number of countries, Chari et al. (2009) show that acquirers only achieve positive abnormal returns when they gain majority control of targets located in emerging markets. Gregory and McCorriston (2005) reach a similar conclusion, showing that returns for UK acquirers are only positive for cross-border acquisitions undertaken outside the US and the European Union. We contribute directly to this literature by showing that globalization and the geographic scope of firms' acquisitions not only affect the expected gains of takeovers but also have an important impact on the uncertainty faced by acquirers.

Our paper contributes to a small but growing literature that investigates how different margins of globalization affect the volatility of firm-level performance outcomes. Riaño (2011) and Vannoorenberghe (2012) study how exporting affects the volatility of firms' sales, and Kurz and Senses (2016) examine the impact of exporting and importing on employment volatility. In contrast to these papers, our focus on stock returns as the underlying performance dimension of interest allows us to use daily data to estimate volatility. Doing so allows us to capture its well-document short-term fluctuations which would otherwise be

smoothed out when volatility is estimated using the type of low-frequency data available in most manufacturing surveys. Our paper is closely related to Girma et al. (2016), which studies how changes on the intensive margin of exports and foreign sales carried out by foreign subsidiaries affect the volatility of stock returns of Japanese firms. We differ from Girma et al. (2016) in two key respects; first, while they study how relatively smaller changes in the intensive margin of foreign sales affect volatility, we focus instead on larger changes in firms' global engagement along the *extensive* margin brought about by the acquisition of new firms. Second, we compare the impact of the domestic acquisitions on volatility to that produced by cross-border transactions and show that the impact of the latter is crucially affected by the type of market—developed vs emerging—that a firm expands into.

Lastly, our paper speaks to the body of work in international trade that investigates the impact of foreign acquisitions on a wide range of outcomes, including total factor productivity, technology transfer, innovation and wage premia, among others (Girma and Görg, 2007; Arnold and Javorcik, 2009; Guadalupe et al., 2012; Wang and Wang, 2015). This literature has primarily focused on the effect of acquisitions on target firms (Stiebale and Trax (2011) and Stiebale (2016) are notable exceptions) in terms of 'real' variables. We contribute to this literature by evaluating how acquisitions affect the uncertainty that financial markets perceive about the expected future profitability of acquiring firms.

The rest of the paper is organized as follows. Section 2 discusses potential channels through which acquisitions can affect firm-level uncertainty. Section 3 describes our data and provides summary statistics. Section 4 describes our empirical methodology and identification strategy. Results of our empirical analysis are presented in Section 5. Section 6 concludes.

2 Globalization, Acquisitions and Volatility

In this section we discuss different mechanisms through which the announcement of an acquisition deal could affect the uncertainty that investors perceive about the future profitability of the acquiring firm—as measured by the volatility of its stock returns. As will become apparent shortly, whether or not a takeover deal extends a firm's boundary across borders plays a key role in shaping how the volatility of stock returns reacts in response to an acquisition.

A central tenet of the theory of the multinational firm is that foreign-owned firms operate at a disadvantage compared to local ones in terms of their knowledge of consumer preferences, business practices and institutions (Caves, 1996). For instance, differences in corporate culture can make the integration between the acquirer and the target firm's management teams more difficult (Child et al., 2001); costlier international monitoring can induce the local manager of a foreign target to behave opportunistically and to not maximize the value of the merged firm (Antràs et al., 2009); differences in accounting practices and disclosure agreements can dent the effectiveness of due diligence processes, making it harder for bidders to accurately assess the value of a prospective acquisition (Mantecon, 2009). The more important these frictions are, the more likely it is that financial markets perceive greater uncertainty about an acquirer's future performance when it takes over a foreign rather than a domestic firm. Furthermore, we would expect this difference to be greater for target firms based in markets that are more dissimilar from that of the bidder's—in the context of our empirical work, when UK firms buy companies in emerging markets.

Alternatively, a firm that acquires a company located in another country or operating in a different industry than its own could experience a reduction in the volatility of its stock returns through a diversification effect. Rowland and Tesar (2004) find that adding multinationals to a portfolio of domestic firms provides diversification benefits for investors in the U.S., Canada and Germany; Fillat et al. (2015) find that the risk premium of US multinationals is lower when they have affiliates in countries with business cycles that are less correlated with the US economy. In this case we would expect deals in which acquirers take

over firms in industries different to their main line of business and cross-border acquisitions in emerging markets to lower the volatility of their stock returns. Acquisitions could also have a negative impact on uncertainty if they expand a firm's internal capital market. This could lower external finance dependence and improve the allocation of resources within the combined firm.

A substantial body of work in finance, however, has identified a robust diversification discount—diversified firms tend to be less valued than a portfolio of comparable, single-segment firms—both along the industry and internationalization margins (Lang and Stulz, 1994; Berger and Ofek, 1995; Denis et al., 2002). This literature, in turn, has found that one of the main reasons why firms remain diversified despite the substantial costs of doing so, is that managers derive private benefits such as higher compensation, more power within the merged firm, the greater prestige that accompanies corporate empire-building, and the ability to diversify their own personal portfolios, to name a few (see e.g. Morck et al., 1990; Denis et al., 1997). If diversifying deals are more prone to be driven by factors unrelated to profit maximization, then it is plausible that rather than reducing uncertainty, these acquisitions could instead lead to greater uncertainty for investors.

Acquisitions can also be understood as real options in the sense that acquirers have flexibility about when to propose a deal to the target and that they constitute an investment that is, to a large extent, irreversible (Morellec and Zhdanov, 2005; Hackbarth and Morellec, 2008). Irreversibility, in turn, implies that the price that the bidder pays for the target is a sunk cost—an expenditure that cannot be fully recovered if the investment were to be undone. Riaño (2011) and Fillat and Garetto (2015) show that when the entry cost of entering a foreign market—either by exporting or by opening an affiliate abroad—is sunk, firms increase their willingness to bear operational losses in order to avoid paying the entry cost again in the future if they decide to leave the market. Since the entry costs involved in servicing foreign markets are substantially larger than those involved in operating domestically, this

mechanism implies that exporters and multinationals are more volatile and riskier[2] than domestic firms. The same intuition applies to foreign entry by means acquisitions as well. A direct implication obtained from this class of models is that the higher the sunk cost is, the larger the effect we should expect on the volatility of stock returns. We would also expect a stronger effect of acquisitions on volatility for transactions targeting firms in emerging markets since the thinness of the market for corporate control in these countries would exacerbate the irreversibility of these investments.

The extent of control that a bidder achieves over a target firm is crucial in shaping the functioning of the combined firm, e.g. determining the scope for transfer of technology, intangible assets and other tacit knowledge such as management practices. The decision to pursue the partial control of a target following an acquisition entails both benefits and costs for the acquirer. Mantecon (2009) suggests that partial ownership allows the acquirer to learn about the profitability of the target at a lower cost than a full acquisition would—an advantage that is more valuable in situations characterized by high valuation uncertainty. Alquist et al. (2019) show that, in the context of cross-border acquisitions, keeping the target's owners as partners can reduce the acquirer's costs of operation—particularly in unfamiliar environments or in places characterized by weaker investor protection. On the other hand, securing only a minority control of a target can increase the risk of failure in integrating the management of the acquiring and target firms and limit the ability of the acquirer to monitor and rein in opportunistic behavior by the target's management. This, in turn, weakens the incentive for outside investors to join in co-financing the venture (Antràs et al., 2009). Limits to full ownership imposed on foreign investors, which are more prevalent in emerging markets, provide less protection for the acquirer's shareholders against the risk of expropriation relative to domestically-owned firms (Bris and Cabolis, 2008).

In summary, there are several channels through which acquisitions can affect the level of uncertainty faced by acquirers. The theory, however, does not provide unequivocal pre-

[2] In the sense of their stock returns covaring more strongly with the economy's stochastic discount factor.

dictions about this relationship. We now turn to our empirical analysis to explore to what extent the different theoretical channels we identify are reflected in our data.

3 Data

Our data comes from two sources: Thomson Reuters' SDC Platinum International Mergers and Acquisitions database and Datastream. SDC reports public and private merger and acquisition transactions involving at least a 5% stake in the target company. For each transaction we observe the deal's value, the share of the target firm's equity purchased, the dates of announcement and completion of the deal, and the country and industry of operation of the acquiring and target firms. Daily stock prices, which we use to construct stock returns and their volatility, as well as other financial variables used in our estimation are sourced from Datastream (see the footnote of Table 2 for their definition).

Our sample consists of 1,316 firms listed in London Stock Exchange observed from the first quarter of 2004 until the third quarter of 2017, which yields 46,021 firm-quarter observations. We calculate stock returns as the first difference of the logarithm of a firm's daily stock price. Following an extensive literature in finance and macroeconomics , we measure firm-level uncertainty by means of the realized volatility of stock returns—i.e. as the standard deviation of firms' daily stock returns within a given quarter.

Table 1 presents summary statistics on the number of acquisitions occurring during our period of analysis. There are a total of 2,085 acquisition deals completed in our data. Slightly over half of these involve the acquisition of another firm in the UK (i.e. domestic acquisitions); in approximately three-quarters of the remaining cross-border deals, the target firm is located in another developed country.[3] In terms of the number of deals, the United States, Germany, Australia, France and Canada are the most important target markets

[3]We classify any acquisition in which the target firm is not based in an OECD country as an emerging market cross-border deal; only a very small number of transactions involve firms in smaller developing countries that would not usually be considered emerging markets—our results are robust to excluding these transactions from the estimation.

among developed countries; the largest number of acquisitions in emerging markets take place in Brazil, South Africa, Russia, India and China respectively. Acquisitions in developed markets tend to be of higher value, are more likely to achieve control of the target firm and are also more likely to be diversifying—in the sense that the main industry of operation of the target firm is different from that of the acquirer. These patterns are closely in line with the stylized facts documented by Chari et al. (2009) and Antràs and Yeaple (2014) using a sample of acquirers from different origin countries (also sourced from SCD) and the Bureau of Economic Analysis's Benchmark Survey of U.S. Direct Investment Abroad respectively.

[Table 1 about here.]

We split the firms in our data in three groups according to their acquisition activities: firms that never engaged in acquisitions during our period of study (non-acquirers), firms that have only acquired other firms in the UK (domestic acquirers) and firms that have acquired at least one firm abroad (cross-border acquirers). Table 2 presents summary statistics about the characteristics of firms in each of these groups. The overarching message is that firms with different propensity to participate in the market for corporate control also differ substantially along a wide range of observable characteristics. Cross-border acquirers have more volatile stock returns, are significantly larger (in terms of their market capitalization) and have higher earnings-per-share than both domestic acquirers non-acquirers—the same pattern that Moeller and Schlingemann (2005) document for U.S. firms. Domestic acquirers are more similar to non-acquirers in terms of their volatility and earnings-per-share, but are significantly larger and exhibit the lowest book-to-market ratio among the three groups.

The decision to acquire another company is obviously not random, and is in fact shaped by observable characteristics of the acquiring firm such as size, profitability and previous experience with acquisitions, that are also likely to affect the volatility of its stock returns. Under these circumstances, the volatility of stock returns for non-acquirers does not provide a good estimate of the counterfactual level of uncertainty that acquiring firms would have experienced had they not engaged in acquisitions. In the next section we describe the

econometric strategy we follow to address the endogeneity of firms' acquisition decision.

[Table 2 about here.]

4 Econometric Strategy

Our objective is to estimate the causal effect of domestic and cross-border acquisitions on the volatility of stock returns of acquiring firms—i.e. the average treatment effect of acquisitions on the level of uncertainty experienced by acquirers. This entails comparing the expected stock return volatility of firms that engaged in different types of acquisitions to the volatility of returns that these firms would have experienced had they not done so. Thus, the main empirical challenge we face is to obtain a consistent estimate of the counterfactual outcome which is, by definition, unobservable.

We employ a matching estimator that utilizes non-acquiring firms that are similar to domestic and cross-border acquirers across a wide range of observable pre-acquisition characteristics to construct counterfactual outcomes for the two types of treated firms. We combine this estimator with a difference-in-differences approach that purges the influence of all observable and unobservable non-random elements of the acquisition decision that are constant over time. Our main identifying assumption is that firms' selection into conducting acquisitions is based upon observable characteristics. Since we use a difference-in-differences approach, the selection-on-observables assumption implies that, conditional on observables, the log differences in potential outcomes across treated and control groups are as good as random. As with any matching estimator, time-varying unobservable factors that influence both the acquisition decision and the volatility of returns could contaminate our estimates.

We use the 'doubly robust' regression approach first proposed by Bang and Robins (2005)—which integrates propensity score weighing with covariates adjustment—to operationalize our matching estimator. By combining inverse probability weighting with regression covariates adjustment, the doubly robust estimator provides two opportunities to adjust

for selection on observables. Thus, a crucial advantage of this estimator is that it delivers unbiased inference of causal effects even under model misspecification—as long as either the conditional mean regression or the propensity score models are correctly specified.

We use a multinomial logit model with three outcomes—no acquisition, domestic acquisition and cross-border acquisition—to estimate the propensity score. All covariates included in the estimation of the propensity score are lagged 4 quarters in order to allay concerns of reverse causality. We then use the estimated predicted probability that firm i would conduct an acquisition of type j in quarter t (using no acquisitions as the reference group) conditional on covariates, $\widehat{P}(A_{it} = j|\mathbf{X_{it-4}})$, to weight treatment observations of group j by the inverse of the predicted probability of receiving a given treatment, $\widehat{P}_j^{-1}$. Doing so gives firms with higher ex-ante probability of engaging in either domestic or cross-border acquisitions less weight in the conditional mean regression, thereby controlling for selection bias.

Our benchmark estimating equation is:

$$\Delta_s \ln y_{it+s} \equiv \ln y_{it+s} - \ln y_{it} = \alpha + \mathbf{A'_{it}}\boldsymbol{\beta} + \mathbf{X'_{i,t-4}}\boldsymbol{\Gamma} + \mathcal{F}(t) + \varepsilon_{it}, \tag{1}$$

where i indexes firms and $t \in \{2004q1, \ldots, 2017q3\}$ denotes time (quarter-years). Our outcome variable is the log difference between quarters $t + s$ and t of firm i's volatility of stock returns. In order to put our results in context with the extensive literature that examines the behavior of the *level* of stock returns, in our first set of results we use mean stock returns as our dependent variable. Our main variables of interest are subsumed in the vector of acquisition dummies, $\mathbf{A_{it}}$, which take the value 1 when firm i announces the acquisition of another firm—either domestically or abroad (with the latter further decomposed in cross-border acquisitions in developed and emerging markets depending on the specification)—in period t and 0 otherwise. The vector $\mathbf{X_{i,t-4}}$ comprises a set of pre-treatment control variables (the same ones used in the estimation of the propensity score) lagged by four quarters and $\mathcal{F}(t)$ denotes an array of quarter and year fixed effects that control for seasonal and aggregate

factors such as merger waves and macroeconomic shocks that affect the acquisition activities of firms.

Determinants of Acquisitions

We now discuss the estimates from the multinomial logit model we use to estimate the propensity score. The choice of explanatory variables is guided by the extensive literature in finance investigating the acquisition decision of firms.

[Table 3 about here.]

Firms that engage in acquisitions often do so repeatedly over time (Fuller et al., 2002). Karolyi et al. (2016) report that one in five public acquirers are 'serial acquirers'—i.e. they purchase five or more targets within 3 years—accounting for two-thirds of the cumulative acquisition value around the world. Thus, to control for the high level of persistence of acquiring activity, we include dummies for past domestic and cross-border acquisitions; these take the value 1 if a firm has successfully acquired at least one target at home or abroad respectively in the previous year and 0 otherwise. We include firms' market capitalization to control for the fact that larger firms are more able to bear the large search and transaction costs involved in acquisitions (Jovanovic and Rousseau, 2002; Moeller et al., 2004).

Firms' market valuation and profitability are captured by Market-to-Book value and earnings-per-share respectively. In the neoclassical model with efficient capital markets of Jovanovic and Rousseau (2002), firms are more likely to use acquisitions to expand when their profitability and market valuation are high. A positive correlation between market valuation and acquisitions also arises in models in which rational managers use acquisitions to exploit arbitrage opportunities that arise when target firms are undervalued by the market (Shleifer and Vishny, 2003; Rhodes-Kropf and Viswanathan, 2004).

As we discussed in Section 2, acquiring another company involves the exercise of a real option. Inasmuch as this decision is at least partially irreversible, higher volatility provides

an incentive to delay the investment as the option value of waiting increases (Leahy and Whited, 1996; Bloom et al., 2007; Grullon et al., 2012). Thus, we include both the volatility of stock returns of the acquirer to account for this effect. Lastly, Andrade et al. (2001) show that acquisitions tend to occur in response to unexpected industry-level shocks such as technological breakthroughs and deregulation; we therefore include the mean volatility of stock returns within 3-digit industries to proxy for the type of market upheaval that makes waves of acquisitions more likely to occur.

Table 3 reports marginal effects for our estimated model for the propensity score. Prior experience with acquisitions, both domestically and across borders, is the most important factor explaining subsequent acquisitions—a pattern that has also been documented for UK and French acquirers by Stiebale and Trax (2011). Size is also a strong predictor of both types of acquisitions, but particularly so for cross-border deals, consistent with the fact that fixed costs for these transactions are substantially larger than for domestic deals. It is interesting to note that while neither the firm- nor industry-level volatility of stock returns have a significant impact on cross-border acquisitions, they tend to inhibit domestic acquisitions. This could be due to the fact that acquisition activity increases when market valuation is high, as Rhodes-Kropf and Viswanathan (2004) document, and this in turn is negatively correlated with stock market volatility (Bloom, 2014).

[Table 4 about here.]

It is worth noting that the role of propensity score estimation in treatment effects models with observational data is not to provide a causal explanation of the mechanisms determining the incidence of treatment—to engage in domestic or cross-border acquisitions in our case—but instead to achieve a 'balancing score' in the sense of weighting the observations to eliminate biases in estimated treatment effects due to differences in the distribution of the baseline covariates. To this end, Table 4 reports standardized differences for the means as well as variance ratios for the covariates used in the estimation of the propensity score. The

results reveal substantial differences between both types of acquirers and non-acquirers in the raw data, thus providing clear evidence of selection into treatment. Once we weight non-treated observations, however, the standardized differences are substantially reduced and variance ratios are closer to one; this indicates that the matching procedure is able to reduce a substantial amount of bias resulting from differences in the observed covariates.[4] Putting it differently, our matching procedure is successful in finding appropriate non-acquiring firms—in terms of being very similar in their pre-treatment observable characteristics to treated firms—to compare with both types of acquirers.

5 Results

In this section we present our matching difference-in-differences estimates of the average treatment effect of acquisitions on the volatility of stock returns of acquiring firms.

We begin our analysis by examining the effect of acquisitions on mean stock returns. This enables us to contrast our results with the extensive body of work examining whether acquisitions create value for shareholders by estimating the reaction of abnormal stock returns to the announcement of a deal (see e.g. Jensen and Ruback, 1983; Andrade et al., 2001; Moeller et al., 2004, and many others). These results are reported in Panel A in Table 5. We find a positive, albeit small, impact of the announcement of domestic acquisitions on the mean stock returns of acquirers relative to what they would have experienced had they not engaged in acquisitions across the 3 quarters following the announcement of a takeover. Cross-border acquisitions produce a stronger and statistically significant increase on bidders' mean returns one quarter after the announcement of the acquisition, but this difference turns insignificant afterwards. These results are in line with the consensus in the literature, which finds that acquisitions do not have a significant effect on the returns of acquirers—neither in the short nor in long-run.

[4]The empirical literature considers standardized differences below 10% and variance ratios between 0.5 and 2 after matching to indicate that covariate balancing has been achieved (see Caliendo and Kopeinig, 2008).

We now turn our attention to the main focus of our analysis—i.e. the effect that acquisitions have on firm-level uncertainty. Our baseline results are presented in Panel B of Table 5. Our first result is that domestic acquisitions have a strong and negative impact on the volatility of stock returns of bidding firms. Our point estimates indicate that in the three quarters following the announcement of the successful acquisition of a firm based in the same country as the acquirer, the volatility of stock returns of acquirers falls, on average, between 6.3% to 9.5% relative what it would have been had they not engaged in domestic acquisitions.

In contrast to domestic deals, we find that the announcement of cross-border takeovers has a positive effect on volatility. While the overall effect is insignificant, this result masks significant heterogeneity in the treatment effect depending on the location of the target firm. Columns (2) and (3) of Table 6 report the effect of cross-border acquisitions according to the location of the target firm in either a developed or emerging market. These results show that while cross-border deals involving target firms in other developed markets do not engender any discernible response on the volatility of acquirers, taking over firms in emerging markets exerts a large and positive effect on the volatility of stock returns of buyers. More precisely, emerging market acquisitions increase the volatility of acquiring firms by 12%. Notably, this effect remains strong in three quarters following the acquisition announcement.

Thus, our benchmark results show that the impact that acquisitions have on markets' perceptions about of the uncertainty faced by acquirers follow a pecking order determined by the geographic scope of transactions. Successfully acquiring a firm within the same country leads to a reduction in uncertainty as proxied by the realized volatility of its stock returns. The direction of the effect changes when firms extend their boundaries across national borders, becoming large and positive when acquisition involve firms located in emerging rather than developed markets.

While abnormal returns are only significant a few days after the announcement of a takeover deal, we find that acquisitions exert a long-lasting effect on the volatility of stock

returns of acquirers. This finding suggests that the success of an acquisition in creating value for shareholders depend crucially on the slow and uncertain process of integration that takes place between the acquirer and the target (Haspelagh and Jemison, 1991). Accordingly, the volatility of stock returns of acquirers is strongly influenced by acquisitions for a long time after the deal's announcement.

[Table 5 about here.]

[Table 6 about here.]

We now move to explore the forces that give rise to this ranking. The literature investigating the reaction of abnormal returns to acquisitions has found that this response is crucially mediated by features such as deal size, the country of operation of the target firm, and whether the acquisition achieved majority control (Fuller et al., 2002; Moeller and Schlingemann, 2005; Chari et al., 2009). In an analogous way, we investigate whether the treatment effect of acquisitions on the volatility of acquirers varies systematically according to characteristics of the transaction. To do so, we add interaction terms between each treatment indicator and different transaction characteristics to the estimating equation (1).

[Table 7 about here.]

We have established that the geographic scope of acquisitions is crucial in determining the impact they have on the volatility of stock returns of acquiring firms. We first investigate whether industrial diversification also plays a role in shaping this relationship. As we discussed in Section 2, an acquirer's expansion to other industries could, in theory, have an ambiguous impact on the uncertainty of its stock returns. On the one hand, a diversification effect could result in lower uncertainty; on the other hand, if the acquirer's expansion to other industries leads to over-investment, resource diversion towards under-performing business segments and agency problems between managers and shareholders, then we would expect uncertainty to increase in the aftermath of the acquisition's announcement.

We classify acquisitions as horizontal—in the sense that the buyer expands its capacity in the same line of business it currently operates—when the acquirer and target firms' 3-digit industry is the same; otherwise, we refer to acquisitions as being diversifying. The results presented in Table 7 show that horizontal acquisitions exert a stronger impact on the volatility of bidders' stock returns—particularly, for cross-border acquisitions in emerging markets. This type of acquisition increases the volatility of the acquirer's stock returns by 15-17%. This finding is consistent with the results of Girma et al. (2016), who show that the volatility of stock returns of Japanese firms increases when their intensity of horizontal FDI activity—measured as the share of sales accounted for by foreign affiliates—rises.

While diversifying domestic acquisitions still lead to a reduction in the volatility of acquirers, the magnitude of this effect is smaller than for horizontal acquisitions. On the one hand, this finding together with the fact that cross-border acquisitions in emerging markets have the largest positive impact on uncertainty, suggest that the diversification channel does not play an important role in shaping the response of volatility to acquisitions. On the other hand, the weaker results for diversifying acquisitions might reflect the fact that this group included both both vertical and conglomerate deals which might have very different impact on acquirers' performance (Herger and McCorriston, 2016). While acquisitions that ease connections between firms in different parts of supply chains can reduce uncertainty by increasing operational flexibility, conglomerate acquisitions have been show to increase resource misallocation within firms and can therefore lead to higher volatility for acquirers. In contrast to most sample splits we consider, we find that horizontal cross-border acquisitions in developed markets have a significant negative effect on volatility of a similar magnitude to that produced by domestic transactions.

[Table 8 about here.]

We now turn to examine how deal size shapes the impact of acquisitions on the volatility of acquirers. To this end, we define large acquisitions as those for which the value paid by

the bidder is above above the median deal size for each type of acquisition (domestic, cross-border developed and cross-border emerging). The results in Table 8 show that only large acquisitions affect the volatility of acquirers' stock returns. Since smaller acquisitions are less likely to have an impact on the expected future profitability of acquirers, it is not surprising that they do not have a significant effect on firm-level uncertainty either. Conditional on the value of the acquisition being sufficiently high, we see that the response of acquirers' volatility to acquisitions follows the same ranking we identified in our benchmark result. Acquiring firms based in emerging markets increases the volatility of stock returns between 18% and 27% in the three quarters following the announcement of a deal, whereas buying another firm in the UK is instead associated with a reduction in uncertainty between 8% to 11%. Foreign acquisitions in other developed countries, once again, have no significant impact on firm-level uncertainty regardless of their size.

These results are consistent with acquisitions in emerging markets being characterized by a higher degree of irreversibility than transactions where target firms are located in the UK and other developed countries. This could be a result of the market for corporate control in emerging markets being less liquid, thereby making it harder for buyers to unwind unsuccessful deals in which synergies, or any other benefits that bidders expect to obtain from the acquisition, fail to materialize. If the extent to which the acquisition price paid by a bidder is sunk is more important when buying target firms in emerging markets, then it follows that acquisitions would exert a positive effect on firm-level volatility in these transactions. The reason is that the higher the sunk cost of acquiring a target firm, the more reluctant an acquirer is to exit in response to negative shocks, which increases the uncertainty faced by the firm's investors. The large differential effect that acquisitions exert on uncertainty according to the country of operation of the target is consistent with previous evidence showing that entry into foreign markets by other means (exports and greenfield FDI) makes firms both more volatile and riskier (Riaño, 2011; Fillat and Garetto, 2015).

[Table 9 about here.]

In our last cut of the data we examine how the impact of acquisitions on firm-level uncertainty is shaped by the extent of control achieved by acquisitions; namely, we divide each class of transactions according to whether the acquisition leaves the acquirer with at least more than half of the target's equity (majority) or not (minority). The results reported in Table 9 show that the degree of control achieved by a takeover is a key factor driving the relationship between acquisitions and firm-level uncertainty. The positive impact that cross-border acquisitions carried out in emerging markets exert on the volatility of stock returns of acquirers is primarily accounted for by minority acquisitions. Our findings suggest that financial markets perceive that partial ownership hampers the ability of acquirers to extend the benefits associated with better institutional and corporate governance practices to targets based in emerging markets, in line with the results of Chari et al. (2009). In contrast, the negative effect we have found following domestic acquisitions is only realized when the acquirer achieves majority control of the target. This result suggests that the reduction in uncertainty following the acquisition of a domestic target occurs in situations in which the acquirer can exert greater control in shaping the process of integration with the target.

6 Conclusion

This paper provides the first evaluation of the causal effect of domestic and cross-border acquisitions on the uncertainty faced by acquiring firms using data from publicly-listed firms in the UK over the period 2004-2017. We utilize a matching estimator combined with differences-in-differences to address the endogenous selection of firms into acquisitions and investigate the channels through which acquisitions shape the volatility of stock returns of acquirers.

We find that the geographic scope of acquisitions gives rise to a pecking order in terms of their impact on the volatility of acquirers. More precisely, we find that the volatility

of stock returns of acquirers falls after the completion of domestic acquisitions; it is not affected by cross-border takeovers involving firms located in other developed markets and increases substantially when target firms are based in emerging markets. Crucially, we find that acquisitions exert a large and long-lasting effect on the level of uncertainty faced by acquirers is not only large but also long-lasting. This result stands in sharp contrast to the mostly insignificant and short-lived impact on the level of abnormal stock returns documented in the extensive body of work that investigates whether acquisitions create or destroy value.

Our results suggest that acquisitions affect uncertainty because they change firms' exposure to shocks—as they operate in new markets or new industries—and also because they are large and risky investments whose returns take time to materialize. Our finding that cross-border acquisitions of targets in emerging markets produce a large and positive impact on the volatility of acquirers is consistent with these investments being characterized by a higher degree of irreversibility than deals involving firms at home or in developed markets. We do not find evidence that international or industrial diversification reduces the volatility of acquirers. We also find that the extent of control achieved through an acquisition is a key determinant of the impact that takeovers have on uncertainty. The positive effect we find in emerging market acquisitions is strongly driven by minority-control deals while the negative effect of domestic deals is accounted for by majority transactions.

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Table 1: Deal Characteristics—by Target Country

	Domestic	Cross-Border	
		Developed	Emerging
Number of deals	1,166	672	247
Median transaction size ($M)	13.00	33.50	22.00
Majority (%)	81.30	85.27	71.66
Diversifying acquisition (%)	50.00	50.30	39.28

Domestic acquisitions are those in which the target firm is based in the UK; developed cross-border deals are those in which the target firm is located in an OECD country. Transaction size is denominated in millions of US dollars. Majority indicates the percentage of deals in which the acquiring firm holds 50% or more of the target firm's equity following the acquisition and did not previously have control. Diversifying acquisitions are those in which the target firm's three-digit SIC industry code is different from that of the acquiring firm.

Table 2: Summary Statistics—by Acquiring Firm Status

	Obs.	Mean	Std Dev	Min	Max
		Non-Acquirers			
(log) volatility	34,937	-1.36	0.76	-6.44	2.94
Industry volatility	35,457	0.33	0.13	0.00	2.26
Stock returns	34,315	-0.01	0.28	-5.16	3.16
(log) Market value	35,201	4.12	2.50	-4.61	11.91
Market-to-Book ratio	34,983	2.72	4.81	-13.91	34.05
Cash flow per share	33,220	0.25	0.82	-2.76	4.93
		Domestic Acquirers			
(log) volatility	6,769	-1.38	0.76	-5.48	1.50
Industry volatility	6,847	0.32	0.15	0.00	2.20
Stock returns	6,610	-0.02	0.28	-4.09	2.21
(log) Market value	6,785	4.17	2.29	-2.53	9.40
Market-to-Book ratio	6,739	3.13	6.53	-13.91	34.05
Cash flow per share	6,348	0.22	0.75	-2.76	4.93
		Cross-Border Acquirers			
(log) volatility	11,515	-1.31	0.68	-5.16	2.01
Industry volatility	11,581	0.35	0.18	0.00	3.89
Stock returns	11,254	-0.01	0.29	-3.70	3.50
(log) Market value	11,508	5.03	2.58	-3.91	11.63
Market-to-Book ratio	11,487	2.74	4.94	-13.91	34.05
Cash flow per share	10,892	0.28	0.83	-2.76	4.93

Non-acquirers are firms that never engage in any acquisition throughout our period of study; domestic acquirers are firms that acquire at least one firm in the UK but never acquire a firm abroad; cross-border acquirers are firms that have, at least once, acquired another firm abroad. Volatility is measured as the standard deviation of daily stock returns in a given quarter. Industry volatility is the value-weighted average of firm-level volatility within a given 3-digit Standard Industry Classification (SIC) industry. Market value is the sum of a firm's share price multiplied by the number of ordinary shares in issue. Market-to-Book value is the ratio of the market value of a firm's equity divided by its book value (the value of the firm's capital stock in its balance sheet). Earnings per share is defined as cash flow (funds from operations) per share outstanding.

Table 3: Determinants of Acquisitions

	Type of Acquisition	
	Cross-Border	Domestic
	(1)	(2)
Past cross-border acquisitions	0.1098***	0.0486***
	(0.010)	(0.009)
Past domestic acquisitions	0.0410***	0.1427***
	(0.007)	(0.011)
Market value	0.0047***	0.0009***
	(0.000)	(0.000)
Market-to-Book value	-0.0002*	-0.0001
	(0.000)	(0.000)
Earnings-per-share	-0.0009	-0.0018*
	(0.001)	(0.001)
Volatility	0.0018	-0.0055***
	(0.001)	(0.001)
Industry volatility	-0.0003	-0.0083***
	(0.002)	(0.002)
Stock returns	0.0012	0.0044
	(0.003)	(0.003)
Year fixed effects	Yes	Yes
Quarter fixed effects	Yes	Yes
Observations	46,021	
Time period	2004q1-2017q3	

Entries on the table are marginal effects evaluated at the mean obtained from estimating a multinomial logit model with three outcomes: no acquisition, domestic and cross-border acquisition. All covariates are lagged by 4 quarters. Standard errors in parenthesis. ***, significant at the 1% level; **, significant at the 5% level; *, significant at the 10% level.

Table 4: Balancing Diagnostics

		Cross-Border Acquisitions		Domestic Acquisitions	
		Standardized Differences	Variance Ratio	Standardized Differences	Variance Ratio
Past cross-border acquisitions	Raw	0.640	12.112	0.234	3.973
	Weighted	0.009	1.067	-0.014	0.901
Past domestic acquisitions	Raw	0.266	4.016	0.560	8.880
	Weighted	-0.002	0.990	-0.003	0.982
Market value	Raw	0.857	1.019	0.257	0.850
	Weighted	-0.058	1.236	0.032	0.888
Market-to-Book ratio	Raw	0.042	0.771	0.012	1.172
	Weighted	-0.028	0.945	-0.005	1.303
Cash flow per share	Raw	0.332	1.188	0.081	0.690
	Weighted	-0.009	0.920	-0.001	0.687
Mean stock returns	Raw	0.124	0.477	0.141	0.658
	Weighted	0.021	0.869	-0.087	0.992
Volatility stock returns	Raw	-0.187	0.653	-0.304	0.998
	Weighted	0.171	1.241	0.064	1.096
Industry volatility	Raw	-0.153	1.428	-0.267	1.442
	Weighted	0.154	1.663	0.094	1.530

The standardized difference for each covariate X_k is given by $SD_k = \frac{\overline{X}_{k,1} - \overline{X}_{k,0}}{\sqrt{(s^2_{k,1} + s^2_{k,0})/2}}$, where $\overline{X}_{k,1}$ and $\overline{X}_{k,0}$ denote the sample mean of covariate X_k in the treatment and control groups respectively and $s^2_{k,1}$ and $s^2_{k,0}$ are the sample variances of covariate X_k in the treatment and control groups respectively. The variance ratio is defined as $VR = s^2_{k,1}/s^2_{k,0}$.

Table 5: Effect of Acquisitions on Stock Returns and their Volatility

Outcome: $\ln y_{t+s} - \ln y_t$	Quarter: s	Acquisitions: Domestic (1) Estimate	Domestic (1) Std. error	Cross-Border (2) Estimate	Cross-Border (2) Std. error
		Panel A: Mean stock returns			
	+1	0.015	(0.010)	0.035**	(0.016)
	+2	0.019**	(0.010)	0.006	(0.013)
	+3	0.004	(0.011)	-0.018	(0.023)
		Panel B: Volatility of stock returns			
	+1	-0.100***	(0.022)	0.030	(0.029)
	+2	-0.065***	(0.022)	0.033	(0.028)
	+3	-0.080***	(0.026)	0.029	(0.030)

Standard errors in parenthesis ***, significant at the 1% level; **, significant at the 5% level; *, significant at the 10% level.

Table 6: Effect of Acquisitions on the Volatility of Stock Returns by Target Market

Outcome: $\ln y_{t+s} - \ln y_t$	Quarter: s	Acquisitions: Domestic (1)	Cross-Border: Developed (2)	Cross-Border: Emerging (3)
Volatility	+1	-0.100***	-0.009	0.119***
		(0.022)	(0.036)	(0.047)
	+2	-0.065***	-0.006	0.121***
		(0.022)	(0.035)	(0.048)
	+3	-0.080***	-0.010	0.116***
		(0.026)	(0.038)	(0.047)

Standard errors in parenthesis ***, significant at the 1% level; **, significant at the 5% level; *, significant at the 10% level.

Table 7: Effect of Acquisitions on the Volatility of Stock Returns: Horizontal and Diversifying Acquisitions

Acquisition	Quarter		
	+1	+2	+3
Domestic			
Horizontal	-0.126***	-0.060**	-0.114***
	(0.032)	(0.035)	(0.040)
Diversifying	-0.074**	-0.069**	-0.045
	(0.029)	(0.031)	(0.034)
Cross-Border			
Developed			
Horizontal	-0.095***	-0.017	-0.001
	(0.045)	(0.038)	(0.047)
Diversifying	0.090	0.007	-0.021
	(0.063)	(0.059)	(0.059)
Emerging			
Horizontal	0.139**	0.159**	0.139**
	(0.058)	(0.065)	(0.062)
Diversifying	0.093	0.070	0.085
	(0.077)	(0.071)	(0.072)

Entries in the table denote the impact of each acquisition type on the change in the volatility of stock returns of acquiring firms between quarters $t + s$ and t for $s = 1, 2, 3$. Standard errors in parenthesis ***, significant at the 1% level; **, significant at the 5% level; *, significant at the 10% level. Horizontal acquisitions are those in which the 3-digit SIC industry of the acquirer and target firms are the same; otherwise acquisitions are classified as diversifying.

Table 8: Effect of Acquisitions on the Volatility of Stock Returns by Deal Size

Acquisition Type	Quarter +1	+2	+3
Domestic			
Low	-0.077***	-0.041	-0.054
	(0.030)	(0.026)	(0.035)
High	-0.116***	-0.081**	-0.097***
	(0.030)	(0.032)	(0.037)
Cross-Border			
Developed			
Low	-0.018	-0.015	-0.054
	(0.044)	(0.036)	(0.044)
High	-0.003	-0.005	0.016
	(0.050)	(0.050)	(0.052)
Emerging			
Low	0.042	-0.056	-0.021
	(0.048)	(0.057)	(0.060)
High	0.169**	0.239***	0.211***
	(0.069)	(0.064)	(0.065)

Entries in the table denote the impact of each acquisition type on the change in the volatility of stock returns between quarters $t + s$ and t for $s = 1, 2, 3$. Standard errors in parenthesis ***, significant at the 1% level; **, significant at the 5% level; *, significant at the 10% level. Low size means that the value of the acquisition in a given category is below the median value; high indicates that the value of the transaction is greater than the median in the corresponding category.

Table 9: Effect of Acquisitions on the Volatility of Stock Returns: By Degree of Control

Acquisition	Quarter		
	+1	+2	+3
Domestic			
Majority	-0.121***	-0.094***	-0.112***
	(0.024)	(0.025)	(0.031)
Minority	-0.020	0.050	0.055
	(0.052)	(0.045)	(0.052)
Cross-Border			
Developed			
Majority	0.005	-0.023	-0.062
	(0.045)	(0.042)	(0.042)
Minority	-0.055	0.054	0.169**
	(0.051)	(0.066)	(0.081)
Emerging			
Majority	0.071	0.107*	0.092*
	(0.057)	(0.061)	(0.055)
Minority	0.251***	0.179***	0.222***
	(0.071)	(0.054)	(0.085)

Entries in the table denote the impact of each acquisition type on the change in the volatility of stock returns of acquiring firms between quarters $t + s$ and t for $s = 1, 2, 3$. Standard errors in parenthesis ***, significant at the 1% level; **, significant at the 5% level; *, significant at the 10% level. Majority indicates that the acquirer achieves more than 50% of the target's equity after acquisition; an acquisition is deemed a minority one otherwise.