The Economic Consequences of a Hypothetical Catalan Secession:  
An Event Study of the Non-binding Referendum of 2014

Oriol Pons-Benaiges  
Stanford University

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Abstract

Catalonia, one of the wealthiest regions of Spain, is threatening with secession. Economists have debated vigorously on the economic consequences of such a secession, but have reached no consensus. This paper brings evidence to the debate on the economic consequences of a hypothetical Catalan secession. In this event study, I analyze the behavior of stock prices of publicly-traded firms operating in Catalonia in the days before and after a referendum on independence that took place on November 9 of 2014. Despite being an informal and non-binding referendum, I argue that this event updated investors’ priors regarding the likelihood of a Catalan secession, and revealed information on the relative strength of separatists and unionists. Using different methods to estimate abnormal returns, I find that stock prices of publicly-traded firms operating in Catalonia did not react to the referendum. Under the assumption that the celebration or the outcome of this referendum was unexpected and informative, these results suggest that investors do not associate large gains or losses to a hypothetical Catalan secession.

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orilot@stanford.edu. Department of Economics, Stanford University, 579 Serra Mall, Stanford, CA 94305.
1 Introduction

Catalonia, one of the wealthiest regions of Spain, is threatening with secession. One of the main arguments in favor of the independence of Catalonia is to protect its distinctive culture and language, which have sometimes been endangered by policies of the Spanish government. Those who support independence also argue that it would allow the government of Catalonia to choose policies that better suit the needs of its people. Despite these cultural and political aspects, economic arguments are often at the heart of the debate. Catalonia is a net contributor to the Spanish public sector, and as a separate state it would be able to significantly lower taxes or increase public spending. Those who oppose independence worry about the costs that may be associated with it, including the possibility of leaving the European Union, the imposition of restrictions to international trade and capital flows, and a potential boycott to Catalan products.

The aim of this paper is to bring evidence to the debate on the economic consequences of a hypothetical Catalan secession. A referendum on Catalan independence celebrated on November 9 of 2014 provides a suitable historical setting to be analyzed with an event study. In particular, the economic consequences that investors associate with a hypothetical Catalan secession can be measured by the abnormal returns around the referendum of publicly-traded firms operating in Catalonia, under the assumption that the referendum revealed information about the likelihood of secession. The particular chain of events leading to the referendum, which involved numerous confrontations between separatists and unionists, together with the clear pro-independence outcome of the referendum, gives credibility to this assumption. In the days before the referendum, it was not clear whether it would take place or not, as the Spanish government repeatedly stated that there would be no referendum, while the Catalan government stated the contrary. The fact that the referendum did occur, and that a majority of voters supported independence, provided new information with which investors could update their priors on the likelihood of secession.

2 Historical Context

The Kingdom of Spain is a collection of regions and historical nationalities. These regions and historical nationalities are politically organized as “autonomous communities” within Spain, and enjoy a considerable degree of self-government. Catalonia, like the Basque Country, is an autonomous community characterized by a strong and long-standing sense of national identity, and has historically been home to active independentist movements. The roots of Catalan nationalism can be traced back, at least, to the end of the Spanish Succession War in 1714, when King Felipe V invaded Barcelona and abolished the Catalan government and constitution. But it was not until the first half of the 20th century that political parties with nationalist ideologies emerged, particularly after the success of Irish independentism in the Easter Rising of 1916. Nationalist parties have typically demanded greater

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As stated in the second article of the Spanish Constitution of 1978.
self-government and financial autonomy for Catalonia, with only a minority seeking full independence from Spain.

Since the beginning of the Great Recession around 2007, the increase in unemployment and the drop of tax revenue have accentuated the deficiencies of the Spanish fiscal system with respect to Catalonia. As a relatively wealthy region, Catalonia is a net contributor to the Spanish public sector. In the years following the Great Recession, Catalonia went through a series of very unpopular budget cuts, which were made necessary by public deficit requirements imposed by government of Spain. This situation, coupled with cultural and political differences between Catalonia and Spain, has fueled a wave of demands for greater self-government and financial autonomy for Catalonia.

In 2008, after receiving significant pressure from regional political parties all over the country, the Spanish government released a report on the net transfers made across regional governments within Spain. For the first time, information on tax revenue and public spending in each autonomous community was publicly available. Using data from 2005, the report identified which autonomous communities were net contributors and net beneficiaries of public funds. In 2005, approximately 8% of the Catalan gross domestic product was taxed but not spend in Catalonia. Releasing these data made the fiscal deficit extremely salient in Catalonia, and opened a debate over the desirability of seceding from Spain. The Catalan government repeatedly proposed changes to the fiscal arrangement, but the Spanish government was not politically able or willing to make the necessary reforms, leading to increased discontent among Catalans.

In September of 2012, more than a million people protested in the streets of Barcelona, the capital of Catalonia, demanding independence from Spain. The Catalan parliament celebrated anticipated elections in November of 2012, and a majority of the newly elected members of parliament supported the right to vote on independence. The Catalan government tried to organize a referendum on independence, but it was not allowed by the Spanish government, considering it unconstitutional. In September of 2013 and September of 2014, similar demonstrations took place in favor of the right to vote on independence. Figure 1 summarizes the evolution of popular support for the independence of Catalonia as measured by several surveys conducted by different media outlets. Support for independence grew steadily from 2005 to 2014, with a marked increase between 2010 and 2013, reaching approximately 50% of survey respondents.

In September of 2013, the Catalan government announced that a referendum on independence would

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2The Spanish public sector is characterized by relatively centralized taxation and decentralized spending, allowing the Spanish government to redistribute public funds across regions. Navarre and the Basque Country, two wealthy regions in the north of Spain, enjoy special fiscal arrangements and make relatively small contributions to the Spanish public sector.

3If one takes into account public spending that benefits Catalonia despite being spent elsewhere (like national defense), the fiscal deficit amounts to approximately 4% of the Catalan gross domestic product.

4On September 11 of 2012, approximately 1,500,000 people marched on the streets of Barcelona demanding independence. On September 11 of 2013, approximately 1,600,000 people formed a 400 kilometers-long (282 miles-long) human chain across Catalonia in favor of independence. This human chain was inspired by a similar demonstration that united the capital cities of Estonia, Latvia, and Lithuania in 1989, when these countries were demanding independence from the Soviet Union.
be celebrated in 2014. In January of 2014, the Catalan parliament asked the Spanish government the authorization to organize a referendum on independence but it was rejected by the Spanish parliament on April, considering it unconstitutional. The Catalan government, however, continued preparations for the referendum. On September 27 of 2014, the Catalan government announced that a non-binding referendum on independence would be celebrated on November 9. Two days later, the Spanish government submitted a petition to the Constitutional Tribunal to prevent the referendum, legally implying that preparations for the referendum had to be stopped until a decision was made. On October 14, given the legal difficulties of organizing the non-binding referendum in its original form, the Catalan government replaced it with an informal non-binding referendum (a “consultation”) with no legal validity, but with the exact same question as the original referendum. Preparations for this informal non-binding referendum were also stopped by the Constitutional Tribunal, after a petition from the Spanish government. The Catalan government then stepped down from the organization of the referendum, and let volunteers take over the last steps.

On November 9, more than 2,300,000 voters casted their ballots, 80% of them in support of independence.

The question to be used in this referendum was also announced. First, voters would be asked: “Would you like Catalonia to become a state?” If the answer was “Yes”, then voters were asked: “Would you like such a state to be an independent state?” Therefore, the question had three possible answers: “No”, “Yes, No”, and “Yes, Yes”, with only “Yes, Yes” being considered as support for independence.

Matt Moffett from The Wall Street Journal reports that the Catalan government continued to be somewhat involved in the preparation of the referendum, as “Catalan officials sent instructions to poll watchers, prepared software used for same-day voter registration and created an instructional website.”

The referendum had a voter turnout of approximately 36%. The 2012 elections to the Catalan parliament had a voter turnout of 68%, suggesting that a referendum on independence with a similar turnout would have had at least 43% of potential voters in favor of independence, which is in line with survey evidence presented in Figure 1. The relatively low turnout on November 9 of 2014 can be explained by the fact that (1) the consultation was non-binding, giving little
3 Related Literature

Secessions, and in particular their economic causes and consequences, have attracted the interest of scholars for decades. One of the first contributions to this literature by economists is the work of Buchanan & Faith (1987), who present a theoretical model were citizens of one political unit can choose to create a new political unit (that is, they can choose to secede). In this model, secessions happen when citizens are not satisfied with the level of public goods provided in their original political unit. The authors explore this form of “internal exit” as a complement to the idea of external exit proposed by Tiebout (1956), that is, the idea that voters might move from one political unit to another, effectively voting with their feet. Following these earlier works, a range of alternative models of political integration and fragmentation have been proposed. For example, Barro (1991) marked the beginning of a body of research on the optimal size of nations, focusing on the tradeoff between (1) economies of scale in the provision of public goods and (2) problems associated with heterogeneous tastes of voters.

Considerable work has also been devoted to the political aspects of secessions. For example, Young (1994) provides an account of some historical cases of peaceful secessions, such as the secession of Singapore from Malaysia in 1965, Hungary from Austria in 1867, and Norway from Sweden in 1905. He observes that those episodes were characterized by speedy negotiations and by pressures to maintain mechanisms of national solidarity and to keep constitutional arrangements unchanged.

Methodologically, this paper is related to the literature on event studies. One of the first event studies was performed by Dolley (1933), who studied the effects of stock splits on stock prices. Since then, event studies have evolved significantly, and their modern version is frequently attributed to Ball and Brown (1968), who studied the impact of annual earnings announcements on stock prices, as well as Fama, Fisher, Jensen, and Roll (1969), who studied the effect of stock split announcements on stock prices. Event studies are frequently used in finance to estimate the effect of an event on the future performance of firms, as perceived by investors. However, event studies have also been used in economics, with contribution such as Cutler (1988), estimating the effects of the 1986 US tax reform on stock prices, or Herron, Lavin, Cram, & Silver (1999) and Knight (2006), studying the effects of the 1992 and 2000 presidential elections on different economic sectors. More recently, Acemoglu, Hassan, & Tahoun (2014) and Acemoglu, Johnson, Kermani, Kwak, & Mitton (2014) use event studies to measure the value of political connections in the context of the Egyptian revolt of 2011, and the nomination of the US Secretary of the Treasury in 2008.

4 Theoretical Framework

This section presents the event study methodology used in the empirical analysis section. Essentially, event studies estimate the effects of an event on the future performance of firms by tracing unusual incentives for voters to vote, (2) the Spanish government had repeatedly warned citizens about the unconstitutionality of voting on independence, suggesting legal consequences for volunteers, voters in general, and public servants in particular, and (3) the number of voting stations was smaller than usual, leading to longer distances for voters outside big cities and creating long lines at some voting points.
behavior of stock prices, as captured by abnormal returns. The credibility of causal relationships estimated using an event study relies on the following three identifying assumptions:

1. Stock markets are efficient: new information affecting a firm’s future performance is immediately incorporated into its stock price.

2. The event under study (or its outcome) is unexpected and informative to investors: abnormal returns measure investors’ reaction to the event.

3. There are no confounding events: abnormal returns can be attributed to the event under study, and not to other events happening at the same time.

These assumptions limit the situations in which event studies can be used properly. In the empirical analysis section, I will present evidence and argue that these identifying assumptions hold reasonably well in the context of the Catalan referendum on independence of 2014.

Event studies require an estimation period, that is, data that will be used to estimate parameters such as average returns or the coefficients of a market model, which will in turn be used to estimate abnormal returns during the event window. In general, longer estimation periods provide more precise estimates, assuming these parameters do not change over time. Otherwise, it is necessary to use shorter estimation periods which provide estimates closer to the true parameters in the event window. The event window is the period of interest around the event under study, when information derived from the event is presumably incorporated into stock prices.\(^8\) Figure 2 summarizes the main elements of an event study on a timeline.

4.1 Estimating Abnormal Returns

Abnormal returns during the event window are calculated as the difference between the actual return of a stock at time \( t \) and the expected return of that stock at time \( t \). Expected returns (denoted by

\[ \text{Expected return} = \text{Actual return} - \text{Abnormal return} \]

\(^8\)The estimation period and the event window are usually set so that they do not overlap; otherwise coefficient estimates might be biased.
are generally estimated using data from the estimation period and then subtracted from actual returns \( R_{it} \) to obtain abnormal returns \( AR_{it} \), as shown in Equation 1.

\[
AR_{it} = R_{it} - E[R_{it}]
\]  

There are many methods to estimate abnormal returns.\(^9\) I now describe the three methods that I use to calculate abnormal returns in the empirical analysis.\(^10\)

1. **Mean-adjusted returns.** The simplest way to estimate a stock’s expected return during the event window is to use the average return of that stock, denoted by \( \bar{R}_i \), during the estimation period. This method is very crude because it does not control for risk differences across firms, or the performance of the overall economy during the event window. However, it only involves the estimation of one parameter per firm, the average return, and it requires no information on the performance of out-of-sample stocks or the market in general. Abnormal returns calculated as mean-adjusted returns have considerably greater variance than those calculated with alternative methods.

\[
E[R_{it}] = \bar{R}_i
\]

\[
AR_{it} = R_{it} - \bar{R}_i
\]

2. **Market-adjusted returns.** In cases where the market is not directly affected by the event under study, expected returns can be estimated as by the return of the market during the event window. This method takes into account economy-wide phenomena that affect the firms in the sample but that are unrelated to the event under study. The advantage of this method is that it does not require estimating any parameter. The variance of abnormal returns calculated as market-adjusted returns is generally lower than those calculated as mean-adjusted returns, but higher than those calculated as residuals from a market model.

\[
E[\hat{R}_{it}] = R_{mt}
\]

\[
AR_{it} = R_{it} - R_{mt}
\]

3. **Residuals from a market model.** Abnormal returns can be calculated as the residuals of a regression stock returns on market returns. The parameters of the market model are estimated using data from the estimation period, usually with Ordinary Least Squares. Then, abnormal returns are calculated as the residuals of that regression in the event window. This method is generally better than using mean-adjusted or market-adjusted returns because it controls for risk differences across firms as well as economy-wide movements of the market during the event window. The main drawback of this method is that it assumes that the parameters of the market

\(^9\)See Binder (1989) for a more detailed discussion on alternative methods to calculate abnormal returns.

\(^10\)More sophisticated methods require data that is not available at daily frequency (such as firm size or book-to-market ratio), or matching firms affected by the event with unaffected firms of similar characteristics.
model are constant over time. To calculate abnormal returns as residuals from a market model it is necessary to specify a model for the return of each firm’s stock as a function of the market return. The usual specification is a linear, one-regressor model, as in Equation 6.

\[ R_{it} = \alpha_i + \beta_i \cdot R_{mt} + \epsilon_{it} \]  

(6)

After estimating parameters \( \alpha_i \) and \( \beta_i \), the model can be used to generate predicted values for the event window, which are used as expected returns to compute abnormal returns.

\[ \hat{E}[R_{it}] = \hat{\alpha}_i + \hat{\beta}_i \cdot R_{mt} \]  

(7)

\[ \hat{AR}_{it} = R_{it} - \hat{\alpha}_i - \hat{\beta}_i \cdot R_{mt} \]  

(8)

Most estimations of abnormal returns are likely to suffer from a problem of misspecification. Either some relevant variables have been omitted from the model, or some irrelevant variables have been included. Generally, estimates of average (across firms) abnormal returns will be unbiased if the sample includes a large number of unrelated firms or if the event is not clustered in time for all firms. Unfortunately, the case of the Catalan referendum studied in this paper involves a relatively small number of firms and an event that affects all firms at the same time, which means that model misspecification will generate some bias in the estimators. As a robustness check, I use different methods to estimate abnormal returns (and find, reassuringly, that their conclusions are consistent).

### 4.2 Measuring the Impact of Events

Once abnormal returns have been estimated for the event window, there are different ways to measure the impact of an event on the stock market. In cases where the event is likely to affect stock prices over more than one day, it is appropriate to calculate cumulative abnormal returns, denoted by \( CAR_{it} \). Cumulative abnormal returns are calculated by summing abnormal returns over the event window, or from the event (normalized as \( t = 0 \)) onwards, as shown in Equation 9.

\[ CAR_{it} = \sum_{s=t}^{s=t} AR_{is} \]  

(9)

where \( AR_{is} \) is the abnormal return of stock \( i \) at time \( s \).

To measure the effect of the event on all firms, we can compute average abnormal returns, denoted by \( AAR_{it} \), and the unweighted average of abnormal returns across firms, as well as the cumulative average abnormal return, \( CAAR_{it} \), as defined in Equation 10 and Equation 11, respectively.

\[ 11 \text{This particular problem can be solved, assuming the market factor changes once, by setting the estimation period after the event window.} \]
\begin{align}
AAR_t &= \sum_{i=1}^{N} \frac{AR_{it}}{N} \\
CAAR_t &= \sum_{s=t}^{N} AAR_s
\end{align}

If the firms in the sample have significantly different sizes, as is the case in this paper, it is more adequate to calculate weighted average abnormal returns (\(WAAR_t\)) and cumulative weighted average abnormal returns (\(CWAAR_t\)) as defined in Equation 12 and Equation 13, respectively. Each firm’s weight \((W_i)\) can determined, for example, by the relative market capitalization of that firm.

\begin{align}
WAAR_t &= \sum_{i=1}^{N} W_i \cdot AR_{it} \\
CWAAR_t &= \sum_{s=t}^{N} WAAR_s
\end{align}

5 Empirical Analysis

In this section, I perform an event study around the Catalan referendum on November 9 of 2014. I use data on daily stock prices from Compustat Global for a sample of Catalan firms. I begin by arguing that the referendum provides a historical setting that allows estimating the consequences of a hypothetical Catalan secession as perceived by investors. Next, I define the estimation period and the event window, and describe the sample of firms used in this study. Finally, I proceed to the estimation of abnormal returns and their interpretation.

5.1 Selecting the Event Date

Figure 3 shows the number of news about Catalan independentism on the websites of the Financial Times, The Wall Street Journal, Bloomberg, and The Economist from September 2012 to April 2015.\(^{12}\) This figure is consistent with the account of events provided in the first section: international media coverage was particularly intense in September 2012, 2013, and 2014 (massive pro-independence demonstrations), November 2012 (anticipated elections leading to majority supporting a referendum), October 2014 (legal battles over the celebration of the referendum), and November 2014 (celebration

\(^{12}\)I exclude news mentioning (but not exclusively talking about) Catalan independentism, such as news on the Scottish referendum on independence of September 2014. Looking at national and regional media would be less informative because Catalan independentism was debated at length almost daily.
Figure 3: Number of news about Catalan independentism from September 2012 to April 2015.

Notes: This figure shows the number of news about Catalan independentism in four economic and financial newspapers and magazines from September 2012 to April 2015. News were counted from a search for “Catalonia” in the search engine embedded in the websites of the Financial Times, The Wall Street Journal, Bloomberg, and The Economist. News mentioning Catalan independentism tangentially were not counted.

of the referendum). This evidence supports the assumption that the referendum provided information on the likelihood of secession. Moreover, the fact that media coverage decreased dramatically after November 2014 suggests that significant uncertainty was resolved by the referendum.

Looking closely at daily coverage during November 2014, Figure 4 shows that news related to Catalan independentism increased during the week before and after the referendum on November 9.

An important assumption underlying this event study is that the referendum, or its outcome, was unexpected and informative to investors (Assumption 2). The strong opposition of the Spanish government made the celebration of the referendum uncertain until the very last day. Even on November 9, while the voting was going on, judges could stop the referendum if they suspected it was illegal. Voter participation was uncertain, as the Spanish government repeatedly warned about the unconstitutionality of the referendum, and possible legal consequences for voters and volunteers (particularly public servants). It was also not clear until the last moment if it would be logistically feasible to hold the referendum, because the public schools that were going to be used as voting centers belong to the government, and it would be illegal for the Catalan government to use them in an unauthorized referendum. Finally, the outcome of the referendum was also uncertain. Even though surveys provided some information on public support for independence, support from actual voters had never been tested.

Matt Moffett from The Wall Street Journal reports that “almost up to the last minute, controversy swirled around the vote. On Saturday [November 8], Catalonia’s government and the Catalan National Assembly, the biggest pro-independence citizens group, reported that their websites had suffered cyberattacks. A public prosecutor announced on Saturday that he was investigating who was responsible for ordering schools to open Sunday [November 9] to serve as polling places. The prosecutor suggested he was laying the groundwork for future legal action against Catalan officials for disobeying the court. Pro-independence activists complained of voter intimidation.”
Taking into account the considerable uncertainty surrounding the celebration of the Catalan referendum, I proceed under the assumption that the celebration and particularly its outcome was informative to investors. Given that the Spanish government had publicly assured that no referendum would take place, together with the fact that the referendum indeed took place, and that it had a clear pro-independence outcome, revealed information to investors on the capacity of the Spanish government to prevent a secession, as well as the determination of a significant fraction of the Catalan people to fight for independence. This supports the assumption that, the referendum allowed investors to update their priors on the likelihood of secession.

Another important assumption underlying this event study is the absence of confounding events (Assumption 3). If events that were relevant (to the firms) but unrelated (to the referendum) took place around November 9 of 2014, abnormal returns would be capturing the effects of these confounding events on top of those of the referendum itself. It is therefore necessary to check for the presence of confounding events. To do so, I examine news in the main Catalan newspaper during the event window (the week before and after the referendum), looking for potential confounding events affecting firms in the sample (presented in sub-section 5.4). Appendix A summarizes all news related to firms in the sample of this event study during the event window. No significant confounding events took place during the event window, and most news relate to events that investors knew beforehand, such as profit announcements.

5.2 Defining the Estimation Period

I have calculated average returns and market model coefficients using an estimation period of 200, 100, and 50 days before the event window, and found that the estimates depend heavily on the length of
the estimation period. Therefore, in the remainder of this paper, I use a short estimation period of 50 days, so that the estimates are as close as possible to the true parameters in the event window. As mentioned above, such a short estimation period comes with the cost of large standard errors, reducing the power of statistical tests.

5.3 Defining the Event Window

Given that information on the Catalan referendum was transmitted in a matter of hours and that financial markets are relatively efficient, I use a short event window of 10 days. In particular, I set the event window to include the week before and the week after the referendum, from Monday 3 to Friday 7 and from Monday 10 to Friday 14 of November 2014. During the week before the referendum, abnormal returns are likely to capture information leaks related to the celebration of the referendum, while during the week after the referendum, abnormal returns are likely to capture the reaction to new information revealed by the celebration of the referendum and its outcome.

5.4 Choosing Firms to be Studied

The ideal sample of firms for this event study would contain data on all firms that (1) are publicly traded and (2) operate mainly, if not exclusively, in Catalonia. To select a sample that approximates this ideal, I use the Orbis database, which contains information on the regional location of a large number of firms worldwide. This database enumerates approximately 740,000 firms in the region of Catalonia, but only 13 of these firms were publicly traded during the period of interest (the days around the referendum of November 2014). These 13 firms greatly overlap with the components of the IndexCat, a stock index containing the largest publicly traded firms with headquarters in Catalonia. The IndexCat, however, contains 4 additional firms not included in the Orbis database. I combine both sources, assembling a sample of 17 publicly traded firms that operate mainly in Catalonia, or have their headquarters there. Table 1 shows the sample of firms used in this paper, their economic sector, and their market capitalization in absolute and relative terms. Appendix B provides additional information on these firms.

This sample of firms has two important limitations. First, it is very small, making statistical inferences complicated and not allowing a separate analysis by firm characteristics. Second, the sample contains firms that operate in Catalonia (according to the Orbis database) and large firms with headquarters in Catalonia (therefore included in the IndexCat) as a proxy for the ideal sample of publicly traded firms that operate mainly in Catalonia. However, it is hard to know how good this proxy is. A firm might be classified as operating in Catalonia or have its headquarters in Catalonia but have significant operations elsewhere (such as Grifols). Despite this limitation, this sample is the closest I can get to the ideal sample described above. Given the small number of firms in the sample, the empirical analysis that follows will concentrate on (weighted) average returns, and not to the returns of individual firms or specific economic sectors.
<table>
<thead>
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<th>Name of Firm</th>
<th>Economic Sector</th>
<th>Capitalization (€)</th>
<th>Capitalization (%)</th>
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<td>13,317,372,000</td>
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<td>Almirall</td>
<td>Pharmaceutical</td>
<td>3,118,309,000</td>
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<td>Testing</td>
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<tr>
<td>Damm</td>
<td>Beer</td>
<td>1,525,968,950</td>
<td>1.66</td>
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<tr>
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Table 1: Sample of firms, their economic sector, and market capitalization.

Notes: This sample of firms includes current and former firms in the IndexCat (an index including the largest publicly traded firms with headquarters in Catalonia) and all publicly traded firms located in the “Catalonia” region according to the Orbis database. All market capitalizations are as of July 2nd of 2015 except Damm, which is as of April 1st of 2015 (it left the stock market due to a merger).
Before turning to the analysis of abnormal returns, it is possible to get a sense of the efficiency of the stock market (Assumption 1) by looking at the traded volume of stocks for our sample of firms during the event window (the week before and after the referendum). As Figure 5 shows, the stocks in the sample are highly traded, with over 30,000,000 stocks being traded daily during the event window. This evidence supports the idea that stock prices reflected investor’s firm valuations during the event window, and that stock prices should have incorporated new information relatively quickly.

5.5 Estimating Abnormal Returns

To provide a benchmark to compare abnormal returns to, Figure 6 shows average returns during the event window. The dotted lines indicate one and two standard deviations away from zero, where the standard deviation is calculated using data from the estimation period, that is, the 50 days prior to the event window. This figure shows that average returns for our sample of firms did not show unusual behavior around the referendum, with most days’ returns being less than one standard deviation away from zero. Only on Monday 3rd and Wednesday 12th returns were slightly negative, around -2%.

Next, I compute abnormal returns as mean-adjusted returns. As explained in Section 4.1, mean-adjusted returns are calculated as the difference between actual returns and the average return during the estimation period. Figure 7 shows average mean-adjusted returns during the event window. Mean-adjusted returns are essentially identical to the actual returns presented in Figure 6, as expected. During most days in the event window, average mean-adjusted returns were less than one standard deviation away from zero, and slightly negative mean adjusted returns took place on Monday 3rd and Wednesday 12th. However, the cumulative effect of abnormal returns during the event window is negligible, with positive and negative returns approximately offsetting one another.

To control for economy-wide phenomena, Figure 7 shows abnormal returns calculated as market-adjusted returns, where the market is represented by the Ibex35 stock index. For 8 out of 10 days
Figure 6: Average returns around November 9, 2014.

Notes: This graph shows weighted average returns during the event window, from November 3 ( $t = -5$ ) to November 14 ( $t = 5$ ).

Figure 7: Average mean-adjusted returns around November 9, 2014.

Notes: This graph shows weighted average abnormal returns, calculated as mean-adjusted returns during the event window, from November 3 ( $t = -5$ ) to November 14 ( $t = 5$ ). The estimation period consist of the 50 days before the event window.
in the event window, average market-adjusted returns where more than one standard deviation away from zero. On Tuesday 4th and Friday 8th (before the referendum), average market-adjusted returns where over two standard deviations above zero. As with mean-adjusted returns, the cumulative effect over the event window is negligible. Monday 10th, the day after the referendum, experienced slightly negative abnormal returns, but by the end of the week the cumulative effect had banished due to positive abnormal returns on Friday 14th.

Finally, Figure 9 shows abnormal returns calculated as residuals from a market model, which takes into account that different stocks have different risks, and also controls for economy-wide phenomena (again, the market is represented by the Ibex35 stock index). The interpretation of these abnormal returns is similar to market-adjusted returns. Tuesday 4th and Friday 8th experienced unusually high abnormal returns, and the slightly negative abnormal returns on Monday 10th where cumulatively negligible by the end of the week.

Appendix C provides graphs of cumulative average abnormal returns, calculated as mean adjusted returns, market adjusted returns, and residuals from a market model. These graphs provide evidence that abnormal returns during the week after the referendum offset each other, so that the net effect of the referendum as captured by abnormal returns is negligible.

6 Conclusions

This event study finds no significant effect on the stock prices of publicly traded firms operating in Catalonia in the days before and after the referendum on November 9 of 2014. Abnormal returns during the week before and after the referendum are cumulatively negligible when calculated as mean-adjusted returns, market-adjusted returns, or residuals from a market model. I have argued that
Figure 9: Average residuals from a market model around November 9, 2014.

Notes: This graph shows weighted average abnormal returns, calculated as residuals from a market model during the event window, from November 3 (t = -5) to November 14 (t = 5). The estimation period consist of the 50 days before the event window.

the referendum was informative to investors and, therefore, abnormal returns can be interpreted as reflecting the economic consequences of a hypothetical secession as perceived by investors. However, there exists the possibility that the referendum did not provide any new information on the likelihood of secession, and that stock prices already reflected investors’ beliefs about the consequences of secession.
References


Appendix A: List of Potential Confounding Events

In this appendix, I present news related to the firms in my sample, as reported by the leading newspaper in Catalonia, during the week before and after the referendum.\(^\text{14}\) I translate the headings, relevant fragments of the text, and I report stock market returns of the relevant firms.

**Tuesday 4, November of 2014**

**Headline:** “Applus earns 15 millions [of euros in profits from January] until September”

**Fragments:** “Applus has reported a net profit of 15 million euros during the first nine months [of 2014], to be compared with loses of 76 million euros during the same period in 2013 [...] the company has announced the acquisition of two American companies [Integrity Aerospace Group and Ingelog]”

**Stock Market:** The return on Applus’ stock was 9%, 2%, and -0.5% on November 3, 4, and 5.

**Wednesday 5, November of 2014**

**Headline:** “Gas Natural [Fenosa] earns 1,239 millions [of euros] in nine months, 10.6% more [than the same period in 2013]”

**Fragments:** “Gas Natural Fenosa earned 1,239 million euros [from January] until September [of 2014], 10.6% more than the same period in 2013, due to extraordinary profits coming from selling GNF Telecomunicaciones”

**Stock Market:** The return on Fenosa’s stock was -0.4%, 0.5%, and 0% on November 4, 5, and 6.

—

**Headline:** “Grifols exceeds [profit] forecasts and experiences a return of 5.5%”

**Fragments:** “[Grifols earned a] profit of 339 million euros during the first nine months of the year [2014]”

**Stock Market:** The return on Grifols stock was 5.3%, 0.2%, and 2.2% on November 4, 5, and 6.

—

**Headline:** “Fluidra settles in Australia”

**Fragments:** “[Fluidra] buys a Kazakhstan company to reinforce its presence in the Asian market [...] Fluidra wants to consolidate its presence in the Australian market, which represents 10% of its business”

**Stock Market:** The return on Fluidra’s stock was 0.6%, 4.3%, and 1.5% on November 4, 5, and 6.

—

**Headline:** “Almirall will transfer 719 workers to the British [company] AstraZeneca”

**Fragments:** “Almirall will transfer 719 workers to the British [company] AstraZeneca, current owner of the respiratory division of the Catalan pharmaceutical [Almirall]”

**Stock Market:** The return on Almirall’s stock was -0.5%, 0.9%, and 1.6% on November 4, 5, and 6.

\(^{14}\)The leading newspaper in Catalonia is La Vanguardia, with around 700,000 readers.
Thursday 6, November of 2014

Headline: “Molins triples its profits [from January] until September”

Fragments: “Molins has earned, until September of this year [2014], a net profit of 30.48 million euros, almost three times the net profits of the same period in 2013”

Stock Market: The return on Molins’ stock was 0% on November 7. Molins’ stock was not traded on November 5 and 6.

—

Headline: “[Fluidra] earns 14.4 million [euros], 72.7% more [than in 2013]”

Fragments: “Fluidra has reported a profit of 14.4 million euros between January and September of this year [2014], which is 72.7% more than the 8.3 millions earned during the same period in 2013”

Stock Market: The return on Fluidra’s stock was 4.3%, 1.5%, and -2.6% on November 5, 6, and 7.

Friday 7, November of 2014

Headline: “CaixaBank will incorporate Barclays [Spanish unit] in the first semester of 2015”

Fragments: “CaixaBank plans to close the acquisition of Barclays on January 1 [of 2015]”

Stock Market: The return on CaixaBank’s stock was -2.2%, -0.2%, and 0.3% on November 6, 7, and 10. November 8 and 9 fell on a weekend, so stock markets were closed.

Saturday 8, November of 2014

Headline: “Almirall considers acquisitions to grow in dermatology”

Fragments: “Almirall is considering acquiring companies from the United States and Europe, preferably in the dermatology sector, although it is also considering opportunities in other therapeutical areas”

Almirall’s stock return: The return on Almirall’s stock was -0.7% and -0.2% on November 7 and 10. November 8 and 9 fell on a weekend, so stock markets were closed.

Sunday 9, November of 2014

Headline: “Banks leave behind restructuring and earn 8.153 millions [of euros from January] until September”

Fragments: “the seven biggest [Spanish] banks make 3.7% more [profits]”

Stock Market: The return on CaixaBank’s stock were -0.2% and 0.3% on November 7 and 10. The return on Sabadell’s stock was -0.3% and 0.2% on November 7 and 10. November 8 and 9 fell on a weekend, so stock markets were closed.
Monday 10, November of 2014

Headline: “The European Union will take care of the energy sector in its plan to reactivate the economy”

Fragments: “[Jean-Claude] Junker will encourage interconnections and the modernization of networks and buildings”

Stock Market: The return on Fenosa’s stock was -0.8%, 1.1%, and 0.8% on November 7, 10, and 11. The return on Fersa’s stock was 3.6%, -3.5%, and 1.2% on November 7, 10, and 11. November 8 and 9 fell on a weekend, so stock markets were closed.

Tuesday 11, November of 2014

Headline: “The pharmaceutical Almirall doubles its profits reaching 42 million [euros]”

Fragments: “Almirall [...] earned a net profit of 42.9 million euros during the first nine months of the year [2014], which is an increase of 96.8% with respect to the same period last year [2013]”

Stock Market: The return on Almirall’s stock was -0.2%, -0.5%, and -1.9% on November 10, 11, and 12.

Wednesday 12, November of 2014

No mention of firms in the sample.

Thursday 13, November of 2014

Headline: “The agreement with the banks punishes the stock market, and the Ibex loses 1.7%”

Fragments: “[the cause of this drop in stock prices is] the multimillion fine that a number of governments have imposed on financial firms that manipulated foreign exchange rates”

Stock Market: The return on CaixaBank’s stock was -0.3%, 0.1%, and 0.1% on November 12, 13, and 14. The return on Sabadell’s stock was -0.3%, -0.1%, and 0.1% on November 12, 13, and 14.

___

Headline: “[Fersa’s] profits decline by 84%”

Fragments: “Fersa [...] closed its first nine months of the year [2014] with 264,000 euros of profits, 84% less [than the same period in 2013]”

Stock Market: The return on Fersa’s stock was -3.6%, 1.2%, and -4.9% on November 12, 13, and 14.

___

Headline: “Gas Natural [Fenosa] issues 1.000 million [euros of bonds]”

Fragments: “these bonds, issued yesterday morning to the European market, have an annual premium of 4.125%”

Stock Market: The return on Fenosa’s stock was -1.6%, -1.1%, and 0% on November 12, 13, and 14.
Friday 14, November of 2014

Headline: “Colonial’s revenue from rents grows 2.6%”

Fragments: “Colonial has increased its revenue coming from rented office buildings in 2.6% during the first nine months of the year [2014]”

Stock Market: The return on Colonial’s stock was 0.7%, -0.5%, and -1.6% on November 13, 14, and 17. November 15 and 16 fell on a weekend, so stock markets were closed.
Appendix B: Details on the Sample of Firms

Table 2 shows which firms in the sample are part of the IndexCat and the Orbis database, and provides the ITIN and SIC codes for each firm in the sample. This appendix shows which firms in the sample are part of the IndexCat and the Orbis database, and provides the ITIN and SIC codes for each firm in the sample.

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<th>SIC</th>
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Table 2: Sample of firms, their presence in the IndexCat and Orbis database, ITIN and SIC codes.

Notes: This sample of firms include all firms in the IndexCat (an index including the largest publicly traded firms with headquarters in Catalonia) and all publicly traded firms located in the “Catalonia” region according to the Orbis database. All market capitalizations are as of July 2nd of 2015 except Damm, which is as of April 1st of 2015 (it left the stock market due to a merger).
Appendix C: Cumulative Abnormal Returns

Figure 10: Cumulative average returns around November 9, 2014.

Notes: This graph shows weighted average returns during the week after the referendum, from November 10 (t = 1) to November 14 (t = 5).

Figure 11: Cumulative average mean-adjusted returns around November 9, 2014.

Notes: This graph shows weighted average abnormal returns, calculated as mean-adjusted returns, during the week after the referendum, from November 10 (t = 1) to November 14 (t = 5). The estimation period consist of the 50 days before the event window.
Figure 12: Cumulative average market-adjusted returns around November 9, 2014.

Notes: This graph shows weighted average abnormal returns, calculated as market-adjusted returns, during the week after the referendum, from November 10 (t = 1) to November 14 (t = 5).

Figure 13: Cumulative average market-model returns around November 9, 2014.

Notes: This graph shows weighted average abnormal returns, calculated as residuals of a market model, during the week after the referendum, from November 10 (t = 1) to November 14 (t = 5). The estimation period consist of the 50 days before the event window.
Appendix D: Alternative Estimators of Abnormal Returns

1. **Deviations from a one-factor CAPM:** Expected returns can also be estimated by means of a one-factor Capital Asset Pricing Model (CAPM). The one-factor CAPM, as specified in Equation 14, assumes that expected returns are a combination of the risk-free return (denoted by $R_{ft}$) and the market excess return (denoted by $R_{mt} - R_{ft}$). The only parameter in the model, the coefficient $\beta_i$, measures the risk of firm $i$’s stock relative to the market.

\[
R_{it} = R_{ft} + \beta_i \cdot (R_{mt} - R_{ft}) + \epsilon_{it}
\]  

(14)

Expected returns can be estimated as the predicted values of this model during the event window, and abnormal returns can be estimated as its prediction errors.

\[
E[R_{it}] = R_{ft} + \hat{\beta}_i \cdot (R_{mt} - R_{ft})
\]

(15)

\[
\hat{A}R_{it} = R_{it} - R_{ft} - \hat{\beta}_i \cdot (R_{mt} - R_{ft})
\]

(16)

2. **Deviations from a multi-factor CAPM:** As a refinement of the previous method, expected returns can be estimated with a multi-factor Capital Asset Pricing Model. As an example, the Fama-French model in Equation 17 adds two risk factors to the one-factor CAPM, which only includes the market excess return. The first additional risk factor is the size of the firm, measured as the difference between the average return of small and big stock portfolios, denoted by $SMB$ for “small minus big”. The second additional risk factor is the book-to-market ratio, measured as the difference in the average return of high and low book-to-market stock portfolios, denoted by $HML$ for “high minus low”. These additional regressors are usually available only in monthly frequency, which makes this method only viable to study events with long-lasting effects.

\[
R_{it} = R_{ft} + \beta_i \cdot (R_{mt} - R_{ft}) + S_i \cdot SMB_i + H_i \cdot HML_i
\]

(17)

Once the parameters of the model have been estimated, the predicted values can be used to estimate the expected returns of each stock.

\[
E[R_{it}] = R_{ft} + \hat{\beta}_i \cdot (R_{mt} - R_{ft}) + \hat{S}_i \cdot SMB_i + \hat{H}_i \cdot HML_i
\]

(18)

\[
\hat{A}R_{it} = R_{it} - R_{ft} - \hat{\beta}_i \cdot (R_{mt} - R_{ft}) - \hat{S}_i \cdot SMB_i - \hat{H}_i \cdot HML_i
\]

(19)

3. **Deviations from a reference portfolio:** The expected return of a stock can be estimated by the return of a matched stock or portfolio of stocks during the event window. The matching process is usually done using information on risk characteristics, such as size (equity market value) or book-to-market ratio, making sure that the firms in the reference portfolio are not affected by the event under study. As with market-adjusted returns, this method requires no

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15Frequently used models include those by Sharpe (1964), Lintner (1965) and Black (1972).
16Models derived from Arbitrage Pricing Theory, such as those discussed by Ross (1976), are frequently used.
17See the work of Ritter (1991), Loughran & Ritter (1995) or Barber & Lyon (1996) for specific applications of this
estimation.

method.