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POLITICAL CONNECTIONS AND ECONOMIC OUTCOMES: THREE EMPIRICAL ESSAYS

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Chapter 1

Introduction

This thesis is composed by three essays, each presenting independent and original empirical research on the impacts of political connections on the economy. This research makes a significant contribution to such empirical literature. In the first place, it highlights the limitations and challenges that are currently faced by researchers in this field, and applies developments to the empirical methods which improve the reliability of results. Secondly, in a research area where the lack of robust data has been a significant shortcoming in the past, two new databases have been created in two European countries, the UK and Spain. Aside from these being to my knowledge the first datasets of this nature in these countries, they contain a degree of detail on the nature of connections which has been only rarely seen in previous studies elsewhere. The datasets also have the potential to be used for further research in the field, as noted in each chapter's conclusions.

As I write these lines, in May 2012, Europe and most of the Western world remain immersed in the midst of the economic stagnation caused by the world financial collapse of 2008. And the role of political connections in the economy could not be unfortunately of any higher currency. In Spain, subject of the analysis in chapters 2 and 3, it has become apparent that the role of politicians in influencing private sector decisions is one of the key contributors to the deep and severe economic and social crisis the country is now immersed in. In the United Kingdom, subject of the analysis in chapter 4, the role of an elite of well-paid and well-connected executives and politicians, as well as the lack of an appropriate control of executives and managers by shareholders, are also increasingly at the core of the public debate. I hope that the empirical evidence provided here can

make a contribution to help decision makers design public policy and institutions in a way which more effectively defends the interests of its citizens and maximises social welfare. In my view, this has to mean to start with for decision makers and institution designers to systematically account for the role that political connections can play in both private and public sector economic outcomes.

According to a well-established line of thought, the existence of political connections is of course not a recent phenomenon, and the economic literature has considered its role in determining economic outcomes for many decades. In a market-based economy the links between the public and private sector are fundamental in explaining the outputs of the economy. This includes the success of private sector firms, the outcomes of public policy, and social and economy efficiency and welfare as a whole.

Government decisions in Western democracies are generally taken in order to maximise the political support to the party in office. The median voter theorem (Downs, 1957) predicts that political parties converge to the ideological position of the median voter. A Government is therefore expected to choose a set of policies which maximises the welfare of such median voter. This theorem however only holds under strict conditions, for example the requirement for perfect information across all relevant agents. In a strict interpretation of the theorem, lobbying and interest groups can never achieve their private objectives because in order to do so a political party needs to deviate from the median voter position and therefore decrease its likelihood of being elected.

Further developments in the economic literature relaxed the strict conditions of the median voter theorem and framed public sector interventions not only as a function of the interests and welfare of the median voter, but also as a function of private interest groups and the institutional structure of the public sector. Stigler (1971), Posner (1974), Peltzman (1976), Shleifer and Vishny (1994) and Grossman and Helpman (1994) are amongst the key exponents of such theoretical developments to the Downsian model. Elected Governments will still try to find an equilibrium which maximises their political support, but this will not always necessarily be achieved by defending the interests of the median voter. In fact, in occasions it will be optimal for politicians to trade off social welfare for the demands of interest groups. Special interest groups can increase the likelihood of a political party being elected, for example by providing financial support

for electoral campaigns. Additionally, they might be able to capture politicians in other ways, for example by offering useful contacts and employment opportunities when politicians exit their political life. Policy outcomes will meet more closely the demands of a particular interest group the less visible and tangible the policy area is to the electorate or when there is a lack of counteractive lobbying forces. In this framework, it is predicted that ties and connections between politicians and the private sector are likely to materialise in politicians being influential in the private sector, and in businesses being influential in defining public policy.

The sign and overall impact of such political connections on either the outcomes of public policy or the performance of private businesses is not however clear. The factors in play are complex, and different forms of political influence can lead to either positive or negative economic outcomes to both the private sector and society at large. Their effects have indeed been shown to vary from country to country and sector to sector. If politically connected firms can obtain a favourable regulatory treatment (Strattman, 2005), better access to public procurement contracts (Goldman et al, 2010) or obtain any other form of preferential treatment, private rents could be obtained by politically connected firms in detriment of society. However, under other scenarios, political connections can have a negative effect on firm performance. In the presence of agency problems, for example where corporate governance does not provide a strong control by shareholders of the management of the firm, private rents may be obtained by managers (and shared with politicians) rather than shareholders. In fact, in countries where political influence and corruption are widespread, long-term negative growth and firm performance has been observed in those firms in more corrupt sectors and/or regions (Mauro, 1995).

Likewise, the impact of varying degrees of private sector influence on public sector decisions is not straightforward either. The provision of information and expert skills by private sector groups to the public sector might help developing more effective policy and regulation. However, the role of private interests in public sector decisions might result in such decisions being more lenient to some businesses than others. Different strands of the literature have considered such phenomena, including the closely linked topics of the independence of regulators (Trillas, 2010), the bias of independent advisers (Landier,

Sraer and Thesmar, 2009) and the question of revolving doors, where professionals transfer between the regulator and the regulated firm (Che, 1995).

By and large, establishing the impact of political connections remains an empirical question. The role of political connections permeates the economic science in many areas of micro and macroeconomic research, spanning from regulatory and corporate business economics to growth and development economics. Consequently, different strands of the empirical economic literature have developed methodologies to this effect: the empirical literature on campaign contributions and lobbying (Potters and Sloof, 1996; Anslobehere, de Figueiredo and Snyder, 2003; and Stratmann, 2005 present good and extensive reviews of this strand); the empirical literature on international development (Frederiksson & Svensson, 2003; Svensson, 2003; Recanatini, Prati & Tabellini, 2005); and the financial economics literature on market reactions to political events (Roberts, 1990; Herron et al., 1999; Jensen and Schmith, 2005; Leblang and Mukherjee, 2005; Jayachandran, 2006).

Such empirical literature has generally faced two main challenges. Firstly, the measurement of political connections and capture is more often than not extremely challenging. The empirical methods available to identify the impact of political connectedness on firms' performance have however progressed significantly in recent years. A landmark development initially pioneered by Fisman (2001) and further developed by Faccio (2006) was to measure political influence by establishing whether individuals serving in a board of directors of a company have links to or have served in office or a political party. The second challenge in the empirical literature is that, even when a good measure of political connectedness can be developed, isolating its impacts remains difficult. As a result, many of the existing research outputs are highly sensitive to the approach that is chosen for the analysis. Whilst many researchers have found a positive relationship between political connections and private sector economic returns (see for example Ferguson and Voth, 2008; Goldman et al, 2009; and Niessen and Ruenzi, 2010) many others have found the opposite result (see for example La Porta, Lopez-de-Silanes, and Zamarippa, 2003; Khwaja and Mian, 2005; and Fisman and Svenson, 2007). The three articles presented here make a contribution to tackle some of

the challenges involved in both effectively defining political influence as well as isolating its impact.

In **Chapter 2** we estimate the impact of a surprise political event on the financial returns of the Spanish markets, including the specific impacts on selected sectors and politically connected companies. Previous studies have analysed the impact of elections on shareholder's expectations. But we do it here with econometric techniques that improve the reliability of significance tests, such as the Seemingly Unrelated Regressions method and bootstrapping.

In the last days of the electoral campaign for the 2004 general election in Spain, on Thursday March 11th 2004, a series of simultaneous terror attacks caused the death of 191 persons in commuting trains in the capital Madrid. Four days later, the opposition party won the election, against all predictions that were made prior to the terror attacks. This change in expectations presents us with a unique opportunity to take advantage of event study techniques to test some politico-economic hypotheses. This is because, as the chapter sets out, there is a strong case to hypothesise that returns on Monday morning, the day after the elections took place, would incorporate the impact of an unexpected political change. If any company's or economic sector's profit was contingent on the political outcome of the elections, their valuation must have significantly changed after the election, as the results were not expected.

We find that investors did not expect significant differences between both major Spanish political parties. Our findings are consistent with the hypothesis of no impact from the change in Government on the expectations for the Spanish economy as a whole. Parties may indeed diverge in non-economic policy dimensions, such as social, religious and cultural norms, foreign policy, or the degree of institutional decentralisation, but overall investors did not expect a major change in economic direction and the expectation was that the degree of convergence in policies affecting the average profits of firms in the overall market would be high. This study shows that as a whole the forces of political convergence are quite strong.

We also test whether the surprise election result had an impact on specific sectors and politically connected businesses. If a businesses´ allegiance to the incumbent political

party had a positive or a negative impact on its profits, an unexpected change in Government will result in a negative (or positive) impact on the firm's financial value. The analysis shows that such hypothesis of capture of politicians by firms, in itself and combined with agency problems in privatized firms with dispersed shareholdings, is not rejected by the data. This is revealed by examining both sector and groups of individual stock price reactions to the surprise electoral result, particularly where businesses are identified as being connected to the incumbent political party. The results therefore also support the hypothesis that particular industries and businesses may be affected by the political structure of Spain and the nature of its business-politicians networks. A number of companies were indeed affected by the election results analysed in this article, and the empirical results provide some support to the hypothesis that the degree of political connectedness of such businesses is at the core of explaining the impact of the surprise election results on their financial returns. The exercise is based on the event study methodology, which depends on market expectations and, in particular, the results are meaningful only to the extent that the semi-strong version of the efficient financial markets hypothesis holds. Besides, partisan macro-economic effects could have an impact on agents that are not the investors in quoted firms, but workers, consumers, or investors in other firms.

As set out earlier, the empirical findings in the literature have been shown to vary substantially depending on the methodological approach that is chosen for the analysis. Such differences can be driven either by the inherent limitations in each empirical technique, or by the studies having been carried out in different points in time and place. In **Chapter 3**, we undertake to overcome some of these constraints by exploring the impact of political connections on firm performance by employing the two main empirical approaches that have been applied to ascertain the impact of connections on the performance of firms: analysis of financial markets reactions to political events; and econometric analysis of the impact of political connections on accounting-type measures of firm performance.

Whereas empirical methods based on financial-markets data tend to find a positive relationship between political connections and firms' value, approaches based on accounting-based measures tend to obtain the opposite result. The accounting-based

methodology, whilst more transparent, is problematic as establishing an econometrically robust relationship between firms' profits and political influence is not straightforward, given the endogeneity between performance and political connectedness. For example, whilst political connections may result in private rents and hence better firm performance, bad performance can also result in firms seeking new political connections in the market for political influence. The financial-value approach circumvents such econometric issues, but it however relies on an indirect outcome of firm's performance (financial markets return), and hence is only meaningful to the extent that financial markets behave efficiently by accounting for the impact of political connections on the market value of a firm.

We built a unique dataset covering 69 of the largest publicly traded Spanish companies with information on the political links of over 1,000 directors over the period 2002-2009. This is a relatively long period of time which allows us to test the impact of different degrees of political connections, as well as any potential differences between connections to the political party in office or in opposition. The dataset also covers two different Governments and a change in the economy to recession which allows us to consider the evolution of political connections during a period in which both national politics and the business cycle were subject to considerable fluctuations.

There are different degrees of tolerance to political connections in time and space, and these vary from country to country. In Spain, in the first decade of the third millennium, the corporate sector displayed a remarkably large number of connections to Spain's major political parties, with one in five directors being connected at any given time, and with approximately half of these directors having held very senior positions in the past either in Government or in a political party. A high level international comparison shows that even though political connections are not a unique Spanish phenomena, and despite the limitations that exist in making a robust international comparison, its scale and intensity is possibly at the higher end of what can be observed internationally elsewhere in countries with similar level of economic development. This connectedness varies from company to company and is responsive over time to the political party in power both centrally and regionally and to the business cycle.

The results of our analysis indicate that in Spain, in the first years of the 21st century, political connections may have had a negative impact on firms' profits. Even though results from the financial markets-based analysis are inconclusive, the econometric analysis of accounting-based measures of performance shows a negative and highly statistically significant negative impact of political connections on firm's performance. The results hold regardless of the particular variable or measure that is used to proxy for political connectedness, and under different considerations of the degree of connections that is considered. The results also hold when controlling for the potential endogeneity that may exist - whereas connections to politicians might result in better (worse) business performance, also changes in business performance might lead to higher (lower) connections.

Finally, **Chapter 4** considers the influence of the private sector on decisions taken by the public sector. This is in contrast with chapters 2 and 3, and most of the empirical literature on political connections, which consider the impacts of politicians on the economic outcomes of the private sector.

In the UK, as in most countries with R&D programmes, grants are conceded in a beauty contest process. The Technology Strategy Board (TSB), the UK agency responsible for offering such grants, jointly with its funding Government Department, identifies technology and research priority areas, after which specific competitions are run and winning projects selected. The empirical strategy draws from the literature on political connections by taking advantage of the institutional structure of the TSB. I define a firm to be connected in a given year when an employment relationship at director level has existed between the firm and at least one of the members of the Board of the TSB. This allows calculating a matrix of direct influences and connections between businesses and the subsidy-allocating agency.

I hypothesise that such connection can have an impact on both the likelihood of receiving a grant and the number of times a company receives a grant in a given year. Whereas the first hypothesis is focused on access to public funding, the second hypothesis considers the total impact of connectedness on the distribution of grants. In order to do that, it is necessary first to empirically establish the optimal allocation of public funding for cooperative R&D that would result if the impact of connections were negligible, for

which I draw on the extensive empirical literature on R&D cooperation and R&D policy. The analysis is carried out by means of panel data discrete choice regression analysis and count panel data selection regression models.

The chapter, based on the analysis of a unique dataset, proposes a methodological development to the literature on political connections by directly linking information on connections to a public body which is responsible for allocating grants to cooperate in R&D with other countries in the United Kingdom, hence providing a direct account of the returns to the connection. This is important because the methodology minimises the likelihood of spurious findings and allows for a direct assessment of the impact of connections on the allocation of grants across firms.

The results suggest that whilst the R&D cooperative programme is to an extent effective in targeting the market failures it aims to address, its allocation of grants across the private sector is biased towards connected businesses, after controlling for company and sector specific factors. Businesses directly connected to the public agency responsible for allocating cooperative R&D grants in the UK are both more likely to obtain R&D grants and to receive more grants than those businesses which are not connected. I find that a business connected to an equivalent of one Board member is more than twice more likely to obtain a grant than a business which is not connected at all. Furthermore, I show that there exists a significant and large positive relationship between the connectedness of a business and the number of grants obtained, after controlling for selection bias. As a result, the allocation of public funding might be suboptimal from a social welfare perspective, increases deadweight in the economy and is inequitable by transferring funds from the taxpayer to connected businesses.

Even though results in this chapter have to be considered in its right context – R&D policy in the UK – the findings are, as in previous chapters, suggestive of more general interactions between Government and the private sector. They also highlight the importance of taking account of Government failures, in particular Government capture, when designing the institutional mechanisms for public sector intervention if a socially acceptable outcome is to be achieved. This also includes the role of advisory and expert groups, which are in some countries broadly used in shaping public sector policy.

References

Ansolabehere, Stephen; de Figueiredo, John M. and Snyder, James M. "Why is There so Little Money in U.S. Politics?" *Journal of Economic Perspectives*, 17(1), pp. 105-130(26), 2003.

Che, Yeon-Koo. "Revolving Doors and the Optimal Tolerance for Agency Collusion", *The RAND Journal of Economics,* 26(3), pp.378-397, 1995.

Downs, Anthony. "An Economic Theory of Political Action in a Democracy", *The Journal of Political Economy*, 65(2), pp. 135-150, 1957.

Faccio, Mara. "Politically Connected Firms", *American Economic Review*, 96(1) pp. 369-386(18), 2006.

Ferguson, T. and H.J. Voth, "Betting on Hitler –the Value of Political Connections in Nazi Germany", *Quarterly Journal of Economics*, 123 (1), pp. 101-137, 2008.

Fisman, Raymond. "Estimating the Value of Political Connections", *American Economic Review*, 91(4), pp. 1095-1102, 2001.

Fisman, Raymond; Svensson, Jakob, "Are corruption and taxation really harmful to growth? Firm level evidence", *Journal of Development Economics*, 83 (1), pp. 63-75, 2007.

Fredriksson, Per G. and Svensson, Jakob. "Political instability, corruption and policy formation: the case of environmental policy", *Journal of Public Economics*, 87, pp.1383–1405, 2003.

Goldman, Eitan; Rocholl, Jörg and So, Jongil, "Do Politically Connected Firms Affect Firm Value?", *Review of Financial Studies*, 22(6), pp. 2331-2360, 2009.

Goldman, Eitan; Rocholl, Jörg and So, Jongil. "Political Connections and the Allocation of Procurement Contracts", mimeo, 2010.

Grossman, Gene M.; Helpman, Elhanan. "Protection for Sale", *American Economic Review*, 84(4), pp. 833-850, 1994.

Herron, M.C.; Lavin, J.; Cram, D.; and Silver, J. "Measurement of Political Effects on the United States Economy: a Study of the 1992 Presidential Election", *Economics and Politics* 11-1, 51-81, 1999.

Jayachandran, Seema. "The Jeffords Effect", *Journal of Law and Economics*, 49, pp.397–426, 2006.

Jensen, N.M. and Schmith, S., "Market Responses to Politics: the Rise of Lula and the Decline of the Brazilian Stock Market", *Comparative Political Studies* 38-10, 1245-1270, 2005.

Khwaja, Asim Ijaz; Mian, Atif, "Do Lenders Favor Politically Connected Firms? Rent Provision in an Emerging Financial Market", *Quarterly Journal of Economics*, 120 (4), pp. 1371-1411, 2005.

La Porta, Rafael; Lopez-de-Silanes, Florencio ; Zamarripa, Guillermo, "Related Lending", *Quarterly Journal of Economics*, 118 (1) pp. 231-268, 2003.

Landier, Augustin; Sraer, David and Thesmar, David. "Optimal Dissent in Organizations", *Review of Economic Studies*, 76(2), pp. 761-794, 2009.

Leblang, D.; Mukherjee, B., "Government Partisanship, Elections, and the Stock Market: Examining American and British Stock Returns, 1930-2000", *American Journal of Political Science*, 49(4): 780-802, 2005.

Mauro, Paolo. "Corruption and Growth", *Quarterly Journal of Economics, 110(3),* pp. 681-712, 1995.

Niessen, Alexandra. Ruenzi, Stefan, "Political Connectedness and Firm Performance: Evidence from Germany", *German Economic Review*, 11(4), pp. 441-464, 2010.

Peltzman, Sam. "Toward a More General Theory of Regulation", *Journal of Law and Economics*, 19(2), pp. 211-240, 1976.

Posner, Richard A. "Theories of Economic Regulation", *The Bell Journal of Economics and Management Science*, 5(2), pp. 335-358, 1974.

Potters, Jan and Sloof, Randolph. "Interest groups: A survey of empirical models that try to assess their influence", *European Journal of Political Economy*, 12(3), pp. 403-442, 1996.

Recanatini, Francesca; Prati, Alessandro and Tabellini, Guido. "Why Are some Public Agencies less Corrupt? Lesson for Institutional Reforms from Survey Data", Paper presented at the Sixth Jacques Polak Annual Research Conference hosted by the International Monetary Fund, 2005.

Roberts, B.E., "Political Institutions, Policy Expectations, and the 1980 Election: A Financial Market Perspective", *American Journal of Political Science,* 34-2, 289-310, 1990.

Shleifer, Andrei and Vishny, Robert W. "Politicians and Firms", *Quarterly Journal of Economics,* 109(4), pp. 995-1025, 1994.

Stigler, George. "The Theory of Economic Regulation", *Bell Journal of Economics and Management Science*, 2, pp. 3-21, 1971.

Stratmann, Thomas. "Some talk: Money in politics. A (partial) review of the literature", *Public Choice*, 124, pp 135–156, 2005.

Svensson, Jakob. "Who Must Pay Bribes and How Much? Evidence from A Cross Section of Firms", *Quarterly Journal of Economics*, 118(1), pp. 207-230, 2003.

Trillas, Francesc. "Independent Regulators: Theory, Evidence and Reform Proposals" *IESE Business School Working Paper*, No. 860, 2010.

Chapter 2

The effects of surprise political events on quoted firms: the case of the March 2004 election in Spain

1. Introduction

In the last days of the campaign for the 2004 general election in Spain, on Thursday March 11th 2004,[1] a series of simultaneous terror attacks caused the death of 191 persons in commuting trains in Madrid. The attacks themselves, according to some, or a deliberate attempt by the incumbent government to hide information about the attacks for electoral reasons in the short period of time between the attacks and the election, according to others, are held responsible for the surprise victory of the Socialist opposition in the election on the next Sunday. This change in expectations presents a unique opportunity to take advantage of event study techniques[2] and use the natural experiment to test some economic and politico-economic hypotheses. One of the problems of many event studies is that long event windows run the risk of including effects of events other than those under analysis; the fact that in this case the election result could not have been predicted four days before the election greatly reduces the meaningful length of the event window and hence the potential for event contamination, except for the potential confusion between the attacks themselves and political change, something we deal with in Section 5.

[1] Electoral campaigns in Spain usually end on Friday, and Saturday is "reflection day." Vote is on Sunday.
[2] See Binder (1985, 1988), Mackinlay (1997) and Khotari and Warner (2007).

The Median Voter Theorem[3] predicts that if two vote-maximizing parties compete in a single political dimension and voter preferences are single peaked, then both parties converge presenting the platform that best suits the median voter. The theorem, an application by Downs (1957) of the Hotelling (1929) location model, tries to explain the strong forces towards convergence to the centre of the ideological spectrum that are observed in politics. The median voter theorem has been used in many applications in economics and has become one of the workhorse models of the literature on political economy (see Persson and Tabbellini, 2000). However, many authors have pointed out that there is evidence that political parties often differ in some important policy dimensions, so that politics would be partisan[4] instead of convergent; Roemer (2001) wonders why would a group of citizens bother to undertake the costs of creating a political party if they end up implementing the same policies as their main rival. Which of both theories does evidence support? This question may have different answers depending on time and place. We test it for one country and place were, according to political rhetoric, one would expect to find high divergence: Spain in 2004. In the months prior to the election, Prime Minister Aznar had supported U.S. President Bush on the Irak war, for example, a move that was strongly criticized by the opposition. Socialist Party main opposition candidate José Luis R. Zapatero was according to some commentators to the left of previous socialist leader Felipe González. It was also a period of increasing polarization in many countries (including the US) between the main political parties. Being Spain a member of the European Union in the Euro area, however, implies that the forces of convergence are also strong, as the European Union establishes very strict norms of fiscal policy and controls monetary policy through the European Central Bank. Whether convergence or partisan forces are stronger is ultimately an empirical question.

Previous studies have analyzed the impact of elections on shareholder's expectations, and we contribute to this literature. For example, Roberts (1990), Shum (1995), Herron et al. (1999), Herron (2000), Pantzalis et al. (2000), Vuchelen (2003), Jensen and Schmith (2005), Leblang and Mukherjee (2005), Füss and Bechtel (2006) and Jayachandran (2006) find different degrees of convergence depending on time and country. Like

[3] See Downs (1957).

[4] See Alesina and Rosenthal (1995). Petterson-Lidbom (2008) find partisan effects at the local level in Sweden, but Ferreira and Gyourko (2009) show that at the local level partisan effects of Mayoral elections in the U.S. are weaker than at the national level.

Jayachandran (2006) we analyze the effect of a surprise political event. But we do it with econometric techniques that improve the reliability of significance tests, such as the Seemingly Unrelated Regressions method and bootstrapping.

We find that, in spite of rhetoric, investors did not expect significant differences between both major Spanish political parties. The expectation was that the degree of convergence in policies affecting the average profits of firms in the overall market would be high.

Even though our findings are consistent with the hypothesis of no impact from the change in Government on the expectations for the Spanish economy as a whole, we also test whether the surprise election result had an impact on specific sectors and politically connected businesses. If a businesses´ allegiance to the incumbent political party had a positive or a negative impact on its profits, an unexpected change in Government will result in a negative (or positive) impact on the firm's financial value. The analysis shows that such hypothesis of capture of politicians by firms, in itself and combined with agency problems in privatized firms with dispersed shareholdings, is not rejected by the data. This is revealed by examining both sector and groups of individual stock price reactions to the surprise electoral result, particularly where businesses are identified as being connected to the incumbent political party.

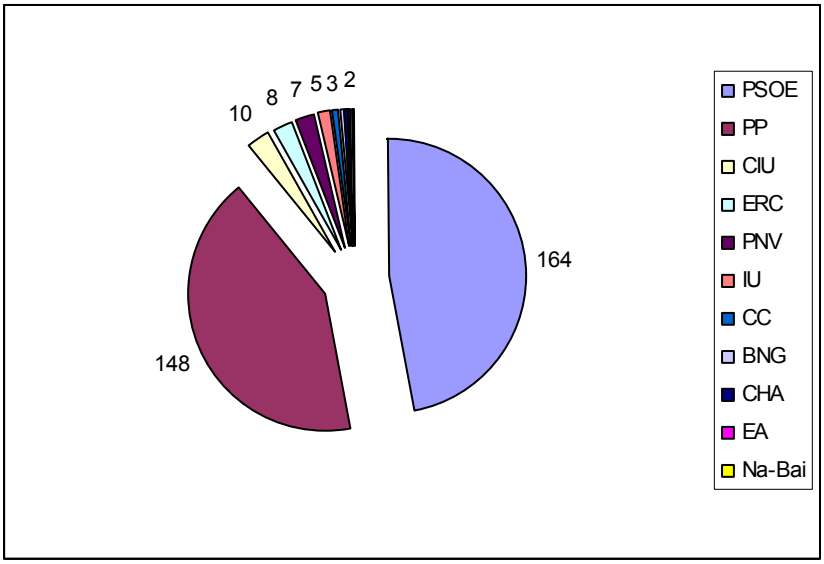
In the rest of this paper, in Section 2 we provide some background on the events of interest, methodological issues and the hypotheses. In Section 3, we test convergence versus partisan theories looking at the joint reaction of stock prices to the surprise election result. In Section 4, we test some other theories that involve firm value expectations, such as capture and agency theories. Section 5 introduces some notes on the effects of the terror attacks. Finally, Section 6 concludes.

2. Background

2.1. The events

On Thursday March 11th 2004, a major terrorist attack killed 191 persons in commuting trains in Madrid, the Spanish capital. On Sunday March 14th 2004, the Socialist Party (PSOE) won the general election by a large though not overall majority (see Figure 1), beating all expectations as reported by electoral polls.

Figure 1. 2004 General election results. Sits in Parliament by political party



Source: *El Mundo*

The special circumstances surrounding the Spanish general election made its final outcome completely unpredictable four days prior to the election,[5] because it was then that the terrorist attacks occurred. Until that day, the ruling Popular Party (PP) had led the polls by 2 to 7 points, according to different poll sources (such as newspapers El Pais, El Mundo, ABC). In fact, according to a poll performed after the election by an official body in Spain (*Centro de Investigaciones Sociológicas -C.I.S*[6].), 21.5% of voters declared being influenced by the terrorist attacks in their voting decision. More interestingly, 9.4% of voters voted for PSOE only because of the terrorist attacks, while only 1.5% of voters voted PP because of the very same reason. It is clarifying to see that the difference between these two values is 7.9%. As the final results gave a 5 point advantage to the Socialist party, it leaves the results, discounting the effect of the terrorist attack on voters' decisions, in a 2.9 point lead by the PP, which is roughly consistent with poll results prior to the terrorist attacks.

[5] The poll that gave the incumbent Popular Party (PP) the narrowest advantage among all published polls over the Socialist Party (PSOE) was published in newspaper La Vanguardia seven days before election day (polls cannot be made public by law in Spain after five days before election day, and the last ones are usually published seven days before, on the previous Sunday). According to this poll, PP was at that time two percentage points ahead of the Socialist Party.

[6] *Estudio Postelectoral del CIS, Marzo-Abril 2004*

García Montalvo (2010) provides statistical evidence that indeed the attacks changed the expected result of the election. By using the postal vote, which by the electoral rules was sent by absent voters prior to the terrorist attack, as a control group, , the study shows that this was significantly different from the vote on election day. The attack had an important electoral impact, rejecting the hypothesis that the identity of the winner was unaffected by the terrorist attack. To be precise, this study claims that the incumbent conservative party would have won the election, had the terrorist attack not taken place, reaching a range between 42% and 45% of the vote, while the Socialist party would have obtained 37%.

Therefore, there is a strong case to hypothesise that returns on Monday morning, the day after the elections took place, would incorporate the impact of an unexpected political change (if the semi-strong version of the financial markets efficiency hypothesis holds[7]). If any company's or economic sector's profit was contingent on the political outcome of the elections, their valuation must have significantly changed after the election, as the results were not expected.

There have been many interpretations of why the terrorist attacks had such an importance in the election results. A stream of opinion suggested that the terrorist attacks confirmed the general opinion in Spain that the PP Government's decision to get involved in Iraq war was a mistake. Opinion polls showed that almost 85% of Spaniards opposed the war in Iraq. Others argue that the main cause of the fall down of the PP was not caused by the terrorist attacks themselves, but by the management of the subsequent crisis by the incumbent Government. When the attacks occurred in the morning of Thursday 11th March 2004 (see Table 1), the initial reaction by most analysts and politicians was to blame ETA, the Basque separatist terrorist group and by far the most active terrorist group in Spain over the last thirty years.[8] Nevertheless, the evidence soon pointed to Al-Qaeda and later the very same day of the attacks most in the international press were assuming that the attacks had been perpetrated by Islamist terrorist groups. Yet the PP's Government kept on blaming ETA for the next four days, until the Election Day (see Table 1). Some commentators suggested that the PP feared losing the election if the

[7] According to this version of the hypothesis, stock prices summarize all publicly available information about a particular stock. Then, only new information affects stock prices.
[8] See Abadie and Gardeazábal (2003).

public concluded that Islamist groups targeted Spain as a result of the Spanish Government's support of the Irak war. In addition, the PP focused its pre-election message on the fight against ETA and on the influence of ETA's separatist objectives on nationalist forces in the periphery willing to support a new Socialist government. Therefore, following this line of reasoning, if the PP Government could hold off the three days remaining until the election blaming ETA, any negative impact on their electoral prospects would be averted and this would reinforce their campaign message. Some commentators noted that the Government was not really interested in transparently investigating the attacks, which had a large emotional impact on public opinion, but only in re-election. To many observers, this was the cause of the unexpected results on the Election Day, Sunday the 14th of March, 2004.

Table 1. From March 11 to March 14

Thursday 11th	07:47	Four trains in Madrid are simultaneously bombed. 191 persons are killed and over 1500 are injured
	13:00	The incumbent president J.M. Aznar reports that ETA is behind the attacks
	15:50	The Government leaks a file from the Spanish Intelligence Service pointing to ETA as the most likely author of the attacks
	20:20	A. Acebes, Minister of the Spanish Home Office at that moment, informs of the finding of a tape in Arabic in a suspicious van, but keeps the hypothesis of ETA as the most likely
	21:30	The Islamic group Abu Hafs Al Masri, linked to Al Qaeda, claims they authored the attacks
Friday 12th	18:00	A.Acebes repeats that ETA is the main hypothesis that the police is pursuing
	18:30	ETA claims it had nothing to do with the attacks
Saturday 13th	16:00	Three Moroccan and two Indian men are arrested by the Spanish police
	19:00	Demonstrators gather in front of PP headquarters in all major Spanish cities, asking for a clear information policy on the authors of the attacks
	20:30	A.P. Rubalcaba, a former Cabinet Minister and member of PSOE's direction, strongly criticizes the role of the Government
Sunday 14th	20:00	The election day reaches its end. PSOE win the election

Sources: *El Mundo*, *El País*

Being the cause of the change in citizen preferences one thing or another, the fact is that the actual results of the election were not the ones that could have been rationally anticipated by the market before the attacks occurred. If any company's or industry's profit depended on the political outcome of the election, their financial valuations were bound to have changed significantly between Thursday 11th in the morning and the opening of the stock market on Monday 15th, already after the election and the week-end break in the stock market.

2.2. Methodology

We carry out an analysis of the effect of the political change in the March 2004 election in Spain on the financial markets. Based on the semi-strong version of the Efficient Market Hypothesis (EMH), if the political change had any effect on the discounted expected future stream of profits of quoted companies, the markets would have reacted to the new information accordingly. The special circumstances surrounding this election make this occasion a unique opportunity to test for effects of political change on the performance of specific groups of businesses and the Spanish stock market as a whole.

The classical abnormal returns computation is not suitable for analysing the effects of an event that affects a group of companies at the same moment in time. When there is event clustering[9] the covariance amongst returns will not be zero, and the asymptotic results of normality no longer hold. An alternative approach is proposed by Binder (1985) which disaggregates the portfolio into a multivariate regression model system of returns equations, with one equation for each of the firms experiencing the events:

$$(1) \qquad R_{1t} = \alpha_1 + \beta_1 R_{mt} + \sum_{a=1}^{A} \gamma_{1a} D_{at} + \varepsilon_{1t}$$

$$R_{2t} = \alpha_2 + \beta_2 R_{mt} + \sum_{a=1}^{A} \gamma_{2a} D_{at} + \varepsilon_{2t}$$

$$\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots$$

[9] Events affecting different firms occur at the same moment in time.

$$R_{nt} = \alpha_n + \beta_n R_{mt} + \sum_{a=1}^{A} \gamma_{na} D_{at} + \varepsilon_{nt}$$

where $i = 1.....n$ are the number of companies we include; R_{it} are company i's stock returns[10]; R_{mt} are the stock market index returns; D_{at} is a dummy variable that takes value 1 on the days of the events of interest and zero otherwise; α_i, β_i, and γ_{ia} are parameters to be estimated; and we allow the error terms $(\varepsilon_{11},...,\varepsilon_{1t},\varepsilon_{21},...,\varepsilon_{2t},...,\varepsilon_{n1},...,\varepsilon_{nt})$ to be heteroskedastic across firms but non-correlated across time.

We estimate the model by either using the Ibex-35 index of the Madrid stock exchange as R_{mt} (M1) or a constant mean returns model (M2) which implies that, from the previous equations, we remove $\beta_i R_{mt}$. This structure allows the coefficients to differ across firms and is an application of the seemingly unrelated regression methodology, SUR (Chang and Lee, 1977)[11]. This multivariate regression model assumes that the disturbances are uncorrelated within each equation but allows for the errors to be contemporaneously correlated across equations. It also presents a number of advantages compared to more standard regression models generally used in event studies. First, it can test joint hypotheses (using the Wald test for instance) while other approaches only test for average effects. Secondly, this property also allows the coefficients not to cancel out with each other when they have different signs i.e. if we want to test the joint effect of an event that causes both positive and negative effects in the different firms tested, by using an averaged time series we would conclude there is no effect as those might cancel out. By

[10] Daily returns can be obtained in the usual fashion

$$r_t = \frac{P_t - P_{t-1}}{P_{t-1}} = \frac{P_t}{P_{t-1}} - 1$$

where P_t stands for prices at time t. Nevertheless, we use the logarithmic transformation

$$R_t = \ln(P_t) - \ln(P_{t-1})$$

where $R_t = \ln(r_t + 1)$, which yields almost identical results, yet a more symmetric distribution, which is clearly convenient for the sake of the analysis as it is far easier to derive the time-series properties of additive processes (such as the natural logarithmic transformation) than of multiplicative processes.

[11] This methodology is also used in a study of financial market perspectives of political expectations by Roberts (1990), without using the bootstrap technique, as we do, to improve the reliability of significance tests.

employing SUR we indeed unveil these effects as long as they are statistically significant. Finally, SUR regression allows robustly testing event windows of a reduced length by multiplying the length of the window across firms and hence increasing the available degrees of freedom.

Testing individual hypotheses is unproblematic under this framework as t-tests can consistently test hypotheses where restrictions are imposed in parameters estimated by SUR estimation. However, we are especially interested in testing joint hypotheses, which present some statistical challenges. Wald tests are available for this type of equation but are only valid asymptotically. In small samples, these tests are biased against the null and tend to over reject. This implies that whereas results are valid when the null hypothesis is not rejected, we need to be cautious in the interpretation of those cases where the null is rejected. Chou (2004) proposes bootstrap methods to address the over rejection problem. Using Monte Carlo simulations, he shows that bootstrapping the sample provides p-values very close to the nominal size of the test. The bootstrap method (Effron, 1979) is a computationally intensive method that allows computing the distribution of a test statistic by re-sampling the data[12]. Horowitz (2001) shows that critical values obtained from this method are always at least as accurate as standard asymptotic theory.

For the purpose of the empirical analysis we propose the following procedure: First, estimate with SUR. Second, test the hypothesis when necessary with the Wald test, and in the case a null hypothesis is rejected at the 5% level, bootstrap the test to obtain the p-values by re-sampling a certain number of times. Due to the fact that this method is very computationally-intensive, we only compute the bootstrapped p-values when the null hypothesis is rejected robustly throughout the different models. Otherwise, we are conservative and understand that there is no sufficient evidence to consider the null rejected. The bootstrap method applied to the Wald test in a SUR framework is applied by following the steps below (Chou, 2004):

[12] Sampling from the original sample. The idea underlying bootstrap is that we pretend that the sample is the population. Thus, we obtain bootstrap samples by sampling from the (original) sample which gives a consistent estimation of the distribution of a test statistic.

1. Estimate the model by Ordinary Least Squares and obtain the residuals ($\hat{\varepsilon}_1, \hat{\varepsilon}_2, ..., \hat{\varepsilon}_T$) and the parameters corresponding to the different alphas, betas and gammas. Calculate the Wald test.
2. Estimate the model by Ordinary Least Squares without the observations corresponding to the event window and obtain the parameters of the model and the residuals ($\hat{\varepsilon}_1, \hat{\varepsilon}_2, ..., \hat{\varepsilon}_{T_1}, \hat{\varepsilon}_{T_2}, ..., \varepsilon_T$), where the event window comprises observations between T_1 and T_2.
3. Repeat a large number of times the following steps:
    a) Draw a bootstrap sample ε_t^* from the residuals in 2. Compute the values of ($R_{1t}, R_{2t}, ..., R_{nt}$) using the parameters from 2 and the bootstrapped residuals ε_t^*. Call the resulting values ($R_{1t}^*, R_{2t}^*, ..., R_{nt}^*$).
    b) Estimate with OLS using the original independent variables data and the bootstrapped dependent variable data ($R_{1t}^*, R_{2t}^*, ..., R_{nt}^*$). Calculate the Wald test and call it τ^*.
4. Calculate the percentage of τ^*'s that are greater than the Wald statistic computed in 1, which provides the bootstrap p-value of the test.

This way, one can obtain reliable joint tests for the hypotheses of interest. These joint tests can be either for all the companies in the sample (Section 3) or for groups of them (Section 4).

We estimate the model for a sample of companies in the MCM (Madrid's Continuous Market) Stock Exchange. 125 companies were originally included in the data set. However, only 87 companies were finally included in the estimation. The 38 remaining companies were excluded because of either thin trading or incomplete data. The estimation period ranges from May 2003 to December 2004, therefore having a pre-event window from May 2003 to March 2004, and a post-event window from March 2004 to December 2004. We use daily returns data for Spanish companies in the MCM Stock Exchange from Infomercados, a financial web site specialized in Spanish equity markets.

Two event windows are included in the estimation, an event window for the terrorist attacks and a window for the period immediately following the general election. The window for the terrorist attacks includes the day of the events, 11th of March, and the day after it, Friday the 12th. In this case the news of the terrorist attacks could not have been discounted, and therefore it does not make sense to include the day before the event as is standard practice in many event studies. There are two reasons for including this event window. In the first place, the attacks might have had an effect on the stock markets by themselves. Secondly, as they were the indirect cause for the change in the election results, economic agents might have partially discounted when the attacks occured that the PP was going to lose the election, or more seemingly, that the probabilities of the PSOE to win the election increased. Section 5 discusses in more detail the literature on terrorism and economy and whether the empirical results support this hypothesis.

The second event window corresponds to the impact of the Spanish general election results. A three-day event window, which is usually the window length chosen for general event studies with daily data, is not the most suitable length in this case. This is because the effects of a change in a government are of a higher and deeper importance than particular events affecting a firm and it might take some days for traders to analyse and understand the nature of the change to its whole extent. We therefore prefer a five-day event window instead. For robustness of the results we roll back and forward the window presenting results for groups of companies for each model with 4, 5 and 6 days event windows (meaning returns from March 15th to 18th, 15th to 19th, and 15th to 22nd). In Section 3, we also test for the joint significance of the attacks plus the election as if they were a single event and we do this for windows between the day of the attacks and the next Monday (3 days), Tuesday (4 days) and so on until Monday of the following week (8 days).

Once the Wald test is computed, we proceed to compute the bootstrap p-values in those cases where the null hypothesis has been rejected consistently. The benchmark we use for considering a null hypothesis robustly rejected is when at least in one of the two models (M1 and M2) the null hypothesis has been rejected in the three different event windows presented (4, 5 and 6 days). If this is the case, in Section 4 and Section 5 we obtain bootstrap p-values at least for the 5 days case.

2.3 Hypotheses

We test two general hypotheses, both related to the political economy literature (see for example Persson and Tabellini, 2000): the partisan theory of political parties and the theory of collusion between politicians and business managers, which is also linked with the theory of capture and the agency theory of a conflict of interest inside firms and in the political arena.

• **Convergence vs partisanship**. According to the partisanship theory, political parties represent different constituencies with different interests. Due to political transaction costs, issues need to be aggregated in a few dimensions, and political parties differ in these broad dimensions. This is reflected for example in different macroeconomic policies. Historically, the macro-economic differences that were postulated assumed the existence of a trade-off between unemployment and inflation, left parties being more pro-employment and right parties being more anti-inflation (Hibbs, 1977). More modernly, these macro-policies were assumed to take the form of left parties being more pro-public investment and pro-welfare state and right parties being more pro-market, pro-tax reductions or pro-supply side policies, depending on the interpretation or emphasis (see Boix, 1996). If a higher inflation and a higher public deficit lead to increasing interest rates, this would have a negative impact in general on firms' profits, and we should expect a higher probability of left-wing policies being implemented causing lower stock valuations in general. Section 3 empirically tests these hypotheses.

• **Political connections and capture**. Some authors, such as Herron et al. (1999), claim that macro-level policies may hide partisan differences at the sector or company specific level. Even if public deficits or inflation end up being very similar under right or left governments, differences in defence policies, environmental issues or other policies affecting particular industries may be significantly different. For example, using data for the 1992 US election, Herron et al. (1999) show that 15 out of 74 sectors (20%) had a stock price performance which denoted that investors in these sectors were not indifferent between presidential candidates.

Some groups of citizens and businesses may overcome free-riding problems and organise in lobbies or interest groups to influence the policy choices of some politicians (Grossman and Helpman, 2002). It is usually claimed that firm' owners or input providers may find it easier to overcome such free-riding problems than consumers, the latter being more atomised and having less at stake per capita in many policy areas. Geographical or historical reasons may also mean that the same firms or groups of firms may find it easier to access some political parties than others.

Agency problems in politics (voters not perfectly controlling politicians) and inside firms with dispersed shareholdings (shareholders not perfectly controlling managers) may be at the root of collusion episodes between politicians and managers (Trillas, 2004). The intensity of political connections in major Spanish firms may have been particularly prominent in Spain in 2004, as the privatization of major firms selling the assets to a dispersed shareholding facilitated the appointment of managers close to the PP government (Bel and Trillas, 2005), something that a new Socialist government would possibly try to reverse.

Additionally, in Spain in the first years of the XXI Century, one important specific industry was subject to important policy controversies: the electricity industry. This industry was experiencing a takeover wave all over Europe, triggered by the liberalization of energy at the European Union level. As a result, all major Spanish electricity firms were actors in the market for corporate control, either as targets or acquirers. The two main political parties in Spain approached the issue with the objective of keeping Spanish firms under Spanish owners, but whereas the Popular Party tried to do this between 1996 and 2004 by trying to stop any takeover and any subsequent reduction in the number of firms, the Socialist party hinted during the 2004 electoral campaign that it would not block mergers between Spanish firms (see Trillas, 2010). Section 4 presents the empirical results resulting from testing such hypotheses.

3. The joint impact of the election on all the firms in the sample

By testing the hypothesis that the attacks and the election had a significant impact on all the companies in the sample, we are effectively testing whether the surprise election following the terror attacks had a significant effect on the stock market as a whole.

In order to do this, we perform a Wald test to the dummy variables and bootstrap results when the variable results are significant due to over-rejection problems of the test in the SUR framework[13]. Now the Wald test is performed to the whole of the 87 companies included. Table 2 reports the results, distinguishing between models M1 and M2 and the different event windows used. It is important to note that the goodness of fit for individual businesses regressions carried out with the M2 structure is considerably lower than with M1. We nevertheless present both outputs in the tables of results to provide evidence of the persistence (or non-persistence) of the results under different econometric specifications.

Table 2. Impact on all firms in the sample

		M1			M2		
	event window length (election effect) (T)	4 days	5 days	6 days	4 days	5 days	6 days
Terror Attacks Effect	*Wald test*	117.56	117.92	119.57	107.55	107.94	109.41
	p-values	0.0162	0.0153	0.0118	0.0699	0.0637	0.0525
	Bootstrap p-values	-	0.2359	-	-	0.3017	-
TxN		174	174	174	174	174	174
Election Effect	*Wald test*	116.40	97.33	102.14	115.17	97.97	97.96
	p-values	0.0194	0.2106	0.1278	0.0233	0.1978	0.1982
	Bootstrap p-values	0.2470	-	-	0.3966	-	-
TxN		348	435	522	348	435	522

As inspection of Table 2 shows, the Wald test rejects the null hypothesis of no effect of the terror attacks across the different event windows. Nevertheless the bootstrap exercise in the 5-day event window shows that there is no statistically significant effect of the terror attacks in the market as a whole. In the case of the election effect, the asymptotical critical values of the Wald test itself already do not reject the null hypothesis of no effect in 4 out of 6 cases. In order to verify this result, we compute the bootstrap structure of the test in the other 2 cases, resulting in both cases in the confirmation of the no effect hypothesis. As a whole, one would conclude that neither the terror attacks nor the election result affected the Spanish economy as a whole. That would reject partisanship and it would be consistent with convergence theories such as the median voter theorem.

This methodology has not been used by other studies that test for the effect of political results on the stock market as a whole. Traditionally, these studies (see for example

[13] As discussed in section 2.2, we then perform the bootstrap in the 5-day window case.

Vuchelen 2003) regress a national stock market index with dummy variables for the dates in which there were political events. We also did this (and it is available upon request) with mixed results: the variable for the terror attacks was significant (more on this in Section 5) but not the variables including the effect of the election results. However, it is doubtful in statistical terms that one can infer any conclusions from such simple approach. More specifically, one cannot invoke a central limit theorem with 2 observations (in the case of the terror attacks).

Both the election results and the bombings could have had more long-term effects on the financial returns of businesses than those that can be captured in the event windows presented above. To address this question we both tested for structural break in M1 and M2 and considered the effects of the results in stock market volatility. Results from the Chow test of structural break indicate that the impact of either the election or the terrorist attacks did not suppose a break in the time series and therefore the relation between the parameters and the dependent variables is stable both before and after the events.

The events could also have had an impact on stock market volatility. In fact we estimated a series of ARCH and GARCH regressions on the returns of the IBEX-35, and tested for an impact on the volatility during the event windows, with the results indicating a weakly significant and positive impact on volatility during the terrorist attacks window and a negative and non-significant impact for the election results window. However and as discussed above, it is statistically doubtful one can extract conclusions from such a procedure where a Central Limit theorem is invoked with 2 and 5 observations respectively.

Another possibility to analyse longer-term effects is to simply extend the event window to cover a longer period of time and therefore increase the power of the test. We considered an event window for the whole period after the events (over 200 days of trading) and the results indicate a significantly lower volatility than for the period preceding the election. It is however not possible to explain this effect on the basis of the events considered in this article, as long event windows fail to isolate the impact of one specific exogenous factor (the election or the bombings) and instead capture the impact of any event occurring during that period of time.

Table 3 presents the results from testing the impact of both events on the market as a whole (as in Table 2), but with a joint event window covering both the bombings and the post-election period. The table shows that the joint effects of the attacks and the election were only significant, although with border line significance levels, if we take the narrowest possible event window (two days for the pre-election window and one day for the post-election window).

Table 3. Joint impact of the two events (bombings + election results)

		M1						M2					
	event window length (election effect)	1 day	2 days	3 days	4 days	5 days	6 days	1 day	2 days	3 days	4 days	5 days	6 days
Joint effects (2 pre-election days +)	*Wald test*	**195.62**	**138.73**	**97.21**	**99.30**	**105.23**	**116.89**	**238.31**	**157.79**	**104.29**	**109.64**	**111.82**	**129.31**
	p-values	**0.000**	**0.000**	**0.213**	**0.173**	**0.089**	**0.018**	**0.000**	**0.000**	**0.099**	**0.059**	**0.037**	**0.002**
	Bootstrap p-values	**0.0374**	**0.269**	**-**	**-**	**-**	**0.384**	**0.020**	**0.154**	**-**	**-**	**0.465**	**0.231**
TxN		261	348	435	522	609	696	261	348	435	522	609	696

Overall, the results outlined in this section only strengthen the argument that the surprise political result had no impact on the Spanish stock market as a whole even though they weakly suggest that the market reacted abnormally immediately after the bombings. We develop this argument further in section 4. The findings however do not rule out an impact on specific economic sectors or on some businesses politically connected to either PP or PSOE. The following section introduces the methodological approach to testing these hypothetical impacts and presents its results.

4. Testing the impact of political connections using individual companies' or sectors' expectations

4.1. Impact on economic sectors

Political partisanship implies that different parties have different visions about the priorities of the country and, in the equilibrium of the platform setting game, they run with different platforms into the elections, and the platform of the winning party is implemented. For example, a hypothetical partisan industrial policy of the Spanish Socialist party could be a will to restructure the electricity market in Spain, attaining a higher concentration of firms and creating 'national champions' in the electricity market, capable of competing in the European Energy Market, due to come into force in June

2007. We do not imply with this that PSOE favours 'national champions' while PP does not. In fact, the PP Government (1996-2004) threatened to use its golden share to stop the merger of Telefónica with the Dutch company KPM. Bel and Trillas (2005) find evidence in this particular case that this Government's veto was not driven by a will to protect Telefónica's shareholders, but by the fear of losing its residual control over the company. The partisan hypothesis is not about PSOE generally favouring 'national champions' and PP not. It is contingent specifically to the electricity sector, as the PP Government had committed itself on keeping the number of companies in the electricity market, and had honoured the commitment by stopping any merger. The arrival of a PSOE government might have caused a change on the prospects of the sector, by making possible the completion of successful transactions in the market for corporate control.

If this were the case, then again the political change in Spain on March 2004 would have caused abnormal returns on the electricity sector as a whole, as the effect of a prospective partisan policy of the socialist party in the electricity sector would have caused the returns to differ from zero, negatively or positively depending on the market's estimate of this policy's effects.

We test whether whole economic sectors are affected by partisan policies, much in the same way as it is done in Herron et al. (2000) for the American economy[14]. Using the Wald test, we formulate for every sector in the Spanish economy the following hypothesis:

$$(3) \qquad \begin{cases} H_0 : \gamma_{1a} = \gamma_{2a} = ... = \gamma_{sa} = 0 \\ H_A : NoH_0 \end{cases}$$

where $i = 1.....s$, and s is the number of companies in a particular sector, while the gammas are the parameter coefficients related to the political change event window.

[14] We also test whether political change had a significant effect on each company separately. We perform the t-test on all companies included in the estimation (available upon request). Only 3 companies out of a sample of 87 have significant abnormal returns robust to the estimation with both M1 and M2 and the different size of the event windows: Iberpapel, a paper company, Endesa, and Red Eléctrica Española, the two latter ones both electricity companies. Endesa has in all the 6 cases negative abnormal returns at the 1% confidence interval.

We use the official industry division of the MCM Stock Exchange to test for the hypothesis that a particular sector was affected by the election results (see Appendix 1 for a breakdown of companies by sector). Table 4 shows that the only economic sector in which the null hypothesis is rejected in all cases is the electricity and gas sector. In this sector, in 5 cases the null is rejected at the 1% confidence interval and in one case at the 5% confidence interval. The bootstrap p-values in Table 8 confirm such levels of significance for the rejection of the null hypothesis. This result is consistent with the hypothesis that the winners had a partisan interest in changing the structure of the electricity and gas market. However, as appendix 2 shows, some of the companies covered in this sector were also politically connected to the incumbent Government. This poses the question of whether the observed impact on their financial returns was due to the different policy platforms in which the two political parties were running the election in regards to the electricity sector or whether the abnormal returns observed reflect the impact on some of the businesses in the sector from losing political connections to the incumbent Government. Section 4.2 explores this further by specifically analysing the impact on politically connected businesses.

The media sector is affected in 5 out of 6 cases, but only at the 10% confidence level using the standard asymptotic critical values. The bootstrap p-values show that with M1 the effects are not statistically significant while using M2 they remain significant at the 10% confidence interval. However, as discussed in section 3, our confidence in M2 is substantially lower than in M1, given the low goodness of fit of the model to the data, and therefore we cannot draw firm conclusions from this marginal significance level. This result might also express the fact that relevant companies in the sector such as Recoletos, Telecinco or Antena3 where lacking data and could not be included in the regression model. It caused that only three companies were included, two of them closely related one to another (Prisa and Sogecable), and commonly considered to be connected to the Socialist party.

Table 4. Effect of the election results on specific industries: Wald test.

H0: No effect on the sector for the election results

	M0			M7			NxT		
event window length	**4-days**	**5-days**	**6-days**	**4-days**	**5-days**	**6-days**	**4-days**	**5-days**	**6-days**
Oil	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*8*	*10*	*12*
Electricity and gas	*RHo****	*RHo****	*RHo***	*RHo****	*RHo****	*RHo****	*24*	*30*	*36*
Water and others	-	-	-	-	-	-	-	-	-
Minerals, metals and transformation of metal products	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*8*	*10*	*12*
Machinery goods	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*RHo***	*20*	*25*	*30*
Construction	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*RHo***	*20*	*25*	*30*
Construction materials	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*8*	*10*	*12*
Chemical industry	-	-	-	-	-	-	-	-	-
Engineering	-	-	-	-	-	-	-	-	-
Aerospacial	-	-	-	-	-	-	-	-	-
Food and beverages	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*24*	*30*	*36*
Clothes	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*16*	*20*	*24*
Paper and graphic arts	*NoRHo*	*NoRHo*	*NoRHo*	*RHo**	*NoRHo*	*NoRHo*	*20*	*25*	*30*
Cars	-	-	-	-	-	-	-	-	-
Pharmaceutical and Biotechnology	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*16*	*20*	*24*
Other consumption goods	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*8*	*10*	*12*
Tourism and entertainment	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*12*	*15*	*18*
Trade	-	-	-	-	-	-	-	-	-
Media	*RHo**	*RHo**	*RHo**	*RHo**	*RHo**	*NoRHo*	*12*	*15*	*18*
Transport and distribution	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*8*	*10*	*12*
Highways and parkings	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*8*	*10*	*12*
Other services	-	-	-	-	-	-	-	-	-
Banking	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*44*	*55*	*66*
Insurance	*NoRHo*	*NoRHo*	*NoRHo*	*RHo**	*RHo**	*RHo**	*8*	*10*	*12*
Financial investment	-	-	-	-	-	-	-	-	-
Real Estate	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*16*	*20*	*24*
Telecommunications	*NoRHo*	*NoRHo*	*NoRHo*	*RHo**	*NoRHo*	*NoRHo*	*16*	*20*	*24*
Electronics and software	*NoRHo*	*NoRHo*	*RHo**	*RHo***	*RHo**	*RHo****	*8*	*10*	*12*
Technological hardware	-	-	-	-	-	-	-	-	-

Note 1: *RHo* (Null Hypothesis is rejected). *NoRHo* (Null Hypothesis is not rejected)

Note 2: When in a certain sector there are not at least two companies, Wald test is not performed.

Note 3: ***, 1% confidence interval; **, 5% confidence interval; *, 10% confidence interval.

Note 4: Values under NxT indicate the number of observations available for the testing of the hypothesis in each case.

4.2. Testing the impact of political connections

Any theory making predictions about the determinants of firm's profits, be these regulatory policies, movements in the corporate control market, managerial or rivals' decisions, etc., can be tested by a an event study, if the event is not anticipated. Partisan versus convergence theories are certainly not the only ones that can be tested. We focus here on the potential of this event study to shed light on capture and agency theories relating to the relationship between firms and politicians in Spain.

This part of the exercise is related to the literature on political connections, which emerged from the pioneering contributions by Fisman (2001) and Faccio (2006). The latter constructs a database, including over 20,000 publicly-traded firms in 47 countries, reporting about members of boards of directors that have a previous or subsequent experience in politics, and documents a significant increase in corporate value when those involved in politics enter the business sector. Fisman (2001) shows that firms linked to the Suharto family experienced a significant decrease in shareholder value when news negatively associated to the dictator's health were known. Since then, a number of studies have computed the economic advantages for firms' shareholders of being connected at the board level with politicians. For example, Ferguson and Voth (2008) show that firms connected to the Nazi party experienced positive abnormal returns associated to the rise of Hitler's party to the German government.[15]

Elsewhere (see Bel and Trillas, 2005) it has been suggested that corporate governance in large Spanish firms give a lot of discretion to managers, and that they may take advantage of this great discretion by sharing rents with politicians in exchange for favours to political parties, in the form of appointing party cronies, funding media empires or supporting particular policies. In this case, an unexpected change in the ruling party implies a break in long term collusion contracts and possibly the signing of new contracts, for example by favouring the government the appointment of new managers through pressures over key shareholders.

Agency problems may explain the fact that society is not fully able of controlling politicians, who can take decisions seeking particular and not general interests. Bel and Trillas (2005) find evidence consistent with collusion between the PP Government (1996-2004) and the managers of Telefónica, a telecommunications firm. Other state-owned companies where this type of collusion between managers and politicians could have happened where privatised as well during the PP government. If this were the case, abnormal returns would have been experienced in these companies when the PSOE won the election.

In order to test the impact of the election on politically connected businesses, we searched on the archives of Google News for press articles containing references to Board

[15] Other examples of this literature are Boubakri et al. (2008) and Goldman et al. (2009).

Members of companies in the sample of this article at the time when the surprise political result occurred.[16] 46 of the 87 companies resulted in having at least one politically connected Board Member. We then classify connections according to their strength in four different categories:

1) Former Minister/ Junior Minister/ Position of high responsibility in a Government (either National or Regional Government)/ Senior member of a political party.
2) Appointed to manage or lead a public company/ Held other senior positions either in Government or in private sector as appointed by Government.
3) Has very clear links to, is close to, a political party.
4) Reported links to a political party but such relationship is not irrefutable.

There are several ways in which we could define a company to be politically connected. In the broadest possible definition we could define as connected any of the 46 companies which were identified as having a connection of any degree (1-4). However this approach would define as equally connected a company with most Board members being connected with degree 1 and a company with one connection of degree 4. Because we only want to identify as connected those companies where the evidence of political connection is stronger, we establish stricter conditions and provide four different definitions for a company being considered as connected, being (a) the most restrictive definition and (d) the most relaxed:

a) At least 4 Board Members are connected with a strength of connection categorised as 1 or 2
b) At least 25% of Board Members are connected with a strength of connection categorised as 1 or 2
c) At least 4 Board Members are connected with any strength of connection (1-4)
d) At least 25% of Board Members are connected with any strength of connection (1-4)

Companies resulting as connected under each category (see Appendix 2) are then tested for abnormal returns following the election with the two standard models of financial

[16] Search performed over the period July 2010-November 2010. The original press articles where political connections are established are available under request.

returns (M1 and M2) and different lengths of event windows for the election results (4 to 6 days).

Table 5 presents the results from running a Wald test on the financial returns of both connected and non-connected businesses during the post-election window as in (3). The results of the test show significant abnormal returns for connected companies when asymptotic p-values are taken into account. Significance levels are 1% when T=4 and vary between 1% and 10% when T=6. Due to the problems of over rejection of the Wald test under the SUR framework outlined in section 2, we also calculate the bootstrap significance levels of the abnormal returns in those cases where the null hypothesis of no abnormal returns is rejected when T=5. The results are less concluding after calculating bootstrap p-values as even though the test rejects the null hypothesis in most groupings, significance levels are lower at between 5-10% confidence interval levels. Therefore we can only say that there is some weak evidence that the profit expectations of connected businesses were impacted by the surprise political result.

Table 5. Impact of the election results on politically connected firms (Wald test asymptotic and bootstrap p-values)

		M1			M2			
Grouping	**Type of business**	**T= 4**	**T= 5**	**T= 6**	**T= 4**	**T= 5**	**T= 6**	**N**
	Non-connected	0.5105	0.8667	0.5863	0.3891	0.83	0.4196	79
	Connected	**0.0045**	**0.0028**	**0.0314**	**0.0013**	**0.0015**	**0.0055**	8
a	*bootstrap p-values*		***0.0201***			***0.0304***		
	Non-connected	0.5303	0.924	0.5862	0.441	0.9046	0.4209	76
	Connected	**0.0015**	**0.0008**	**0.0243**	**0.0005**	**0.0005**	**0.0055**	11
b	*bootstrap p-values*		***0.0264***			***0.0284***		
	Non-connected	0.6917	0.8639	0.6626	0.5864	0.8434	0.504	72
	Connected	**0.0029**	**0.0141**	**0.0799**	**0.001**	**0.0084**	**0.0219**	15
c	*bootstrap p-values*		*0.1068*			***0.0677***		
	Non-connected	0.593	0.8782	0.6611	0.4669	0.8497	0.5123	65
	Connected	**0.0045**	**0.0172**	**0.0985**	**0.0019**	**0.0122**	**0.0349**	22
d	*bootstrap p-values*		***0.0962***			***0.0976***		

Note 1: Bootstrap p-values are calculated for t=5 if significant abnormal returns are encountered for a particular grouping of companies

Connected companies as identified so far include companies connected either to PSOE, PP or to both parties, hence results may disguise that only companies connected to one party experienced a change in their profits expectations as a result of the surprise political change. To explore this further, for politically connected companies we establish whether

the company is connected to PSOE, PP or whether it has connections to both parties. We define a company as connected to PP(PSOE) if more than 70% of Connected Board Members are connected to PP (PSOE). If less than 70% of Board Members are connected to any one given party we define the company as being connected with a mixed strategy. We then run specific Wald tests for companies connected to PP, PSOE or with a mixed strategy. Where the null hypothesis of no significant impact is rejected, we obtain bootstrap p-values for the 5-day event window as in section 3 to overcome the over rejection problems (Table 6).

Table 6. Impact of the election results on PP connected, PSOE connected and mixed strategy businesses (asymptotic and bootstrap Wald test p-values)

		M1			M2			
Grouping	**Type of business**	**T= 4**	**T= 5**	**T= 6**	**T= 4**	**T= 5**	**T= 6**	**N**
	PP connected	**0.0002**	**0.0001**	**0.0049**	**0.0001**	**0.0001**	**0.0006**	**4**
	PSOE connected	0.9196	0.6366	0.3863	0.3286	0.3005	**0.0701**	1
	Mixed strategy	0.8873	0.9333	0.7359	0.7257	0.7646	0.2686	3
a	*bootstrap p-values*		***0.0028***			***0.0042***		
	PP connected	**0.0001**	**0.0001**	**0.0054**	**0.0000**	**0.0000**	**0.0011**	**6**
	PSOE connected	0.6617	0.8846	0.7411	0.9322	0.5853	0.7517	1
	Mixed strategy	0.7045	0.4482	0.5597	0.7463	0.4761	0.2694	3
b	*bootstrap p-values*		***0.0028***			***0.01***		
	PP connected	**0.001**	**0.0027**	**0.0443**	**0.0004**	**0.0014**	**0.0086**	**9**
	PSOE connected	0.8532	0.7489	0.5477	0.3091	0.3818	**0.0883**	2
	Mixed strategy	0.4713	0.8191	0.5769	0.1795	0.5782	0.1416	4
c	*bootstrap p-values*		***0.0212***			***0.0053***		
	PP connected	**0.0005**	**0.0011**	**0.0276**	**0.0002**	**0.0006**	**0.006**	**12**
	PSOE connected	0.9085	0.903	0.7411	0.4762	0.5853	0.1814	3
	Mixed strategy	0.6116	0.7805	0.7246	0.1953	0.4727	0.2498	6
d	*bootstrap p-values*		***0.0349***			***0.0174***		

The results indicate that businesses connected to the incumbent political party experienced strong abnormal returns after the election, with confidence intervals of bootstrap p-values being statistically significant at the 1-5% level depending on the model and grouping used in the test. Non-connected businesses, businesses connected to the opposition party and businesses connected to both PP and PSOE did not experience significant abnormal returns.

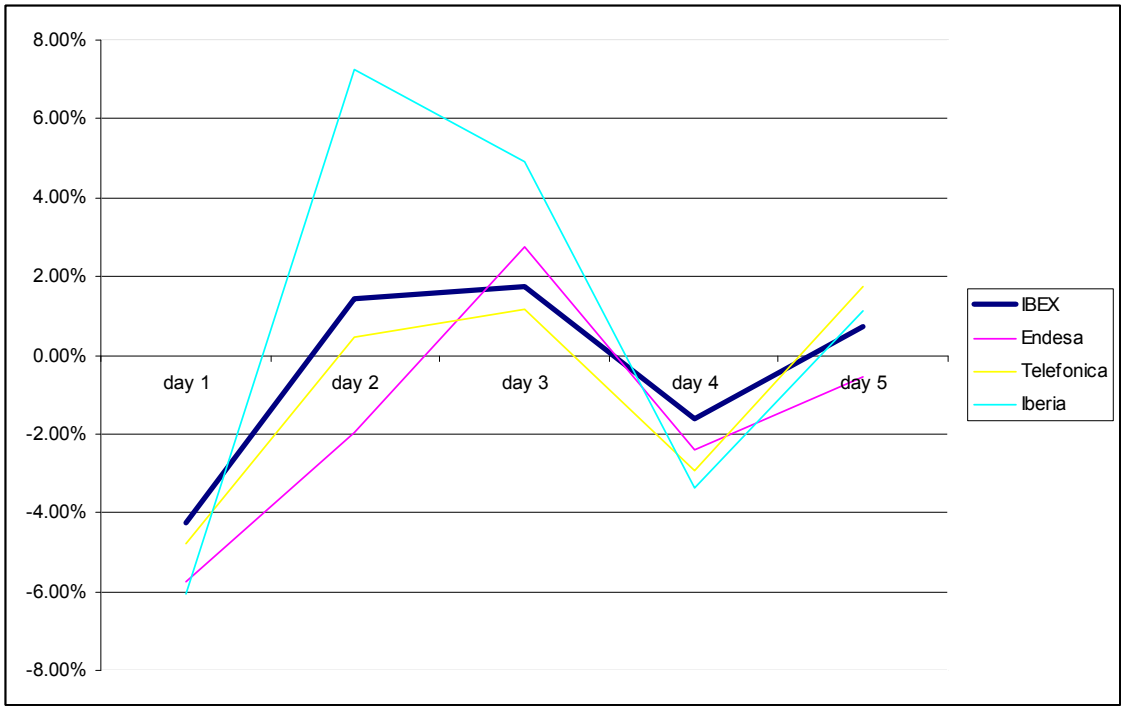
It has to be noted that we have a limited amount of data available for testing the hypotheses in some of the Wald tests presented in Table 7. However tests performed on companies connected to PP generally have a sufficiently large number of observations, between 30 in grouping 1 (T=5 and N=6) and 60 in grouping 4 (T=5 and N=12). This,

combined with the persistence of the statistical significance of the results under different regression models, event windows, groupings of companies, and asymptotic and bootstrap significance levels reinforces the robustness of the results.

The expectation of a potential change in the value of political connections for PP connected companies seems therefore to be at the root of the abnormality of the returns during the election window. The results from the Wald test identify that the behaviour of stock market returns is significantly abnormal but they do not provide information on whether this impact is positive or negative. As outlined at the beginning of this section, capture and political connections, jointly with agency problems within companies, suggest that a company losing political connections to the Government may have either a positive or a negative impact on a company's prospects of profitability. On the one hand, if society is not fully able of controlling politicians these may then collude with some businesses providing a private benefits to these businesses' shareholders. If this were the case, we would expect businesses connected to the PP to experience abnormal negative returns as a result of the surprise election result. On the other hand, if in addition to agency problems between society and politicians there are agency problems between managers and shareholders, managers could collude with politicians to the detriment of both shareholders and citizens. In such case a change in Government could produce positive abnormal returns.

As t-tests for individual companies cannot be robustly performed given the low number of observations available (between 4 and 6 for each company in the post-election window) it is not possible to robustly answer this question with the data available to us. We did perform such tests anyway and these showed negative and significant effects for some PP-connected companies (e.g. Endesa) and positive and significant for others (e.g. Iberia). This may suggest that both factors may have had a role in explaining the abnormal returns observed for PP connected businesses in the aftermath of the election. Figure 2 illustratively shows the financial returns of some of the largest PP-connected companies during the post-election window against the returns of the IBEX-35 stock market index.

Figure 2. Financial returns after the election for selected PP-connected businesses



Finally, there might be several reasons why a change in Government had only an impact on the financial returns of businesses connected to the incumbent party but not to businesses connected to the opposition party or to businesses connected to both parties. In the first place, whereas it may be possible for traders to understand the value to a particular company of being politically connected to the incumbent party, it may take some more time to obtain reliable information on the financial value of connections to a new Government. Secondly, loss aversion bias, as identified in the behavioural finance literature (see Tversky and Kahneman, 1991), may have played a role in explaining that businesses losing a political connection were penalised more heavily than businesses gaining political connections to the new Government.. Finally, it needs to be noted that at the point the election took place, only a limited number of companies where connected to the opposition party, hence reducing the power of the Wald test. The number of companies connected to the PSOE range from 1 to 3 under the different specifications, with a window of T=5 meaning the test is run with only 5 to 15 observations. As Appendix 2 shows, the number of companies connected to the incumbent political party when the election took place was considerably larger. For example, during the PP Government six large companies were privatised -Telefónica (which afterwards spun-off Telefónica móviles), Argentaria (which became after a merger BBVA), Iberia, Altadis,

Endesa and Repsol-, with most of them being identified as connected to PP in our analysis.

5. A remark on the effects of the terrorist attacks

The terrorist attacks in Madrid on March 11 2004 had a potential double effect on the economy. First, the attacks might have directly affected certain economic sectors. Second, the attacks might have had the effect of increasing the probability of PSOE winning the election, and therefore if any company or group of companies were affected (positively or negatively) by the change of government, the effect of the terrorist attacks on their returns would have been different from zero. This is why in our model we used two different event windows (one for the terrorist attacks, another for the election results), in order to avoid considering as consequences of the election results something that was directly related to the attacks themselves. In this short section, we want to show this double effect of the attacks with an example of its effect on specific industries and show how the proposed approach of using two separate windows is largely successful in isolating the direct impacts of the terrorist attacks and the direct impacts of a change in Government.

The literature on the effects of terrorist attacks on the economy[17] points towards a negative impact of terrorism on overall economic growth[18] and also some specific impacts on particular economic sectors. A considerable attention has been paid to the significant and negative impact of terrorist attacks on the tourist sector, for example in Enders and Sandler (1991), Enders et al. (1992) and Richardson et al. (2007). A negative effect on foreign direct investment has also been reported by scholars, for example in Enders and Sandler (1996) and Abadie and Gardeazábal (2008). Finally, Abadie and Dermisi (2008) analyze the impact of terrorist attacks on the office real estate markets in large financial centers, their results suggesting that economic activity in Central Business Districts can be greatly affected by changes in the perceived level of terrorism.

Table 7 presents the effects of the attacks by industry as in Table 4. Table 8 presents the bootstrap p-values for those industries where the null hypothesis of no effect of the terrorist attacks is rejected robustly. Three industries are identified as affected by the

[17] See Frey et al. (2007) and Blomberg and Hess (2008) for surveys.
[18] That is clearly the case of the Basque Country in Spain, as reported by Abadie and Gardeazábal (2003).

terrorist attacks: Tourism and entertainment, Minerals, metals and transformation of metal products and Electricity and gas. As shown in Table 2 the only of these three industries affected by the election result was Electricity and gas. Results reported in Table 4 suggest that the two former sectors were genuinely affected by the attacks themselves as abnormal returns disappear for the post-election window, even though we need to be cautious given the reduced number of observations employed for carrying out the tests (see Table 7). The effect on the Electricity and gas sector however could be also related with the variation in the likely winner of the election that were being held three days after the attacks occurred and the fact that most companies in the sector where also connected to the PP party. This is consistent with results discussed above in section 4.

Table 7. Effect of the terrorist attacks on economic sectors: Wald test

H0: No effect on the sector for the terrorist attacks

	M0			M7			
event window length	**4-days**	**5-days**	**6-days**	**4-days**	**5-days**	**6-days**	**NxT**
Oil	*NoRHo*	*NoRHo*	*NoRHo*	*RHo***	*RHo***	*RHo***	*4*
Electricity and gas	*RHo***	*RHo***	*RHo***	*RHo****	*RHo****	*RHo****	*12*
Water and others	-	-	-	-	-	-	-
Minerals, metals and transformation of metal products	*RHo****	*RHo****	*RHo****	*RHo****	*RHo****	*RHo****	*4*
Machinery goods	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*10*
Construction	-	-	-	-	-	-	*10*
Construction materials	*NoRHo*	*NoRHo*	*NoRHo*	*RHo**	*RHo**	*RHo**	*4*
Chemical industry	-	-	-	-	-	-	-
Engineering	-	-	-	-	-	-	-
Aerospacial	-	-	-	-	-	-	-
Food and beverages	*NoRHo*	*NoRHo*	*NoRHo*	*RHo***	*RHo***	*RHo***	*12*
Clothes	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*8*
Paper and graphic arts	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*10*
Cars	-	-	-	-	-	-	-
Pharmaceutical and Biotechnology	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*8*
Other consumption goods	*NoRHo*	*NoRHo*	*NoRHo*	*RHo**	*RHo**	*RHo**	*4*
Tourism and entertainment	*RHo****	*RHo****	*RHo****	*RHo****	*RHo****	*RHo****	*6*
Trade	-	-	-	-	-	-	-
Media	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*6*
Transport and distribution	*NoRHo*	*NoRHo*	*NoRHo*	*RHo***	*RHo***	*RHo***	*4*
Highways and parkings	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*4*
Other services	-	-	-	-	-	-	-
Banking	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*22*
Insurance	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*4*
Financial investment	-	-	-	-	-	-	-
Real Estate	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*8*
Telecommunications	*NoRHo*	*NoRHo*	*NoRHo*	*RHo**	*RHo**	*RHo**	*8*
Electronics and software	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*NoRHo*	*4*
Technological hardware	-	-	-	-	-	-	-

Note 1: *RHo* (Null Hypothesis is rejected). *NoRHo* (Null Hypothesis is not rejected)
Note 2: When in a certain sector there are not at least two companies, Wald test is not performed

Note 3: ***, 1% confidence interval; **, 5% confidence interval; *, 10% confidence interval

Note 4: Values under NxT indicate the number of observations available for the testing of the hypothesis in each case.

Table 8. Bootstrap p-values obtained from the 5-days election results event window model, compared to the p-values of the Wald test

		M0		M7		
		Wald	Bootstrap	Wald	Bootstrap	NxT
Election results	Media	0.099	0.119	0.079	0.086	15
	Electronics	-	-	0.095	0.106	10
	Electricity	0.000	0.001	0.000	0.002	30
	Insurance	-	-	0.070	0.112	10
Terrorist attacks	Electricity	0.042	0.091	0.002	0.022	12
	Minerals	0.031	0.058	0.004	0.023	4
	Construction materials	-	-	0.067	0.113	4
	Food and beverages	-	-	0.048	0.101	12
	Other consumption goods	-	-	0.071	0.092	4
	Tourism and entertainment	0.005	0.030	0.000	0.007	6
	Transport and distribution	-	-	0.021	0.043	4
	Telecommunications	-	-	0.086	0.118	8

Overall, given the economic literature on the impact of terrorism and the empirical results provided in this article, there is no obvious reason to think that those businesses connected to the PP would have been more directly affected by the bombings than any other company in our sample. Companies connected to the PP are from different sectors of the economy, many of them not affected directly by the terrorist attacks neither according to the literature or by the empirical results in Tables 7 and 8.

To provide further support to the use of the two separate windows, we did test for the impact of the two-day terror attack effect on PP connected businesses, with mixed results (see Table 9). Testing the impact with M1, the model with the best goodness of fit, suggests strongly that no abnormal returns where observed in PP companies in the immediate aftermath of the terror attacks. Of the four groupings of PP connected businesses considered, only one case shows a weak significant impact, and this is at the 10% confidence interval level. However when testing the hypothesis with M2, a more simplistic model with a lower goodness of fit, the Wald test provides levels of significance across the four groupings considered, even though at varying degrees of significance between 1-10% confidence interval levels. This result may be spurious given the poor goodness of fit of such model and the reduced number of observations in the Wald test (note that the statistical significance of the results decreases when the sample size increases). In any case, the results provide at most some weak evidence for slight

abnormality of the financial returns of PP-connected businesses in the immediate aftermath of the bombings, suggesting perhaps that in fact the potential change in the expectations for the election results could have started to be discounted from that point in time. This is problematic, as suggests that the use of two separate windows in the analysis may not perfectly isolate the separate impacts of the bombings and the surprise election results. In any case though, the results are clear in indicating that any potential effect observed on PP companies in the immediate aftermath of the bombings is considerably weaker than after the election, when the change in companies' profit expectations was fully confirmed with the surprise results of the general election.

Table 9. Impact on PP-connected businesses after the bombings

		M1	M2	
Grouping	Type of business	terrorist	terrorist	**NxT**
a	PP connected	**0.0682 (0.0869)**	**0.0013 (0.0127)**	20
b	PP connected	0.1225	**0.0031 (0.0244)**	30
c	PP connected	0.1845	**0.0056 (0.0486)**	45
d	PP connected	0.2424	**0.0095 (0.0923)**	60

(Boostrap p-values in brackets)

6. Conclusions

This study shows that as a whole the forces of political convergence are quite strong. Political rhetoric in Spain is acrimonious, and memories of the 1936-1939 Century Civil War and the 1939-1975 Franco´s Dictatorship are (and have increasingly been in the recent past) commonly used in the political debate. Post-election political evolution confirms that macro-economic policy has not been the main political cleavage between right and left in Spain. Although Prime Minister Zapatero was portrayed by the opposition as the most radical Prime Minister in Spanish democratic history, the Finance Minister since 2004 was Pedro Solbes, a former EU Commissioner committed with fiscal discipline and macro-economic stability, who had also been Finance Minister in the González governments of the early 1990's, when Spain applied for membership in the Euro area. The opposition focused on nationalist tensions as the main political issue, and it concentrated on economic issues only on occasion of the takeover of the electricity firm Endesa and similar matters related to corporate control and regulatory institutions (mainly

microeconomic issues[19]). The overall results are consistent with no partisanship (so no effect on expected macro policies such as fiscal policy, inflation, public expenditure or unemployment policies that may affect the market as a whole). Parties may indeed diverge in non-economic policy dimensions, such as social, religious and cultural norms, foreign policy, or the degree of institutional decentralization (for example, they bitterly fight over how to put an end to violence in the Basque Country). But the profit expectations of the stock market as a whole remained unaffected.

The results however also support the hypothesis that particular industries and businesses may be affected by the political structure of Spain and the nature of its business-politicians networks. A number of companies were indeed affected by the election results analysed in this article, and the empirical results provide some support to the hypothesis that the degree of political connectedness of such businesses is at the core of explaining the impact of the surprise election results on their financial returns. Our exercise is based on the event study methodology, which depends on market expectations and, in particular, the results are meaningful only to the extent that the semi-strong version of the efficient financial markets hypothesis holds. Besides, partisan macro-economic effects could have an impact on agents that are not the investors in quoted firms, but workers, consumers, or investors in other firms.

Differences over economic policies between right and left vary over time and across countries; in 2004 in a Euro-area country such as Spain, there was no clear and robust evidence of significant differences. However, capture and political connections, jointly with agency problems within companies, appear to have had a significant impact on those firms where such conditions were present, particularly when such connections were with the incumbent Government.

[19] Although in February 2007 the two main political parties were reaching an agreement on takeover and competition policy legislations.

References

Abadie, A. and S. Dermisi, "Is Terrorism Eroding Agglomeration Economies in Central Business Districts? Lessons from the Office Real Estate Market in Downtown Chicago", *Journal of Urban Economics*, 64: 451-463, 2008.

Abadie, A. and J. Gardeazábal, "The Economic Costs of Conflict: A Case Study of the Basque Country", *American Economic Review*, 93(1): 113-132, 2003.

Abadie, A. and J. Gardeazábal, "Terrorism and the World Economy", *European Economic Review*, 52: 1-27, 2008.

Alesina, A. and Rosenthal, H., *Partisan Politics, Divided Government and the Economy*, Cambridge University Press, 1995.

Bel, G. and Trillas, F., "Privatization, Corporate Control and Regulatory Reform: The case of Telefónica?", *Telecommunications Policy* 29, 25-51, 2005.

Bergman, T., *Constitutional Rules And Party Goals In Coalitions Formation. An Analysis Of Winning Minority Governments In Sweden*, Umea Universiteit, 1995.

Binder, J.J., "Measuring the Effects of Regulation with Stock Price Data", *The RAND Journal of Economics* 16-2, 167-183, 1985.

Binder, J.J., "The Event Study Methodology Since 1969", *Review of Quantitative Finance and Accounting,* 11, 111-137, 1998.

Blomberg, S.B. and Hess, G.D., "Economics of Terrorism", *New Palgrave Dictionary of Economics*, Second Edition, 2008.

Boix, C., *Partidos políticos, crecimiento e igualdad. Estrategias económicas conservadoras y socialdemócratas en democracias avanzadas.* Madrid: Alianza Editorial, 1996.

Boubakri, N.; Cosset, J.C.; Saffar, W., "Political Connections of Newly Privatized Firms", *Journal of Corporate Finance*, 14: 654-673, 2008.

Chou, P., "Bootstrap Tests for Multivariate Event Studies", *Review of Quantitative Finance and Accounting,* 23, 275-290, 2004.

Downs, A., *An Economic Theory of Democracy*, Harper and Row, New York, 1957.

Effron, B., "Bootstrap Methods: Another Look at the Jacknife", *Annals of Statistics* 7, 1-26, 1979.

Enders, W.K. and T. Sandler, "Causality between Transnational Terrorism and Tourism: The Case of Spain", *Terrorism*, 14(1): 49-58, 1991.

Enders, W.K. and T. Sandler, "Terrorism and Foreign Direct Investment in Spain and Greece", *Kyklos*, 49: 331-352, 1996.

Enders, W.; Sandler, T.; Parise, G.F., "An Econometric Analysis of the Impact of Terrorism on Tourism", *Kyklos* 45(4): 531–554, 1992.

Faccio, M., "Politically Connected Firms", *American Economic Review*, 96 (1): 369-386, 2006.

Ferguson, T. and H.J. Voth, "Betting on Hitler –the Value of Political Connections in Nazi Germany", *Quarterly Journal of Economics*, 123 (1): 101-137, 2008.

Ferreira, F. and J. Gyourko, "Do Political Parties Matter? Evidence from U.S. Cities", *Quarterly Journal of Economics*, 124 (1): 399-422, 2009.

Fisman, R., "Estimating the Value of Political Connections", *American Economic Review*, 91(4): 1095-1102, 2001.

Frey, B.S.; Luechinger, S.; Stutzer, A., "Calculating Tragedy: Assessing The Costs Of Terrorism", *Journal of Economic Surveys*, 21(1): 1-24, 2007.

Füss, R.; Bechtel, M. "Partisan Politics and Stock Market Performance: The Effect of Expected Government Partisanship on Stock Returns in the 2002 German Federal Election", mimeo, 2006.

García Montalvo, J. "Voting after the Bombing: A Natural Experiment on the Effect of Terrorist Attacks on Democratic Elections", *Review of Economics and Statistics*, forthcoming, 2010.

Goldman, E.; Rocholl, J.; So, J., "Do Politically Connected Boards Affect Firm Value?", *Review of Financial Studies*, 22(6): 2331-2360, 2008.

Grossman, J.M. and Helpman, E., *Special Interest Politics*, MIT Press, 2002.

Herron, M.C., "Estimating the Economic Impact of Political Party Competition in the 1992 British Election", *American Journal of Political Science*, 44(2): 326-337, 2000.

Herron, M.C., Lavin, J., Cram, D. and Silver, J., "Measurement of Political Effects on the United States Economy: a Study of the 1992 Presidential Election", *Economics and Politics* 11-1, 51-81, 1999.

Hibbs, D.A., "Political Parties and Macroeconomic Policy", *American Political Science Review* 71: 1467-1487, 1977.

Horowitz, J.L., "The Bootstrap", *Handbook of Econometrics* 5, 3159-3228, North Holland, 2001.

Hotelling, H., "Stability in Competition", *The Economic Journal* 39-153, 41-57, 1929.

Jayachandran, S., "The Jeffords Effect", *Journal of Law and Economics*, XLIX: 397-425, 2006.

Jensen, N.M. and Schmith, S., "Market Responses to Politics: the Rise of Lula and the Decline of the Brazilian Stock Market", *Comparative Political Studies* 38-10, 1245-1270, 2005.

Khotari, S.P. and Warner, J.B., "Econometrics of Event Studies", *Handbook of Corporate Finance: Empirical Corporate Finance,* Chapter 1, 2007.

Laver, M. and Schofield, N., "*Multiparty Government: The Politics of Coalition in Europe",* The University of Michigan Press, 1998.

Leblang, D.; Mukherjee, B., "Government Partisanship, Elections, and the Stock Market: Examining American and British Stock Returns, 1930-2000", *American Journal of Political Science*, 49(4): 780-802, 2005.

MacKinlay, A.C., Event Studies in Economics and Finance, *Journal of Economic Literature* 35, 13-39, 1997.

Pantzalis, C.; Stangeland, D.A. ; Turtle, H.J., "Political Elections and the Resolution of Uncertainty: The International Evidence", *Journal of Banking and Finance*, 24: 1575-1604, 2000.

Persson, T.; Tabbellini, G., Political Economics. Explaining Economic Policy, The MIT Press, 2000.

Petterson-Lidbom, P. "Do Parties Matter for Economic Outcomes? A Regression-Discontinuity Approach", *Journal of the European Economic Association*, 6(5): 1037-1056, 2008.

Reniu, J.M., Las teorías de las coaliciones políticas revisadas: la formación de gobiernos minoritarios en España, 1977-1996, Universitat de Barcelona, 2001.

Richardson, H.W.; Gordon, P.; Moore, J.E.; Kim, S.; Park, J.; Pan, Q., "*Tourism and terrorism: The National and Interregional Economic Impacts of Attacks on Major US theme Parks*", in Richardson, Gordon and Moore, eds. The Economic Costs and Consequences of Terrorism, Edward Elgar, 2007.

Riker, W.H., The Theory of Political Coalitions, Greenwood Publishing Group, 1962.

Roberts, B.E., "Political Institutions, Policy Expectations, and the 1980 Election: A Financial Market Perspective", *American Journal of Political Science* 34-2, 289-310, 1990.

Roemer, J.E., Political Competition. Theory and Applications, Harvard University Press, 2001.

Shum, P.M., "The 1992 Canadian Constitutional Referendum: Using Financial Data to Assess Economic Consequences", *The Canadian Journal of Economics* 28 4a, 794-807, 1995.

Trillas, F., "The Structure of Corporate Ownership in Privatized Utilities", *Investigaciones Económicas*, May 2004, Vol. XXVII (2): 257-284, 2004.

Trillas, F., 2010, "*Corporate Control in the Electricity Industry*", in Energy Regulation in Spain: from Monopoly to Market, edited by J.C. Jiménez and J.L. García Delgado, Thomson Civitas, 2010.

Tversky, A. and Kahneman, D., "Loss Aversion in Riskless Choice: A Reference Dependent Model". *Quarterly Journal of Economics* **106**, 1039-1061, 1991.

Vuchelen, J., "Electoral Systems and the Effects of Political Events on the Stock Market: The Belgian Case", *Economics and Politics* 15-1, 85-102, 2003.

Appendix 1. Companies grouped by industries

Economic sector	Company
Oil	Cepsa
	Repsol
Electricity and gas	Endesa
	Enagas
	Iberdrola
	Gas Natural
	Red Eléctrica
	Unión Fenosa
Water and others	-
Minerals, metals and transformation of metal products	Acerinox
	Turbacex
Machinery goods	Azkoyen
	Gamesa
	Duro Felguera
	Mecalux
	Zardoya Otis
Construction	ACS
	Acciona
	FCC
	Ferrovial
	Sacyr Vallehermoso
Construction materials	Portland
	Uralita
Chemical industry	-
Engineering	-
Aerospacial	-
Food and Beverages	Campofrio
	Ebro Puleva
	Natra
	Pescanova
	SOS Cuetara
	Viscofan
Clothes	Adolfo Dominguez
	Dogi
	Inditex
	Sniace
Paper and Graphic Arts	Ence
	Iberpapel
	Miquel i Costas
	Europac
	Unipapel
Cars	-
Pharmaceutical and Biotechnology	Puleva Biotech
	Faes
	Natraceutical
	Zeltia
Other consumption goods	Altadis
	Vidrala
Toruism and entertainment	NH Hoteles
	Sol Melia
	Telepizza
Trade	-
Media	Prisa
	Sogecable
	TPI
Transport and distribution	Iberia
	Logista
Highways and parkings	Abertis
	Europistas
Other services	-
Banking	Banco Andalucia
	BBVA
	Bankinter
	Banesto
	Banco Valencia
	Banco de Credito Balear
	Banco Guipuzcoano
	Banco Pastor
	Banco Popular
	Banc Sabadell
	BSCH
Insurance	Catalana Occidente
	Mapfre
Financial investment and holding	-
Real Estate	Inmocaral
	Colonial
	Metrovacesa
	Urbis
Telecommunications	Tecnocom
	Jazztel
	Telefonica
	Telefonica moviles
Electronics and software	Amper
	Indra
Technological hardware	-

Appendix 2. Companies connected under each grouping

	Abertis, S.A.	mixed strategy
	Banco Santander, S.A.	mixed strategy
	Endesa, S.A.	PP
	Metrovacesa S.A.	PP
	Red Electrica Corporacion, S.A.	PP
	Repsol YPF, S.A.	PP
	Sogecable	PSOE
Grouping a	Sol Melia,S.A.	mixed strategy
	Adolfo Domínguez, S.A.	PSOE
	Endesa, S.A.	PP
	Iberia, Lineas Aereas de España, S.A.	PP
	Jazztel, P.L.C.	Mixed strategy
	Metrovacesa S.A.	PP
	Natraceutical,S.A.	PP
	Red Electrica Corporacion, S.A.	PP
	Repsol YPF, S.A.	PP
	Sol Melia,S.A.	mixed strategy
	Tecnocom,Telecomunicaciones y Energia,S.	mixed strategy
Grouping b	Turbacex	PNV
	Abertis, S.A.	mixed strategy
	Acciona, S.A.	PSOE
	ACS, S.A.	PP
	Banco de Valencia	PP
	Banco Santander, S.A.	PP
	Enagas, S.A.	PP
	Endesa, S.A.	PP
	Gas Natural Sdg, S.A.	mixed strategy
	Metrovacesa S.A.	PP
	Red Electrica Corporacion, S.A.	PP
	Repsol YPF, S.A.	PP
	Sogecable	PSOE
	Sol Melia,S.A.	mixed strategy
	Telefonica moviles	mixed strategy
Grouping c	Telefonica, S.A.	PP
	Acciona, S.A.	PSOE
	ACS, S.A.	PP
	Adolfo Domínguez, S.A.	PSOE
	Banco de Valencia	PP
	Enagas, S.A.	PP
	Endesa, S.A.	PP
	Gas Natural Sdg, S.A.	mixed strategy
	Iberia, Lineas Aereas de España, S.A.	PP
	Jazztel, P.L.C.	Mixed strategy
	Logista	PP
	Metrovacesa S.A.	PP
	Natraceutical,S.A.	PP
	Red Electrica Corporacion, S.A.	PP
	Repsol YPF, S.A.	PP
	Sogecable	PSOE
	Sol Melia,S.A.	mixed strategy
	Tecnocom,Telecomunicaciones y Energia,S.	mixed strategy
	Telefonica moviles	mixed strategy
	Telefonica, S.A.	PP
	Turbacex	PNV
	Uralita, S.A.	mixed strategy
Grouping d	Viscofan, S.A.	PP

Chapter 3

Profits and political connections: The Spanish puzzle

1. Introduction

Understanding the nature and outcomes of business-government interactions is essential to many fields of economics, notably regulatory economics, but also development and business economics. In the economics literature, the outcomes of public sector intervention have been mainly theorised on the basis of the nature and motivations of the interaction between the public and private sectors. These in turn can be predicted to be a function of the stake of private and corporate interest groups and the institutional structure of the public sector (Stigler, 1971; Posner, 1974; and Peltzman, 1976). Theoretical models generally describe different results by firms with political influence compared to their non-connected or less influential counterparts. However the factors in play are complex, and different forms of political influence can lead to either positive or negative economic outcomes to both society at large and the private sector. Empirical research in the area has developed vastly over the last decades.

If politically connected firms can obtain a favourable regulatory treatment (Strattman, 2005), better access to public procurement contracts (Goldman et al, 2010) or obtain any other form of preferential treatment, private rents can be obtained by politically connected firms in detriment of society. However, under other scenarios, political connections can have a negative effect on firm performance. In the presence of agency problems, for example where corporate governance does not provide a strong control by shareholders of the management of the firm, private rents may be obtained by managers (and shared with politicians) rather than shareholders. For example, managers may

collude with politicians to defend themselves from takeover threats. This may be especially relevant in countries, periods and industries where there is substantial activity in the market for corporate control. Economic theory and empirical results also suggest a positive relationship between human capital and firm performance (Bloom and Van Reenen, 2007), and it is not clear that managers or directors which provide political connections can offer the same managerial ability and skilled human capital than their non-connected counterparts. A substitution effect on human capital is therefore possible. Furthermore, when political influence and corruption are widespread, it is usual to observe long-term negative growth and firm performance by those firms in more corrupt sectors and/or regions (Mauro, 1995). Connections and their effects will vary from country to country and sector to sector, driven by amongst other factors the level of tolerance of the electorate.

The empirical research has devoted increasing attention to the relationship between political influence and firm performance, for example by systematically defining measures of political connectedness for a country or firm. This is typically determined by whether board members have links to office or a political party. Such methodologies have allowed testing the effects of political influence on different measures of firm performance. Two distinct empirical approaches have generally been used to test this relationship: event studies of financial markets performance in response to events relevant to political connectedness; and econometric studies that attempt to estimate the impact of political connectedness on accounting-based measures of firm performance.

In financial markets-type studies, most researchers find a positive and statistically significant effect of political influence on the financial value of firms. Fisman (2001) shows that firms linked to the Suharto family experienced a significant decrease in shareholder value when news negatively associated to the dictator's health were known. Jayachandran (2006) finds that the surprise political event of Senator Jim Jeffords leaving the Republican Party and tipping control of the U.S. Senate to the Democrats in 2001 resulted in a firm losing 0.8% of market value for every $250k it gave to the Republicans in the previous election cycle. Faccio (2006) constructs a database of over 20,000 publicly-traded firms in 47 countries and some information on members of boards of directors that have a previous or subsequent experience in politics, and documents a

significant increase in corporate value when those involved in politics enter the business sector. Ferguson and Voth (2008) show that firms connected to the Nazi party experienced positive abnormal returns associated to the rise of Hitler's party to the German government. Goldman et al (2009) find positive abnormal stock returns in S&P 500 firms following the announcement of the nomination of a politically connected individual to the board. Niessen and Ruenzi (2010) find better stock market performance in German firms which are politically connected.

On the other hand, research based on the analysis of accounting-based measures of performance generally finds a negative and statistically significant relationship between political influence and the performance of firms. La Porta, Lopez-de-Silanes, and Zamarippa (2003) show how well-connected Mexican banks engaged in a considerable amount of irresponsible lending before the 1995 crisis, which the authors argue contributed to the severity of the crisis. Khwaja and Mian (2005) use a set of more than 90,000 firms in Pakistan to find that politically connected firms borrow 45 percent more and have 50 percent higher default rates. Fisman and Svenson (2007) exploit a data set containing information on the estimated bribe payments of Ugandan firms to study the relationship between bribery payments, taxes and firm growth, finding that bribery is negatively correlated with firm growth. Boubakri, Cosset and Saffar (2008) investigate the performance of newly privatised firms in developing countries in the presence of political connections and find that politically-connected firms show a worse performance than non-connected firms. Menozzi, Gutierrez & Vannoni (2011) find that politically connected directors in public Italian utilities increase employment in firms[1] but have a negative impact on their performance. Desai and Olofsgard (2011) use data from the World Bank's Enterprise Surveys of approximately 8,000 firms in 40 developing countries and find that politically influential firms are worse-performing than their non-influential counterparts.

Finally, a reduced number of studies, also based on accounting-based measures of firm performance, report a positive relationship between influence and firm performance. Li et al (2008) find that Communist Party membership of private entrepreneurs has a positive effect on the performance of their firms; and Cingano & Pinotti (2009) find that political

[1] Bertrand, Kramarz, Schoar and Thesmar (2004) find similar results in France, with politically connected CEOs creating more jobs in politically contested areas.

connections add a premium to the revenues of those firms which are connected. However, neither of these papers considers endogeneity issues which, as we will argue in section 4, are an important factor which needs to be considered carefully in such empirical assessments because bad performance may trigger attempts to increase political influence.

Overall, whereas empirical methods based on financial-markets measures of performance tend to find a positive relationship between political connections and firms' value, approaches based on accounting-based measures tend to mostly encounter the opposite result. The accounting-based methodology, whilst more transparent, is problematic as establishing an econometrically robust relationship between firm profits and political influence is not straightforward given the likely endogeneity between performance and political connectedness. For example, whilst political connections may result in private rents and hence better firm performance, bad performance can also lead to firms seeking new political connections in the market for political influence. Additionally, accounting-based measures of performance might not necessarily be a good proxy of economic performance, as firms' accounts will tend to artificially smooth earnings and costs across years in order to maintain investors' confidence. The financial-value approach circumvents such econometric issues, but it however relies on an indirect outcome of a firm's performance (financial markets returns), and hence is only meaningful to the extent that financial markets behave efficiently by accounting for the impact of political connections on the market value of a firm. Constraints and limitations to both methods mean that it cannot be strongly argued that one approach is neatly superior to the other.

Empirical findings have been shown to vary substantially depending on the methodological approach that is chosen. Such differences can be driven either by the inherent limitations in each empirical technique, or by the studies having been carried out in different points in time and place. In this paper, we undertake to overcome some of these constraints by exploring the impact of political connections on firm performance by employing both direct (accounting-based) and indirect (financial value) empirical methods.

We do it for a country (Spain) where the degree of connections between its private sector and politicians is a stable and enduring feature over the period of the analysis. We built a

unique dataset covering 69 of the largest publicly traded Spanish companies with information on the political links of over 1,000 directors over the period 2002-2009. This is a relatively long period of time which also allows us to test the impact of different degrees of political connections, as well as any potential differences between connections to the political party in office or in opposition. The dataset also covers two different Governments and a change in the economy to recession which allows us to consider the evolution of political connections during a period in which both national politics and the business cycle were subject to considerable fluctuations.

A perfect comparison of the number of political connections in this paper to those for other countries is impossible because no author has used exactly the same definition of political connections. However, keeping in mind the differences in definitions and sample bases, we cautiously claim that the extent of political connections in Spain according to our data (50 out of 69 firms, i.e. 72%, are politically connected) is at the higher end of the presence of political agents in boards of directors, especially if we compare it with Boubakri et al (2008) and Goldman et al. (2009), who take a similar definition to ours. Actually, the percentage is closer to the percentage of politically connected privatized firms in developing countries according to the findings by Boubakri et al (2008) (close to 75%) than to the percentage observed in a developed country such as the US according to Goldman et al. (2009) of around 30%.

Only a limited amount of previous research has been conducted to date in Spain. On accounting-based measures, Cunat and Caricano (2010) find that those Spanish savings societies whose chairman is politically connected experience a worse loan performance. Castells and Trillas (2011), taking advantage of event-study techniques, find significant abnormal returns (both negative and positive) on politically connected firms on the eve of a surprise political result. Finally, Faccio (2006) considers as part of a multi-country analysis about 200 Spanish firms, and only finds 3 of them being politically connected, dramatically underestimating the extent of political connections by large firms that we observe in our database.

Results from our analysis suggest that in Spain, in the first years of the 21st century, political connections may have had a negative impact on firms' profits. Even though results from the financial markets-based analysis are inconclusive, the econometric

analysis of accounting-based measures of performance shows a negative and highly statistically significant negative impact of political connections on firm's performance. The results hold regardless of the particular variable or measure that is used to proxy for political connectedness and under different considerations of the grade of connections that is considered. The results also hold when controlling for the potential endogeneity that may exist - whereas connections to politicians might result in better (worse) business performance, also changes in business performance might lead to higher (lower) connections.

As opposed to most papers based on financial markets-based analysis (analyzing the US, Germany and several developing countries as well as international cross-country evidence), but similarly to some of the research considering accounting-nased measures of firm performance, such as Bertrand et al. (2006) for France, we find a negative correlation between political connections and corporate performance, although in Spain the connections cannot be attributed to an elite of highly trained technocrats as in France. Desai and Olofsgard (2011) also find a negative correlation between influence of firms in policy and performance for a cross-section of developing countries. We discuss at large the potential reasons underlying these results in section 5.

Section 2 presents the dataset and describes it in the context of the broader literature on political connections. Section 3 analyses the financial returns observed following the appointment of politically connected members of the Board. Section 4 presents econometric analysis on the impact of connectedness on business profitability. Section 5 concludes.

2. The big picture of political connections in Spain

a) Political connections data

We built a large dataset of politically connected board members in firms publicly listed in the Spanish Stock Exchange (Madrid's Mercado Continuo, MMC). The dataset covers 69 of the largest publicly traded Spanish companies over the period 2002-2009[2]. The number of firms that traded over this period on the MMC is somehow larger, but we focus on

[2] The database covers information on appointments for the period 2002-2009, and information on the yearly composition of the board for each of the 69 companies.

those firms which have remained publicly quoted over most of the period and for which data on financial returns is available on a daily basis[3].

The dataset includes information on the composition of the board of directors for every year in the period, the date in which each director was appointed, and the political affiliation of the individual. Data on the appointment is obtained from the independent regulator of the Spanish Stock Exchange[4], and was clerically gathered from yearly company reports on the structure and composition of the Board of Directors[5] which are submitted yearly to the regulator by each company.

The political affiliation (if any) of directors is obtained by means of searching the names of the members of the Board in the archives of the Spanish version of Google News, an internet-based aggregator of Spanish newspapers. Searches in Google News were performed between July 2010 and November 2010. When these searches revealed a connection to a political party which was previous to the appointment of the Director to the Board, this was recorded, filed and categorised. The type and nature of connections identified in news stories showed a high degree of divergence in regards to the source and degree of connectedness for different Board Members. We therefore classified connections according to their strength in four different categories:

Grade 1) Former Minister/ Junior Minister/ Position of high responsibility in a Government (either National or Regional Government)/ Senior member of a political party.
Grade 2) Appointed to manage or lead a company owned by the state or where the state participates in its ownership/ Held other senior positions either in Government or in private sector as appointed by Government.
Grade 3) Has very clear links to, is close to, a political party.
Grade 4) Reported links to a political party but such relationship is not irrefutable.

[3] This allows us to undertake the analysis in section 3, which is based on financial markets returns. Note that this typically corresponds to the largest stocks in the market.
[4] Comision Nacional del Mercado de Valores, CNMV
[5] Informe de Gobierno Corporativo. The reports cover information on the composition of the Board at 31st December of each calendar year, as well as the date in which Board Members were appointed.

It has to be noted that our approach to measuring political connections is likely to underestimate the presence of politicians in private sector firms. This is because, firstly, many firms are not traded in the stock market, and hence not covered by our database. Secondly, political connections are not in practice restricted to the board of directors, but also exist in (sometimes artificial) jobs in the company operations, in subsidiary and parent companies and in advisory bodies. Additionally, in Spain savings societies ("Cajas de Ahorro"), which tend to be highly politicised, have large ownership stakes in many of the companies in our sample. Our approach to identifying connections focuses exclusively on political connections in the board of directors, and therefore if there is presence of political connections elsewhere in the company these will not be reflected in our database.

In the rest of this paper, we sometimes refer to connections of grade 1 and 2 as simply "highly politically connected" directors, whereas grades 3 and 4 are referred to simply as "politically connected" directors.

b) Overview

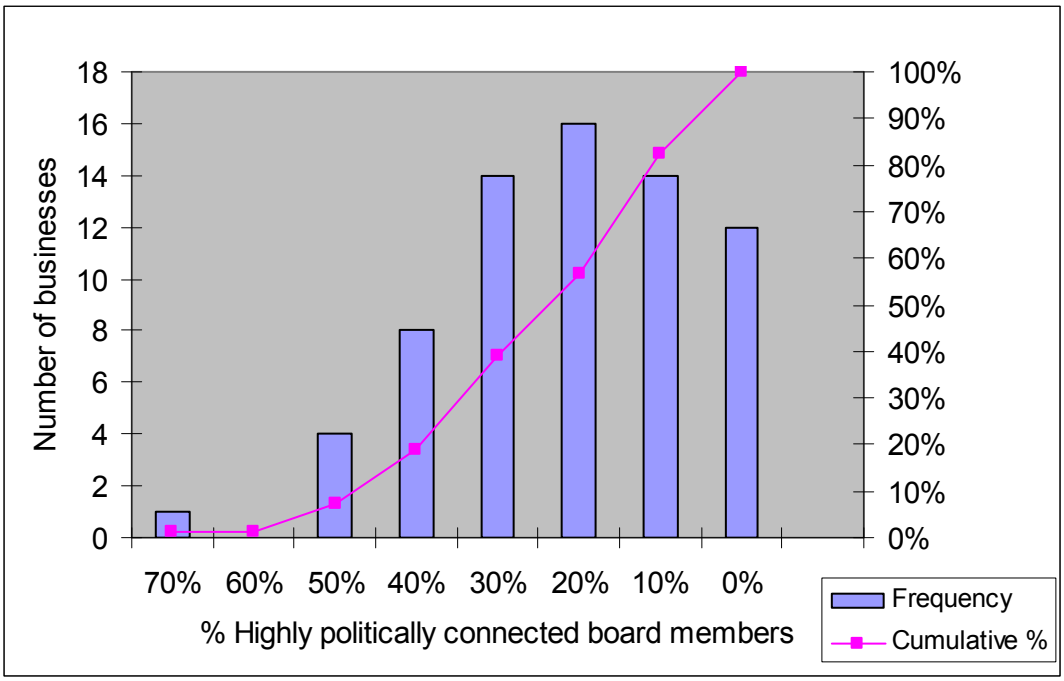
Only 12 of the 69 companies considered in the analysis remained with no connections to any political party every single year during the period 2003-2009. If we focus exclusively on highly politically connected board members (i.e. connections of grade 1 or 2) then still only 19 of the 69 companies appear as not having had a politically connected director at some point during the seven year period. Over the period of consideration, the intensity of political connectedness remained fairly stable, with one in five of all board members at any given time being politically connected, and one in ten being highly politically connected.

The degree of connectedness varies quite substantially from one business to another. Within a business, there also is variability in its political connectedness through time; however drastic changes in overall levels of connectedness are rare. This suggests that whereas there might be particular short term reasons for having certain connections to one or several political parties, for one particular company the decision to have political connections seems to be motivated by long term factors.

The most frequent firm typology in regards to political connections is for a business to have approximately 20% of board members being either connected or highly connected (Figure 1). This typology is followed by companies with either 30% or 10% of board members connected. It is revealing to note that a company with no political connections is only the fourth most frequent typology of board structure when considering any type of connections, and the second when considering only highly politically connected board members.

Figure 1. Political connections by firm

Highly politically connected board members (grades 1 and 2)



Politically connected board members

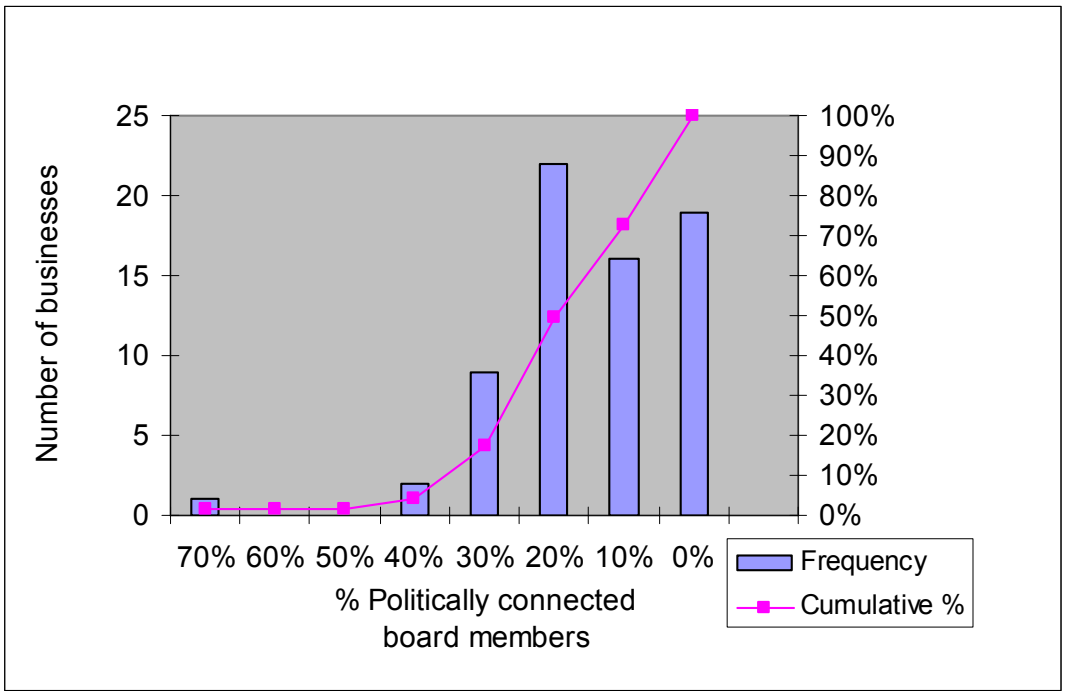


Table 9 (see Annex) sets out the average number of politically connected board members in all businesses in the sample. Considering at the same time both the percentage of connected and highly connected board members, Sol Melia, a tourism company, Tubacex, an industrial manufacturer, or Sogecable, a communications company, appear towards the top of the ranking, with on average approximately one in three of their board members being highly politically connected over the period. There are also a large number of political connections in the board of the two state-owned companies that are covered in the dataset, Enagas and Red Electrica. Both firms have more than 40% of their board members connected to a political party in most years. The ownership structure of these companies, with large stakes held by the public sector, make them more prone to be connected to political parties than any other company in the MMC. Over the period, both companies shifted from being almost exclusively connected to the centre-right PP (Partido Popular) when this party was in power to being almost exclusively connected to the PSOE (Socialist Party) after the latter party won the 2004 Spanish general election. Both businesses are therefore given a different treatment in this section and are excluded from the analysis in sections 3 and 4. Finally, it is worth noting that the variation in strategies towards political connectedness shifted quite drastically in some particular cases. Iberdrola, jointly with Red Electrica, are amongst the companies that increased more substantially their degree of connectedness over the period, by over 25%. On the

other end of the spectrum, Metrovacesa and Repsol reduced their political connections by similar magnitudes.

c) Connections and economic sectors

Grouping firms by economic sector shows that those sectors which have historically been subject to more stringent regulation by the public sector or have a higher stake on public policy outcomes are more politically connected (see Table 1). Firms operating in areas where there is some degree of natural monopoly in the exploitation of the business operation (electricity and gas, transport and distribution, highways, telecommunications) appear towards the top of the list of politically connected sectors. In contrast, sectors where the interaction with Government has been historically lower (pharmaceutical & biotechnology, paper and graphic arts, or consumption goods) are typically less connected with the political class. This is consistent with the economic literature on capture which suggests that those companies with more at stake will be the ones with a higher degree of political connection.

Table 1. Political connections by sector

Sector	%connected	% highly connected	Number of businesses
Electricity and Gas	40%	26%	5
Tourism and Entertainment	26%	25%	2
Metals and Minerals	24%	24%	2
Other	31%	21%	1
Telecommunications	24%	19%	4
Transport and Distribution	28%	18%	2
Oil	24%	14%	2
Real Estate	23%	14%	2
Clothes	17%	13%	3
Highways	16%	12%	1
Electronics and Software	24%	10%	2
Media	20%	9%	3
Machinery	10%	9%	2
Food and Beverages	11%	8%	6
Banking	11%	7%	10
Construction Materials	10%	7%	2
Pharmaceutical and Biotechnology	7%	7%	4
Other Consumption Goods	7%	7%	2
Paper and Graphic Arts	12%	6%	4
Construction	24%	5%	5
Insurance	3%	3%	2

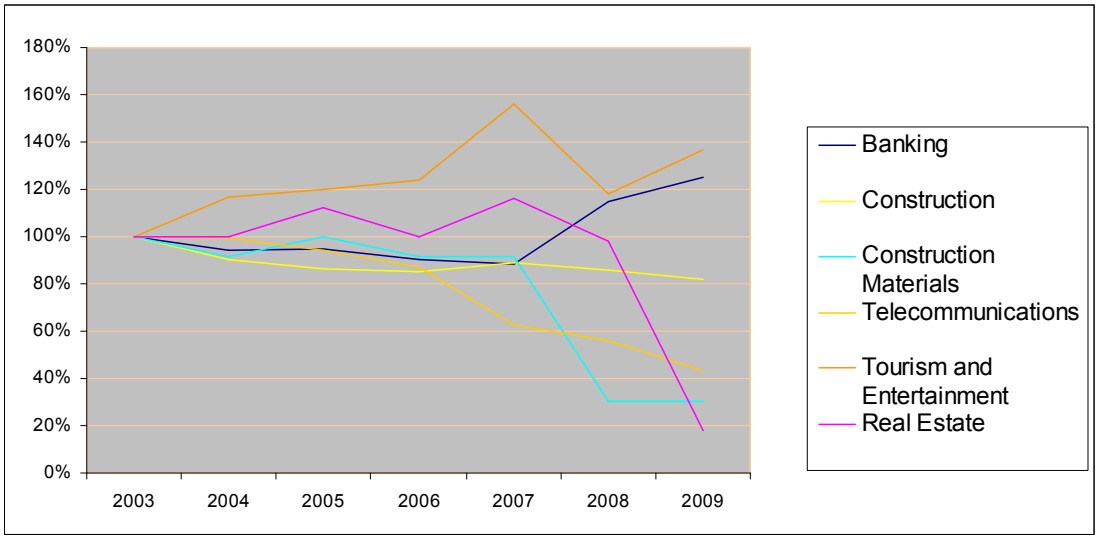
Machinery Goods	1%	1%	3
Total	17%	11%	69

Over the period 2003-2009 the intensity of political connectedness across sectors remained generally fairly stable, with three of the four most highly connected sectors in 2003 still appearing at the top of the list in 2009, with the exception of telecommunications. Even though the general trend over the period was for the percentage of connectedness to remain fairly stable, some specific sectors changed significantly their overall degree of political connectedness. In particular, some of those sectors which most suffered the 2008 financial crisis (tourism, construction and banking) where amongst those which most increased their share of political connections. Independently of the measure we use to define connectedness[6] a suggestive trend is observed: tourism and entertainment and banking increased their level of connectedness over the period by between 20 and 50%. For the construction sector, a similar trend is observed, but only for high calibre political connections. For real estate and construction materials however, the opposite trend was observed. This suggests that some businesses may try to protect themselves from shocks to their profitability by increasing their influence to the political class, even though this was not a consistent trend amongst all sectors. Section 4 explores this effect in more detail. Companies in telecommunications, real estate or construction materials on average reduced their political connections by between 40-70% during the period. Real estate and Construction materials both decreased their degree of connectedness over the period, even though both sectors were amongst those most directly impacted by the crisis. For telecommunications' companies, whilst it is not possible to establish with confidence the driver of such trend, it is theoretically conceivable that the trend observed in the period might have been linked to the process of liberalisation that this sector experienced in this period. However, liberalization was accompanied by increasingly complex regulation. Moreover, the results for the telecommunications sector include those of the incumbent firm, Telefonica, which has many international subsidiaries, and is well known for appointing politically connected individuals (such as former Vice-President of Government Narcís Serra, or the Spanish King's son in law) in boards or other positions in their subsidiaries.

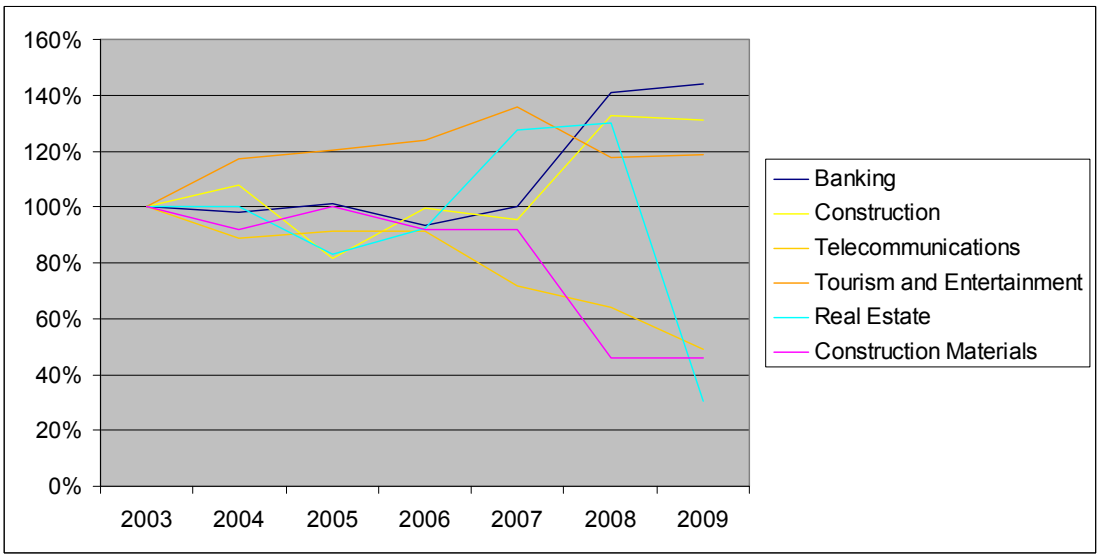
[6] Either all connections or just those which we have defined as connections of grade 1 and 2.

Figure 2.Change in political connectedness over time (selected sectors)

All political connections



Highly politically connected directors



d) Connections and political parties

Connections in the Spanish company board are strongly biased to the two main political parties, the centre-right Popular Party (PP)[7], and the centre-left Socialist Party (PSOE). Between the two, they represented approximately 80% of the political connections which

[7] Individuals with a connection to UCD, a centre-right political party that formed the first Spanish democratic Government in 1977 and ceased to exist in 1982, are accounted for the purpose of the analysis as connections to PP. This is because both are centre-right parties and indeed many UCD members joined over time the PP.

we identified in total (see Figure 3). CIU and PNV, centre-right moderate nationalist parties in Catalonia and the Basque Country respectively, account for approximately 5% of connections each, whereas other type of connections represent the remaining 10%. The third political party in number of votes over the period, the ex-communist Izquierda Unida (IU, or United Left) did not have a single connection.

Figure 3 shows the variation in the sign of political connections that occurred in the period. In 2003, the last full year of the 8-year span of the PP in power between 1996 and 2004, this party represented approximately 55% of all connections, compared to 25% for PSOE. From 2004, and after the socialist party took office, the degree of connectedness shifted considerably from PP to PSOE, with both parties reaching in 2008 the same share of political connections at 37% each. It is quite remarkable however that in 2009, after 5 years of socialist government, the PP remained the most connected political party in the corporate sector in Spain. This trend is exacerbated when focusing only on those board members highly connected to political parties (Figure 4), with the Popular Party having a higher than average share of these connections than PSOE. PP started the period having approximately 70% of the connections in the Spanish Board, and this percentage remained at around 50% after 5 years of socialist Government[8]. Connections to the PP were not only larger than to any other political party, they were also of a higher calibre.

Overall, the data suggest that being connected to the party in power was important for the companies in the sample, and indeed a substantial shift to the party in office occurred. However, connections to the centre-right party appeared to be quite resilient, possibly driven by the fact that the centre-right party and the corporate sector share policy and ideology to a larger extent than the centre-left party and the corporate sector, and an upper class elite (possibly attending the same schools) may dominate in Spain both right wing parties and boards of directors of large firms. Furthermore, despite the centre-right party not being in the central Government office it however retained its stronghold in

[8] This result is further exacerbated if we exclude from the comparison the two publicly-owned firms in the energy sector, Red Electrica and Enagas. Both showed a drastic change in the composition of political connections from 2003 to 2009. In 2003 Red Electrica had 11 board members, of which 6 were politically connected, all of them to the PP. In 2009 it had 10 board members, 8 of them politically connected, of which 7 were connected to the socialist party. For Enagas a similar trend developed. In fact, if we exclude these two companies, where political connections shifted drastically to PSOE over the period, in 2009 the degree of highly connected board members was still drastically biased to the opposition party, with 52% of all high calibre connections to PP against 32% to PSOE.

many of Spain's regional and local Governments, especially in the last few years in our sample.

Figure 3. Political connections by party

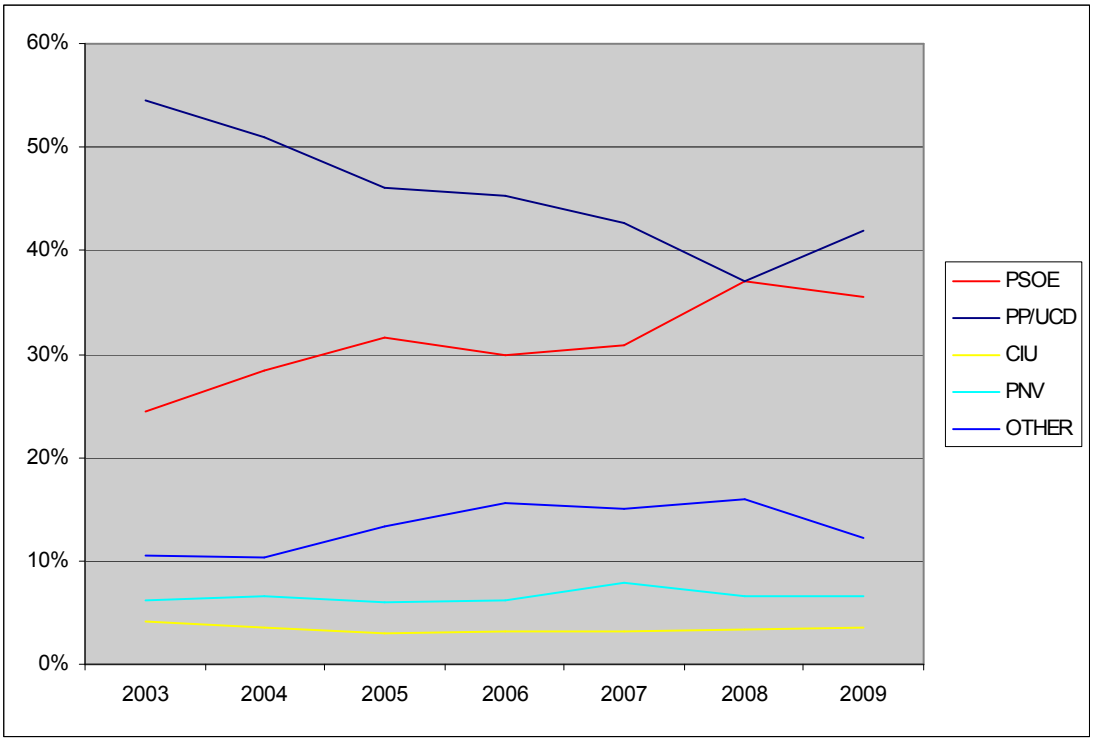
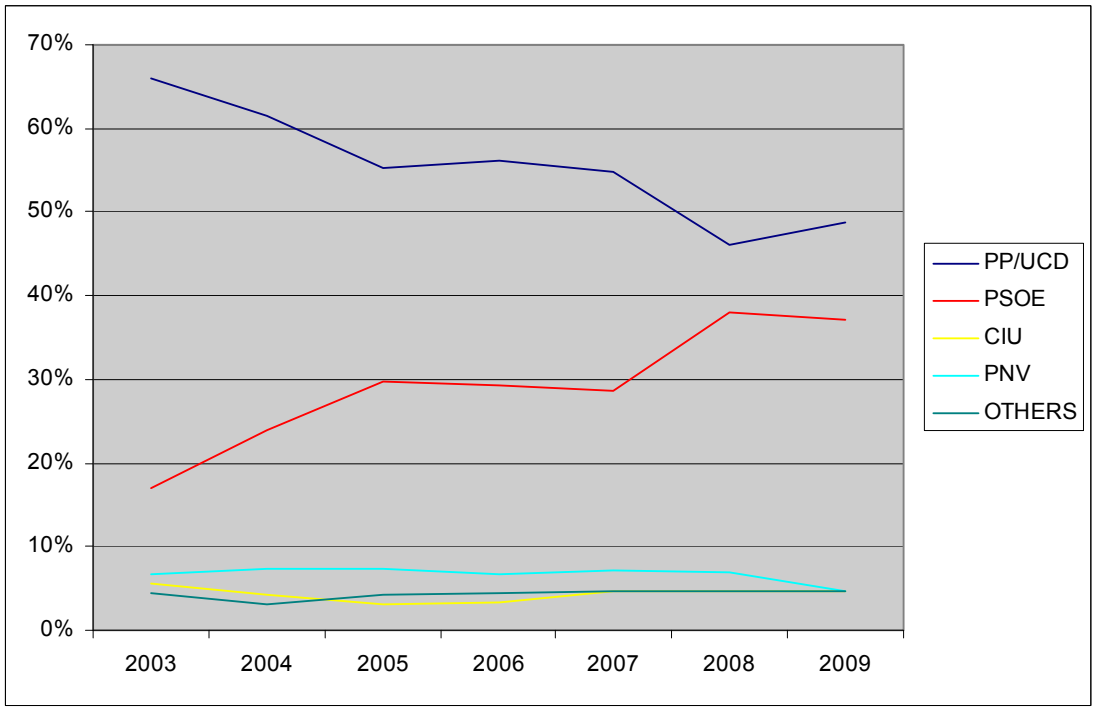


Figure 4. Political connections (only grades 1 and 2) by party



Category "others" includes board members which are politically connected to more than one party.

The analysis by political party also allows us to characterise businesses according to the degree in which they are connected to one party, the other, or to both (what we call a mixed strategy). We follow a similar approach to Castells & Trillas (2011), even though whilst connections there are considered in a particular point in time (14/03/2004), here we expand the assessment to cover the whole period from January 2003 to December 2009.

There are several ways in which we could define a company to be politically connected. In the broadest possible sense we could define as connected any of the 57 companies which were identified as having at least one connection of any degree (1-4). However this approach would define as equally connected a company with most Board members being connected with degree 1 and a company with one connection of degree 4. Because we only want to identify as connected those companies where the evidence of political connection is stronger, we establish stricter conditions and provide two different definitions for a company being considered as connected:

a) At least 25% of Board Members are connected with a strength of connection categorised as 1 or 2
b) At least 25% of Board Members are connected with any strength of connection (1-4).

We define a company as connected to PP (PSOE) if more than 70% of Connected Board Members are connected to PP (PSOE). If less than 70% of Board Members are connected to any one given party we define the company as being connected with a mixed strategy. We consider this characterisation first for all political connections, followed then by an assessment of only those political connections of higher calibre (grades 1 and 2).

In 2003, and based on any type of connection, 24 companies had no political connections, 20 were dominated by connections to the PP, 16 had mixed strategies, 4 were PSOE dominated, 4 PNV dominated and only one was connected to CIU. Considering only those companies characterised as connected under criteria a), a similar distribution of strategies emerges, with a large majority having a strategy of being predominantly connected to the incumbent party (PP). Overall, between 30 and 50% of companies appear as connected to PP depending on the definition employed with another 20-40% of

connected companies with a mixed strategy, and a smaller number of connected companies connected to the opposition party (between 5 and 10%).

It is revealing to look at how these connections changed six years later, in December 2009, and after a five-year span of PSOE in Government. A substantive shift in the colour of political connections had materialised. Possibly influenced by the change of party in Government, the number of companies characterised as connected to PSOE increased three-fold from 5-10% in 2003 to between 20-35% in 2009. On the other hand, the number of companies dominated by connections to PP decreased considerably either if we focus on those companies with a high overall degree of connections or only connections to very senior members of political parties. However, when taking a broader definition of political connections, these remained fairly stable (see first column in Table 2). Overall, the data suggests that the change in Government was at the core of the observed shift towards PSOE over the period.

Table 2. Strategies towards political parties

	Number of companies (all political connections considered)		Number of companies (only companies with more than 25% of Board Members connected considered)		Number of companies (only companies with more than 25% of Board Members connected with degree 1 or 2 considered)	
	2003	**2009**	**2003**	**2009**	**2003**	**2009**
Mixed	16	13	7	8	4	3
PP dominated	20	20	10	5	6	3
PSOE dominated	4	14	2	6	1	4
PNV dominated	4	3	1	2	1	1
CIU dominated	1	1	0	0	0	0
None	24	18	49	48	57	58

	All connections (as % of companies in sample)		Companies with more than 25% of Board Members connected (as % of connected companies)		Companies with more than 25% of Board Members connected with degree 1 or 2 (as % of connected companies)	
	2003	**2009**	**2003**	**2009**	**2003**	**2009**
Mixed	23%	19%	35%	38%	33%	27%
PP dominated	29%	29%	50%	24%	50%	27%
PSOE dominated	6%	20%	10%	29%	8%	36%

PNV dominated	6%	4%	5%	10%	8%	9%
CIU dominated	1%	1%	0%	0%	0%	0%
None	35%	26%	NA	NA	NA	NA

e) Stylised facts

Based on the above analysis we can define some general stylised facts on the intensity and nature of political connections in the Spanish corporate sector over the period:

1. In Spain, in the first decade of the second millennium, the corporate sector displayed a remarkably large number of connections to Spain's major political parties, with one in five Directors in their Boards being connected at any given time, and with approximately half of these Directors having held very senior positions in the past either in Government or in a political party. A high level international comparison shows that even though political connections are difficult to compare across countries and these are not a unique Spanish phenomena, its scale and intensity is possibly at the higher end of what can be observed internationally elsewhere in countries with similar level of economic development. This might be because the tolerance by the general public might be higher than in other countries, or because connections to politicians might be in Spain particularly valuable for managers or shareholders – we explore this further in sections 3 and 4.
2. Despite a change in Government and two general elections taking place, the period of analysis was business as usual in regards to the essential nature and degree of political connections, as overall the ratio of politically connected board members remained broadly stable throughout the period.
3. The degree and intensity of political connections varies strongly by sector, with sectors which are subject to more stringent regulation by the public sector generally amongst those with the highest degree of connectedness with politicians. This is consistent with the economic literature which predicts links between businesses and politicians to be stronger the more contingent profits are to decisions by the public sector.
4. The period of analysis covers two distinct periods, with PP handing over control of the Government to PSOE in March 2004. We indeed observe from that point a

substantial shift to the political party which happens to be in power (PSOE), which suggests that political connections are particularly valuable for managers or shareholders when these relate to the political party in office, and Spanish firms generally adjusted their strategies accordingly.

5. Political connections to the opposition party (PP) remained strong and widespread five-years after losing office. Connections to PP remained certainly larger than they were to PSOE when this party was in opposition. Connections to PP may also be more widespread due to business people and right-wing politicians sharing the same social background and policy preferences. Spanish Regional Governments ("Comunidades Autónomas", or CCAA) have substantive discretion in taxation, regulation and spending, and some CCAA had a PP-led government during this period.
6. Amongst those businesses which most increased their number of political connections during the period were those in construction, tourism and banking, those sectors most directly impacted by the 2008 global financial crisis. This might suggest that businesses might seek to gain influence on public policy decisions by appointing politically connected directors to the board particularly when they find themselves in financial difficulties.
7. The cause-effect between political connections and business performance may therefore actually be a two-way affair. Connections to politicians might result in better (worse) business performance, but also changes in business performance might lead to higher (lower) connections – we explore these complex interactions further in section 4.

Spain has a high degree of political connectedness, and this connectedness varies from company to company and is responsive over time i) to the political party in power and ii) to the business cycle. Over the rest of this paper we undertake to explore whether political connections result in better (worse) business performance and whether they create or destroy value for businesses.

3. The financial value of politically connected appointments (Spain 2002-2009)

a) Introduction

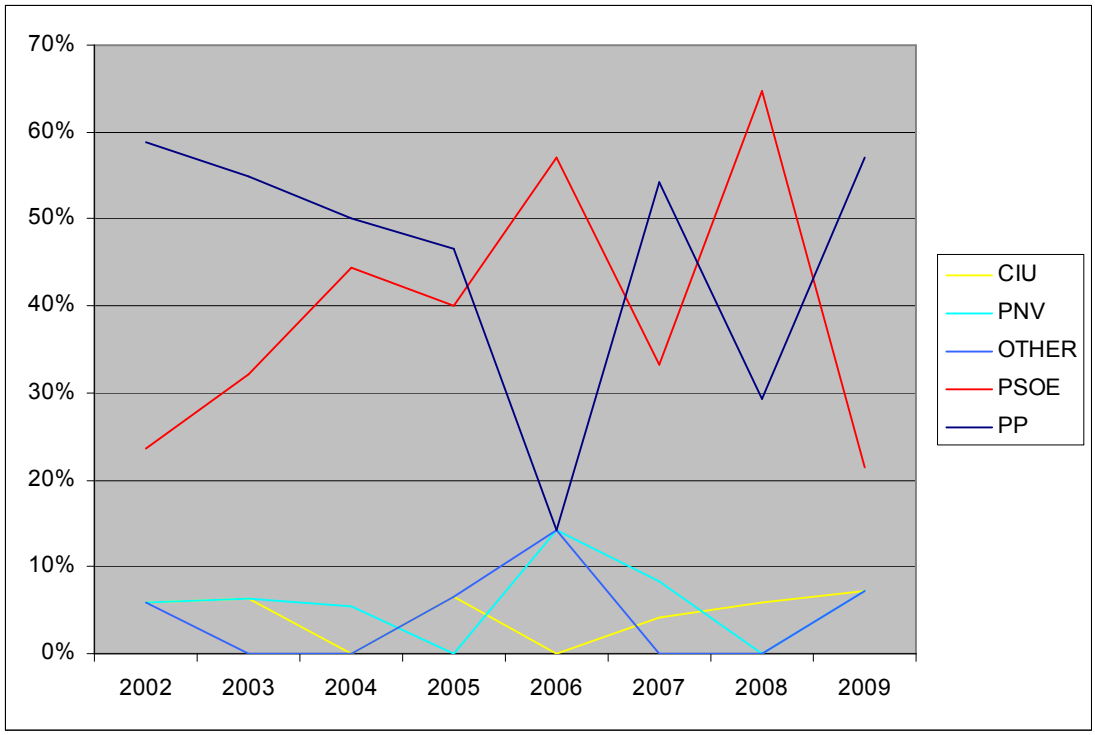
Over the period 2002-2009[9] a total of 759 appointments were made to the board of directors in our sample, resulting in an average of 95 new directors per year. Of these, approximately one in five, or an average of roughly 20 a year[10] were identified as politically connected to a party. The proportion of politically connected directors to total directors was also of one in five at both the start and the end of the period, suggesting that the period was business as usual in regards to the essential nature and degree of political connections, with the overall ratio of politically connected board members remaining broadly stable (i.e. including the large majority of directors which was of course not newly appointed).

Figure 5 below shows the distribution of political appointments by political party. Over the period an average of 50% of political appointments were connected to PP and nearly 40% to PSOE. The distribution in the table is clearly distinct before and after the general election in March 2004. Whereas before the election PP connections dominated new political appointments, from 2004 onwards the percentage of PSOE connections increased dramatically.

Figure 5. New political connections by political party, 2002-2009

[9] In contrast with section 2, where data is available for the period 2003-2009, data on appointments is available from 2002.

[10] Year by year, the ratio of one in five politically connected appointments remains remarkably constant, except for 2003, the year before the general election, when the ratio was higher and particularly biased towards the centre-right incumbent PP. The timing suggests that the relationship between the political colour of connections and political change exhibits causality mainly in one direction: from political change to connections with the winning party, since after the unexpected result of the March 2004 election (see Castells and Trillas, 2011) the connection to PSOE increased significantly.



Based on the semi-strong version of the efficient markets hypothesis (EMH), if a new piece of information is unexpected, and such information has an impact on the expected future returns of a company, this will be rapidly absorbed by the financial markets and reflected almost immediately in the market value of the firm(s) involved. Therefore, if we can isolate the impact of new political connections on a firm from other relevant events which have an impact on their financial returns we should be able to establish whether there is a financial value for shareholders from acquiring political connections, as we would expect such value to be reflected immediately in the market value of the company.

The detailed information contained in our dataset also allows to test whether the financial value of political connections is contingent on specific characteristics of the appointee and/or the company. For example, we are also interested in explaining whether all type of connections generate the same value for shareholders (i.e. connections of different intensity and to different political parties), or whether such connections generate a different return to shareholders depending on the specific characteristics of the company i.e. sector, performance, or the existing degree of political connectedness in the company at the time when the appointment is made.

Section b) discusses our methodological approach to assess the financial value of connected appointments, drawing from the event-study methodology. Results are set and discussed in section c).

b) Methodological approach to the calculation of abnormal returns

The semi-strong version of the EMH implies that if an appointment to the Board is unexpected, immediately following the appointment the traded value of the company will reflect the impact of such appointment on the discounted expected future stream of profits.

To measure such impact we draw from the well-established event-study technique, which allows calculating the Abnormal Return (*AR*) of a company following an unexpected event. The abnormal return is defined as the actual return of the stock over the period in which the impact of the appointment is expected, minus the expected return of the stock without taking into consideration the event itself. In our case appointments of politically connected board members do not occur at the same time, but over the period 2002-2009. In the absence of event clustering[11], the classic approach originally set out by Fama, Fisher, Jensen and Roll (1969) and Brown and Warner (1985) is well suited and provides a strong statistical framework for robustly testing hypotheses about the significance of abnormal returns at both the specific company level and for groups of companies.

We calculate the abnormal return for company *i* as:

$$(1) \qquad AR_{it} = R_{it} - E(R_{it} / X_{it})$$

where AR_{it}, R_{it}, and $E(R_{it} / X_{it})$ are respectively the abnormal, actual and expected return for company *i* at time *t*. To estimate the abnormal return we therefore need to define first a model to establish the expected return for company *i*. Campbell, Lo and MacKinlay (1997) provide an excellent survey of the available approaches to calculating

[11] An alternative approach, followed by amongst others Castells and Trillas (2011), calculates the abormality of returns when there is event clustering, by taking advantage of Seeming Unrelated Regressions (SUR) approach.

the expected normal return. Here, we use the standard market model, where the expected return is a function of a trend and the overall returns of the market:

$$E(R_{it} / X_{it}) = \alpha_i + \beta_i R_{mt} + \varepsilon_{it} \quad (2)$$

where α_i and β_i are the parameters to be estimated for every company i, R_{mt} are the market returns and ε_{it} is the error term, assumed to be normally distributed with zero mean. We estimate the model by using the Ibex-35 MCM market index as R_{mt}.

There are several alternative approaches to the calculation of expected returns. In its simplest expression, the expected return of a security can be assumed to be a random walk with a trend, the so-called constant mean returns model i.e. where in (2) the second term on the right hand side is assumed to be equal to zero. This approach has been shown in occasions to produce results similar to more complex models as the market returns model, however it typically will have a larger variance, which will make inferences about the statistical significance of deviations from it more unreliable, providing a lower goodness of fit to the data. More complex models, such as multi-factor models, or models which impose an auto-correlated structure to the error term (for example GARCH models), may add some explanatory power, but these gains have been typically shown to be limited (see Cambell, Lo and Mackinlay, 1997).

For robustness, we obtain data on the daily returns of the companies in our sample from a variety of financial information providers (Infomercados, Yahoo Finance, Invertia), with data checks across sources resulting in almost perfect matches. Daily returns can be obtained in the usual fashion:

$$r_t = \frac{P_t - P_{t-1}}{P_{t-1}} = \frac{P_t}{P_{t-1}} - 1 \quad (3)$$

where P_t stands for prices at time t. Nevertheless, we use the logarithmic transformation

$$R_t = \ln(P_t) - \ln(P_{t-1}) \quad (4)$$

where $R_t = \ln(r_t + 1)$. This yields almost identical results, yet a more symmetric distribution, which is appropriate as it is far easier to derive the time-series properties of additive processes (such as the natural logarithmic transformation) than of multiplicative processes.

The estimation window i.e. the period for which the parameters in (2) are estimated, is as is standard practice in event studies with daily data, chosen to be 50 days before the event and not to include the event window as inclusion of the event in the estimation window might result in the estimated parameters being contaminated with the impact of the event. We rolled back and forth the estimation window to cover a larger (smaller) number of days, with no significant gain in the explanatory power of the regression.

The preferred length for the event window is three days, as this covers the day of the appointment (when we expect most of the impact to be reflected), the day before (when the news might have been leaked to the press) and the day after (the appointment might have occurred after close of the markets). In the results section we present two-day and one-day event windows alongside the three-day window.

The abnormal return for company *i* in day *t* is calculated as:

(5) $$\overline{AR}_{it} = R_{it} - \hat{\alpha}_i - \hat{\beta}_i R_{mt}$$

where $\hat{\alpha}_i$ and $\hat{\beta}_i$ are the estimated parameters from (2) for every company *i,* and $\overline{AR}_{it}$ is the abnormal return for company *i* in day *t*. The average cumulative abnormal return $\overline{CAR}_{N,(T-1,T+1)_t}$ over the period of the event window (*T-1* to *T+1*), three days in our central case, and across *N* companies with politically connected appointments is calculated as:

(6) $$\overline{CAR}_{N,(T-1,T+1)} = \frac{1}{N}\sum_{1}^{N}\frac{1}{3}\sum_{T-1}^{T+1}\overline{AR}_{it}$$

Provided that from (1) ε_{it} is normally distributed with mean zero it can be shown that:

(7)
$$\varepsilon_{it} \approx N(0,\sigma^2_{\varepsilon_i}),$$
$$\overline{AR}_{it} \approx N(0,\sigma^2_i) \text{ , and}$$
$$\overline{CAR}_{N,(T-1,T+1)} \approx N(0,\sigma^2_{N,(T-1,T+1)})$$

We can therefore test the statistical significance of $\overline{CAR}_{N,(T-1,T+1)}$ with the following test statistic:

(8)
$$\frac{\overline{CAR}_{N,(T-1,T+1)}}{\left[\hat{\sigma}^2_{N,(T-1,T+1)}\right]^{\frac{1}{2}}} \approx N(0,1)$$

$\hat{\sigma}^2_{N,(T-1,T+1)}$ needs to be estimated, as the variance is unknown, and this can be consistently estimated by:

(9)
$$\hat{\sigma}^2_{N,(T-1,T+1)} = \frac{1}{N^2}\sum_1^N \hat{\sigma}^2_i$$

where $\hat{\sigma}^2_i = \chi' V \chi$, χ is a vector with values equal to the unity between *T-1* and *T+1*, and V is the covariance matrix obtained from the individual values in the estimation window of the regression.

c) The financial value of political connections

In this section we estimate abnormal returns for the appointments of politically connected Board Members, and group such appointments according to the grade of the political connection and the political party to which the connection refers to.

From our original sample of 102 announcements of politically connected board members[12], only 47 have an event window which is uncontaminated by other events. If other events occur at the same time as the political appointment, there is no sensible way to separate the impact of the two events. We exclude such appointments from the analysis

[12] 107 announcements are identified, of which 5 correspond to Enagas and Red Electrica, two companies with large ownership by the public sector which are excluded from the analysis.

to ensure as much as possible that the effect that we observe is actually the impact of a new political connection rather than something else, although at the price of losing a significant number of observations. As a result, 55 announcements had to be removed from the analysis as coincided in time with other relevant company-specific news. It has to be noted that in our sample this mostly occurs where other non-connected board members are appointed at the same time as the politically connected appointee - reshuffles of the board with several new members appointed at once not being unusual in Spain. In some other few cases, the appointment is contaminated by significant company specific news which happen to occur in the same day of the appointment, for example announcements of changes in the ownership structure or other relevant corporate announcements that are bound to have an impact on the profit expectations of the company.

We also eliminate observations where there is thin trading or incomplete data in the event window as these make the calculation of abnormal results not possible. The number of trading days available for the analysis is reduced to a maximum of 108 with a three-day window, 72 with a two-day window, and 36 with a one-day window. Overall, a significantly large number of observations is lost by filtering out contaminated data. We however remain with an acceptable number of observations, particularly when the estimation is done with three-day and two-day event windows.

Table 3 presents the observed cumulative average abnormal return during the appointment of politically connected board members. The results are presented for robustness across different event windows (from one to three days) and tested separately by political party and intensity of the connection.

Table 3. Cumulative abnormal returns

	Political party	Intensity of connection	Cumulative abnormal return	N	TXN	Test statistic	P-value
3 day	All	All (1-4)	-0,28%	36	108	-0,29	0,78
	All	1 and 2	-0,35%	26	78	-0,27	0,79
	All	Only 1	-0,24%	14	42	-0,26	0,79
	PP	All (1-4)	-0,30%	20	60	-0,23	0,82
	PP	1 and 2	-0,13%	14	42	-0,08	0,95
	PP	Only 1	0,88%	8	24	0,80	0,41

	PSOE	All (1-4)	-0,11%	13	39	-0,06	0,95
	PSOE	1 and 2	-0,13%	10	30	-0,06	0,95
	PSOE	Only 1	-1,13%	4	12	-0,65	0,52
2 day (day of event and day after)	All	All (1-4)	-0,22%	36	72	-0,12	0,90
	All	1 and 2	-0,38%	26	52	-0,16	0,87
	All	Only 1	-0,48%	14	28	-0,49	0,62
	PP	All (1-4)	-0,30%	20	40	-0,12	0,90
	PP	1 and 2	-0,34%	14	28	-0,10	0,92
	PP	Only 1	0,02%	8	16	0,02	0,98
	PSOE	All (1-4)	-0,01%	13	26	0,00	0,99
	PSOE	1 and 2	-0,08%	10	20	-0,02	0,98
	PSOE	Only 1	-0,62%	4	8	-0,31	0,76
2 day (day of event and day before)	All	All (1-4)	-0,49%	36	72	-0,29	0,77
	All	1 and 2	-0,48%	26	52	-0,21	0,83
	All	Only 1	-0,49%	14	28	-0,23	0,82
	PP	All (1-4)	-0,45%	20	40	-0,35	0,73
	PP	1 and 2	-0,35%	14	28	-0,21	0,83
	PP	Only 1	0,30%	8	16	0,25	0,80
	PSOE	All (1-4)	-0,24%	13	26	-0,07	0,94
	PSOE	1 and 2	-0,16%	10	20	-0,03	0,98
	PSOE	Only 1	-0,82%	4	8	-0,33	0,74
1 day	All	All (1-4)	-0,43%	36	36	-0,99	0,32
	All	1 and 2	-0,45%	26	26	-0,80	0,42
	All	Only 1	-0,61%	14	14	-1,29	0,20
	PP	All (1-4)	-0,45%	20	20	-0,88	0,38
	PP	1 and 2	-0,43%	14	14	-0,66	0,51
	PP	Only 1	-0,34%	8	8	-0,63	0,53
	PSOE	All (1-4)	-0,15%	13	13	-0,17	0,87
	PSOE	1 and 2	-0,12%	10	10	-0,11	0,91
	PSOE	Only 1	-0,30%	4	4	-0,34	0,73

The results show that, except for three cases involving PP appointees, all combinations of announcements under any event window length show negative but statistically non-significant average abnormal returns from political appointments. The negative returns tend to be larger under the one-day event window, suggesting that impacts might be rapidly absorbed by the stock markets. However the statistical non-significance persists above the 10% level. There is no significant difference either between parties or grades of connection in regards to the magnitude of the negative abnormal return.

Beyond the results in Table 3, we also explored other combinations of appointments. For example, we considered the hypothesis that only those appointments which suppose a significant change in the overall political connectedness of a business result in significant abnormal returns. We calculated cumulative abnormal returns only for those businesses which had no connections when the political appointment was made (and for which a

connection may have therefore been more valuable). The financial returns over the three-day window were negative and of a larger magnitude than those reported in Table 3, with an average abnormal negative return of 1% of the traded value of those firms. However the p-values remained non-significant at the 10% confidence level. We obtained similar results when performing the test only for those appointments which supposed the first connection of a business to a given political party, obtaining again negative but statistically non-significant returns.

Overall, the results show that negative abnormal returns were generally observed following the appointment of politically connected board members. The results hold under different specifications of the party to which the board member is related to and the intensity with which the board member is linked to a given political party. Statistically, the results are non-significant and hence we cannot rule out that the negative return is not driven by random or unrelated fluctuations in the stock market. The absence of a positive result on shareholders begs the question of why do companies appoint politically connected individuals.

4. Political connections and business performance

a) Introduction

Political connections not resulting in positive impact on business performance is slightly puzzling, given the large number of political connections in Spain. There might be several reasons that can explain such surprising results. In the first place, the analysis in section 3 considers the aggregate abnormal return, potentially failing to capture abnormal returns being both positive and negative at the individual firm level, but cancelling each other out in aggregate, resulting in an overall non-significant impact. Secondly, as noted in section 3, the number of observations for some of the specifications is rather limited, which necessarily means that the results need to be treated with caution. Thirdly, the results are contingent on the efficient markets hypothesis holding, and on the assumption that traders are able to establish the importance of a particular connection prior to such connection being in place, which might in occasions be difficult. Finally, if indeed political connections do not yield positive returns, the effectiveness of capture of

politicians by shareholders may not be the driving force behind the appointment of politically connected directors.

In this section, we propose a different empirical approach, assessing the direct relationship between accounting measures of profits and political connections, including consideration of how different strategies towards political connectedness might lead to different performance results. The key hypothesis we want to test is whether political connections have an impact on business performance. Studies (see section 1) have shown how political connections can result in more favourable regulation, better access to public sector spending and other favourable treatment resulting from exerting influence. If businesses do indeed benefit from political connections in such a way, it would be expected that this can result in better profitability when compared to their non-connected counterparts. On the other hand, if a company's board is dominated by ex-politicians, this could well be at the expense of not appointing more experienced and skilled managers for the job at hand. Agency problems might also lead to decisions being taken which are not at heart of shareholders interests, for example if there is collusion between senior managers and politicians to protect the managerial team from takeovers or other corporate events that might challenge their position in the company.

The equation we want to estimate can be described as:

$$\Pr ofitability_{it} = \beta X + \alpha Y + \varepsilon \tag{10}$$

where X is a matrix of control variables and financial characteristics of company *i* in year *t*; Y is a matrix of political connectedness for company *i* and year *t*; and ε is a vector of error terms.

To examine the impact on business performance indicators of both the company's degree of connectedness and its strategy in regards to political connections we build a panel of data. Data is obtained from SABI, a commercial database with company accounting and financial information. As key performance indicators we consider both the return on asset and the return on equity for every year over the period 2003-2009, following the

approach of for example Bertrand, Kramarz, Schoar and Thesmar (2004), and Li, Meng, Wang and Zhou (2008).

As control variables (see Table 4) we consider leverage, solvency ratio, total assets, number of employees and sector and year. We also introduce variables that distinguish between politically and non-politically connected firms, the varying degrees of intensity of such connection, and the overall strategy to connectedness that a company is following at a given year. Table 4 lists the variables employed, describes them and provides their basic summary statistics.

Table 4. Summary statistics and variable description

	Variable	Description	Mean	Min	Max	Standard Deviation
Political connections	Political connections	Dummy variable equal to 1 if there is at least one political connection in the company, 0 otherwise	0.74	0	1	0.44
	Political connectedness index 1	Average connectedness of the Board of Directors in year t, where each Director is allocated a value of between 0-4 where 0 is no connection, 1 connection of grade 4, 2 connection of grade 3, 3 connection of grade 2, and 4 connection of grade 1. The index presents the average value of connections across Board members in a given year	0.48	0	2.9	0.47
	Political connectedness index 2	Share of board members connected	0.18	0	0.8	0.16
	Political connectedness index 3	Share of board members connected with grade 1	0.07	0	0.6	0.09
	Political connectedness index 4	Share of board members connected with grade 1 and 2	0.11	0	0.7	0.12
	Political connection strategy	0/1 dummy variables for non-connected, mixed, PSOE or PP dominated strategy, as previously defined in section 2	N/A	N/A	N/A	N/A
	Political connection strategy 2	As above but only counted as connected with mixed, PP or PSOE dominated strategy if at least 25% of board members are connected	N/A	N/A	N/A	N/A
	Political connection strategy 3	As above but only counted as connected with mixed, PP or PSOE dominated strategy if at least 25% of board members are connected with grades 1 and 2 of political connection	N/A	N/A	N/A	N/A
Dependent variables	ROE (Return on equity)	Return on equity	13.48	-478.94	192.67	46.81
	ROA (Return on assets)	Return on assets	4.35	-47.93	56.81	8.97

Control variables	Liquidity ratio	Ratio employed to measure the company's ability to pay back its short-term liabilities with its short-term assets.	1.97	0.02	59.29	6.55
	Solvency ratio	Ratio employed to measure the company's ability to meet long-term obligations.	34.38	0.39	88.92	23.74
	Total assets	Used as a proxy for company size (entered in logs in the regression).	3.76*e07	36326	1.11*e09	1.24*e08
	Total employment	Used as a proxy for company size (entered in logs in the regression)	17328	3	257426	38560
	Sector	N/A	N/A	N/A	N/A	N/A
	Year	N/A	N/A	N/A	N/A	N/A

b) Regression results

Under certain general conditions, including as we will later see the critical assumption on the exogeneity of vectors X and Y from the dependant variable, both random and fixed effects methods are available. Whether fixed or random effects are more appropriate is an empirical question which depends on whether random effects are a consistent estimator of parameters (fixed effects always are). The Hausman specification test of systematic differences[13] was performed in all regressions in Tables 5 and 6, with mixed results. In some occasions the test did not reject the null hypothesis that random effects are both consistent and a more efficient estimator than fixed effects. However, in a number of other instances, the null hypothesis was rejected. The analysis in the rest of this section was performed with both fixed and random effects regression methods, and these yielded fully consistent results for the key variables of interest. For simplicity, parameters presented in Tables 5 and 6 refer to fixed effects estimations as these always are consistent estimators.

Table 5 presents the value of estimated parameters and statistical significance values resulting from regressing profitability only on the key control variables, including sector and year[14]. We use both ROE and ROA as dependent variables and present the results for both random and fixed effects regressions.

[13] Where under the null hypotheses both fixed and random effects are assumed to be consistent (but random effects are more efficient), and under the alternative hypothesis only fixed effects are consistent.

[14] Sector variables, which are a key explanatory variable between groups, have to be dropped in the fixed effects estimation as variability over time is a key requirement for fixed effects panel data regression.

Table 5. Outputs from examining the performance of control variables after fixed and random effects panel data regressions

	(1)		(2)		(3)		(4)	
	ROE. re		ROA. re		ROE. fe		ROA. fe	
Constant	-90.74**	0.04	-1.70*	0.09	16.71	0.85	2.17	0.85
Total assets (log)	4.41**	0.04	0.53	0.29	-2.79	0.63	-0.27	0.72
Current ratio	0.69	0.24	0.22	0.14	0.19	0.93	0.10	0.72
Solvency ratio	0.62***	0.00	0.17***	0.00	1.12***	0.00	0.18***	0.00
2004	0.09	0.99	0.52	0.52	0.68	0.91	0.63	0.44
2005	0.47	0.94	0.35	0.67	3.12	0.63	0.58	0.49
2006	1.00	0.88	0.45	0.60	6.02	0.39	0.90	0.32
2007	1.33	0.84	0.53	0.54	7.37	0.32	1.08	0.25
2008	-21.67***	0.00	-2.21**	0.01	-13.80*	0.07	-1.60*	0.10
2009	-21.92***	0.00	-3.58***	0.00	-14.60*	0.06	-3.00***	0.00
Banking	32.17	0.18	8.09	0.22	-	-	-	-
Clothes	9.03	0.71	7.27	0.32	-	-	-	-
Construction	38.19	0.12	9.86	0.15	-	-	-	-
Construction Materials	28.60	0.28	10.99	0.17	-	-	-	-
Electricity and Gas	30.01	0.19	10.49	0.12	-	-	-	-
Electronics and Software	13.17	0.61	3.17	0.69	-	-	-	-
Food and Beverages	19.76	0.39	7.30	0.27	-	-	-	-
Highways	32.67	0.32	10.33	0.29	-	-	-	-
Machinery	25.30	0.35	6.94	0.39	-	-	-	-
Machinery Goods	70.52***	0.00	18.78**	0.01	-	-	-	-
Media	-8.87	0.72	-1.25	0.87	-	-	-	-
Metals and Minerals	15.23	0.56	6.82	0.39	-	-	-	-
Oil	22.71	0.39	12.56	0.12	-	-	-	-
Other	-98.53***	0.00	6.89	0.49	-	-	-	-
Other Consumption Goods	63.08**	0.02	12.17	0.13	-	-	-	-
Paper and Graphic Arts	17.76	0.47	8.23	0.26	-	-	-	-
Pharmaceutical and Biotechnology	14.94	0.52	6.84	0.33	-	-	-	-
Real Estate	-7.06	0.80	4.83	0.55	-	-	-	-
Telecommunications	-4.94	0.83	-1.15	0.87	-	-	-	-
Tourism and Entertainment	-6.59	0.80	-0.82	0.92	-	-	-	-
Nº groups	67		67		67		67	
Nº observations	453		454		453		454	
R-sq between	0.49		0.33		0.01		0.02	
R-sq within	0.11		0.19		0.13		0.19	
R-sq overall	0.29		0.30		0.00		0.05	

Under each regression, first value is the estimated parameter and second value is the p-value. *** 1% significance level; ** 5% significance level; * 10% significance level.

Table 5 provides an insight into the drivers of profitability in Spanish firms during this period. The solvency ratio was as expected a good predictor of profitability, with higher solvency ratios resulting in larger profits. Company size (proxied by the value of company's assets) did not consistently display a statistically significant impact on profitability, albeit in (1) a positive impact on profitability appears to be significant at the 5% confidence interval. Year and sector control variables also have some explanatory power. In 2008 and 2009, as a result of the world-wide financial crisis, profits were significantly lower, with ROE being between 13% to 21% percent lower on average, depending on random or fixed effects estimations. Finally, there are some sectors which performed in a significantly different manner, namely machinery goods and to some extent other consumption goods, even though for the latter the coefficient is not statistically significant when regressed on ROA. These results are largely sustained in regressions (5) to (12) (Table 6) when political connections are entered in the regression analysis.

Table 6 introduces to the regression analysis the measures of political connectedness set out in Table 4. The outputs presented in this table are obtained through fixed effects panel data regressions using ROE as the dependent variable. We replicated this regression analysis using in turn and in combination ROA as a dependant variable and random effects methods, yielding almost identical results on the magnitude, sign and statistical significance of the key variables[15].

Table 6. Fixed effects panel data regressions examining the impact of political connections on profitability (ROE)

	(5)		(6)		(7)		(8)	
Constant	3,25	0,97	-17,74	0,84	-9,50	0,91	-6,05	0,95
Total assets (log)	-0,05	0,99	0,71	0,90	0,06	0,99	-0,36	0,95
Current ratio	-0,32	0,88	0,15	0,95	0,25	0,91	0,10	0,96
Solvency ratio	1,06***	0,00	1,17***	0,00	1,15***	0,00	1,14***	0,00
2004	2,05	0,74	1,61	0,79	1,75	0,78	0,90	0,88
2005	5,29	0,40	2,91	0,64	3,23	0,61	2,64	0,68
2006	7,21	0,30	4,08	0,56	5,03	0,47	3,61	0,60
2007	8,25	0,25	4,71	0,52	5,75	0,43	5,22	0,47
2008	-11,20	0,13	-16,61**	0,03	-15,82**	0,04	-15,95**	0,03
2009	-13,15*	0,08	-18,28**	0,02	-18,40**	0,02	-17,53**	0,02

[15] These results are available under request.

Political connections	-34,27***	0,00						
Political connectedness index 1			-36,93***	0,00				
Political connectedness index 2					-91,85***	0,00		
Political connectedness index 3							-178,13***	0,00
Political connectedness index 4								

R-sq within	0,17	0,17	0,16	0,17
R-sq between	0,00	0,00	0,01	0,01
R-sq overall	0,02	0,02	0,00	0,03

Nº Observations	453	453	453	453
Nº Groups	67	67	67	67

	(10)		**(11)**		**(12)**	
Constant	8,21	0,92	23,34	0,79	-33,44	0,70
Total assets (log)	-0,64	0,91	-2,91	0,61	-2,16	0,71
Current ratio	-0,16	0,94	0,62	0,77	0,25	0,90
Solvency ratio	1,12***	0,00	1,16***	0,00	1,14***	0,00
2004	2,14	0,72	2,32	0,71	0,79	0,90
2005	5,32	0,40	3,74	0,55	3,40	0,60
2006	7,98	0,25	7,04	0,31	6,24	0,38
2007	8,64	0,23	7,64	0,29	7,26	0,33
2008	-10,31	0,17	-12,13	0,11	-13,81*	0,07
2009	-11,75	0,12	-12,63*	0,10	-14,43*	0,06
Political connection strategy _mixed	-44,67***	0,00				
Political connection strategy _psoe	-37,30***	0,00				
Political connection strategy _pp	-29,66***	0,00				
Political connection strategy 2 _mixed			-32,36***	0,00		
Political connection strategy 2 _psoe			-32,78**	0,01		
Political connection strategy 2 _pp			-16,72	0,12		
Political connection strategy 3 _mixed					-2,63	0,79
Political connection strategy 3_psoe					-3,14	0,84
Political connection strategy 3_pp					8,98	0,41

R-sq within	0,18	0,16	0,13
R-sq between	0,00	0,00	0,00
R-sq overall	0,02	0,00	0,01

Nº Observations	453	453	453
Nº Groups	67	67	67

Under each regression, first value is the estimated parameter and second value is the p-value. *** 1% significance level; ** 5% significance level; * 10% significance level.

In regressions (5)-(9) we test the impact of political connectedness on firm´s profitability. The impact of political connections on firm´s performance is reported to be negative and highly statistically significant at the 1% confidence interval across all regressions[16]. The result holds regardless of the particular variable or measure that is used to proxy for political connectedness. The mere fact of having at least a board member connected (regression (5)) results in lower profit levels than would otherwise have occurred with no connected board members; the more politically connected a business is (regression (6)) the less profitable the business turns out to be; and as regressions (7), (8) and (9) show, these results also hold under different considerations on the grade of connections that is considered.

Regressions (10)-(12) introduce another dimension to the analysis by distinguishing non-connected companies from companies connected to the centre-right party (PP), the centre-left party (PSOE) or to both[17]. The results here are less clear. Regressions (10) and (11) indicate that the negative relationship between political connectedness and profits is felt more strongly for those companies connected with a mixed strategy and to the centre-left party PSOE, with businesses connected to the centre-right PP displaying a lower negative impact on profitability from their political connectedness in regression (10), and a non-significant impact in regression (11). Regression (12), which only considers political connection strategies which are of a higher political calibre, suggests a non-significant relationship between a specific strategy and profitability.

Overall, the results provide support to the hypothesis that political connections in Spain resulted in poorer business performance during the period. There are however two strong reasons to be very cautious with these results. In the first place, the dependent variables (ROA and ROE) have both high kurtosis and negative skewness[18]. In the second place, it

[16] These results are sustained under random effects regression and using ROA instead of ROE as a dependant variable.

[17] We use the same definitions used in section 2 to categorise a company as PSOE, PP or mixed.

[18] Independent variables were also checked for normality, deciding to apply a logarithmic transformation exclusively to the total assets variable. Other variables, namely the indices of political connectedness, present clustering around zero. However, the data is otherwise a relatively good fit to the normal distribution, and the sign and statistical significance obtained in the coefficients for these indices is indeed

is not clear the political connection variables are always strictly exogenous to the dependant variable(s). We undertake to explore these questions further in the remainder of this section.

c) Non-normality

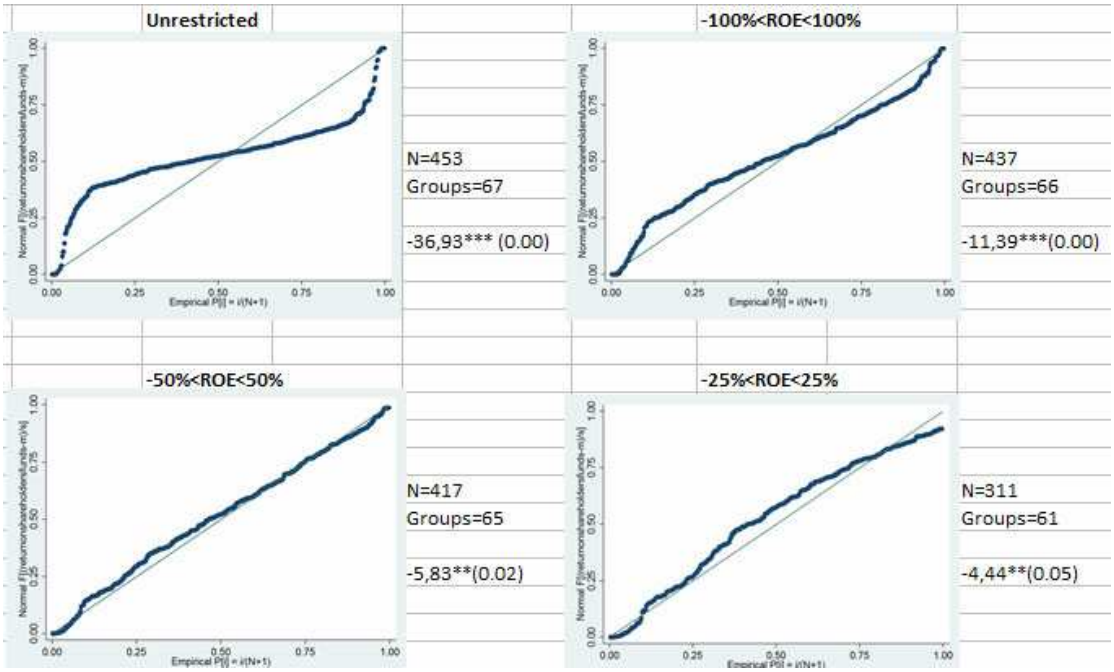
The dependent variables (ROE and ROA) have high kurtosis and skewness. This could mean that the normality condition is violated, and could also mean that the estimated coefficients are driven by the presence of extreme values. In small samples non-normality could lead to the critical values used to infer statistical significance becoming invalid. However, violations of normality should, under the central limit theory, produce estimates which as the sample size increases converge to normality. Given the size of our sample this is not the main concern. Our main concern is that the presence of extreme values might show a linear relationship between connectedness and profits that in fact is driven by a number of extreme observations and that hence cannot be generalised to the whole population. By restricting the analysis to central values of ROE results (and hence eliminating extreme values) we can correct the non-normality of the data and test whether the observed negative correlation between connectedness and profitability still holds (Figure 6).

Figure 6 merits close examination. Here we replicate the regressions presented in Table 6 but restricting the analysis to those observations where the value of the ROE is between (-100%, 100%), (-50%, 50%), and (-25%, 25%), subsequently eliminating more and more values from the analysis. For each regression, we present the plots of the probability distribution of the data against that of the standardised normal distribution. We also present the number of groups (companies) and observations that are actually included in the regression, jointly with the coefficient and statistical significance for political connections that is obtained when regressing the data using fixed effects[19].

very similar to the ones obtained with a simple dummy variable ("political connections" variable), which does not present any distributional challenges. There was therefore limited value in attempting to address these issues for these variables.

[19] The reported coefficients and p-values refer to regression (6), but similar results were obtained when testing with other proxies for political connections.

Figure 6. Replication of regression (6) under restricted sample sizes



The plot of the unrestricted ROE confirms that ROE is non-normal. Restricting the observations to those observations with ROE values between -100% and 100% considerably increases the normality of the data, obtaining an almost perfect fit when we restrict further the ROE variable to cover only those values between -50% and 50%. We have reduced the sample by 35 observations, and the negative and statistically significant effect of political connections on profitability persists, even though at the 5% confidence interval rather than the 1% obtained when regressing with the full sample.

In the bottom-right corner the sample is restricted to ROE observations between minus and plus 25%, which results in a drastic reduction in the number of observations in the sample. However the negative and statistically significant relationship between political connections and profits persists. In fact, non-significance of political connections is only achieved by disposing of about half of the sample[20]. We can conclude that despite the fact that non-normality is present in the dependent variable, this is not driven by a few extreme values, and in fact the negative and significant correlation between political connections and profits persists once the data has been normalised. In fact, the analysis in this section provide an interesting insight on the nature of such negative correlation, with

[20] This is achieved by restricting the variability of the ROE to plus and minus 20%.

political connectedness having a good explanatory power for large departures from zero-profits, but not being such a good predictor when returns are more modest.

d) Endogeneity

The second reason to be cautious with the results is that political connections may not be strictly independent from the profitability of the company. If political connections are not exogenous to profitability, the estimator will be biased and inconsistent. We may have found a correlation between the two variables, but not explanatory power and causality. In the first place, if a firm's strategy towards political connections is partly driven by the profitability of the firm there is a possibility of simultaneous causality bias i.e. X causes Y and Y causes X. For example, as a response to poor performance companies may choose to build up their connections to politicians. Political connections can help secure a more effective influence in shaping up the regulatory and legal framework under which the firm operates, and turn it to the advantage of the business. They can also improve its profit expectations by protecting it from the challenges that are causing bad performance, or by obtaining preferential treatment in the procurement of public sector contracts. In fact, as already observed in the descriptive analysis in section 2, the degree of political connectedness increased in Spain in some of the sectors most severely impacted by the world-wide financial crisis in 2008 and 2009.

Secondly, there is also some potential for omitted variables. If an omitted variable is correlated to both the endogenous variable and political connections then the estimators are going to be inconsistent. For example, human capital and managerial ability have been found to be a good predictor of firm performance (Bloom and Van Reenen, 2007). At the same time, increasing the number of politicians in the board is likely to be at the expense of directors and professionals with the right set of managerial skills. Or, in other words, a substitution effect between managerial ability and political connections might be at play.

The solution to such econometric challenge typically is to identify an instrument(s) that is uncorrelated to the error term (and hence profits), and at the same time, is highly correlated with political connectedness. Good instruments need two conditions to hold to produce consistent and unbiased estimates:

(11) $COV(IV, \varepsilon) = 0$

and

(12) $COV(IV, X) \neq 0$

where IV is the instrumental variable, and X is the independent variable, in this case political connections.

There are serious difficulties with obtaining good instrument(s) for our analysis in the usual manner. Best candidates for instruments in our case would be exogenous shocks that only impact political connections levels, for example a regulatory change or an unexpected event. For example, Kirschner (2006) used the unexpected death of a politician as an instrument for changes in political connections. We considered whether changes to the regulation of board membership and politically connected members might have occurred during the period of interest in Spain but failed to identify any significant regulatory event. We also regressed political connections indices on all variables set out in Table 4. This approach only identified a few dummy variables for some sectors as potential candidates, but with relatively low correlation with political connectedness making them very weak instruments. Instrumental variables regressions with such very weak instruments generally do not improve two-stage least squares estimators and therefore we do not pursue this strategy further (Stock, Wright and Yogo, 2002).

Some in the empirical literature on growth and political connections, as well as in the related empirical literature on development economics and corruption, have simply judged that endogeneity issues were likely to be small in their particular analysis and hence not tried to address it in their econometric analysis (Cinganno and Pinotti, 2010; Li, Meng, Wang and Zhou, 2011). Others however, whilst recognising the challenge to find good strong instruments, argue that industry and/or location averages are good instruments for political connectedness. For example, Fisman and Svensson (2007) instrument corruption levels in Ugandan firms by using the averaged degree of corruption in the sector and location of the company. Desai and Olofsgard (2011) also use grouped-averages in a study of firms' political influence in 40 developing countries. Following

this approach, we assume that political connections Y_{it} can be decomposed in two elements:

(13) $$Y_{it} = Ys_t + Y^*_{it}$$

In this specification, Ys_t is the sector average, i.e. the inherent degree of connection in the sector, which is in turn a function of how contingent the sector is on public sector decisions, for example because the sector is highly regulated by Government, or because the sector receives large public procurement orders. If this assumption holds, then the sector-average of political connectedness Ys_t is exogenous to the performance of a particular company, and therefore a valid instrument as it is free from any endogeneity bias resulting from a correlation between profits at the firm level and its degree of political connectedness.

Table 7. Fixed-effects IV regressions

	(13)		(14)		(15)		(16)	
Constant	-65.07	0.48	-48.17	0.60	-33.16	0.71	-58.47	0.53
Total assets	5.51	0.37	4.26	0.48	2.54	0.67	4.88	0.43
Current ratio	0.09	0.97	0.35	0.87	-0.01	1.00	0.26	0.91
Solvency ratio	1.23***	0.00	1.20***	0.00	1.16***	0.00	1.15***	0.00
2004	2.90	0.65	3.33	0.60	1.17	0.85	1.84	0.78
2005	2.63	0.69	3.39	0.61	2.06	0.75	1.76	0.79
2006	1.42	0.85	3.57	0.62	0.73	0.92	0.46	0.95
2007	1.07	0.89	3.35	0.66	2.67	0.72	0.11	0.99
2008	-20.47**	0.01	-18.81**	0.02	-18.50**	0.02	-19.72**	0.01
2009	-23.33***	0.00	-24.00***	0.00	-21.03**	0.01	-21.76**	0.01
Political connectedness index 1	-87.66***	0.00						
Political connectedness index 2			-227.36***	0.00				
Political connectedness index 3					-390.35***	0.00		
Political connectedness index 4							-342.14***	0.00
F-test of instruments	19.75***	0.00	26.42***	0.00	38.52***	0.00	25.51***	0.00
Hausman-Wu test of endogeneity	14.87	0.14	17.47*	0.06	23.25**	0.01	20.91**	0.02
Nº groups	453		453		453		453	
Nº observations	67		67		67		67	
R-sq within	0.09		0.09		0.11		0.07	
R-sq between	0.01		0.01		0.02		0.01	
R-sq overall	0.03		0.00		0.04		0.03	

Under each regression, first value is the estimated parameter and second value is the p-value. *** 1% significance level; ** 5% significance level; * 10% significance level.

The results of instrumental variable regressions (13)-(16) suggest that after correcting for endogeneity, the negative and statistically significant relationship between political connections and profits holds. In fact, the negative value of the political connections parameters is stronger in magnitude than previously suggested with the least squares estimators in Table 6. The results are more robust to those obtained with least squares only if the instrumental variables approach is effective in correcting for the potential endogeneity of the covariates. We undertake the necessary checks to qualify these results as appropriate over the rest of this section.

Firstly, we tested whether there are systematic differences between the instrumental variables and the least squares estimators through the Wu-Hausman test. The null hypothesis that there is no systematic difference between the IV and least squares estimators is rejected in specifications (14)-(16), indicating that least squares covariates are not a consistent estimator and showing indeed that endogeneity might have been an issue in regressions (5)-(12). However, the test is not rejected in specification (13) i.e. no systematic difference is encountered. In the second place, we need condition (12) to hold for the instrument to be valid.

In order to test the strength and validity of our instrument Table 7 presents the F-test across all regressions indicating that the sector-level averages are a very good predictor of individual firm's connections in a particular year. One long-standing strategy for assessing instruments' validity, the Sargan test, is not available in this case as the number of instruments (one) does not exceed the number of troublesome variables we are considering (also one). Even though the F-tests indicate that our instruments are strong, we need to be convinced that condition (11) holds, or in other words, that sector-averages of political connections are strictly exogenous to individual firms' profits.

Whereas the principle that sector-level of political connectedness is in theory uncorrelated with individual firms' profits holds, it is also true that sectors as a whole might respond in coordination to challenging business conditions across the sector by individually or collectively seeking political influence. For example, we have seen in section 2 that the degree of connectedness in those sectors that struggled in the financial

crisis of 2008 and 2009 were amongst those which increased their overall level of connectedness. This could perhaps suggest that the sector-level degree of connectedness is indirectly endogenous to individual firm profits in the presence of shocks which impact all companies in a sector.

To address this potential limitation in the instruments, we considered employing non-time varying sector averages as instruments, which should in theory eliminate any endogeneity derived from dynamic short term changes in a sector's connections driven by profitability changes. As fixed-effects estimation cannot account for non-time varying cross-sectional variables we can only pursue this approach with random-effects. The Hausman tests of fixed and random effects indicates that random-effects estimation yields non-consistent estimators on specifications (13) and (14), and we therefore restrict the use of such instruments to specifications (15) and (16). Non-time varying instruments are also a weaker instrument as they are less well correlated with individual level of political connections in a particular year. After controlling for any hypothetical time-induced endogeneity, the results (Table 8) still suggest a negative and statistically significant relationship between political connections and profits, albeit with lower statistical significance levels (at the 5% level).

Table 8. Non-time varying instruments, random effects

	(17)		(18)	
Constant	-54.27	0.13	-65.62*	0.06
Total assets	4.46**	0.03	5.08**	0.02
Current ratio	0.27	0.68	0.35	0.59
Solvency ratio	0.54***	0.00	0.58***	0.00
2004	1.25	0.84	1.28	0.84
2005	1.10	0.86	0.98	0.87
2006	0.35	0.96	0.68	0.91
2007	1.22	0.85	0.64	0.92
2008	-21.82***	0.00	-21.88***	0.00
2009	-22.91***	0.00	-22.61***	0.00
Political connectedness index 3	-185.00**	0.04		
Political connectedness index 4			-120.40**	0.05
Nº groups	453		453	
Nº observations	67		67	
R-sq within	0.15		0.15	
R-sq between	0.04		0.03	
R-sq overall	0.07		0.06	

Under each regression, first value is the estimated parameter and second value is the p-value. *** 1% significance level; ** 5% significance level; * 10% significance level.

We explored other complementary approaches to further understand the causality between political connections and profits. These are less robust and conclusive methods than an instrumental variables approach, but are helpful in shedding some more light on the question. In the first place, we entered lags of political connectedness into the equation and used these lags as an instrument to provide an insight into the dynamics of the relationship between political connections and profits. Using lagged variables as instruments is generally problematic in the presence of serial correlation in the error term, and particularly in our case, where indeed it should be possible for managers to anticipate a future change in profitability and respond to it in advance by increasing the number of political connections. We found in all cases were we performed such analysis in regressions (5)-(12) that both a one and a two year lag of the political connection variable resulted in a negative and statistically significant parameter at the 1% confidence interval. We also explored the opposite approach by regressing political connections on profitability, and lagging then profits one and two years. The results in this case resulted in statistical significance dropping to 5% confidence level with one lag, and profits becoming non-statistically significant when lagged two years. This provides useful insights into the sequence of the effects, suggesting that changes to political connectedness occur before changes on profitability. This sequence of events does not necessarily prove causality, but in conjunction with earlier results in this section increases our confidence in the robustness of the results.

We explored further the possibility of regressing political connections on profitability, including through instrumental variables methods using 2008 and 2009 as instruments - where profitability was hit quite hard but where the degree of connectedness did not overall change widely. The results from this approach showed that after controlling for the recession years there is no evidence of profitability having an impact on the company's strategy on political connections. This provides further support to the results obtained above in Tables 7 and 8.

There is clear evidence of simultaneous causality and non-normality between political connections and business performance. Controlling for such endogeneity and for the potential for omitted variables is challenging. In particular, it is important to note that it is conceivable that an omitted variable such as human capital might be correlated with both political connections and firm's profits, and economic theory and empirical results elsewhere suggest a positive relationship between human capital and firm performance. There is therefore a risk that human capital, which is omitted from our analysis as is not available in our dataset, might be correlated to both political connections and to profits. However, under all approaches considered in this paper to control and mitigate for such endogeneity the result holds that political connectedness has a negative impact on business performance.

5. Conclusion

Different forms and degrees of political influence can lead to either positive or negative impacts on business performance. Furthermore, the cause-effect relationship between political connections and business performance could be a two-way affair, with international empirical evidence showing that connections to politicians potentially can result in better (worse) business performance, but also changes in business performance can potentially lead to higher (lower) political connections.

Empirical research has developed vastly over the last decades, and the empirical methods available to identify the impact of political connectedness on firms' performance have progressed significantly. Typically, two main empirical approaches have developed: event-study type analysis of financial markets reactions to political events; and econometric analysis of the impact of political connections on accounting-type measures of firm performance. Whereas empirical methods based on financial-markets data tend to find a positive relationship between political connections and firms' value, approaches based on accounting-based measures tend to encounter the opposite result.

The accounting-based methodology, whilst more transparent, is problematic as establishing an econometrically robust relationship between firm profits and political influence is not straightforward, given the endogeneity between performance and political connectedness. For example, whilst political connections may result in private rents and

hence better firm performance, bad performance can also result in firms seeking new political connections in the market for political influence. The financial-value approach circumvents such econometric issues, but it however relies on an indirect outcome of firm's performance (financial markets return), and hence is only meaningful to the extent that financial markets behave efficiently by accounting for the impact of political connections on the market value of a firm. Constraints and limitations to both methods mean that it cannot be strongly argued that one approach is neatly superior to the other. Any serious exploration therefore needs to consider various approaches in conjunction and this paper importantly highlights the limitations of either empirical method, using a common set of data on political connections in Spain.

There are different degrees of tolerance to political connections in time and space, and these vary from country to country. In Spain, in the first decade of the third millennium, the corporate sector displayed a remarkably large number of connections to Spain's major political parties, with one in five directors being connected at any given time, and with approximately half of these directors having held very senior positions in the past either in Government or in a political party. A high level international comparison shows that even though political connections are not a unique Spanish phenomena, and despite the limitations that exist in making a robust international comparison, its scale and intensity is possibly at the higher end of what can be observed internationally elsewhere in countries with similar level of economic development. This connectedness varies from company to company and is responsive over time to the political party in power both centrally and regionally and to the business cycle.

Our findings for one country (Spain) in the first years of the XXIst century suggest that political connections may have had a negative impact on firms' profits. The results we obtain are therefore more consistent with some of the findings in the literature based on econometric analysis of firm performance, but inconsistent with those based on event-study approaches. Whilst results from the financial markets-based analysis are inconclusive, the econometric analysis of accounting-based measures of performance shows a negative and highly statistically negative impact of political connections on firm's performance. The results hold regardless of the particular variable or measure that is used to proxy for political connectedness and under different considerations of the

degree of connections that is considered. The results also hold when controlling for the potential endogeneity that may exist - whereas connections to politicians might result in better (worse) business performance, also changes in business performance might lead to higher (lower) connections.

The results immediately raise the question of why do companies then appoint politically connected board members. Given the simultaneity between hypothetical cause and effects, the possibility that omitted variables such as managerial ability might also be causing endogeneity issues, and the lack of consistency across the findings obtained through different empirical methods, further research is needed to underpin some of the microeconomic foundations of the observed impacts.

One possible hypothesis is that the appointment of politically connected board members is not an attempt by firms to obtain preferential or favourable treatment, but rather a reward to politicians or ex-politicians which have helped the firm in the past. Under such hypothesis, one would expect a political appointment to result in no statistically significant abnormal returns, which is consistent with the results we obtain in section 3. However, such hypothesis is not consistent with the negative correlation between connections and profits that is presented in section 4. Similarly, another possibility is that in the bargain by which firms relinquish a portion of control rights in exchange for subsidies and protection (as argued by Desai and Olofsgard, 2011), politicians have more bargaining power than individual firms, which is consistent with results in section 3 but not results in section 4.

In our view, three are the key leading hypotheses that provide a closer fit to the empirical evidence presented in this paper, and as such should be particularly targeted for further empirical work. Firstly, given that economic theory and empirical results elsewhere (Bloom and Van Reenen, 2007) suggest a positive relationship between human capital and firm performance, a substitution effect on human capital is likely to occur. It is not clear that managers or directors which provide political connections can offer the same managerial ability and skilled human capital than their non-connected counterparts. This could explain to an extent a negative impact on firm performance from political connectedness. And indeed politicians may be appointed because of behavioural judgmental biases where politicians, being more public and salient figures, are more

likely to be appointed than other candidates. It is therefore possible that firms recruit politicians because they are well known (availability bias) and are thought to be able (after analysing their political career) to stir circumstances in the direction of the firm's objective (attribution bias).

A second key microeconomic foundation which also deserves further empirical research is that in the presence of agency problems, for example where corporate governance does not provide a strong control by shareholders of the management of the firm, private rents can be obtained by managers rather than shareholders. Many large Spanish firms in our sample had been in the past state-owned firms that were privatized with a dispersed shareholding. In a number of instances, and despite the privatisation, subsequent Governments still thought the need to maintain control over those firms, for example by protecting them from takeovers (see Bel and Trillas, 2005 for a case in the telecommunications sector and Trillas, 2010 in the energy sector in Spain). Such a lack of an appropriate control of executives and managers by shareholders, including accusations of crony capitalism, has gained relevance in the public debate, particularly in the aftermath of the world economic crisis that started in 2008. If indeed this is the case, it would be conceivable to expect that the presence of politicians in the board could facilitate extraction of rents by politically connected board members, negatively impacting the performance of the firm.

For example, managers may collude with politicians to protect themselves from the threat of takeovers that could benefit shareholders, or may pursue value-destroying empire building to suit political strategies. An alternative hypothesis to explain such negative effect of political connections on profitability would be that politicians might be able to redirect the objectives of firms toward the common good and away from profit maximization. However, the few papers that analyze the social costs of political connections (such as Khwaja and Mian, 2005, for Pakistan, and Cingano and Pinotti, 2009, for Italy) show that there are high net social costs from political connections and not only lower firm profits. This suggests that the diversion of objectives is not towards the common good but towards other objectives held by politicians.

Empirically, it should be possible to examine whether the negative effect on firm's performance is correlated to the shareholding structure of the business. If the microeconomic foundation is correct, we would expect those companies with a more dispersed shareholding structure to experience a stronger and more negative relationship.

References

Bel, Germa and Trillas, Francesc, "Privatization, Corporate Control and Regulatory Reform: The case of Telefónica?", *Telecommunications Policy* 29, 25-51, 2005.

Bertrand, Marianne; Francis Kramarz; Antoinette Schoar and David Thesmar. "Politically Connected CEOs and Corporate Outcomes: Evidence from France", mimeo University of Chicago, 2004.

Bloom, Nicholas; Van Reenen, John. "Measuring and Explaining Management Practices Across Firms and Countries", *The Quarterly Journal of Economics*, 122(4), pp. 1351-1408, 2007.

Boubakri, Narjess; Cosset, Jean-Claude; Saffar, Walid, "Political connections of newly privatized firms", *Journal of Corporate Finance*, 14 (5), pp. 654-673, 2008.

Castells, Pau; Trillas, Francesc, "The effects of surprise political events on quoted firms: the March 2004 election in Spain", *SERIEs: Journal of the Spanish Economic Association*, 1-30, 2011.

Cingano, Federico and Pinotti, Paolo. "Politicians at Work: The Private Returns and Social Costs of Political Connections", *Bank of Italy Temi di Discussione Working Paper Series*, 709, 2005.

Cuñat, Vicente and Garicano, Luis. "Did Good Cajas Extend Bad Loans? Governance, Human Capital and Loan Portfolios", *Working Papers FEDEA 2010,* 08, 2010.

Desai, Raj M.; Olofsgård, Anders, "The Costs of Political Influence:
Faccio, Mara. "Politically Connected Firms", *American Economic Review*, 96(1) pp. 369-386(18), 2006.

Ferguson, T. and H.J. Voth, "Betting on Hitler –the Value of Political Connections in Nazi Germany", *Quarterly Journal of Economics*, 123 (1), pp. 101-137, 2008.
Firm-Level Evidence from Developing Countries", Working Paper, 2011.

Fisman, Raymond. "Estimating the Value of Political Connections", *American Economic Review*, 91(4), pp. 1095-1102, 2001.

Fisman, Raymond; Svensson, Jakob, "Are corruption and taxation really harmful to growth? Firm level evidence", *Journal of Development Economics*, 83 (1), pp. 63-75, 2007.

Goldman, Eitan; Rocholl, Jörg and So, Jongil, "Do Politically Connected Firms Affect Firm Value?", *Review of Financial Studies*, 22(6), pp. 2331-2360, 2009.

Goldman, Eitan; Rocholl, Jörg and So, Jongil. "Political Connections and the Allocation of Procurement Contracts", mimeo, 2010.

Jayachandran, Seema. "The Jeffords Effect", *Journal of Law and Economics*, 49, pp.397–426, 2006.

Khwaja, Asim Ijaz; Mian, Atif, "Do Lenders Favor Politically Connected Firms? Rent Provision in an Emerging Financial Market", *Quarterly Journal of Economics*, 120 (4), pp. 1371-1411, 2005.

Kirschner, Aron Lowe. "Death of a Congressman: Estimating the Economic Value of Campaign Contributions", Stanford University Working Paper, 2006.

La Porta, Rafael; Lopez-de-Silanes, Florencio ; Zamarripa, Guillermo, "Related Lending", *Quarterly Journal of Economics*, 118 (1) pp. 231-268, 2003.

Li, Hongbin; Meng, Lingsheng; Wang, Qian; Zhou, Li-An, "Political connections, financing and firm performance: Evidence from Chinese private firms", *Journal of Development Economics*, 87 (2), pp. 283-299, 2008.

Mauro, Paolo. "Corruption and Growth", *Quarterly Journal of Economics, 110(3),* pp. 681-712, 1995.

Menozzi, Anna; Gutiérrez Urtiaga, María; Vannoni, Davide, "Board composition, political connections, and performance in state-owned enterprises", *Industrial and Corporate Change*, 2011.

Niessen, Alexandra. Ruenzi, Stefan, "Political Connectedness and Firm Performance: Evidence from Germany", *German Economic Review*, 11(4), pp. 441-464, 2010.

Peltzman, Sam. "Toward a More General Theory of Regulation", *Journal of Law and Economics*, 19(2), pp. 211-240, 1976.

Posner, Richard A. "Theories of Economic Regulation", *The Bell Journal of Economics and Management Science*, 5(2), pp. 335-358, 1974.

Stigler, George. "The Theory of Economic Regulation", *Bell Journal of Economics and Management Science*, 2, pp. 3-21, 1971.

Stratmann, Thomas. "Some talk: Money in politics. A (partial) review of the literature", *Public Choice*, 124, pp 135–156, 2005.

Trillas, Francesc, "Corporate Control in the Electricity Industry, in Energy Regulation in Spain: from Monopoly to Market", edited by J.C. Jiménez and J.L. García Delgado, Thomson Civitas, 2010.

Annex

Table 9. Average number of politically connected directors, by company

	Average (2003-2009)	
	Politically connected board members (as % of total board members)	Highly politically connected board members (as % of total board members)
Red Electrica Corporacion, S.A.	69%	61%
Sol Melia,S.A.	36%	36%
Turbacex	31%	31%
Sogecable	48%	27%
Tecnocom,Telecomunicaciones y Energia,S.	25%	25%
Banco Santander, S.A.	24%	24%
Enagas, S.A.	40%	23%
Metrovacesa S.A.	38%	23%
Iberdrola, S.A.	28%	23%
Miquel y Costas & Miquel, S.A.	23%	23%
Repsol YPF, S.A.	42%	22%
Reyal Urbis, S.A.	31%	21%
Iberia, Lineas Aereas de España, S.A.	23%	19%
Jazztel, P.L.C.	19%	19%
Endesa, S.A.	40%	18%
Adolfo Domínguez, S.A.	31%	18%
Telefonica, S.A.	23%	18%
Banco Guipuzcuano	20%	18%
Sos Corporacion Alimentaria, S.A.	19%	18%
Acerinox, S.A.	18%	18%
Indra Sistemas, S.A., Serie A	27%	17%
Logista	33%	16%
Natraceutical,S.A.	16%	16%
Uralita, S.A.	21%	15%
Altadis	15%	15%
Telefonica moviles	29%	14%
ACS, S.A.	35%	13%
Viscofan, S.A.	27%	13%
Nh Hoteles, S.A.	15%	13%
Banco Pastor, S.A.	13%	13%
Abertis, S.A.	16%	12%
Campofrio Food Group, S.A.	12%	12%
Dogi International Fabrics, S.A.	11%	11%
Azkoyen, S.A.	11%	10%
Banco Español de Crédito, S.A.	10%	10%
Inditex	9%	9%
Ebro Foods, S.A.	9%	8%

Gamesa Corporacion Tecnologica, S.A.	9%	8%
Fomento de Constr. y Contratas S.A.	9%	8%
Puleva Biotech,S.A.	8%	8%
Compañia Española de Petroleos, S.A.	7%	7%
Banco de Valencia	23%	6%
Mapfre	6%	6%
Inmobiliaria Colonial, S.A.	8%	5%
Zeltia, S.A.	5%	5%
Amper, S.A.	21%	4%
Gas Natural Sdg, S.A.	23%	3%
Bankinter, S.A.	3%	3%
Mecalux	3%	3%
Acciona, S.A.	44%	2%
Sacyr Vallehermoso, S.A.	20%	0%
Iberpapel Gestion, S.A.	20%	0%
Prisa	12%	0%
Ferrovial, S.A.	11%	0%
Banco de Sabadell, S.A.	8%	0%
Banco Bilbao Vizcaya Argentaria, S.A.	7%	0%
Unipapel, S.A.	7%	0%
Banco de Credito Balear	0%	0%
Banco Popular Español, S.A.	0%	0%
Catalana Occidente	0%	0%
Cementos Portland Valderrivas, S.A.	0%	0%
Duro Felguera, S.A.	0%	0%
Europac	0%	0%
Faes Farma, S.A.	0%	0%
Natra S.A.	0%	0%
Pescanova, S.A.	0%	0%
TPI	0%	0%
Vidrala S.A.	0%	0%
Zardoya Otis, S.A.	0%	0%

Chapter 4

When businessmen make public policy: Business-Government connections and the allocation of cooperative R&D grants in the United Kingdom

1. Introduction

This article empirically tests the general hypothesis that connected businesses are able to influence public policy decisions. It does so by empirically analysing the allocation of cooperative R&D subsidies[1] in the United Kingdom in the period 2004-2008.

Governments grant subsidies for R&D to businesses in order to correct a well established market failure by which the social rate of return to R&D investment exceeds the private rate, leading to a socially sub-optimal rate of investment in R&D. However connected firms' influence on public policy outcomes may result in policy becoming ineffective in delivering its objectives, with tax-payers resources being transferred to those businesses which are able to exert such influence.

Public R&D grants could be socially ineffective if recipients of funds are not as careful in their use of tax-payers money as they are of their own (Jaffe, 2002), if public support crowds out private investment (David, Hall & Toole, 2000)[2], or if Governments fail to

[1] Subsidies to businesses participating in joint R&D projects with other businesses, research centres or universities.
[2] Public resources are raised via socially costly revenue mechanisms producing deadweight in the economy.

allocate funds where the market failure really occurs. This paper focuses on the latter, a relatively under-researched area in the empirical economic literature on R&D, by examining whether connected firms are able to appropriate part of these funds by influencing who receives subsidies and how many grants they receive. This thus bridges a gap in the literature by providing empirical evidence to a problem long identified in the theory, whereby lobbying and political pressures can help divert publicly funded R&D grants to projects with lower, sub-optimal social returns (Cohen & Noll, 1991; David, Hall & Toole, 2000).

The empirical strategy draws from the literature on political connections by taking advantage of the institutional structure of the UK agency responsible for offering grants, the Technology Strategy Board (TSB). This allows calculating a matrix of direct influences and connections between businesses and the subsidy-allocating agency.

A firm is defined to be connected if an employment relationship at director level[3] has existed between the firm and at least one of the members of the public agency's Board. Most empirical research articles looking at the impact of business interest groups influence on public sector decisions consider links between indirect outcomes of public policy (via financial markets reactions or aggregated measures of public sector performance) and indirect measures of connection. In contrast, I gather information on the both the connections of firms to the public body which allocates grants and how many grants each business receives, hence providing a direct account of the returns of the connection. Our methodology identifies clearly the causal relationship, minimises the possibility of spurious findings, and allows for a straight assessment of the impact of connections on the allocation of grants across firms[4].

The results show that firms directly connected to the public agency are more likely to be successful in obtaining support for cooperative R&D projects, after controlling for company and sector specific factors. I find that a business connected to an equivalent of one Board member is more than twice more likely to obtain a grant than a business which is not connected at all. Furthermore, I show that there exists a significant and large

[3] Defined in the Bureau Van Dijk (Mint UK) database as directors, managers, administrators and executives as stated in the company's annual report.
[4] It however does not capture other mechanisms of influence which may have a bearing on a firm receiving a grant, for example influence being exerted at a higher political level.

positive relationship between the connectedness of a business and the number of grants obtained, after controlling for selection bias.

Even though results have to be considered in its right context – R&D policy in the UK – the findings are suggestive of more general interactions between Government and the private sector. They also highlight the importance of taking account of Government failures, in particular Government capture, when designing the institutional mechanisms for public sector intervention if a socially acceptable outcome is to be achieved. This also includes the role of advisory and expert groups, which are in some countries broadly used in shaping public sector policy.

I focus on cooperative R&D policy because of the already large body of research in the economic literature discussing the factors driving firms to cooperate on R&D. Furthermore, Government action in this area is largely driven by market failure arguments which, even though difficult to measure –as discussed in section 3– make it feasible to determine the optimal distribution of grants in the economy.

In order to undertake the empirical analysis, I did carry out extensive work in manually creating a unique set of micro-data at the firm level for the largest business R&D spenders in the UK. The dataset contains company level information on all variables of interest: R&D performance, detailed business and financial characteristics, innovative capacity, grants obtained from the public sector and connectedness measures. Annex 1 discusses the data matching process. Section 3 presents the variables selected from the dataset for the analysis.

The chapter is structured as follows: section 2 defines the hypotheses on the basis of the literature on public sector support for R&D and the theoretical and empirical literature on political connections and lobbying; section 3 presents the data, defines the variables of interest and provides a statistical overview; section 4 presents the results; and section 5 concludes.

2. Hypotheses and empirical strategy

a) Hypotheses

Two hypotheses are tested in this paper: a) Connected firms are more likely to receive an R&D grant than non-connected firms; and b) Connectedness has an impact on the number of grants obtained. Whereas the first hypothesis is focused on access to public funding, the second hypothesis considers the total impact of connectedness on the distribution of grants. Additionally, I also test the impact of connections on the likelihood to obtain R&D funding by rival, non-connected businesses.

In order to do that, it is necessary first to empirically establish the optimal allocation of public funding for cooperative R&D that would result if the impact of connections were negligible, for which I draw on the extensive empirical literature on R&D cooperation and R&D policy as discussed in section 2b. It is important to note that both the factors driving firms to cooperate in R&D projects with each other, and the factors which drive Governments decisions to concede grants, may not necessarily be the same, and both factors need to be taken into account for an accurate empirical specification.

Such optimal equilibrium is unlikely to materialise where interest groups actively participate in the policy-making process. The theoretical framework underlying this idea is based on a long and well established tradition in economic theory initiated by Stigler (1971) and substantially developed since, for example by Grossman and Helpman (1994).

Elected Governments will generally try to find an equilibrium which maximises their political support. This will be done by trading off social welfare (defending the interests of the electorate by allocating R&D grants efficiently) with the demands of interest groups (as these can provide financial and other type of support to politicians). These theoretical models predict that certain policy outcome will meet more closely the demands of particular interest group the less visible and tangible the policy area is to the electorate, or when there is a lack of counteractive lobbying forces. In the case of R&D policy, the electorate will typically not perceive an immediate welfare gain or loss from a particular allocation of R&D grants, and will also generally lack visibility of sometimes complex and non-transparent allocation processes. R&D policy is therefore one policy area where outcomes are likely to be substantially influenced by the actions of special interest groups.

To express this choice in simple analytical terms, we consider that a rational Government will maximise its utility (U) by maximising the number of votes (v) it receives in the next election. This can be achieved by developing policies that satisfy the majority of the electorate and improve social welfare (W_e), but also by obtaining valuable financial contributions from interest groups to support electoral campaigns (C). Improving the welfare of special interest groups may also be important by itself (W_{sig}) as these can also offer useful employment opportunities when politicians exit their political life. To define its strategy to allocate R&D grants the Government will try to maximise the number of votes that can be obtained from its policy in this area:

(1) $U = f(v)$

(2) $v = f(\Delta W_e, \Delta C, \Delta W_{sig})$

Assuming a linear structure, the objective function that the Government will try to maximise can be expressed as:

(3) $\underset{v}{Max} = a\Delta W_e + b(\Delta C + \Delta W_{sig})$

Parameters a and b reflect the fact that some characteristics of the policy area will have a bearing on the importance of general welfare, contributions and special interest groups' welfare in maximising the number of votes. For example, in an extreme scenario where the electorate has no visibility of the allocation of R&D grants, the value of a will approximate zero, and therefore Government is unlikely to consider social welfare improvements from its R&D policy, even when positive changes to social welfare could be achieved.

The utility function in (3) is difficult to estimate in practice. For example, data on changes in consumer welfare or campaign contributions as a result of the allocation of R&D grants are in practice very difficult to obtain.

The empirical approach in this paper therefore does not attempt a structural estimation of expression (3), but instead considers a limited form equation (see sub-section d) where the likelihood of a firm to obtain a grant is estimated as a function of the drivers of changes in consumer welfare as a result of R&D grants (ΔW_e), as well as direct measures of connections between firms and Government, which are in turn drivers of both ΔC and ΔW_{sig}. The results of such approach equally allow to establish how the Government's approach in allocating R&D grants is aimed at increasing W_e, C or W_{sig}.

One of the most popular mechanisms for public sector intervention are public grants to private R&D cooperative projects, which do invariably involve cooperation between businesses and in some programmes also include universities and research centres. For example, the EU provides a large framework for subsidies under the Eureka-Framework Programme since the 1980s. In the UK, the Technology Strategy Board (TSB) is the main public agency responsible for running R&D grants competitions, selecting the projects which receive funding and establishing the value of the grant[5].

The Technology Strategy Board was set up in 2004 as an advisory body within the then Department of Trade and Investment (DTI), later department for Business, Innovation and Skills (BIS). The advisory board was composed by members mainly with a business background, but also from the venture capital and regional development industries. The TSB became an independent body at arm's length of the Government department in July 2007. Even though the TSB is also responsible for the delivery of R&D policy through other mechanisms, such as knowledge transfer networks and partnerships[6], its main mechanism for intervention has been the Collaborative Research & Development Programme (CR&D), which over the period 2004-08 has provided support to R&D investment with a total value of over £1bn[7].

[5] In the UK, a range of public bodies offer support for R&D activities. In addition to the TSB, the Research Councils offer support, mainly to primary and academic research. Regional Development Agencies and the devolved administrations also have several mechanisms supporting private R&D.

[6] www.innovate.org.uk

[7] Other public programmes in support of CR&D exist in the UK. The Energy Technologies Institute and the Carbon Trust provide support for CR&D on behalf of Government Departments, and Regional Development Agencies also run similar programmes. However the TSB CR&D Programme was by size and scope the central provider of this type of public funding during the period analysed here.

In the UK, as in most countries with R&D programmes, grants are conceded in a beauty contest process in which competitions for funding take place and, on the basis of an examination of the projects, grants are conceded following the assessment of some pre-specified criteria. In the UK, the TSB, jointly with its funding Government Department, identifies technology and research priority areas, after which specific competitions are run and winning projects selected. All applications are assessed by independent reviewers drawn from industry and academia. Applicants need to be able to demonstrate why there is a need for support from the CR&D programme, why it is not possible to fund the project themselves and why the project adds value and is beneficial to the UK. This is important, because as discussed in section 2b, it determines the empirical strategy to assess our hypotheses.

b) R&D cooperation and Government grants

Two aspects will determine a company's likelihood of receiving a public subsidy for cooperative R&D. In the first place, the decision of a firm to seek public financing will be determined by its interest in conducting R&D joint ventures with other firms. Secondly, the factors driving a Government's decision to concede R&D subsidies to some firms and not others will determine whether a firm is supported with public funds.

Both aspects have been subject to extensive debate in both the theoretical and empirical economics literature since the early Schumpeterian analysis of innovation (Schumpeter, 1942) and the seminal work of Arrow (1962) on the limits to the appropriability of private property such as the generation of knowledge.

Public intervention in subsidising R&D is explained by the presence of higher social than private returns to R&D and the fact that knowledge has characteristics similar to those of a public good (Griliches, 1992) and is non-rival and partially non-excludable[8].

[8] The fact that one researcher uses some knowledge doesn't prevent other researchers from using it (non-rival), and once knowledge has been generated, even with the presence of mechanisms for the protection of the innovation such as patents, it is not possible to fully exclude others from taking advantage of it (partially non-excludable).

From a social welfare point of view, R&D investment is likely to be too low without Government intervention. Limited appropriability, financial market failure or positive externalities to the production of knowledge suggest that reliance on the market will result in underinvestment in innovation, relative to the socially desirable level. Hall & Van Reenen (2000) and Jaffe (2002) amongst others present interesting surveys on the empirical literature on public support for R&D.

Amongst the large number of policy instruments available to promote private investment in R&D —competition policy, tax policy, subsidies and actual R&D carried out by the public sector including universities and research centres— I focus on subsidies to support cooperative R&D.

Financial support for cooperative R&D is a public sector instrument designed to tackle the market failures discussed above by subsidising private R&D for those businesses which cooperate in their R&D efforts, hence preventing free-riding and inducing firms to cooperate with each other. Whereas a general subsidy to R&D boosts the private returns to R&D, subsidies to cooperative R&D agreements may be the best way to internalise the positive externality when R&D involves high cost and risk and there is limited appropriability of knowledge in the sector (Okada & Kushi, 2004). In other words, there is a strong case for cooperative R&D when spillovers amongst cooperating firms are high.

Knowledge spillovers may arise both within an industry —where imitation may occur through for example imperfect patent protection and from the mobility of R&D employees — and across industries — where spillovers emerge for example from patents which are relevant to sectors seemingly unrelated with the innovation, or through vertical supplier-buyer firm relationships (Jaffe ,1986). Several have attempted to show the effect that spillovers have on companies' propensity to collaborate (Aspremont & Jacquemin, 1988; Lukach & Plasmans, 2005). Generally, when spillovers are high enough, firms have strong incentives to cooperate with each other. Cassiman & Veugelers (2002) identify that firms which deem important spillovers from external R&D efforts and which are able to appropriate effectively their own R&D efforts are more likely to enter into cooperative R&D agreements.

Spillovers are however not the only factor that may drive firms to enter into cooperative R&D agreements. A substantive empirical and theoretical literature has identified a myriad of other factors which can play an important role in determining such decision. Some of these key factors are the appropriability conditions in the sector, complementarity amongst firms, cost sharing of R&D, size of the firm, R&D intensity, access to finance, research synergies, pre-empting competition and persistence and path dependence in R&D cooperative efforts[9].

Results in the empirical analysis have shown positive and significant findings for every single factor – see for example Kleinknecht & Reijnen (1992), Colombo & Gerrone (1996), De Bondt (1997), Röller et al (1997), Lerner (1999), Wallsten (2000), Benfratello & Sembenelli (2002), Kaiser (2002), Cassiman and Veugelers (2002), Caloghirou, Ioannides and Vonortas (2003), Hernan, Marin & Siotis (2003), Miotti & Sachwald (2003). However, the magnitudes depend largely on the methodological approach followed to carry out the analysis. The factors that have more robustly showed an impact across the empirical literature are spillovers, appropriability conditions in the sector, access to finance and firm size.

In the UK empirical studies of cooperative R&D are scarce, and hence the empirical approach in this paper also draws from the findings of the international empirical literature discussed above. Tether (2002) discusses the UK empirical findings on the determinants of cooperation in R&D. Becker & Pain (2003) find evidence which indicates that factors discussed in the broader international literature such as spillovers and firm/industry appropriability conditions are also relevant for cooperative R&D in the UK. Abramovsky et al (2005) compare cooperative R&D activity across four European countries, including the UK. In all cases the findings are consistent with results shown in the broader literature.

c) Politically connected firms and policy outcomes

[9] The organisational structure of firms and transaction cost economics (Pisano, 1990; Oxley, 1997) has also been used to explain the reasons why firms join cooperative R&D ventures, as high cost and complex R&D projects are more efficiently dealt with when companies enter into cooperative R&D agreements (Aghion and Tirole, 1994; Penrose, 1959). From this perspective, cooperative R&D agreements are an efficient way of economising on transaction costs, because high spillovers and incomplete contracts make the possibility of free riding high.

A vast array of economic research has developed extensive theoretical frameworks on the influence exerted by special interest groups on public policy and the way that such processes shape the scope and direction of public sector intervention.

The median voter theorem (Downs, 1957) predicts that political parties converge to the ideological position of the median voter in order to maximise their likelihood of being elected. In a strict interpretation of the theorem, lobbying and interest groups cannot fully achieve their private objectives because in order to do so a political party needs to deviate from the median voter position and therefore decrease the likelihood of being elected. However the central voter theorem only holds under strict conditions, most notably perhaps the requirement for perfect information across all relevant agents. Politically connected firms can therefore take advantage of preferential treatment from Governments when these conditions do not hold as theorised by Shleifer and Vishny (1994). For example, if politicians can favour a private business without the knowledge of the general public, then it may be optimal for the politician to do so[10].

Theoretical models of regulatory capture predict the outcomes of public sector intervention on the basis of the nature and motivations of the interaction between the public and private sectors. Stigler (1971), Posner (1974) and Peltzman (1976) theorised public sector intervention as a function of demand and supply of regulation, which in turn is determined by the organisation and stake of private interest groups and the institutional structure of the public sector. A rich theoretical literature on the institutions of microeconomic policies developed, with consideration of aspects of particular importance to this article, such as the provision of information as a mode of exerting influence (Austen-Smith and Wright, 1996), the independence of regulation (see Trillas (2010) for a review of the literature on independence), the bias of independent advisers (for example, Landier, Sraer and Thesmar, 2009) or the question of "revolving doors" – i.e. the effect of employment churn between the public and private sector (Che, 1995).

[10] See Grossman and Helpman (1994) for a theoretical development of this idea.

The empirical literature, even though extensive, has several data and methodological shortcomings, mainly because measuring capture is tricky[11]. Different strands of the empirical economic literature have developed methodologies to this effect: the empirical literature on campaign contributions and lobbying; the empirical literature on international corruption; the literature on market reactions to political events; the literature on politically connected firms[12].

The empirical literature on campaign contributions and lobbying (see Potters and Sloof (1996), Anslobehere, de Figueiredo and Snyder (2003) and Stratmann (2005) for extensive reviews of this strand) has not provided a robust and conclusive answer to the question of whether lobbying has an impact on policy outcomes. The related economic literature on financial markets reactions to political events can be deemed as an indirect approach to understanding whether lobbying or connectedness has an impact on policy outcomes. This empirical approach typically consists of analysing whether a correlation exists between political events or policy announcements and the market value of firms, and hence infer whether some firms' profits are contingent on a political party being in office. Roberts (1990), Herron et al. (1999), Jensen and Schmith (2005), Leblang and Mukherjee (2005), Jayachandran (2006) and Castells & Trillas (2008) find different degrees of impact on financial markets depending on time and country. The approach is however limited by its reliability on the hypothesis that markets are an efficient mechanism to internalise the impact of news on the traded values of firms[13].

The empirical literature on corruption (Mauro, 1995) is closely linked to the field of development economics and has a markedly different focus as compared to the empirical literature discussed so far. Its empirical approach generally relies on country-level indices of corruption which tend to include an important degree of noise, and looks at international comparisons as opposed to intra-country analysis. Frederiksson & Svensson (2003) analyse the determinants of environmental policy across various countries and test the influence of the corruption level in the country. Svensson (2003) uses a more detailed

[11] The literature shows that is very difficult to determine what would have been a policy decision without the influence of interest groups and to obtain effective proxies for the multiple ways in which such influence can be exerted.
[12] As well as the approach by other strands of the economic literature, for example the empirical literature on international trade (Lenway et al., 1996; Goldberg & Maggi, 1999).
[13] The efficient markets hypothesis has been challenged by some in the behavioural finance literature, see for example Shleifer (2000), Shiller (2003) for an introduction to the key aspects of this criticism.

and innovative dataset with micro level information on Ugandan firms on how many bribes they have to pay, concluding that firms that have to pay more bribes tend to grow less than their non-bribe paying counterparts. Recanatini, Prati & Tabellini (2005), based on the analysis of survey data, conclude that public agencies are more corrupt when they deal with businesses than with consumers.

The empirical literature on politically connected firms addresses many of the data and methodological constraints which have been discussed so far by defining measures of political connectedness. This is typically determined by whether a board member of a firm is serving or has links to office. Fisman (2001) is arguably the inaugural paper to this specific approach by analysing how political connectedness in Suharto´s Indonesia has an impact on the market value of firms. Faccio (2006) looks at broader political connections across 47 countries and estimates both the determinants of political connections and the value that connections add to company market value. Ferguson and Voth (2008) find that firms connected to the Nazi movement experienced significant growth in market value during the raise of the Nazi party.

These articles establish a relation between the political connection and indirect outcomes (financial returns). Whereas this is a valid approach, it has some limitations, already discussed above, as it establishes an impact between connections and financial markets performance rather than direct, observable policy outcomes. Others have analysed the impact of connectedness on firm performance. Menozzi, Gutierrez & Vannoni (2010) find that politically connected directors increase employment in firms but have a negative impact on their performance. Cunat & Caricano (2010) find that those Spanish saving banks whose chairman is politically connected show worse loan performance.

Some more recent articles have attempted to uncover the direct influence of political connections on policy outcomes. Cingano & Pinotti (2009) estimate the real value of political connections in Italy. They find that political connections have a 5% premium on revenues to those firms that are connected, and that such connections reduce the provision of public goods by 20%. Goldman, Rocholl & So (2009) also show that politically connected firms are able to increase their allocation of public procurement contracts. Bertrand, Kramarz, Schoar and Thesmar (2004) show how politically connected CEOs in France create more jobs in politically contested areas, and how these

firms are then paid back through preferential access to public subsidies. I build on this literature by analysing the allocation of public funding when there is a direct connection between some potential recipients of the funding and the body which allocates R&D subsidies.

Finally, it is important to note that this is not the first research article which considers the influence of politically active businesses on the outcomes of R&D policy. Ades & Di Tella (1997), based on the analysis of surveys of managers and economic leaders at the country level, argue that the benefits derived from active industrial policies such as support for R&D must be qualified down in the presence of corruption. They empirically prove that under corruption rent seekers are able to capture part of the subsidies. de Figueiredo & Silverman (2006) study the distribution of academic earmarks across universities and find that lobbying spending by Universities has a significant and positive impact on the amount of research that is funded.

d) Empirical strategy

Drawing on section b, the decision of a firm to engage in cooperative R&D and for a Government to provide financial support can be stylised as a function of some key drivers. These include the size of the business, its R&D intensity, the amount of spillovers a company generates, the degree to which the business can appropriate its innovations, and having obtained subsidies in the past. Section 3 discusses in detail these and others variables which are considered in the regression analysis.

The analytical function that is specified to test the probability of receiving a subsidy on R&D cooperation can be defined as:

$$P(s^*_{it} > 0 / F_{1,it}) = P(s_{it} = 1) = P(\beta X_{it} + \varepsilon_{it}) =$$
$$F_{1,it}(\beta, Size_{it}, R\,\&\,D\,\text{int}ensity_{it-1}, Spillovers_{it}, Appropriab\,ility_{it}, s_{it-1}, \varepsilon) \quad (4)$$

where s^*_{it} is the total number of subsidies received by company i in year t; s_{it} takes the value of 1 when s^*_{it} is larger than 0, and 0 otherwise; $F_{1,it}$ establishes the functional relationship between a vector of parameters β and a matrix of factors X which drive the probability of company i in year t of obtaining a grant.

The second hypothesis that needs to be specified is whether connections have an impact on the total number of grants obtained by a company in a given year[14]. In the absence of publicly available data on the monetary value of grants obtained by individual companies, the number of times a business is awarded a subsidy is considered as a proxy. In this case we also need to understand the factors driving the number of times that company i in year t obtains grants in the absence of connections. These can be specified as a function of both the probability of obtaining public funds in the first place and the factors driving the number of times a grant is awarded:

$$(5) \qquad s^*_{it} = F_2(\alpha R, P(s^*_{it} > 0 / F_{1,it}))$$

where R is a matrix of factors which drive the number of times a subsidy is awarded. This can be specified in a similar fashion as (4) and is discussed in more detail in section 3.

I define a firm to be connected in a given year when an employment relationship at director level has existed between the firm and at least one of the members of the Board of the TSB. This definition follows in essence the empirical literature on political connections discussed above in section 2c, but differs from it in that it provides a direct link between the connected firm and the way in which the firm takes advantage from the connection.

I hypothesise that such connection can have an impact on both the likelihood of receiving a grant and the number of times a company receives a grant in a given year. In the period 2004-08 this could happen through several mechanisms, namely: if connected firms are able to influence the selection of priority areas, which are determined by the TSB and the funding Government Department; if they can influence the technology area which a competition is going to run; if connected firms are able to influence the composition of the panel of independent assessors; or, as Board members are appointed by Government, if there is a high level political connection between a firm and the governing party which materialises in the appointment of a Board member connected to such firm.

[14] Section 3 contains a discussion of pros and cons of using publicly available project level data on the monetary value of the award.

In addition to the two central hypotheses, I also want to explore whether the connection of a firm has an impact on the prospects of receiving a grant of non-connected businesses in the same sector or technological area (expressed as the variable Sector Connection in (6) below). The likelihood of receiving public funding for such businesses could indirectly increase if the influence of connected firms occurs through influencing the selection of the technological area of the competition. On the contrary, if the influence of connected firms occurs through influencing the composition of the project evaluation board, there could be a negative effect for businesses in the same sector as the connected firm.

Introducing connection measures to (4) and (5) results in:

$$
\begin{aligned}
&P(s^*_{it} > 0 / F_{1,it}) = P(s_{it} = 1) = P(\beta X_{it} + \delta Z_{it} + \varepsilon_{it}) \\
&= F_{1,it}(\beta, \delta, Size_{it}, R\ \&\ D\,\text{int}\,ensity, Spillovers_{it}, Appropriab\,ility_{it}, \\
&s_{it-1}, Connection_{it}, SectorConn\,ection_{it}, \varepsilon)
\end{aligned} \tag{6}
$$

$$
\begin{aligned}
&s^*_{it} = F_2((\alpha R, \delta Z), P(s^*_{it} > 0 / F_{1,it})) = \\
&F_2(\alpha R, \delta Z)\_if\_P(s^*_{it} > 0 / F_{1,it}) \neq 0 \\
&0\_if\_P(s^*_{it} > 0 / F_{1,it}) = 0
\end{aligned} \tag{7}
$$

where X_{it} is a matrix of the factors driving the probability of company i in year t of obtaining a grant and Z_{it} is a matrix of connections between company i and the agency in year t.

3. Variables

No existing source provided data for all variables discussed in section 2. Therefore a major data gathering exercise was needed in order to create a unique dataset with sufficient information at the individual company level on connections, spillovers, size, R&D, appropriability conditions and public sector R&D grants received. Annex 1 discusses in detail the creation of the "UK R&D Connections database", the data gathering exercise, the specific properties of the data, and sources for each of the

variables created. This section describes the variables, their rationale, and presents some key descriptive statistics.

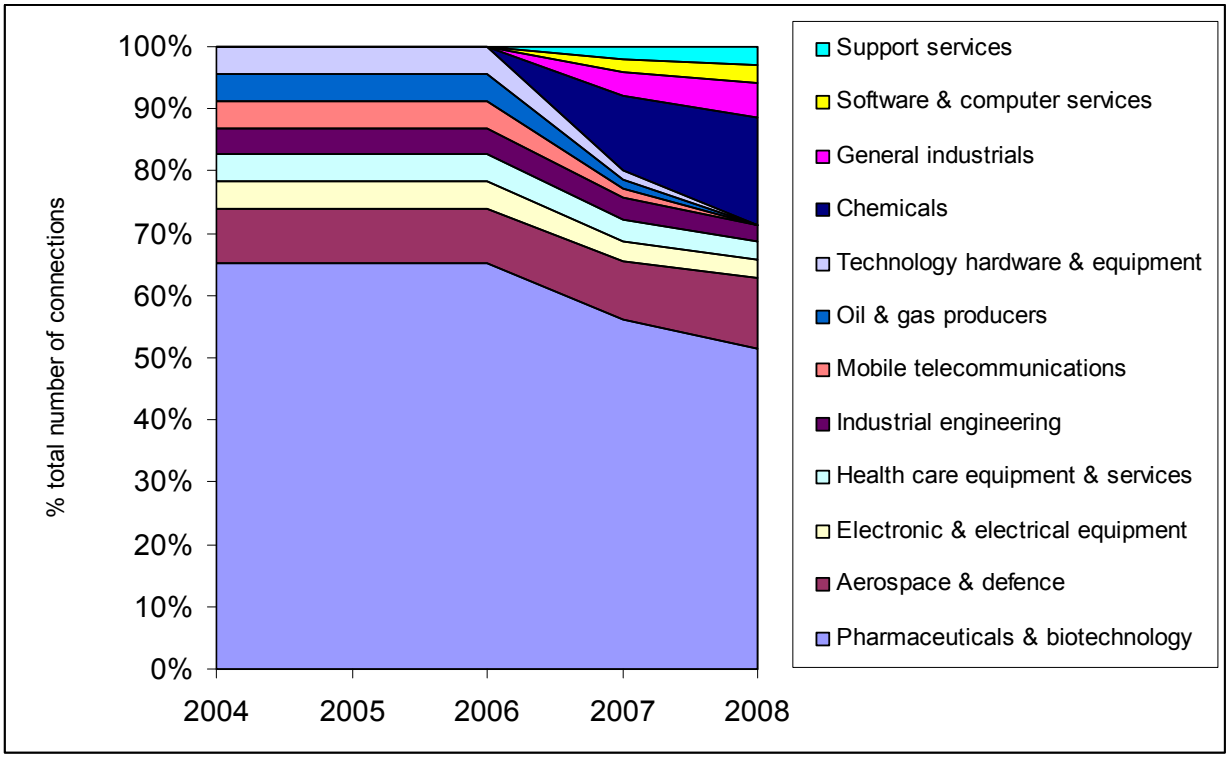
The UK business population realistically susceptible of receiving subsidies from the Technology Strategy Board on cooperative R&D is composed by relatively large businesses which have already engaged in R&D activities in the past and smaller, highly specialised R&D businesses, laboratories and universities. The UK R&D Scoreboard[15] covers yearly individual company records for the largest R&D investing businesses in the United Kingdom from 1991 to the time this article was being written. Companies included in the yearly UK R&D scoreboard represent a good proportion of the business target population of TSB cooperative R&D grants even though it is inevitably biased towards larger businesses. Companies covered in the R&D scoreboard database have been involved in 60% of all projects subsidised by the TSB programme in the 5 year period from 2004 to 2008. This is the sample of companies for which I analyse the allocation of R&D grants in section 4 and for which variables are generated as discussed in this section.

a) Business connections

In order to test the two key hypotheses it is necessary to establish whether businesses are connected to the Government agency allocating R&D grants. The particular institutional organisation for decision-making in the TSB provides an excellent and unique opportunity to do it. For every year in the period 2004-2008 I establish the composition of the agency Board and the connections of its individual members, hence creating a map of direct influence between businesses and the TSB. A Board member is identified as being connected to a business if the TSB Board member has held in the past a director level position in that company. For example, AstraZeneca, with 3 connections in both 2007 and 2008, is the company with the highest number of connections in any given year. Annex 1 discusses in detail how this dataset was created.

Figure 1. Business connections by sector in the agency's board

[15] http://www.innovation.gov.uk/rd_scoreboard/



A range of different connection measures can be constructed once the connection between TSB board members and businesses is established. A dummy variable shows whether a company is directly connected:

$$\begin{cases} \text{if } N^{o}\text{Connection}_{it} \neq 0 & \rightarrow \text{Direct Connection}1_{it} = 1 \\ \text{if } N^{o}\text{Connection}_{it} = 0 & \rightarrow \text{Direct Connection}1_{it} = 0 \end{cases} \quad (8)$$

Figure 1 aggregates connections to the board by year and sector, highlighting the dominance of pharma and biotech connections.

The richness of the dataset allows creating more complete measures of connection which not only account for the single fact of being connected as in (8), but also for the intensity of such connection. I define the intensity of connection as the sum over all TSB board members of the ratio of connections of a company with an agency board member over the total number of connections of such TSB board member in a given year:

$$\text{Direct Connection } 2_{it} = \sum_{b}^{B} N^{o}\ Connections_{bit} / N^{o}\ Connections_{bjt} \quad (9)$$

where $b=1..B$ is the total number of board members; i is the company in question and j are all other companies connected to board member b.

If *Direct Connection 2* takes a value of 1, a business has an influence equivalent to a full-time board member of connection – i.e. a board member which is only connected to this company and none other. If for example the intensity of connection takes a value of 0.25, it indicates that the business is connected to 25% of the time of the board member. It can be argued that this intensity measure is a more accurate representation of connectedness than simply counting the total number of connections of a company with the TSB as it weights the connection by the total number of connections a Board member has in a given year. For example, if board member A has been a Director of only 1 company over a 30 year career, this connection is weighted more highly than another company connected to board member B whom is also connected to 25 other companies at the same time. In both cases, both companies would appear as connected with the same intensity based on the total number of connections. For example Rolls Royce and AstraZeneca both have in 2005 two direct connections to the TSB. However, when employing Direct Connection 2, Rolls Royce remains with a value of 2, whereas AstraZeneca drops to 0.15.

Additionally, in order to account for changes through time in the overall level of connections in a given year, which may have an impact on the measure of intensity of connection as defined in (9), a second measure for intensity of connection is created in which *Direct Connection 2* is expressed in terms of the total weighted influence by all other companies in that given year[16]:

$$\text{Direct Connection } 3_{it} = \frac{\text{Direct Connection } 2_{it}}{\sum_{i} \text{Direct Connection } 2_{\text{it}}} \quad (10)$$

In section 2a I discussed the impact of connections on the prospects of non-connected businesses in the competition for funding. Companies in the same sector as a connected

[16] An even more refined measure of connection would be to compute weighted influence controlling for the time in which a board member is connected to a given company. However this was not possible based on existing data sources at the time this article was being written.

company may take advantage of the connection –free-ride– and increase their chances of receiving a grant. This could occur if the technology area is set to favour connected companies and, as a collateral effect, non-connected companies in the same technology area become more likely to receive public funding; or because the Board member is more likely to be connected to companies in the same sector where he/she developed its professional career. Alternatively, companies in the same sector than a connected company may become less likely to receive a grant if connectedness does not have an impact on the total number of grants allocated per sector but rather in the selection of specific projects. Establishing this relationship also provides an insight into which decisions connected businesses are able to influence in the grant allocating process.

Equivalent indicators to the direct measures of connection discussed above are constructed at the sector level, discounting for the effect of the individual connection when a company is already directly connected as appropriate:

$$\begin{cases} \bullet \text{ if } \sum \text{N}^{\text{o}}\text{Connections}_{\text{ijt}} \neq 0 \\ \quad \& \text{ Direct Connection 1}_{\text{it}} = 0 \rightarrow \text{Sector Connection 1}_{\text{it}} = 1 \\ \bullet \text{ otherwise} \qquad \rightarrow \text{Sector Connection 1}_{\text{it}} = 0 \end{cases} \tag{11}$$

$$\text{Sector Connection 2}_{\text{ijt}} = \sum_{j} \text{Direct Connection 2}_{\text{ijt}} - \text{Direct Connection 2}_{it} \tag{12}$$

where *j* refers to the sector *j* to which company *i* is part of (*N=1…j*)

b) R&D grants

As shown in specifications (6) and (7) the two dependent variables of relevance required for the analysis can be derived from the number of times a company is granted a subsidy in a given year.

It is important to note that whereas it is possible to obtain original information at a company level on the number of times a company has participated in the programme and the year when this occurred, information on the monetary value of the grant is only made

available at the project level. I did consider several ways to proxy for the subsidy that a specific company receives on the basis of the available information. For example, it could be assumed that the grant is shared equally amongst partners, or even carry out further transformations to the data and allocate different amounts to partners according to their size or R&D spending. Any such approach however would need to impose very strong ex-ante assumptions to the way that the value of the subsidy is allocated across firms, probably to the extent of making any results obtained from such analysis unreliable and rightly open to criticism. I therefore prefer to restrict the analysis to data which is directly observed (number of grants obtained by a company) rather than extending it to cover data which would need to be strongly manipulated first (monetary value of subsidy received by a company).

Over the period 2004-2008, and according to information published in the TSB website, companies in the R&D Connections database were involved in 282 of the 485 projects supported by TSB funding. These projects were subsidised by a total amount of just under £200 million over the five year period. On average, a TSB financed collaborative R&D project has 5 partners, of which 4 are businesses and one either a university or a research centre. Figure 9 in Annex 1 shows how participation in the programme varies substantially amongst sectors. In particular, aerospace and defence stand out as the more frequent participants, with involvement in over 100 projects, in contrast with an average participation of 10 to 25 for most other sectors. Companies in the aerospace and defence industry also top the ranking of businesses with the largest number of participations in the programme.

c) Knowledge spillovers

There are different empirical techniques to determine how much knowledge spills over from a company to the rest of society. One way of calculating spillovers is by using survey data on a firm's assessment of the importance of different sources of information for the firm's own success in innovating. For example, in the UK such data is available under request from the Office of National Statistics based on the two-yearly European wide Community Innovation Surveys (Cassiman and Veugelers, 2002; and Belderbos et al., 2004). An alternative approach is to directly measure the flow of citations between

different companies in a given year (Trajtenberg, Henderson & Jaffe, 1992; Bloom, Schankerman & Van Reenen, 2007).

The former approach is limited as it is based on stated rather than revealed spillovers which may cause the data to be unreliable. Furthermore, it provides an indication of how much information a particular company is capable of absorbing from others (suppliers, providers, competitors, etc.), but crucially does not indicate the total amount of spillovers that a specific company produces. Therefore it makes it difficult to test the hypothesis that the amount of spillovers a company produces should increase both the likelihood of cooperating in R&D and the number of times a subsidy is received.

The alternative approach, based on citations, is preferred because it is both a more direct measure and it can also be used to test the theory. Annex 1 discusses in detail the sources of this data. It is important to note that his approach has also limitations, as citations only capture knowledge flows between patented pieces of knowledge (Caballero & Jaffe, 1993). Lukach & Plasmans (2005) also discuss that patent citations are sometimes added by the patent examiner even when the inventor may not actually be aware of it.

The key variable of interest is the average number of citations received by a company's patent[17]. Even though the data allows obtaining such measure yearly, it is preferred to calculate a 5-year average. This is because as R&D and patenting processes tend to be clustered and very cyclical, the knowledge spilled over by a company in a given year is not well captured by exclusively looking at its patenting activity in that given year. For example, knowledge may spill over during the research and development period which precedes an innovation. This makes the use of a five-year average citations measure preferable:

$$\text{Citations per patent (5 - year average)}_{it} = \sum_{t-4}^{t} \text{Citations per patent}_{it}$$

where

$$\text{Citations per patent}_{it} = \sum_{p}^{P} \text{N}^{o}\text{Citations}_{p}/\text{Patents}_{pt} \quad (13)$$

where $p=1...P$ are patents produced by company i in year t

[17] See Annex 1 for a detailed discussion of how this variable is constructed.

d) Appropriability conditions

The capacity for a company to appropriate the knowledge it produces has an important bearing on a company's decision to cooperate in R&D projects. The protection of innovation from competitors (horizontal spillovers) varies sector by sector and market by market, because innovation may be easier to appropriate in some areas than others. For example, it is well documented that whereas product innovation in the pharmaceutical sector is well protected by a generally strong and reliable patenting system, innovation in other sectors may be more difficult to protect[18] (Mansfield, 1985; Cohen, Nelson & Walsh, 2000). A pharmaceutical company which can limit the amount of horizontal knowledge spillovers it produces is likely to carry out R&D effort without cooperating with competitors as innovation may result in gaining a competitive edge within its industry and free-riding can be restricted through effective protection mechanisms.

Measures of appropriability conditions at the company level are rarely available. Some researchers (Dachs, Ebersberger & Pyka, 2008) have used company level data from the two-yearly Community Innovation Survey (CIS) for Austria, Finland and Spain respectively. This is because some of the questions in CIS can be used as a proxy for the degree of appropriability of innovation by a company[19]. For the purpose of this analysis, I use sector level data on the effectiveness of protection in the UK based on survey data from the CIS-3 from Barros (2008)[20]:

(14) $\text{Appropriability}_{it} = \text{Appropriability}_{j}$

where *j* refers to the appropriability conditions for the sector which company *i* is part of

Appropriability conditions are very stable through time in different countries and points in time (Mansfield, 1985; Cohen, Nelson & Walsh, 2000). Figure 2 below shows a 60%

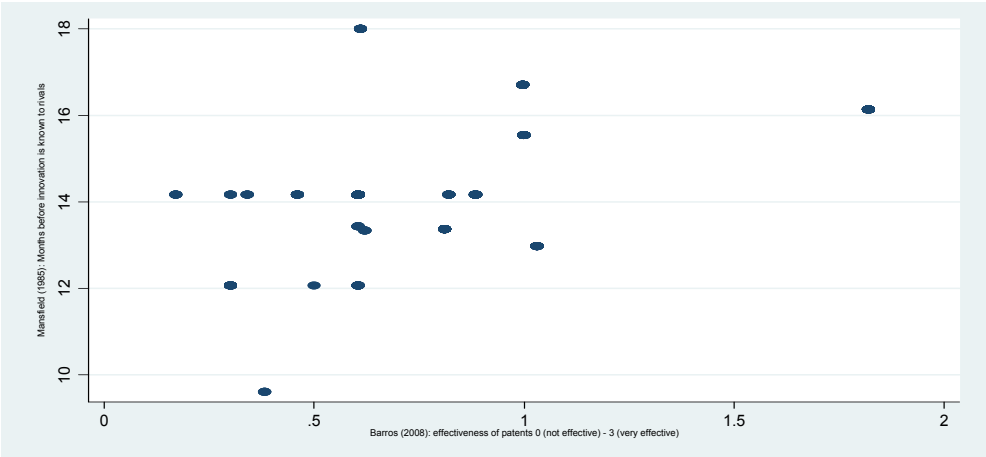
[18] In the IT sector, due to very common cross-patenting and the large number of components for any end product, it may result in cases impossible to protect competitors from immediately replicating an innovation.

[19] For example, the second part of question 15 of the CIS 3 questionnaire poses the following question: "During the period 1998-2000, please indicate the importance to your enterprise of the following methods to protect innovations".

[20] Annex 1 contains a detailed discussion of the different approaches available for the analysis and the rationale for the source chosen in this case.

correlation between appropriability conditions by sector in the US in 1985 and the UK in 2000, even though the measures are calculated with different methodologies. This indicates that using a non-time varying appropriability measure is not a major constraint as the conditions for appropriability in a sector tend to remain stable through time, even in different countries.

Figure 2. Correlation between months before innovation is known to rivals and effectiveness of patents (US, 1985; UK, 2000)



e) Other variables

R&D intensity

As scoped in section 2b, the expected relationship between the likelihood of receiving a grant and R&D intensity is a positive one. This is because an R&D intense company will be more likely to enter into cooperative R&D projects in order to spread the cost of R&D. It is also likely that the public programme targets such type of barriers to businesses' investment in R&D.

R&D intensity is calculated as the natural logarithm of the ratio of R&D investment to sales in a given year:

$$\text{R \& D intensity}_{it} = \ln\left(R\&D_{it} / sales_{it}\right) \quad (15)$$

The average R&D intensity over the period 2004-08 is over 150%. Excluding those companies with less than 100 employees (approximately 20% of all companies) the average R&D intensity drops to 12%. This is because smaller, younger companies tend to have disproportionately large R&D investment levels compared to sales. R&D intensity also varies considerably amongst sectors. Figure 7 in Annex 1 shows R&D intensity by sector for companies with more than 100 employees. Whereas pharmaceutical companies have high levels of R&D intensity, close to 60%, most sectors have intensity ratios below 10%.

Size of the business

It is expected that the size of a business increases the likelihood of receiving a subsidy. Larger businesses are more likely to participate in both more R&D projects and R&D projects of larger scale. Furthermore, it is possible that larger businesses can more easily overcome fixed costs of entering a competition for public funding and reaching R&D venture agreements with partners.

Company size is proxied by the natural logarithm of the average number of employees of company *i* in year *t*[21], following the approach by Hernan, Marin & Siotis (2003):

$$\text{Size}_{it} = \ln(\text{employees}_{it}) \tag{16}$$

The average size of a business covered in the sample is of just over 7,000 employees. Figure 8 in Annex 1 shows that business size differs substantially amongst different sectors of the economy.

State dependence

Dynamic effects are recognised as important in the empirical literature on public funding of cooperative R&D. If a company has received a subsidy in the previous year, it may become more likely to receive a subsidy in the current year:

[21] When the average number of employees is not available in the company books I use year-end figures.

$$(17)\quad \begin{cases} \bullet \text{ if } Subsidy_{it-1} = 0 \rightarrow State\ Dependance_{it} = 0 \\ \bullet \text{ if } Subsidy_{it-1} \neq 0 \rightarrow State\ Dependance_{it} = 1 \end{cases}$$

Sector and time heterogeneity

Unobserved heterogeneity in sectors may have an impact on the likelihood of obtaining R&D grants and we introduce sector dummy variables for those sectors where the number of companies is large enough in order to avoid encountering spurious effects. Similarly, in order to capture unobserved heterogeneity in a given year time fixed effects are also considered.

Exports intensity, relative comparative advantage, UK ownership and state aid

Public support for R&D can also be used as an instrument of industrial policy to increase the competitiveness of UK businesses. EU legislation forbids state aid when this favours certain businesses or sectors and prevents effective competition in the common market. Other forms of subsidies –such as public support for cooperative R&D– are not forbidden, and Governments committed to the idea of state aid can use R&D programmes to financially support strategic sectors and businesses which are undergoing structural or cyclical difficulties.

For example, the cooperative R&D programme can contribute to the consolidation and expansion of UK businesses abroad by boosting their competitiveness if support is granted to businesses with a high exports to sales ratio. Similarly, competitions for cooperative R&D funding can be restricted to those sectors where the UK has a relative comparative advantage to the rest of the world.

The degree to which a company is oriented to international markets is captured by the natural logarithm of the ratio of sales outside the UK to total company sales:

$$(18)\quad Exports\ intensity_{it} = \ln\left(Sales\ outside\ the\ UK_{it} \Big/ Sales_{it}\right)$$

Relative comparative advantage can be measured by the Balassa Index (Balassa, 1965), which captures the "revealed" comparative advantage of a sector to the rest of the world

based on observable export patterns. In the analysis, I use exports data from the International Monetary Fund and the United Nations Comtrade database[22]:

$$\text{(19)} \qquad \text{Revealed Comparative Advantage}_{it} = \ln\left(\frac{\text{Exports}_{UK,j}/\text{Exports}_{UK}}{\text{Exports}_{World,j}/\text{Exports}_{World}}\right)$$

where *j* refers to the sector which company *i* is part of

Additionally, if the state aid hypothesis holds, unprofitable businesses should be more likely to receive a grant. This is represented by the profits to sales ratio of a business in a given year:

$$\text{(20)} \qquad \text{Profitability}_{it} = \ln(\text{profits}_{it-1}/\text{sales}_{it-1})$$

4. Results

The analysis is carried out by means of panel data discrete choice regression analysis and count panel data selection regression models, which test respectively analytical identities (6) and (7) which were first presented in section 2. In order to test equation (6) on whether connected businesses are more likely to receive public funding on cooperative R&D I employ panel data discrete choice models with random effects. In order to test equation (7) on whether connected firms receive more grants than non-connected firms I employ negative binomial and zero-inflated selection models for panel data. The variables presented in section 3 are regressed on the discrete dependent variable of cooperative R&D grants.

The analysis presented in this section is only valid to the extent that there are no endogeneity issues in the regression analysis. Endogeneity could arise in our approach for two main reasons. In the first place, more grants can lead to more spending on R&D, but more R&D activity may lead to more grants received. It can be argued that given the large magnitude of the R&D spending of the companies in our sample, the impact of grants received through the TSB programme on these firms overall level of R&D

[22] International Monetary Fund Balance of Payments; UN Comtrade; Exports data on Aerospace is sourced from HM Revenues & Customs

spending is very limited. Despite that, in order to minimise any such effect we introduce R&D variables with a lag in the regression.

The second area where endogeneity could arise is if there are omitted variables in our analysis. Omitted variables which are correlated to both the endogenous and an exogenous variable, for example connections, could lead to inconsistent estimators. It could be argued that one of the drivers of both connections to the TSB and the number of grants allocated is the complexity of a particular technology area. If an area is very complex the public agency might need to use private sector expertise to assess the R&D proposals. In a way, this can be seen as similar to the phenomenon of revolving doors, where specialists move from the private to the public sector. We however judge this argument and its the relevance and impact to be limited in this particular case. Many of the technological areas covered by the cooperative R&D programme are complex, but there does not seem to be an apparent correlation between technological complexity and the degree of connections in a particular sector.

Finally, it could also be the case that some of the dependent variables are driving both the degree of connections of a company to the TSB and the number of grants received, for example the sector or size of a company might be linked to both connections and the number of grants. An observation of the general correlations between these variables does not show however strong correlations. Overall, even though we cannot rule out the possibility of endogeneity completely, our assessment indicates that this is unlikely to be a major issue.

a) Connections and the probability of obtaining a cooperative R&D subsidy

The equation that needs to be estimated can be described as in (6):

$$P(s*_{it} > 0 / F_{1*,it}) = P(s_{it} = 1) = P(\beta X_{it} + \delta Z_{it} + \varepsilon_{it})$$

where s_{it} takes a value of 1 if the company receives a subsidy and 0 otherwise. $s*_{it}$ represents the number of subsidies the company receives in a given year.

This expression can be consistently estimated by dynamic logit and probit random effects panel data estimation. Fixed effects are problematic, as non-time varying variables (such as sector appropriability or some connections) cannot be entered in the regression as they remain stable throughout the 5 year period. Random effects estimation assumes that differences between groups are random variations from the parametric value, which may be problematic if there is unobserved heterogeneity between groups. This is however mitigated by the introduction of dummy variables at the sector and year level as shown from regression (7) below (see Table 1)[23] and by the introduction of a state dependence variable, discussed in the paragraph below, which also captures unobserved heterogeneity.

Dynamic effects may play an important role in determining the likelihood of receiving an R&D grant, as it is necessary to correctly identify the persistence in receiving a subsidy which is attributable to firms´ heterogeneity other than those characteristics of the firm which are already captured in the independent variables. For instance, firms may possess some characteristics –both observable and unobservable to the researcher– which makes them particularly prone to pursue R&D subsidies. Thus, to the extent that these characteristics show persistence over time, they might induce persistence in firms' decision to seek R&D grants. State dependence is introduced by a lagged dependent variable as the key expected dynamic effect: firms which received a subsidy in the past can be more likely to receive a grant again in the future.

As data for 2008 is limited for some variables (such as knowledge spillovers, as discussed in Annex 1) all regression analysis has been carried out on both the full dataset and a reduced dataset which does not include the year 2008. This section presents the results for the full dataset. Results for a reduced dataset excluding 2008 showed no significant difference and hence are not presented. Regressions are also run on both probit and logit random effects panel data regression models, obtaining almost identical results. Only logit outputs are presented in the tables below and probit results are available under request.

[23] Unobserved heterogeneity is captured by introducing dummy variables for different years and sectors. Unobserved heterogeneity at company level cannot be introduced in this manner as it would result in failing to determine the impact of some of the key variables in the analysis.

Up to 9 different regressions, providing different combinations of independent variables, are carried out in order to test the robustness of the results. Overall, these show that connectedness has a robust, persistent and positive effect in increasing the likelihood of receiving a cooperative R&D grant. In regression models (4)-(11) the coefficients for connectedness are significant with p-values below either 5% or 1%.

The only model showing no significant impact of connectedness is model (3), where the simplest 0/1 discrete variable measure of connection (Direct Connection 1) does not present a statistically significant impact. This result could suggest that the intensity of the connection rather than simply being connected is the key factor in gaining influence through connection. This result however is more likely to arise from the omission of key variables in model (3), such as state dependence and sector and year heterogeneity[24], as Direct Connection 1 shows a positive and significant effect when introduced in more complete specifications of the model (9).

Regression model (1) tests the impact of the key variables discussed in the R&D literature in section 2b. Note that no connection measure is introduced in this first regression. The results are consistent with findings in the literature and overall the public programme meets to some extent its role in addressing R&D related market failures, being more likely to subsidise those companies with large knowledge spillovers and those with high R&D intensity levels. The size of the company also has a positive and significant effect in increasing the likelihood of receiving an R&D grant. The results however are more inconclusive in regards to sector specific appropriability conditions.

R&D intensity has a positive and significant effect, as a large proportion of R&D spending over total sales increases the incentives for a company to participate in cooperative arrangements and joint ventures. It is also possible that the programme targets such businesses in order to correct a market failure whereby R&D investments are not carried out due to limited funding. The results also show that the more R&D spillovers a company produces the more likely it is to obtain a cooperative R&D grant,

[24] Additionally, and as discussed in section 3b, 0/1 measures of connections – as in most empirical studies on political connections - are likely to include more noise than weighted measures of connection as in measures 2 and 3 in this article. For example, a company recorded as connected to 1 board member is more likely not to actively pursue any influence than a business connected to 5 board members.

even though statistical significance is lower when controlling for sector and time heterogeneity, resulting in the non-significance of spillovers in regressions (7) and (9) . As with all other variables discussed above, it is not possible to establish whether these results reflect a stronger inclination of some businesses to pursue public funding or an active targeting of such businesses by the grant-allocating body, or a combination of both.

The degree of innovation appropriability in the sector produces inconclusive results as the coefficient is not statistically significant in regressions (1) - (7) and is significant in regressions (8) and (9). Appropriability shows as expected a negative coefficient providing weak evidence that the easier it is to appropriate an innovation, the less likely it becomes to obtain funding for cooperative R&D.

UK ownership, revealed comparative advantage and the financial health of the business are tested in model (2) and model (11) where the results are assessed in the full specification model by including connectedness and other significant variables. The results show that the variables used to proxy for international competitiveness of the business and the ownership of the business have no statistically significant impact on the likelihood of obtaining a cooperative R&D grant. The financial health of the company, proxied by the profits to sales ratio of the business, has the expected sign as the less profitable a business is the more likely it is to receive a subsidy. However, it is only weakly significant in specification (2) and displays no statistical significance at the 10% level of confidence when entered in regression (11). The results overall suggest that the cooperative R&D programme is not targeting specific companies or sectors as an indirect way of increasing UK businesses competitiveness in key strategic areas.

The exports to sales ratio is also discussed in section 3 as potentially another good measure to proxy a hypothetical interest by the public sector in financially supporting export-oriented businesses. The impact of this factor on the likelihood of obtaining a cooperative R&D grant is not presented in Table 1 as data is only available for a limited number of businesses, which results in a biased sub-sample and therefore distorts the coefficients estimated for all other regressors. In any case, I have entered the exports to sales ratio throughout models (1)-(11), which show no significant impact on the likelihood of obtaining a grant.

From regression (3) I introduce measures of connectedness. The intensity of connection has a positive and significant effect in increasing the likelihood of receiving a cooperative R&D grant. Both weighted connection measures (Direct Connection 2 and 3) are significant at the 5% level throughout all regressions in which they are entered.

The effect remains strong and significant in (6) when introducing a variable controlling for state dependence. This variable is highly significant and substantially increases the goodness of fit in the models where it is entered, as it captures the fact that a business which received a grant in the previous year is more likely to receive a subsidy in the following year. The reasons why having been granted a subsidy in the past increases the probability of receiving a subsidy in the future may include the unobserved heterogeneity of the business, and a learning effect from having been successful once in the competition process.

In regression models (7) and (8) dummy variables controlling for sector and year heterogeneity are introduced[25]. This is because results obtained from connection measures could be driven by correlations to unobserved heterogeneity conditions in specific sectors and years. The results show significant parameters for certain years and sectors – operating in the aerospace or chemicals sectors makes it more likely for a business to obtain a grant, whereas being a pharmaceutical, biotechnology or software business makes it more unlikely – but connection measures remain statistically significant, indicating that results for connectedness are robust.

In regressions (9) and (10) I test whether non-connected businesses in the same sector of activity than connected businesses are more or less likely to receive a subsidy. In section 2d I hypothesised that the likelihood of receiving public funding for such businesses could increase if connected firms influence the selection of the technological area of the competition. In contrast, if the influence of connected firms occurs through influencing the selection of independent appraisers, there could be a negative effect for businesses in the same sector as the connected firm. The results show that being in the same sector than

[25] When introducing sector dummy variables, sector appropriability is dropped due to multicollinearity. Only those sectors with a sufficiently large number of observations are included to avoid spurious results. When testing for sector connection effects sector dummies are also eliminated due to risk of multicollinearity.

a connected company increases the likelihood of receiving an R&D grant, which suggests that connected companies are not fully able to appropriate the return from their connection.

Table 1. Dynamic discrete choice panel data results

	(1)			(2)			(3)			(4)			(5)			(6)			(7)			(8)			(9)			(10)			(11)		
	Coeff.	P-val		Coeff.	P-val		Coeff.	P-val		Coeff.	P-val		Coeff.	P-val		Coeff.	P-val		Coeff.	P-val		Coeff.	P-val		Coeff.	P-val		Coeff.	P-val		Coeff.	P-val	
Constant	-7,38	0,00	***	-6,88	0.00	***	-7,27	0,00	***	-7,10	0,00	***	-7,10	0,00	***	-5,08	0,00	***	-4,83	0,00	***	-5,06	0,00	***	-4,81	0,00	***	-4,46	0,00	***	-5,38	0.00	***
Size	0,51	0,00	***	0,50	0.00	***	0,50	0,00	***	0,47	0,00	***	0,47	0,00	***	0,30	0,00	***	0,34	0,00	***	0,35	0,00	***	0,35	0,00	***	0,33	0,00	***	0,34	0.00	***
R&D intensity	0,19	0,01	**	0,26	0.00	***	0,19	0,02	**	0,18	0,02	**	0,18	0,02	**	0,11	0,07	*	0,13	0,05	*	0,23	0,00	***	0,11	0,11		0,10	0,14		0,28	0.00	***
R&D spillovers	0,06	0,00	***	0,06	0.00	***	0,06	0,00	***	0,06	0,00	***	0,06	0,00	***	0,03	0,00	***	0,02	0,10		0,03	0,08	*	0,02	0,16		0,03	0,07	*	0,02	0.09	*
Sector appropriability	-0,21	0,52		-0,30	0.37		-0,25	0,44		-0,25	0,43		-0,25	0,43		-0,26	0,30		-0,25	0,35		-	-	-	-0,63	0,04	**	-0,75	0,02	**	1.13	0.36	
Direct connection 1	-	-	-	-	-	-	0,31	0,50		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,26	0,00	***	-	-	-	-	-	-
Direct connection 2	-	-	-	-	-	-	-	-	-	1,58	0,05	**	-	-	-	1,43	0,03	**	1,85	0,02	**	1,77	0,04	**	-	-	-	1,79	0,02	**	1,72	0.03	**
Direct connection 3	-	-	-	-	-	-	-	-	-	-	-	-	1,29	0,05	**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
State dependance	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,85	0,00	***	1,86	0,00	***	1,56	0,00	***	1,87	0,00	***	1,82	0,00	***	1,57	0.00	***
Year 2006	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-0,44	0,03	**	-0,40	0,06	*	-0,45	0,03	**	-0,43	0,04	**	-0,41	0.05	**
Year 2007	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-1,27	0,00	***	-1,26	0,00	***	-1,46	0,00	***	-1,27	0,00	***	-1,24	0.00	***
Year 2008	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-2,17	0,00	***	-2,27	0,00	***	-2,31	0,00	***	-2,24	0,00	***	-2,25	0.00	***
Aerospace & Defence	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,48	0,00	***	-	-	-	-	-	-	1,44	0.00	***
Chemicals	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,72	0,02	**	-	-	-	-	-	-	0,09	0.89	
General industrials	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,19	0,60		-	-	-	-	-	-	-0,39	0.55	
Automobile	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,19	0,67		-	-	-	-	-	-	-0,28	0.63	
General retailers	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-0,26	0,81		-	-	-	-	-	-	-0,38	0.72	
Software & Computer services	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-2,01	0,00	***	-	-	-	-	-	-	-2,21	0.00	***
Electronic & Electrical equipment	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-0,16	0,66		-	-	-	-	-	-	-0,56	0.34	
Technology & Hardware	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-0,50	0,26		-	-	-	-	-	-	-0,98	0.15	
Health care technology	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-0,05	0,92		-	-	-	-	-	-	-0,64	0.41	
Pharmaceutical & Biotechnology	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-1,00	0,03	**	-	-	-	-	-	-	-2,49	0.12	
Sector connection 1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,59	0,01	***	-	-	-	-	-	-
Sector connection 2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,37	0,01	**	-	-	-
UK ownership	-	-	-	-0,23	0.34		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-0,09	0.65	
RCA	-	-	-	0,02	0.91		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,04	0.88	
Profits ratio	-	-	-	-0,13	0.08	*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-0,10	0.13	
N of observations	*2992*			*2992*			*2992*			*2992*			*2992*			*2477*			*2477*			*2477*			*2477*			*2477*			*2477*		
N of groups	*728*			*728*			*728*			*728*			*728*			*726*			*726*			*726*			*726*			*726*			*726*		
T	*5*			*5*			*5*			*5*			*5*			*4*			*4*			*4*			*4*			*4*			*4*		
Wald chi2(4)	*84,1*	*0*	***	*81.6*	*0*	***	*84,9*	*0*	***	*88,31*	*0*	***	*88,3*	*0*	***	*212*	*0*	***	*201*	*0*	***	*212*	*0*	***	*209*	*0*	***	*205*	*0*	***	*214*	*0*	***

In order to contextualise the results and aid to the interpretation of the coefficients, Table 2 presents the marginal effects and elasticities for key selected variables in regressions (1)-(11). This is done by providing the % change in the likelihood of obtaining a cooperative R&D grant when dummy variables change in value from 0 to 1.

Marginal effects confirm the importance of dynamic effects in the allocation of grants. All other variables being equal, a company which received a subsidy in year t-1 is more than three times more likely to receive a grant in year t than a company which did not receive a grant previously.

More importantly, marginal effects show the magnitude and importance of connectedness. The simplest measure of connection (Direct Connection 1) provides the more straightforward interpretation of marginal effects. A connected company is more than twice more likely to receive a cooperative R&D grant than a company which is not connected at all. For businesses in the same sector as the connected business, the likelihood of obtaining a subsidy is 60% higher than for businesses in a different sector.

The interpretation of the marginal effects with the intensity-sensitive measure of connection (Direct Connection 2) is less straightforward but more representative of the importance of connectedness. A change in a company from no connection to being connected to an equivalent of the time of one board member increases the likelihood of obtaining a grant by between 130-190%. Additionally, it is also possible to calculate the impacts on likelihood when there are changes in the intensity of the connection. For example, increasing the connectedness of a business from $1/10^{th}$ of a board member time to $1/4^{th}$ of a board member time increases the likelihood of obtaining a subsidy by over 40%.

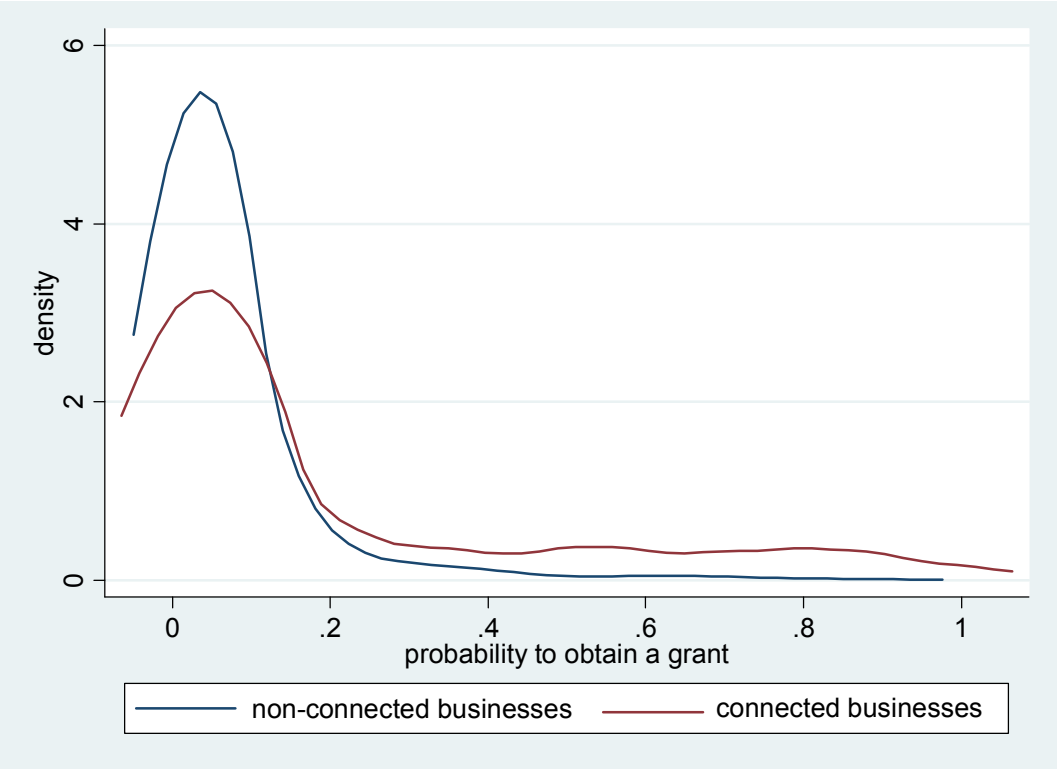
Table 2. Marginal effects

	% change in likelihood of obtaining an R&D grant (moving from 0 to 1)										
Regression model	1	2	3	4	5	6	7	8	9	10	11
Direct connection 1	-	-	26%	-	-	-	-	-	120%	-	-
State dependance	-	-	-	-	-	357%	350%	266%	367%	353%	298%
Direct connection 2	-	-	-	152%	-	136%	186%	171%	-	180%	167%
Sector connection 1	-	-	-	-	-	-	-	-	58%	-	-
Sector connection 2	-	-	-	-	-	-	-	-	-	37%	-

Figure 3 presents the distribution of predicted probabilities of obtaining a grant, based on Kernel non-parametric density estimations of probability in the model with the highest goodness of fit model as measured by the Wald test, specification (8). The density of the distribution for non-connected businesses is as expected more concentrated around very low likelihoods and less concentrated on higher probabilities than for connected businesses.

It is therefore possible to hypothesise what would be the impact on the likelihood of obtaining a grant if the institutional design of the cooperative R&D programme was resilient to connectedness. Controlling for all factors other than connections the prediction shows that under specification (8), on average a connected business is 19% likely to obtain a grant. In contrast, if this connection is assumed not to have an impact our prediction shows that its likelihood drops to under 15%. Therefore, in a world where connections had no impact, connected businesses would have been on average 20% less likely to obtain a cooperative R&D grant than they were in the period 2004-2008 in the UK.

Figure 3. Kernel density estimates for connected and non-connected businesses



b) Connections and the number of grants obtained

The analysis is not complete without considering the impact of connectedness on the number of grants a business receives in a given year. Panel data count models assume probability distributions with dependant variables of positive value with no theoretical higher bound, and these are well suited for the analysis of the dependant variable of interest, the number of R&D projects from a company receiving a grant in a given year.

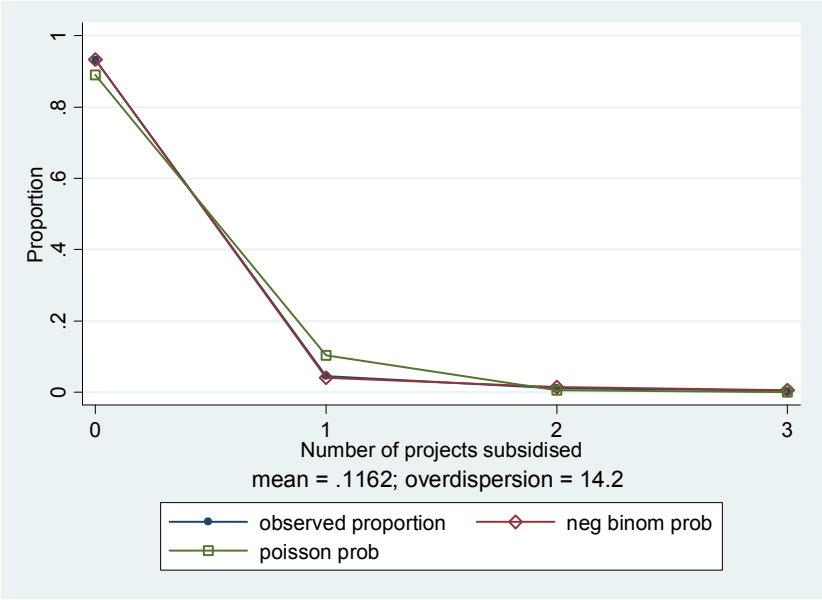
As in the discrete choice analysis, fixed effects are problematic as the dependent variable does not vary from zero in a large number of cases, which is required in fixed effects analysis of count data models. As in section a in order to capture any possible unobserved heterogeneity in the data, I estimate a panel of dynamic random effects controlling for heterogeneity at sector and year level. Additionally, heterogeneity at the business level with an impact on the number of grants obtained is expected to be captured through the state dependence variable.

Regression analysis of counts of data is a common statistical technique in many scientific fields, including economics. The most common count data model, the Poisson regression model (21), is however unsuitable for the analysis of our dataset, as it assumes a probability distribution where mean and variance are the same. In our dataset, there is clear evidence of over dispersion as the variance of the number of grants obtained is more than 3 times larger than the mean.

(21) $$\Pr(Y = y) = \frac{\lambda^{y} e^{-y}}{y!}$$
where $E(Y) = \lambda$ and $Var(Y) = \lambda$

Figure 4 plots the observed distribution of grants against Poisson and negative binomial distributions, the latter reflecting more accurately the observed distribution of the data than a Poisson distribution.

Figure 4. Poisson vs Negative Binomial distribution



The negative binomial distribution (21) is a general case of the Poisson distribution so that when α converges to infinity the probability converges to that of a Poisson distribution. This also allows for testing the statistical significance of the over dispersion parameter. The likelihood ratio test rejects no over dispersion across all regressions presented in Table 3, confirming the superiority of the negative binomial over the Poisson distribution in accurately reflecting the distribution of the underlying data.

(21) $$\Pr(Y = y) = \left(\frac{\alpha}{\alpha+\lambda}\right)^{\alpha} \quad \frac{\tau(\alpha+y)}{\tau(y+1)\tau(\alpha)} \left(\frac{\lambda}{\alpha+\lambda}\right)^{y}$$

where τ is the gamma function, $E(Y) = \lambda$ but $Var(Y) = \lambda + \lambda^2/\alpha$

Even though the negative binomial regression allows for over-dispersion, the nature of the selection problem could also mean that the number of projects which receive a subsidy in a given year is not generated by a single data process -as the negative binomial regression assumes- but by separate mechanisms: one for generating zeros (the likelihood of receiving a subsidy) and another for non-zero counts (the number of subsidies received). As very different probability distributions underlie these models, I analyse the data allowing for both processes and therefore, in addition to a negative binomial regression I consider a zero-inflated count data model, which assumes different probability distributions for the two processes (22).

(22)
$$f(y) = \begin{matrix} \pi + (1-\pi)f(0) \text{ for } y = 0 \\ (1-\pi)f(\text{neg.bin}) \text{ for } y > 0 \end{matrix}$$

where $\pi\epsilon(0,1)$ is a zero-inflation parameter , f(0) is the probabilistic process generating the zeros in the sample (such as a logit or probit model), and f(neg.bin) is the probability function of the negative binomial regression model (21). If f(0) and f(neg.bin) are correctly specified, maximum likelihood estimation ensures that the estimators will be robust and asymptotically efficient as in a negative binomial estimation (Winkelmann, 1997).

Vuong (1989) develops likelihood ratio tests to compare the suitability of the data to negative binomial models and zero inflated models. Results of the test favour the zero inflated models across all regressions, suggesting that two different data generating processes are occurring when determining the number of grants obtained in a given year.

Table 3 presents coefficients and p-values for both negative binomial dynamic panel data regression and dynamic zero-inflated negative binomial regression models, the latter clustered at the company level. The inflation part of the zero-inflated model is calculated on the basis of logit models (8), (9) and (10) already presented in Table 1.

The sign and significance of right-hand side variables in dynamic panel data count analysis (Table 3) is largely consistent with results presented in Table 1, even though there are some distinctive results noted in the following paragraphs. The results suggest that those factors driving the probability of obtaining a grant are also generally important in determining the number of grants obtained by a company in a given year. More importantly, they confirm that connectedness does have an impact not only on the probability of obtaining a grant but also on the number of grants obtained. This can be interpreted as confirmation that connected firms do not only have better access to public funding, but do also capitalise on better access to obtain more grants than non-connected businesses.

The intensity of the connection of a business to the public agency has a significant impact on increasing the number of grants received. This is shown consistently across both negative binomial and zero-inflated models throughout regression models (1)-(11). A

business connected to an intensity equivalent of one board member increases by between 0.4 and 1 the number of R&D projects that are subsidised by the Government agency in a given year.

The impact of connectedness on non-connected businesses in the same sector than connected businesses, which was encountered to be positive and significant in increasing the likelihood of receiving a grant, is non-significant when it refers to the number of projects subsidised. This result is particularly strong in zero-inflated regressions (9) and (10), where the impact of connections at sector level is considered. This suggests that even though non-connected businesses may be able to partially free-ride on the connections of its competitors to increase their likelihood of receiving a grant, they certainly do not benefit as much as connected firms.

Size, R&D intensity, amount of knowledge spillovers, sector and year heterogeneity, and having received a grant in the past, have all signs and levels of statistical significance which are consistent with results presented in the discrete choice analysis. For example, size and intensity have a positive and significant effect over the number of grants obtained (through 30 of the 33 econometric specifications in Table 3), and the amount of knowledge spillovers shows an inconclusive effect, with low statistical significance in approximately half of the specifications.

In contrast, the degree of appropriability of innovation, which showed rather inconclusive results on the probability of obtaining a grant, presents more robust significance levels, particularly when zero-inflated models are used. Industrial policy factors, such as UK ownership, revealed comparative advantage and the financial health of the business, do not have a consistently significant effect in determining the number of grants obtained. For example, even though the revealed comparative advantage of a sector shows the expected sign (i.e. those businesses with revealed comparative advantage are expected to receive more grants), and this appears to be a significant factor in regression (2), the coefficient becomes non-significant when the functional model is specified more comprehensively in regression (11) by including other key variables, such as sector and year heterogeneity and state dependence.

Table 3. Dynamic panel count data results

	(1)				(2)				(3)				(4)				(5)				(6)			
	Neg bin.	Zero-inflated (logit -8)	Zero-inflated (logit -9)	Zero-inflated (logit -10)	Neg bin.	Zero-inflated (logit -8)	Zero-inflated (logit -9)	Zero-inflated (logit -10)	Neg bin.	Zero-inflated (logit -8)	Zero-inflated (logit -9)	Zero-inflated (logit -10)	Neg bin.	Zero-inflated (logit -8)	Zero-inflated (logit -9)	Zero-inflated (logit -10)	Neg bin.	Zero-inflated (logit -8)	Zero-inflated (logit -9)	Zero-inflated (logit -10)	Neg bin.	Zero-inflated (logit -8)	Zero-inflated (logit -9)	Zero-inflated (logit -10)
Constant	-3.87 ***	-1.94 ***	-1.92 ***	-1.74 ***	-3.53 ***	-1.93 ***	-1.88 ***	-1.73 ***	-4.03 ***	-1.72 **	-1.70 **	-1.53 *	-3.75 ***	-1.62 **	-1.65 ***	-1.47 **	-3.75 ***	-1.62 **	-1.65 **	-1.47 **	-4.47 ***	-1.65 **	-1.65 **	-1.50 **
Size	0.42 ***	0.29 ***	0.30 ***	0.31 ***	0.41 ***	0.27 ***	0.28 ***	0.29 ***	0.46 ***	0.27 ***	0.27 ***	0.28 *	0.39 ***	0.25 ***	0.25 ***	0.26 ***	0.39 ***	0.25 ***	0.25 ***	0.26 **	0.29 ***	0.18 **	0.17 **	0.19 -
R&D intensity	0.14 **	0.28 ***	0.29 ***	0.25 ***	0.20 ***	0.29 ***	0.30 ***	0.28 ***	0.16 **	0.28 ***	0.28 ***	0.24 -	0.12 *	0.26 ***	0.26 ***	0.25 ***	0.12 *	0.26 ***	0.26 ***	0.25 **	0.12 **	0.29 ***	0.27 ***	0.25 -
R&D spillovers	0.05 ***	-1.20 *	-0.04 ***	-0.04 *	0.06 ***	-0.04 *	-0.04 **	-0.04 *	0.06 ***	-0.04 **	-0.04 **	-0.04 -	0.05 ***	-0.04 **	-0.04 **	-0.04 *	0.05 ***	-0.04 **	-0.04 **	-0.04 *	0.03 ***	-0.04 **	-0.03 *	-0.03 -
Sector appropriability	-0.19 -	-0.04 ***	-1.36 ***	-1.78 ***	-0.22 -	-1.27 ***	-1.34 ***	-1.53 **	-0.19 -	-1.31 ***	-1.43 ***	-1.82 -	-0.17 -	-1.18 ***	-1.27 ***	-1.53 -	-0.17 -	-1.18 ***	-1.27 ***	-1.53 -	-0.32 -	-1.15 ***	-1.17 **	-1.53 -
Direct connection 1	-	-	-	-	-	-	-	-	-0.52 *	0.27 -	0.37 -	0.31 -	-	-	-	-	-	-	-	-	-	-	-	-
Direct connection 2	-	-	-	-	-	-	-	-	-	-	-	-	0.83 **	0.59 ***	0.65 ***	0.59 ***	-	-	-	-	1.00 ***	0.51 ***	0.57 ***	0.53 **
Direct connection 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.71 *	4.77 ***	5.24 ***	4.79 **	-	-	-	-
State dependance	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.56 ***	0.99 ***	1.01 ***	0.96 ***
Year 2006	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Year 2007	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Year 2008	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aerospace & Defence	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chemicals	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
General industrials	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Automobile	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
General retailers	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Software & Computer services	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Electronic & Electrical equipment	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Technology & Hardware	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Health care technology	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pharmaceutical & Biotechnology	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sector connection 1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sector connection 2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UK ownership	-	-	-	-	-0.02 -	-0.07 -	-0.15 -	-0.11 -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RCA	-	-	-	-	0.04 -	0.67 **	0.49 **	0.28 -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Profits ratio	-	-	-	-	-0.15 **	0.04 -	0.04 -	0.02 -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
N of observations	*2992*				*2992*				*2992*				*2992*				*2992*				*2477*			
N of groups	*728*				*728*				*728*				*728*				*728*				*726*			
T	*5*				*5*				*5*				*5*				*5*				*4*			
Wald chi2(4)	*75.6* ***				*77* ***				*75.3* ***				*84* ***				*83.9* ***				*292* ***			

	(7)				(8)	x	x		(9)		x	x	(10)			x	x (11)			
	Neg bin.	Zero-inflated (logit -8)	Zero-inflated (logit -9)	Zero-inflated (logit -10)	Neg bin.	Zero-inflated (logit -8)*	Zero-inflated (logit -9)	Zero-inflated (logit -10)	Neg bin.	Zero-inflated (logit -8)	Zero-inflated (logit -9)*	Zero-inflated (logit -10)	Neg bin.	Zero-inflated (logit -8)	Zero-inflated (logit -9)	Zero-inflated (logit - 10)*	Neg bin.	Zero-inflated (logit -8)	Zero-inflated (logit -9)	Zero-inflated (logit -10)
Constant	-3.04 ***	-0.72 -	-0.87 -	-0.72 -	-3.74 ***		-1.42 -	-1.74 -	-2.91 ***	-0.86 -		-0.87 -	-2.58 ***	-0.69 -	-0.79 -		-3.58 ***	-0.10 -	-1.21 -	-1.52
Size	0.38 ***	0.14 **	0.15 **	0.15 **	0.36 ***		0.15 **	0.17 **	0.39 ***	0.15 **		0.16 *	0.35 ***	0.13 **	0.13 **		0.35 ***	0.11 -	0.15 ***	0.17 **
R&D intensity	0.16 ***	0.19 ***	0.20 ***	0.18 ***	0.23 ***		0.22 **	0.18 *	0.14 **	0.16 **		0.16 **	0.12 **	0.14 *	0.15 **		0.25 ***	0.18 -	0.22 **	0.18 *
R&D spillovers	0.02 -	-0.05 ***	-0.05 **	-0.05 **	0.02 -		-0.04 -	-0.03 -	0.02 -	-0.05 ***		-0.05 **	0.02 -	-0.05 **	-0.05 **		0.02 -	-0.04 *	-0.04 -	-0.03
Sector appropriability	-0.32 -	-0.82 **	-0.92 ***	-0.99 **	0.91 -		0.03 -	0.21 -	-0.68 **	-0.98 ***		-1.16 **	-0.83 ***	-0.91 ***	-0.98 ***		0.76 -	-1.27 -	-0.30 -	-0.10
Direct connection 1	-	-	-	-	-		-	-	0.76 **	0.62 *		0.69 **	-	-	-		-	-	-	-
Direct connection 2	0.70 **	0.56 ***	0.63 ***	0.61 ***	0.44 -		0.48 **	0.49 **	-	-		-	0.79 **	0.63 ***	0.69 ***		0.49 -	0.49 *	0.53 **	0.54 **
Direct connection 3	-	-	-	-	-		-	-	-	-		-	-	-	-		-	-	-	-
State dependance	1.31 ***	1.18 ***	1.24 ***	1.19 ***	1.14 ***		0.97 ***	0.92 ***	1.26 ***	1.18 ***		1.22 ***	1.29 ***	1.11 ***	1.19 ***		1.19 ***	1.02 **	1.01 ***	0.95 ***
Year 2006	-0.57 ***	-0.96 ***	-0.95 ***	-0.99 ***	-0.53 ***		-0.79 ***	-0.88 **	-0.59 ***	-0.94 ***		-0.99 ***	-0.57 ***	-0.85 ***	-0.89 ***		-0.54 ***	-0.77 *	-0.82 ***	-0.90 **
Year 2007	-1.44 ***	-1.64 ***	-1.71 ***	-1.64 ***	-1.42 ***		-1.67 ***	-1.65 ***	-1.65 ***	-1.77 ***		-1.78 ***	-1.46 ***	-1.66 ***	-1.71 ***		-1.39 ***	-1.75 ***	-1.69 ***	-1.67 ***
Year 2008	-2.31 ***	-2.43 ***	-2.02 ***	-2.35 ***	-2.32 ***		-2.24 ***	-2.49 ***	-2.49 ***	-2.51 ***		-2.44 ***	-2.41 ***	-2.39 ***	-2.12 ***		-2.29 ***	-1.52 -	-2.24 ***	-2.52 ***
Aerospace & Defence	-	-	-	-	1.40 ***		0.54 -	0.64 *	-	-		-	-	-	-		1.24 ***	0.14 -	0.39 -	0.49
Chemicals	-	-	-	-	0.13 -		0.14 -	0.14 -	-	-		-	-	-	-		0.13 -	0.20 -	0.30 -	0.28
General industrials	-	-	-	-	-0.25 -		-0.38 -	-0.06 -	-	-		-	-	-	-		-0.23 -	-0.06 -	-0.25 -	0.05
Automobile	-	-	-	-	-0.24 -		-0.19 -	-0.21 -	-	-		-	-	-	-		-0.30 -	-0.38 -	-0.04 -	-0.07
General retailers	-	-	-	-	-0.44 -		0.31 -	0.08 -	-	-		-	-	-	-		-0.49 -	-2.46 **	0.14 -	-0.06
Software & Computer services	-	-	-	-	-2.14 ***		-2.21 ***	-2.20 ***	-	-		-	-	-	-		-2.19 ***	-1.75 **	-2.27 ***	-2.27 ***
Electronic & Electrical equipment	-	-	-	-	-0.43 -		-0.81 *	-0.48 -	-	-		-	-	-	-		-0.40 -	-0.45 -	-0.50 -	-0.17
Technology & Hardware	-	-	-	-	-0.86 -		-1.06 *	-0.81 -	-	-		-	-	-	-		-0.82 -	-0.19 -	-0.75 -	-0.50
Health care technology	-	-	-	-	-0.42 -		-0.43 -	-0.22 -	-	-		-	-	-	-		-0.35 -	0.46 -	-0.18 -	0.03
Pharmaceutical & Biotechnology	-	-	-	-	-2.06 -		-1.16 -	-1.50 -	-	-		-	-	-	-		-1.92 -	0.75 -	-0.82 -	-1.19
Sector connection 1	-	-	-	-	-		-	-	0.65 ***	0.34 -		0.31 -	-	-	-		-	-	-	-
Sector connection 2	-	-	-	-	-		-	-	-	-		-	0.41 ***	0.24 -	0.23 *		-	-	-	-
UK ownership	-	-	-	-	-		-	-	-	-		-	-	-	-		-0.12 -	-0.21 -	-0.19 -	-0.18
RCA	-	-	-	-	-		-	-	-	-		-	-	-	-		0.08 -	0.28 -	0.27 -	0.27
Profits ratio	-	-	-	-	-		-	-	-	-		-	-	-	-		-0.05 -	-0.02 -	0.00 -	-0.01
N of observations	*2477*								*2477*				*2477*				*2477*			
N of groups	*726*								*726*				*726*				*726*			
T	*4*								*4*				*4*				*4*			
Wald chi2(4)	*246* ***				*241* ***				*243* ***				*205* ***				*214* ***			

*Regression not presented as right hand side variables of first step logistic instrumental regression equal independent variables of second step count data regression.

5. Conclusion

This article provides empirical evidence on how businesses directly connected to the public agency responsible for allocating cooperative R&D grants in the UK are both more likely to obtain R&D grants and to receive more grants than those businesses which are not connected. The results suggest that even though the R&D cooperative programme is to an extent effective in targeting the market failures it aims to address, its allocation of grants across the private sector is biased towards connected businesses. These are defined as those where an agency's board member has in the past held a Director level position in the business. As a result, the allocation of public funding might be suboptimal from a social welfare perspective, increases deadweight in the economy and is inequitable by transferring funds from the taxpayer to connected businesses[26].

The paper, based on the analysis of a unique data set, proposes a methodological development to the literature on political connections by, in contrast with most empirical papers, directly linking information on connections to the public body which allocates grants, hence providing a direct account of the returns to the connection. This is important because the methodology identifies the causal relationship, minimises the possibility of spurious findings, and allows for a direct assessment of the impact of connections on the allocation of grants across firms. Also in contrast with most articles on connections, both simple measures of connection and other more complex constructions are tested.

The findings have public policy implications for the institutional design of frameworks for the allocation of Government grants. These are specific to the case of collaborative R&D grants in the UK but also can in spirit be generally applicable to the allocation of public subsidies in any area and any country.

[26] A statistically significant relationship between businesses and TSB members does not necessarily imply that such businesses will be exerting influence on the agency to obtain private returns from such connection – even though this is of course a clear possibility. A more benign interpretation of the results is that agency board members which have worked in particular companies or sectors are likely to focus on those sector or technological areas which they know best. Regardless of whether it is one thing or the other, the institutional design for allocations of grants would prove to be equally inefficient in both cases.

Public grants to cooperative R&D projects are one of many mechanisms available to the public sector to address sub-optimal private investment in R&D. Support for R&D cooperation is generally seen as effective in the economic literature when the investment has high risk and cost and there is limited appropriability of the innovation (see section 2b). In the UK, as in most other countries where such public programmes exist, projects are ranked on the basis of pre-specified criteria and grants are allocated in a beauty contest process where winners are selected through a competition for funding.

Theoretical predictions in the political science and political economy literatures indicate that the conditions which dominate competitions for grants in areas such as collaborative R&D –where there is low visibility of outcomes, limited scrutiny of the process by the general public and lack of counteractive lobbying forces– are propitious for the success of special interest groups. Empirical results in this article support the prediction in the theory.

Policy-makers can take some practical steps towards mitigating such risks of Government failure by improving transparency in the system, for example by publicising results more widely, carrying out more frequent evaluations or designing a scheme more resilient to lobbying efforts by setting a stronger set of rules.

A selection process based on ranking a set of individual projects, in addition to be subject to the influence of interest groups, fails to induce competition amongst applicants, hence typically resulting in applicants not revealing the amount of public support that would induce them to carry out the project. Some have suggested auction based approaches (Blum & Kalus, 2003; Ensthaler and Giebe, 2009), even though these need yet to be tested in practice. In the UK, such an approach should be possible by restricting the role of the agency to establishing the size and nature of the market failure, which could be followed then with an auction designed to maximise the amount of private R&D induced subject to some general conditions. Further work is however needed to determine the feasibility of such approach, as this might prove difficult to implement in practice.

Finally, the results also highlight the need for further research. In the first place, even though this article shows that connections distort the allocation of grants amongst businesses, it does not show whether public support for cooperative R&D complements

or substitutes private investment in R&D, which would allow estimating the economic cost of connectedness to society. Secondly, the article does not attempt either to provide an explanation onto the process which leads to the creation of direct connections for some companies and not others. A better understanding of the network-creation process may in fact be the key for designing a resilient institutional framework for policy-making which minimises the risk of Government failure and maximises social welfare.

References

Abramovsky, Laura; Kremp, Elisabeth; López, Alberto; Schmidt, Tobias and Simpson, Helen. "Understanding co-operative R&D activity: evidence from four European countries", *Institute for Fiscal Studies Working Papers*, W05/23, 2005.

Ades, Alberto and Di Tella, Rafael. "National Champions and Corruption: Some Unpleasant Interventionist Arithmetic", *The Economic Journal,* 107(443), pp. 1023-1042, 1997.

Ades, Alberto and Di Tella, Rafael. "Rents, Competition, and Corruption", *American Economic Review*, 89(4), pp. 982-993, 1999.

Aghion, Philippe and Tirole, Jean. "The Management of Innovation", *Quarterly Journal of Economics, 109(4),* pp. 1185-1209, 1994.

Aidt, Toke S. "Review: Economic Analysis of Corruption: A Survey", *The Economic Journal*, 113(491), pp. 632-652, 2003.

Ansolabehere, Stephen; de Figueiredo, John M. and Snyder, James M. "Why is There so Little Money in U.S. Politics?" *Journal of Economic Perspectives*, 17(1), pp. 105-130(26), 2003.

Arrow, Kenneth. "Economic welfare and the allocation of resources for invention", Princeton University Press, 1962.

Austen-Smith, David and Wright, John R. "Theory and Evidence for Counteractive Lobbying", *American Journal of Political Science*, 40(2), pp. 543-564, 1996.

Balassa, Bela. "Trade Liberalisation and "Revealed" Comparative Advantage", *The Manchester School*, 33(2), pp. 99-123, 1965.

Barros, Henrique M. "The interaction between patents and other appropriability mechanisms: firm-level evidence from UK manufacturing", *IBMEC WORKING PAPER*, WPE 57, 2008.

Becker, Bettina and Pain, Nigel. "What determines industrial R&D expenditure in the UK?", *The Manchester School*, 76(1), pp 66-87, 2008.

Beghin, John C. and Kherallah, Mylène. "Political Institutions and International Patterns of Agricultural Protection", *Review of Economics and Statistics*, 76(3), pp. 482-489, 1994.

Belderbos, Rene; Carree, Martin and Lokshin, Boris. "Cooperative R&D and firm performance", *Research Policy*, 33(10), pp 1477-1492, 2004.

Benfratello, Luigi and Sembenelli, Alessandro. "Research joint ventures and firm level performance", *Research Policy*, 31(4), pp 493-507, 2002.

Bertrand, Marianne; Francis Kramarz; Antoinette Schoar and David Thesmar. "Politically Connected CEOs and Corporate Outcomes: Evidence from France", mimeo University of Chicago, 2004.

Bhagwati, Jagdish N. "Directly Unproductive, Profit-Seeking (DUP) Activities", *Journal of Political Economy*, 90(5), pp. 988-1002, 1982.

Bloom, Nicholas; Schankerman, Mark A. and Van Reenen, John M. "Identifying Technology Spillovers and Product Market Rivalry", *NBER Working Paper Series*, W13060, 2007.

Blum, Ulrich and Kalus, Falk. "Auctioning public financial support incentives", *International Journal of Technology Management*, 26(2-4), pp.270-276, 2003.

Caballero, Ricardo J. and Jaffe, Adam B. "How High Are the Giants' Shoulders: An Empirical Assessment of Knowledge Spillovers and Creative Destruction in a Model of Economic Growth", *NBER Macroeconomics Annual, 8,* pp. 15-74, 1993.

Caloghirou, Yannis; Ioannides, Stavros and Vonortas, Nicholas S. "Research Joint Ventures", *Journal of Economic Surveys*, 17(4), pp. 541-570, 2003.

Cassiman, Bruno and Veugelers, Reinhilde. "R&D Cooperation and Spillovers: Some Empirical Evidence from Belgium", *American Economic Review*, 92(4), pp. 1169-1184, 2002.

Castells, Pau; Trillas, Francesc, "The effects of surprise political events on quoted firms: the March 2004 election in Spain", *SERIEs: Journal of the Spanish Economic Association*, 1-30, 2011.

Che, Yeon-Koo. "Revolving Doors and the Optimal Tolerance for Agency Collusion", *The RAND Journal of Economics,* 26(3), pp.378-397, 1995.

Cingano, Federico and Pinotti, Paolo. "Politicians at Work: The Private Returns and Social Costs of Political Connections", *Bank of Italy Temi di Discussione Working Paper Series*, 709, 2005.

Cohen, Linda R. and Noll, Roger G. "The Technology pork barrel", The Brookings Institution, 1991.

Cohen, Wesley M.; Nelson, Richard R. and Walsh, John P. "Protecting Their Intellectual Assets: Appropriability Conditions and Why U.S. Manufacturing Firms Patent (or Not)", *NBER Working Paper Series*, W7552, 2000.

Colombo, M. and Gerrone, P. "Technological cooperative agreements and firm's R&D intensity. A note on causality relations", *Research Policy*, 25(6), pp.923-932. 1996.

Cuñat, Vicente and Garicano, Luis. "Did Good Cajas Extend Bad Loans? Governance, Human Capital and Loan Portfolios", *Working Papers FEDEA 2010,* 08, 2010.

Dachs, Bernhard; Ebersberger, Bernd and Pyka, Andreas. "Why do firms cooperate for innovation? A comparison of Austrian and Finnish CIS3 results", *International Journal of Foresight and Innovation Policy*, 4(3-4), pp.200-229, 2008.

Dal Bo, Ernesto. "Regulatory capture: a review", *Oxford Review of Economic Policy*, 22(2), pp. 203-225, 2006.

D'Aspremont, Claude and Jacquemin, Alexis. "Cooperative and Noncooperative R & D in Duopoly with Spillovers", *American Economic Review,* 78(5), pp. 1133-1137, 1988.

David, Paul A. and Hall, Bronwyn H. "Heart of darkness: modeling public–private funding interactions - inside the R&D black box", *Research Policy*, 29, pp. 1165-1183, 2000.

David, Paul A.; Hall, Bronwyn H. and Toole, Andrew A.. "Is public R&D a complement or substitute for private R&D? A review of the econometric evidence", *Research Policy*, 29(4-5), pp 497-529, 2000.

De Bondt, Raymond. "Spillovers and innovative activities", International Journal of Industrial Organization, 15(1), pp.1-28, 1997.

de Figueiredo, John M. and Silverman Brian S. "Academic Earmarks and the Returns to Lobbying", *The Journal of Law and Economics*, 49(2), pp 597-626, 2006.

Downs, Anthony. "An Economic Theory of Political Action in a Democracy", *The Journal of Political Economy*, 65(2), pp. 135-150, 1957.

Ensthaler, Ludwig and Giebe, Thomas. "Subsidies, Knapsack Auctions and Dantzig's Greedy Heuristic", *DIW Berlin Discussion Paper*, 880, 2009.

Faccio, Mara. "Politically Connected Firms", *American Economic Review*, 96(1) pp. 369-386(18), 2006.

Ferguson, Thomas and Voth, Hans-Joachim. **"**Betting on Hitler—The Value of Political Connections in Nazi Germany", *The Quarterly Journal of Economics*, 123(1), pp.101-137, 2008.

Fisman, Raymond. "Estimating the Value of Political Connections", *American Economic Review*, 91(4), pp. 1095-1102, 2001.

Fredriksson, Per G. and Svensson, Jakob. "Political instability, corruption and policy formation: the case of environmental policy", *Journal of Public Economics*, 87, pp.1383–1405, 2003.

Giebe, Thomas; Grebe, Tim and Wolfstetter, Elmar. "How to allocate R&D (and other) subsidies: An experimentally tested policy recommendation", *Research Policy*, 35(9), pp.1261-1272, 2006.

Gilbert, Richard and Griliches, Zvi. "Appropriating the Returns from Industrial Research and Development", *Brookings Papers on Economic Activity*, 1987(3), pp. 783-831, 1987.

Goldberg, Pinelopi Koujianou and Maggi, Giovanni. "Protection for Sale: An Empirical Investigation" *American Economic Review*, 89(5), pp. 1135-1155, 1999.

Goldman, Eitan; Rocholl, Jörg and So, Jongil. "Political Connections and the Allocation of Procurement Contracts", Working Paper, 2009.

Griffith, Rachel; Harrison, Rupert and Van Reenen, John. "How Special Is the Special Relationship? Using the Impact of U.S. R&D Spillovers on U.K. Firms as a Test of Technology Sourcing", *American Economic Review*, 96(5), pp. 1859-1875, 2006.

Griliches, Zvi. "The Search for R&D Spillovers", *The Scandinavian Journal of Economics*, 94, pp. 29-47, 1992.

Grossman, Gene M.; Helpman, Elhanan. "Protection for Sale", *American Economic Review*, 84(4), pp. 833-850, 1994.

Hall, Bronwyn H. and Van Reenen, John M. "How effective are fiscal incentives for R&D? A review of the evidence", *Research Policy*, 29(4), pp. 449-469, 2000.

Hall, Bronwyn H.; Jaffe, Adam B. and Trajtenberg, Manuel. "The Nber Patent Citation Data File: Lessons, Insights and Methodological Tools", *NBER Working Paper Series*, 8498, 2001.

Hernán, Roberto; Marín, Pedro L and Siotis, Georges. "An empirical evaluation of the determinants of Research Joint Venture Formation", *The Journal of Industrial Economics*, 51(1), pp. 75-89, 2003.

Herron, Michael C.; Lavin, James; Cram, Donald and Silver, Jay. "Measurement of political effects on the United States Economy: a study of the 1992 presidential election", *Economics and politics*, 11(1), pp.51-81, 1999.

Jaffe, Adam B. "Building Programme Evaluation into the Design of Public Research-Support Programmes", *Oxford Review of Economic Policy*, *18, pp.* 22-34, 2002.

Jaffe, Adam B. "Demand and Supply Influences in R&D Intensity and Productivity Growth", *Review of Economics and Statistics*, 70(3), pp. 431-437, 1988.

Jaffe, Adam B. "Technological Opportunity and Spillovers of R & D: Evidence from Firms' Patents, Profits, and Market Value", *American Economic Review*, 76(5), pp. 984-1001, 1986.

Jayachandran, Seema. "The Jeffords Effect", *Journal of Law and Economics*, 49, pp.397–426, 2006.

Jensen, Nathan M. and Schmith, Scott. "Market responses to politics: the rise of Lula and the decline of the Brazilian stock market", *Comparative political studies*, 38(10), pp.1245-1270, 2005.

Kaiser, Ulrich. "Measuring knowledge spillovers in manufacturing and services: an empirical assessment of alternative approaches", *Research Policy*, 31(1), pp. 125-144, 2002.

Kirschner, Aron Lowe. "Death of a Congressman: Estimating the Economic Value of Campaign Contributions", Stanford University Working Paper, 2006.

Kleinknecht, Alfred and Reijnen, Jeroen O. N. "Why do firms cooperate on R&D? an empirical study", *Research Policy*, 21(4), pp. 347-360, 1992.

Kroszner, Randall. S and Stratmann, Thomas. "Interest-Group Competition and the Organization of Congress: Theory and Evidence from Financial Services' Political Action Committees", *American Economic Review*, 88(5), pp 1163-1187, 1998.

Landier, Augustin; Sraer, David and Thesmar, David. "Optimal Dissent in Organizations", *Review of Economic Studies*, 76(2), pp. 761-794, 2009.

Leblang, David and Mukherjee, Bumba. "Government Partisanship, Elections, and the Stock Market: Examining American and British Stock Returns, 1930–2000", *American Journal of Political Science*, 49(4), pp.780-802, 2005.

Lenway, Stefanie; Morck, Randall and Yeung, Bernard. "Rent Seeking, Protectionism and Innovation in the American Steel Industry", *The Economic Journal*, 435(106), pp. 410-421, 1996.

Lerner, Josh. "The Government as Venture Capitalist: The Long-Run Impact of the SBIR Program", *The Journal of Business,* 72(3), pp. 285-318, 1999.

Levin, Richard C.; Klevorick, Alvin K.; Nelson, Richard R.; Winter, Sidney G.; Lukach, Ruslan and Plasmans, Joseph. "Measuring knowledge spillovers in the new economy firms in Belgium using patent citations, *Global Business and Economics Review*, 5(1), pp. 75-99, 2005.

Mansfield, Edwin. "How Rapidly Does New Industrial Technology Leak Out?", *The Journal of Industrial Economics*, 34(2), pp. 217-223, 1985.

Martin, Stephen and Scott, John T. "The nature of innovation market failure and the design of public support for private innovation", *Research Policy*, 29(4-5), pp. 437-447, 2000.

Mauro, Paolo. "Corruption and Growth", *Quarterly Journal of Economics, 110(3),* pp. 681-712, 1995.

Menozzi, Anna; Gutiérrez Urtiaga, María and Vannoni, Davide. "Board Composition, Political Connections and Performance in State-Owned Enterprises",

Working Papers University of Torino, Department of Economics and Public Finance "G. Prato", 9, 2010.

Miotti, Luis and Sachwald, Frederique. "Co-operative R&D: why and with whom?: An integrated framework of analysis", *Research Policy*, 32(8), pp.1481-1499, 2003.

Okada, Yosuke and Kushi, Takahito. "Government-Sponsored Cooperative Research in Japan: A Case Study of the Organization for Pharmaceutical Safety and Research (OPSR) Program", COE/RES Discussion Paper Series, 2004.

Oxley, Joanne E. "Appropriability Hazards and Governance in Strategic Alliances: A Transaction Cost Approach", *Journal of Law, Economics, and Organization*, 13(2), pp.387-409, 1997.

Peltzman, Sam. "Toward a More General Theory of Regulation", *Journal of Law and Economics*, 19(2), pp. 211-240, 1976.

Penrose, Edith T. "*The Theory of the Growth of the Firm"*, Oxford University Press, 1959.

Pisano, Gary P. "The R&D Boundaries of the Firm: An Empirical Analysis", *Administrative Science Quarterly*, 35, 1990.

Pittman, Russell. "Market structure and campaign contributions", *Public Choice*, 9(1), pp. 37-52, 1977.

Posner, Richard A. "Theories of Economic Regulation", *The Bell Journal of Economics and Management Science*, 5(2), pp. 335-358, 1974.

Potters, Jan and Sloof, Randolph. "Interest groups: A survey of empirical models that try to assess their influence", *European Journal of Political Economy*, 12(3), pp. 403-442, 1996.

Recanatini, Francesca; Prati, Alessandro and Tabellini, Guido. "Why Are some Public Agencies less Corrupt? Lesson for Institutional Reforms from Survey Data", Paper presented at the Sixth Jacques Polak Annual Research Conference hosted by the International Monetary Fund, 2005.

Roberts, Brian E. "Political institutions, policy expectations, and the 1980 election: a financial market perspective", *American journal of political science*, 34(2), pp.289-310, 1990.

Röller, Lars-Hendrik; Tombak, Mikhel M. and Siebert, Ralph. "Why Firms Form Research Joint Ventures: Theory and Evidence," CIG Working Papers FS IV 97-06, Wissenschaftszentrum Berlin (WZB), 1997.

Schumpeter, Joseph A. "Capitalism, socialism and democracy", Cambridge MA Harvard University Press, 1942.

Shiller, Robert J. "From Efficient Markets Theory to Behavioral Finance"**,** *Journal of Economic Perspectives*, 17 (1), pp. 83-104, 2003.

Shleifer, Andrei and Vishny, Robert W. "Politicians and Firms", *Quarterly Journal of Economics,* 109(4), pp. 995-1025, 1994.

Shleifer, Andrei. "Inefficient markets: An introduction to behavioral finance", Oxford University Press, 2000.

Stigler, George. "The Theory of Economic Regulation", *Bell Journal of Economics and Management Science*, 2, pp. 3-21, 1971.

Stratmann, Thomas. "Some talk: Money in politics. A (partial) review of the literature", *Public Choice*, 124, pp 135–156, 2005.

Stratmann, Thomas. "What Do Campaign Contributions Buy? Deciphering Causal Effects of Money and Votes", *Southern Economic Journal*, 57(3), pp. 606-620, 1991.

Svensson, Jakob. "Eight Questions about Corruption", *The Journal of Economic Perspectives*, 19(3), pp. 19-42, 2005.

Svensson, Jakob. "Who Must Pay Bribes and How Much? Evidence from A Cross Section of Firms", *Quarterly Journal of Economics*, 118(1), pp. 207-230, 2003.

Tether, Bruce S. "Who co-operates for innovation, and why: An empirical analysis", *Research Policy*, 31(6), pp.947-967, 2002.

Trajtenberg, Manuel, Henderson, Rebecca M. and Jaffe, Adam B. "Ivory Tower Versus Corporate Lab: an Empirical Study of Basic Research and Appropriability", *NBER Working Paper Series*, 4146, 1992.

Trillas, Francesc. "Independent Regulators: Theory, Evidence and Reform Proposals" *IESE Business School Working Paper*, No. 860, 2010.

Vuong, Q. H. 1989. "Likelihood ratio tests for model selection and non-nested hypotheses", *Econometrica,* 57, pp. 307–333, 1989.

Wallsten, Scott J. "The Effects of Government-Industry R&D Programs on Private R&D: The Case of the Small Business Innovation Research Program", The RAND Journal of Economics, 31(1), pp. 82-100, 2000.

Winkelmann, R., "Econometric Analysis of Count Data", 2nd. edition, Berlin, Springer, Verlag, 1997.

Annex 1. The UK R&D Connections Database

This Annex discusses in detail the creation of the dataset used for the analysis in this paper, the UK R&D Connections database, the data gathering exercise, the specific properties of the data and its sources for each of the variables created and discussed in section 3.

1. The sample

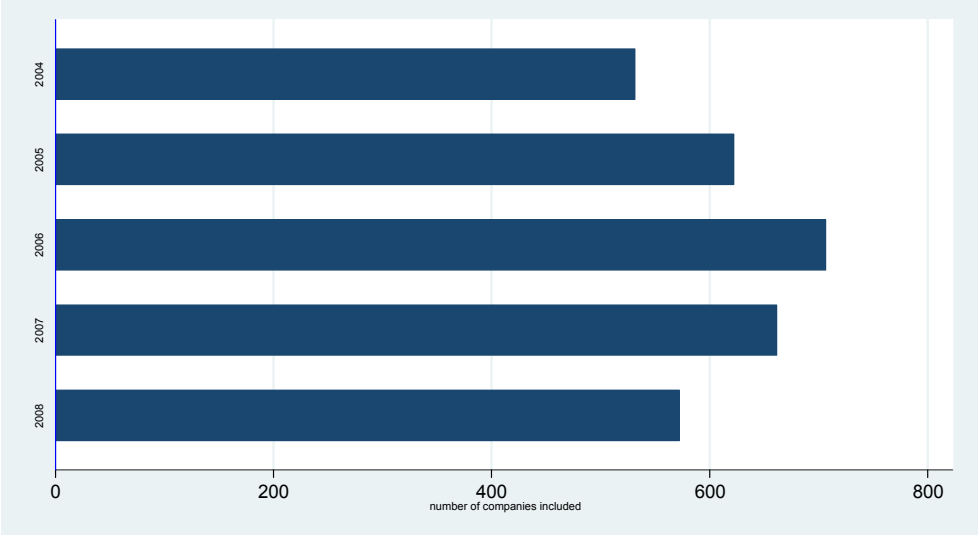
The sample of businesses covered in the database is based on R&D Scoreboard datasets (www.innovation.gov.uk/rd_scoreboard) containing company level information for the largest R&D spending businesses in the UK[27]. Companies represented in the Scoreboard spent a vast majority of the total R&D spending conducted by businesses in the United Kingdom. Even though it is not possible to accurately make direct comparisons, the approximately £22 billion in R&D spent by companies in the Scoreboard in for example 2007 with UK-wide statistics of total R&D spent by businesses[28], according to the UK Office of National Statistics the 400 largest R&D spending businesses represent 85% of the total R&D carried out by businesses in the UK. This figure provides a very conservative lower bound of the total amount of UK business R&D spending covered in the analysis presented in this article, which covers yearly at least the 700 largest R&D spenders.

In order to keep dynamic consistency in our dataset, only those companies which appear in at least two years in the dataset are included. Records are then manually adjusted to account for name changes, corporate mergers, acquisitions, bankruptcies and companies that cease to exist. This process is carried out by manually checking the original R&D scoreboard yearly datasets against Mint UK, a well known business register database. The resulting dataset covers R&D investment for 737 companies in the period 2003-2007[29] and contains all variables included in the annual R&D scoreboards[30]. The number

[27] The number of companies included in the R&D scoreboard was of 700 in the 2004 edition, 750 in 2005, 800 in 2006, and 850 in 2007 and 2008.
[28] It is not possible to compare R&D scoreboard data, which proceeds from company books and which also includes R&D carried out outside of the UK, with Official Statistics on Business Expenditure in R&D, which is calculated by the UK Office of National Statistics (ONS) on the basis of surveys. However it is important to note that both measures are based on the internationally agreed definition of R&D in the OECD Frascati manual.
[29] A financial year covers the period 1st of April – 31st March. For example, FY 2007 hence covers the period April 2006 – March 2007

of companies covered in any given year varies, with the central years of coverage being slightly more populated (see Figure 5).

Figure 5. Number of companies in the sample (2004-2008)



Different sectors are involved in R&D activities to substantially different degrees. Capturing the sector to which a company belongs to is important for the database, as some determinants of the levels of R&D cooperation and spending can be attributed to sector characteristics rather than company specific aspects.

The sector classification used in the UK R&D Connections Database is the Dow Jones Industrial Classification Benchmark (ICB). The ICB classifies a company by the sector or sub-sector which better identifies the nature of the business carried out by a company. This contrasts with official sector classifications based on Standard Industrial Classifications (SICs), which are not as well fitted for the analysis of R&D activities. This is because a large number of businesses involved in R&D activities are classified as "Other business activities not elsewhere classified" or "Research and Experimental Development on natural sciences and engineering". These classifications provide no or very little information on the nature of these R&D activities. For example, the activities of BAE Systems are better defined as "Aerospace & Defence" (ICB) than as "Research and experimental development on natural sciences and engineering" (SICs).

[30] R&D, profits, sales, capital expenditure, turnover, number of employees, market turnover, sales outside of the UK and growth rates of the aforementioned over 1 and 4 years.

The total amount of R&D spending is very concentrated in a few sectors. Figure 6 shows how pharmaceuticals and biotechnology is the largest area of R&D spending (with over one third of the total R&D investment in the period), followed by aerospace and defence and automobiles and parts. Figures 7 and 8 present the distribution of R&D intensity and number of employees by sector.

Figure 6. R&D spending by sector, £million, 2004-08

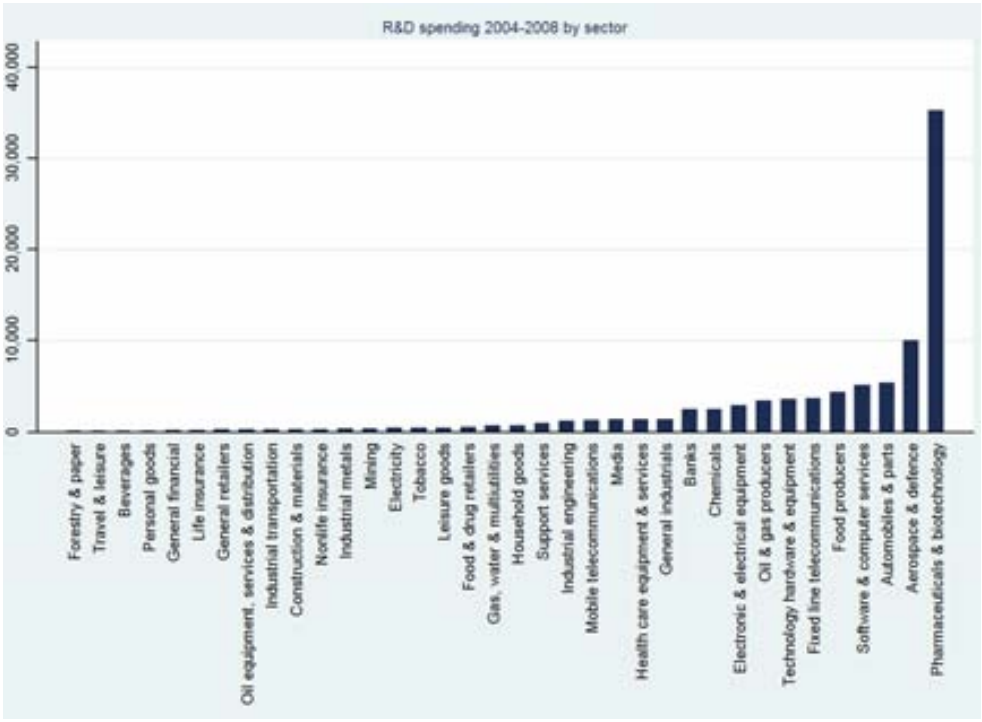


Figure 7. R&D intensity by sector 2004-2008

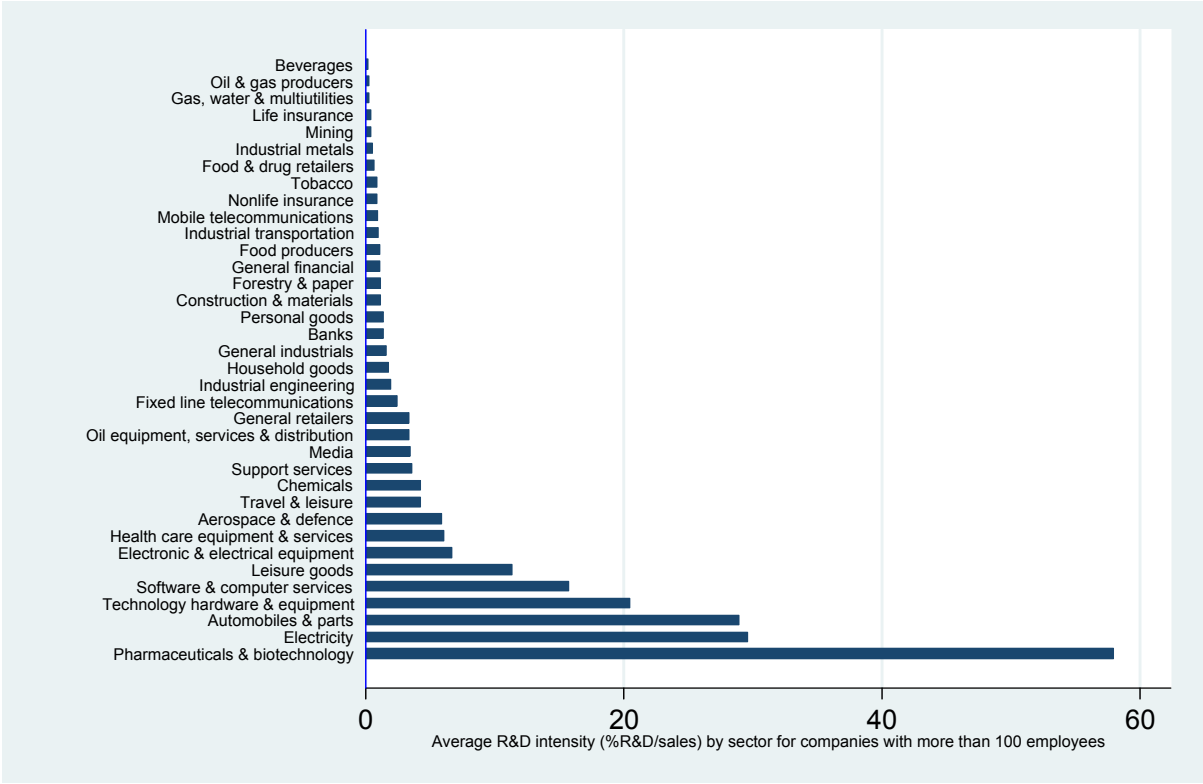
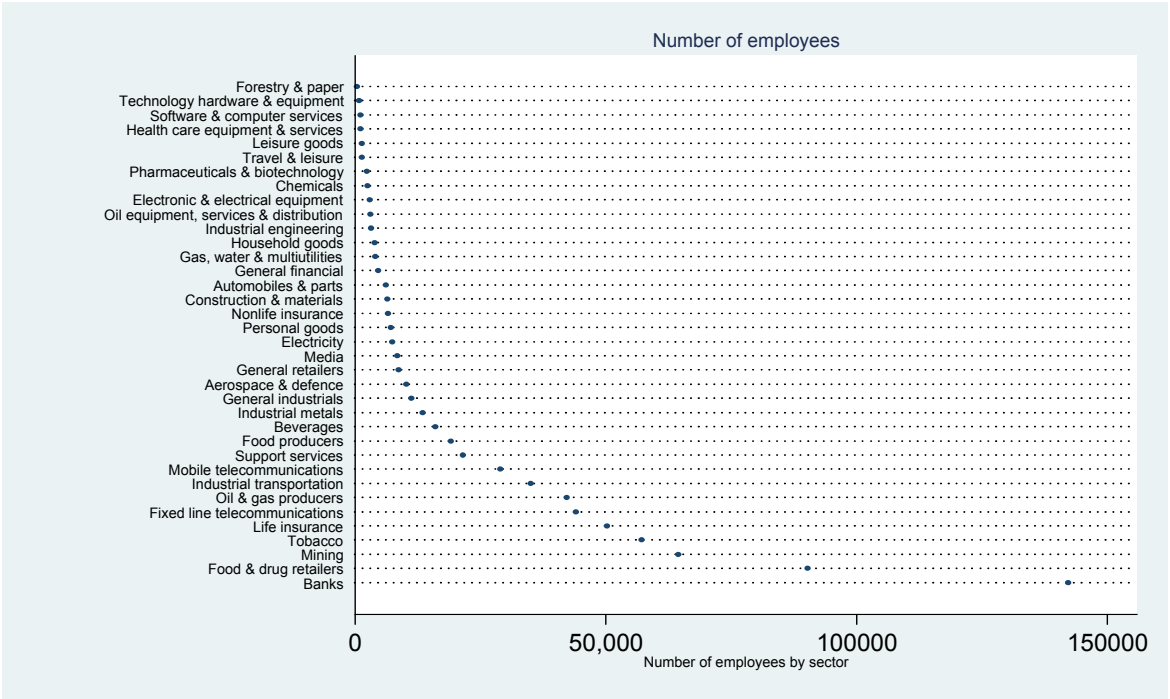


Figure 8. Average number of employees by sector (2004-08)



2. Data on connections

Allocation of Collaborative R&D grants by the TSB is determined in two different stages. First, the Government Department specifies, following advice by the TSB, a number of priority areas (technological and sector areas) where competition for funding is going to be held. Secondly, the Board appoints a sub-board of independent assessors which is then responsible for assessing applications for funding in a specific area against a set of pre-specified criteria.

Information on the individuals involved in the assessment is only available for TSB board members (see Table 4 below). Information is however not available on the independent assessors appointed to sub-boards for specific competitions. As the TSB Board is responsible for both setting the area targeted by competitions for funding and the appointment of independent assessors, it is expected that any impact of connections on the latter is already captured by determining the nature of connections on the former.

I establish the directorship positions held by TSB Board members by manually searching the professional records of these individuals in the Mint UK database, which keeps the record of Directorship positions held in companies registered in the United Kingdom. This is then complemented by searches conducted in alternative sources of information such as the TSB's own description of its Board members careers. After eliminating those connections related to non-for profit organisations and charities, during the period 2004-08 every year there are between 54 and 59 businesses directly connected to the TSB. After matching to the R&D Connections database, the number of businesses directly connected to the TSB per year is reduced to between 25 and 35. It is important to note that whereas some companies remained connected throughout the whole period, some others only become connected at some point, others lose their connection, and some others change the intensity of such connection.

Table 4. Members of the TSB in each year

Board member	Period
Ms Anne Margaret Glover	November 2004-2008
Ms Julia King	November 2004-2008
Mr Nicholas Brian Buckland	November 2004-2008
Dr Graham Nigel Spittle	November 2004-2008
Dr John Robert Brown	November 2004-2008
Dr Joseph Michael Feczko	November 2004-2008
Ms Anne Margaret Glover	November 2004-2008

Dr Alan Robert Begg	November 2004-May 2007
Dr Michael Gilbert James William Howse	November 2004-May 2007
Mr Michael Walker	November 2004-May 2007
Dr Catherine Susan Beech	November 2004-May 2007
Ms Fields Wicker-Miurin	November 2004-May 2007
Dr Janet Marjorie Brown	November 2004-May 2007
Mr Jonathan Kestenbaum	June 2007-2008
Dr Graeme Armstrong	June 2007-2008
Dr David Grant	June 2007-2008
Mr Andrew Brett Milligan	June 2007-2008
Dr Jeremy Watson	June 2007-2008
Dr Peter Stuart Ringrose	June 2007-2008
Mr Iain Gray	November 2007-2008

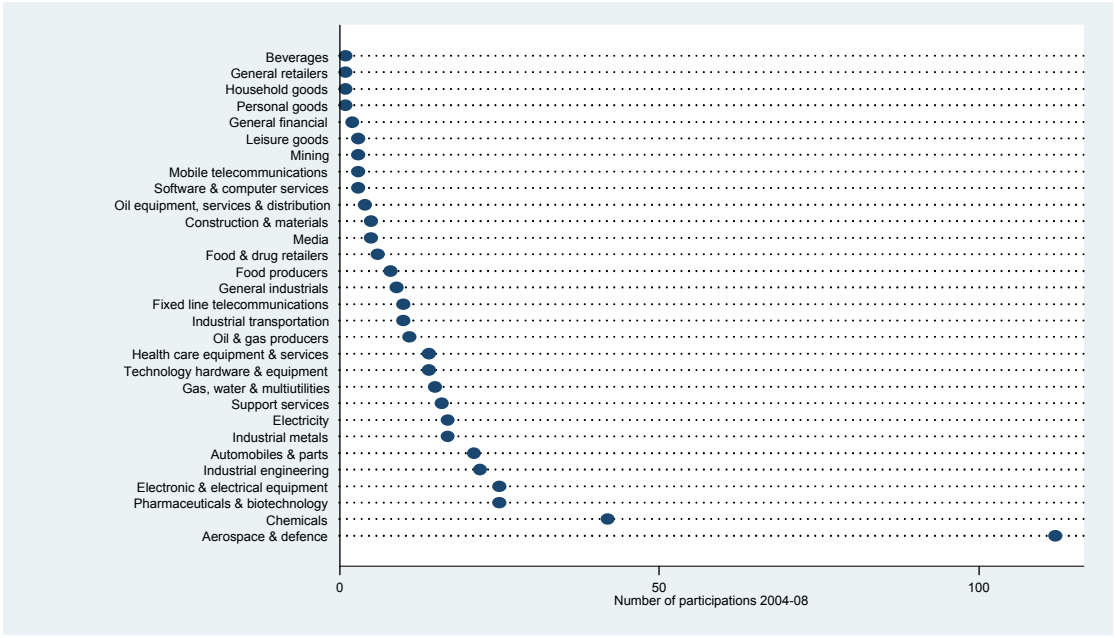
3. Collaborative R&D data

Data on subsidies granted by the Collaborative R&D Programme are available on the Technology Strategy Board (TSB)[31] website, including project specific information on businesses and university partners for each project, the technological area of the competition, the total cost of the project, and the total amount given as a subsidy to a project. The lead company in the project is also identified. This data is manually matched to company level R&D data from the Scoreboard, so that the UK R&D Connections database identifies companies which are in the R&D scoreboard and have received a cooperative R&D grant. The data available in the website for 2008 appears not to be fully consistent however with the number of competitions that the TSB ran in that year. In the regression analysis in section 4 this possible shortcoming is addressed by analysing both the periods 2004-07 and 2004-08 as discussed in section 4.

In the period 2004-2008 a total of 16 competitions were carried out by the Technology Strategy Board, covering a diverse range of technological and priority areas. Some competitions, such as the November 2004 competition, were targeted to multiple priority areas; whereas other calls, for example the Autumn 2006 Zero Emissions Enterprise were directed to very specific areas. Figure 9 shows the number of project participations by sector over the period 2004-08.

Figure 9. Number of participations by sector

[31] www.innovateuk.org



4. Knowledge spillovers data

Most UK companies generally patent innovations in the UK Intellectual Property Office (IPO), European Patent Office (EPO) and the United States Patent Office (USPTO)[32]. Citations data at company level from IPO and EPO is only accessible under licence through the Worldwide Patent Statistical Database (PATSAT), which contains raw data from patents and its citations for over 80 countries. USPTO data on number of patents and citations has already been formatted for economic research and is freely available through the National Bureau of Economic Research (NBER) website: The NBER Patent Citations Data File[33]. Created in 2001, this database contains patent and citations information over more than 30 years for over 3 million patents and 16 million citations.

For the purpose of the analysis, only USPTO citations are matched into the UK R&D Connections Database. This is because the resource, effort and cost needed to extract the required information from PATSAT would have been disproportionate to the value that this data improvement could add to the analysis. This is not to say that the UK R&D Connections database would not benefit in the future from adding EPO and IPO data, as there are some difficulties when using USPTO citations data as a key measure to capture knowledge spillovers by UK companies, for example the data will show a general bias

[32] Even though patenting in the Japanese Patent Office is not completely unheard of.
[33] www.nber.org/patents

towards US patented inventions. In particular, UK companies with presence in US markets are likely to display larger spillovers than other businesses which are more focused on the national market. However, using USPTO citations data has also some advantages: most companies covered in the UK R&D Connections database are large companies with presence in the United States; almost all UK patents of significant value are registered with the USPTO; and capturing only USPTO patented innovations discriminates against those innovations with lower value added.

The UK R&D Connections database is clerically matched to all patent applications[34] by UK[35] companies in the US patent office between 1996 and 2006. There are over 20,000 UK patents registered in that period. Names of the filing institution in the NBER database are then clerically checked by name changes and other corporate changes. Over 8,000 patents finally result in positive matches into one of the businesses included in the UK R&D Connections database.

Data on the number of citations received by each of these patents is corrected by self-citations as these introduce noise by capturing citations bearing no transfer of knowledge between different companies. Citations data is also corrected by applying a factor to control for citation lags[36]. The number of citations received by a company is by definition biased when looking at a panel of data where patents are applied for in different years. This is because a patent becomes less likely to be cited the closest it gets to the present time. This factor corrects the truncation problem, even though data for the latest available year (2007) remains problematic as most citations are produced at least one year after the publication of the patent and hence the factor is less effective in dealing with like by like inconsistencies.

Figures 10 and 11 list respectively those businesses with the highest average number of citations per patent and the businesses with the highest knowledge spillover size (calculated as the total sum of the product of citations by number of patents). Figures 12

[34] These patents are registered in the UK R&D Connections database in the year when they are applied for. Patent applications capture better the time of the innovation than the year in which the patent was eventually granted.
[35] This refers to patents in the NBER database registered to businesses in England, Wales, Scotland or Northern Ireland.
[36] The number of citations is corrected by applying factors available in the NBER Citations Datafile and discussed in more detail in Hall, Jaffe and Trajtenberg (2001).

and 13 show the distribution of patent citations and the size of knowledge spillovers by sector.

Figure 10. Businesses with the highest average number of citations per patent

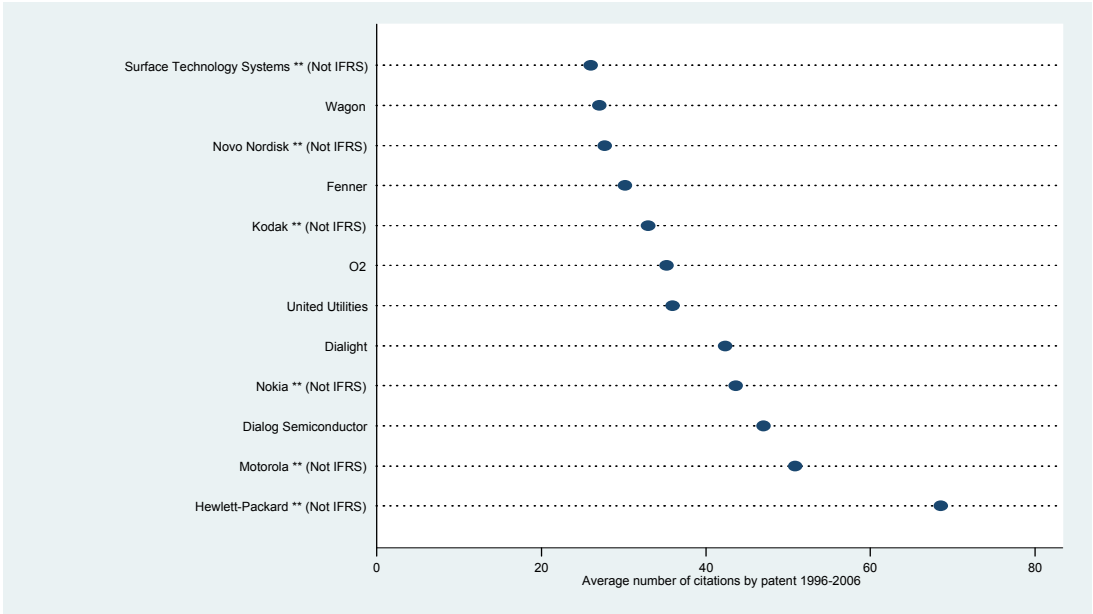


Figure 11. Businesses with the largest knowledge spillovers

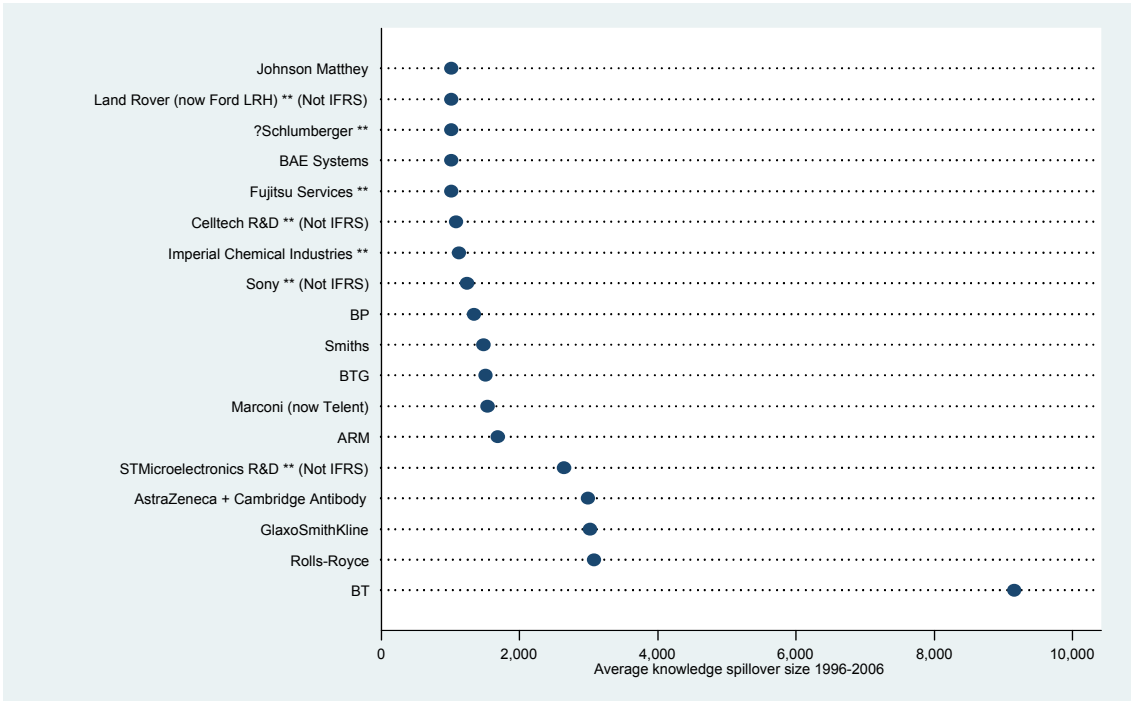


Figure 12. Average number of citations by sector

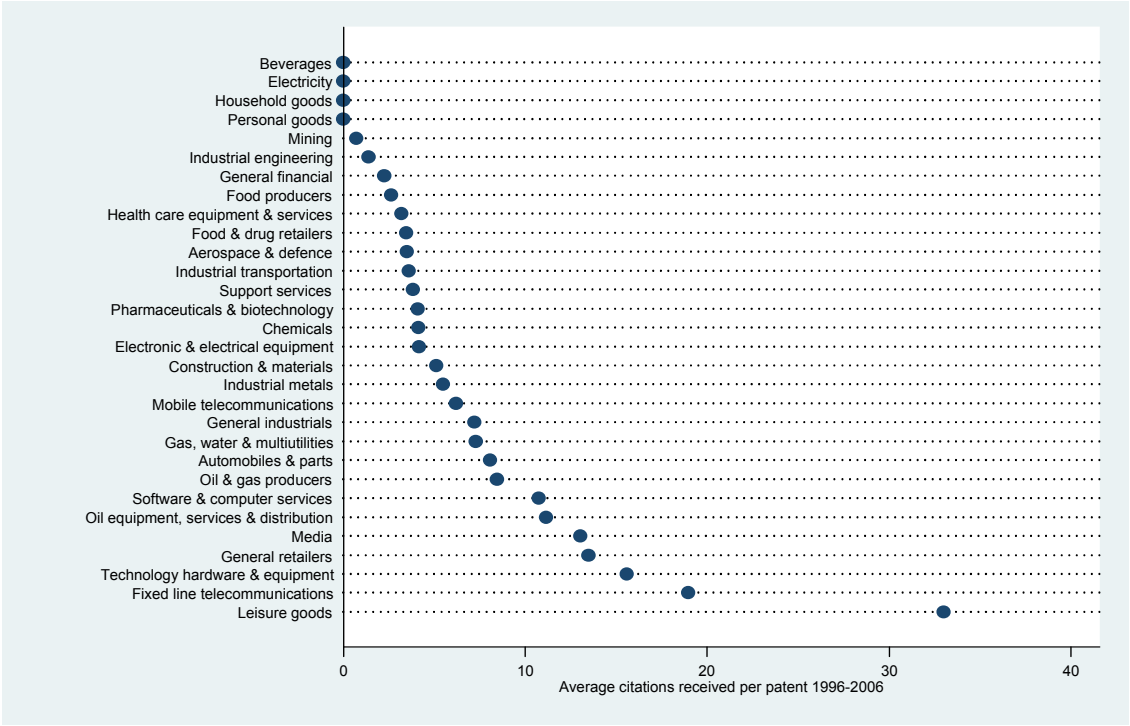
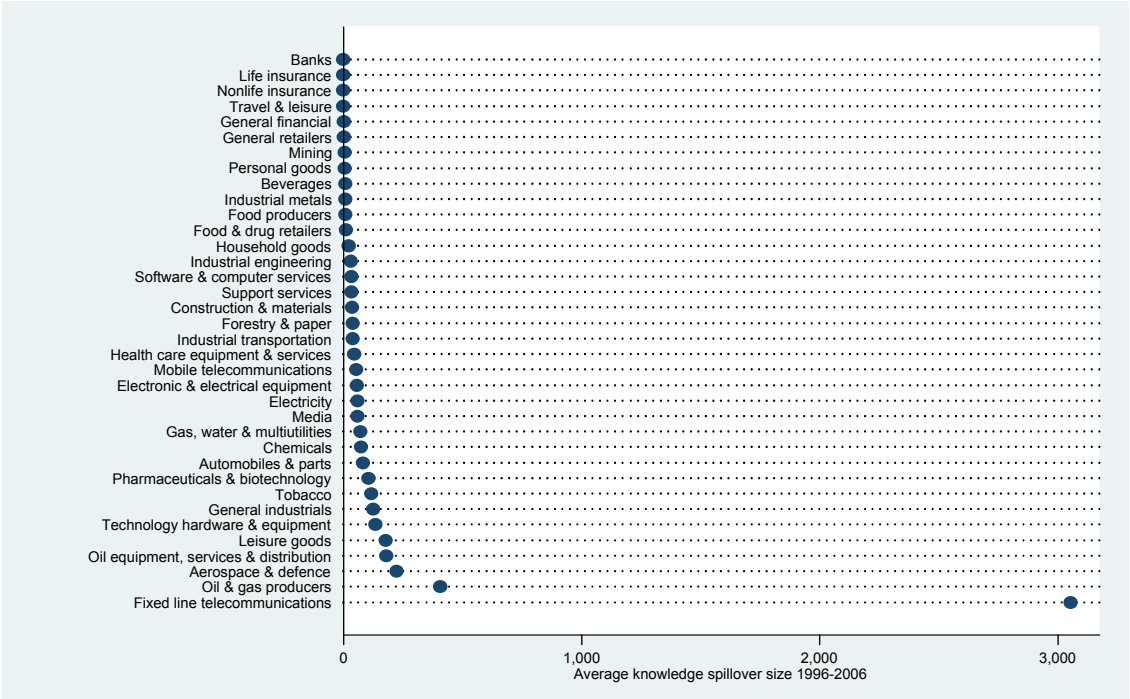


Figure 13. Average knowledge spillover size by sector



5. Data on appropriability conditions

Section 3 discusses the approach to calculating appropriability conditions and identifies how some studies have employed survey data, particularly from the Community Innovation Survey (CIS). CIS is not directly used in the present analysis. At the time the analysis for this paper was being conducted CIS4 (2004-2006) was the only available edition which contained relevant information for the period of analysis (2004-2008). CIS 2008 (covering the period 2006-08) was underway but not available. It is important to note that because of confidentiality of CIS data and its different coverage, any analysis including this data would reduce the number of observations considered in the analysis.

An alternative approach, as in Hernan, Marin & Siotis (2003), is to use data from one-off surveys on the effectiveness of protection mechanisms and the speed at which innovation spreads out in different sectors of the economy (Mansfield, 1985; Levin et al., 1987; and Cohen, Nelson & Walsh, 2000). Even though these surveys are more targeted than CIS and hence provide more relevant information on the appropriability conditions of innovation, their drawback is that results reflect appropriability at one point in time, these are presented at sector level, and they normally refer to the US, which adds an extra layer of complexity when using the data for analysis in the UK[37].

The preferred approach is relying on data based on a mixture of the two general methodologies scoped above from Barros (2008) which contains data on appropriability conditions in the UK by sector during the period 1998-2000 based on CIS3 data. This data has the advantage of being based on responses by UK businesses –in many cases for the same companies covered in the UK Connections database. Although one may argue that the information is outdated, appropriability conditions in different points in time and different countries are relatively stable through time (see section 3). Table 5 harmonises data from Mansfield (1985), Nelson, Cohen and Walsh (2000) and Barros (2008)[38], comparing the results obtained by different researchers on the effectiveness of

[37] Note though that this has not prevented other researchers from using this data as a for example Hernan, Marin and Siotis (2003) for a European based analysis.

[38] Levin et al. (1987) also present a similar exercise. Their results have not been included in this meta-analysis as their data is difficult to harmonise meaningfully to the sector classification used in Table X. This is because the number of companies per sector included in the survey is unknown and hence it becomes impossible to actually determine appropriability for those ICB sectors that are composed by a mix of the sectors included in Levin et al. (1987).

appropriability mechanisms in different sectors of the economy in different countries and points in time[39].

Table 5. Appropriability conditions by sector

	Effectiveness of patents from 0 (not effective) to 3 (completely effective). Barros (2008)	Average number of months for both process and product innovation before this is known to rivals (Mansfield, 1985)	Average of % of businesses who find product and process effectiveness for the following mechanisms of protection: patents, secrecy, lead time, complementary sales, complementary manufacturing. Cohen, Nelson and Walsh (2000)	% of businesses for which the most effective appropriability mechanism sector (amongst patents, secrecy, lead time, complementary sales, complementary manufacturing) is effective for product and process innovation. Cohen, Nelson and Walsh (2000)
Pharmaceuticals & biotechnology	1,82	16,14	40,2%	60,9%
Health care equipment & services	1,03	12,98	41,2%	52,1%
Industrial engineering	1,00	15,54	37,6%	48,3%
Chemicals	1,00	16,71	36,4%	58,0%
Technology hardware & equipment	0,88	14,16	36,5%	52,3%
Automobiles & parts	0,82	14,16	41,0%	58,6%
Electronic & electrical equipment	0,81	13,37	30,3%	40,3%
Oil & gas producers	0,62	13,34	34,8%	59,7%
Construction & materials	0,61	18,00	36,3%	53,7%
Household goods	0,60	12,06	37,4%	51,7%
Industrial transportation	0,60	13,43	37,4%	51,7%
Banks	0,60	14,16	37,4%	51,7%
Electricity	0,60	14,16	37,4%	51,7%
Fixed line telecommunications	0,60	14,16	37,4%	51,7%
Food & drug retailers	0,60	14,16	37,4%	51,7%

[39] Sectors presented in these three articles all use different classifications. The matrix of sector classification equivalences created to harmonise the sectors into one comparable classification based on ICB classification is available under request.

Gas, water & multiutilities	0,60	14,16	37,4%	51,7%
General financial	0,60	14,16	37,4%	51,7%
General industrials	0,60	14,16	37,4%	51,7%
General retailers	0,60	14,16	37,4%	51,7%
Leisure goods	0,60	14,16	37,0%	50,6%
Life insurance	0,60	14,16	37,4%	51,7%
Mining	0,60	14,16	31,9%	47,5%
Mobile telecommunications	0,60	14,16	37,4%	51,7%
Nonlife insurance	0,60	14,16	37,4%	51,7%
Oil equipment, services & distribution	0,60	14,16	37,4%	51,7%
Software & computer services	0,60	14,16	34,1%	46,3%
Support services	0,60	14,16	37,4%	51,7%
Travel & leisure	0,60	14,16	37,4%	51,7%
Forestry & paper	0,50	12,06	36,7%	56,9%
Aerospace & defence	0,46	14,16	36,9%	53,6%
Industrial metals	0,38	9,60	36,8%	54,4%
Personal goods	0,34	14,16	44,9%	62,2%
Food producers	0,30	12,06	37,3%	57,2%
Beverages	0,30	14,16	37,4%	51,7%
Tobacco	0,30	14,16	37,4%	51,7%
Media	0,17	14,16	35,8%	64,9%

The first column shows the effectiveness of patents across sectors in a range from 0 (no effectiveness) to 3 (complete effectiveness). The second column is based on Mansfield (1985) and displays the average number of months before innovation is known to rivals. The third and fourth columns, based on Cohen, Nelson and Walsh (2000) show the proportion of companies in the sector which consider, respectively, how effective all protection mechanisms available to them are and how many find effective the most effective mechanism.