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Lobbying for Capital Tax Benefits and Misallocation of Resources during a Credit Crunch

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Abstract

Corporations often have strong incentives to exert influence on the tax code and obtain additional tax benefits through lobbying. For the U.S. financial crisis of 2007–09, this paper shows that lobbying activity intensified, driven by large firms in sectors that depend more on external finance. Using a heterogeneous agent model with financial frictions and endogenous lobbying, the paper studies the aggregate consequences of this rise in lobbying activity. When calibrated to U.S. micro data, the model generates an increase in lobbying that matches the magnitude and the cross-sector and within-sector variation observed in the data. The analysis finds that lobbying for capital tax benefits, together with financial frictions, accounts for 80 percent of the decline in output and almost all the drop in total factor productivity observed during the crisis for the non-financial corporate sector. Relative to an economy without lobbying, this mechanism increases the dispersion in the marginal product of capital and amplifies the credit shock, leading to a one-third larger decline in output. The paper also studies the long run effects of lobbying. Restricting lobbying implies welfare gains of 0.3 percent after considering the transitional dynamics to the new steady state.

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Lobbying for Capital Tax Benefits and Misallocation of Resources during a Credit Crunch[*]

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1 Introduction

Understanding the factors that contribute to large declines in total factor productivity (TFP) during financial crises is key for designing policies that lead to robust recoveries. A growing consensus among economists views resource allocation among firms as an important driver of TFP over time (Oberfield (2013) and Gopinath et al. (2015)). During periods of financial distress, financial frictions can prevent productive firms from operating at the optimal scale leading to misallocation and lower TFP (Khan and Thomas (2013)). In this paper, I show that financial frictions affect lobbying decisions that aim to extract tax benefits, and that this channel is relevant to explaining the changes in TFP observed during financial crises. I focus on tax benefits associated to capital, since those are the most important ones in the tax code.[1]

I make three contributions. First, I document the increase in lobbying activity intended to affect the tax code that occurred during the U.S. financial crisis in 2007-2009.[2] Second, I contribute to the literature that studies the effects of financial frictions on resource allocation and productivity fluctuations over business cycles by quantifying a new channel —lobbying— that interacts with financial frictions and changes the effects of that source of misallocation. Third, I conduct counterfactual experiments to study the long run implications of lobbying and fiscal reforms.

The main finding of the paper is that lobbying for capital tax benefits amplifies the misallocation that arises due to financial frictions during a credit crunch. The interaction between lobbying and financial frictions generates two opposing effects, one that increases misallocation and one that alleviates the distortions. In the calibrated economy, the first effect dominates. Compared to an economy without lobbying, I find that the lobbying economy amplifies the distortions arising from financial frictions, leading to a one-third larger decline in output.

Using data from Compustat that I match with firm-level lobbying expenditures from the Center for Responsive Politics (CRP), I document three novel facts on lobbying during a financial crisis. First, aggregate lobbying expenditure increased during the crisis. Between 2007 and 2009, the deviation from a linear trend in aggregate lobbying expenditure increased by 15 percentage points. This captures changes in both the extensive (number of firms) and intensive (average expenditure) margins. Second, sectors that depend more on external finance (Rajan and Zingales (1998)), and therefore are more likely to be affected by the shock, drove the increase in lobbying activity. I show that the share of these sectors in total lobbying expenditure increased from 53% in 2007 to 63% by 2010. Third, I use a triple difference approach that exploits variations in time (before and

[1] The U.S. government provides different types of tax breaks to corporations allowing them to reduce their tax burden. The literature has found that the tax code can be influenced through lobbying. Since lobbying entails substantial fixed costs, then large and capital intensive firms can target those benefits to themselves. Special tax provisions for individual firms have been documented by Siegfried (1974), Barlett and Steele (1988) and McIntyre and Nguyen (2004). See Richter et al. (2009) and Arayavenchkit et al. (2014) for a discussion of different tax benefits associated with capital and the endogeneity of the tax code.

[2] Throughout, I will refer to "lobbying to affect the tax code" and "lobbying for capital tax benefits" simply as "lobbying". In the lobbying data there are 77 issues that firms can choose to lobby for. The one that firms use to try to influence the tax code is Taxation. This is the most important issue in terms of expenditure, and it is the one used in the empirical analysis.

after the shock), firm size (small and large), and external financial dependence (low and high) to show that large firms increased lobbying expenditure relative to small firms, and that this difference is disproportionately larger in sectors that rely more on external finance. In addition, small firms reduced lobbying, and this reduction was larger in sectors that depend more on external finance. This finding suggests that the crisis affected the incentives of small firms and large firms differently, negatively affecting smaller firms, and favoring larger firms. Since firms in sectors that rely more on external finance are empirically more capital intensive, this has implications for the allocation of the tax benefits associated with capital.

Motivated by this evidence—and the corresponding increase in resources devoted to the corporate sector by the U.S. government during the crisis—I ask whether lobbying reinforces or alleviates the misallocation created by financial frictions when the economy suffers a credit crunch.[3] To address this question, I introduce lobbying into a standard general equilibrium model in which financial shocks affect the allocation of capital among producers. Lobbying varies across firms according to their financial position and their productivity. Because the credit shock affects the flow of funds among firms, it also has an effect on the decision to lobby. I use the model to quantify the contribution of the lobbying channel to the behavior of TFP and the macroeconomy after a financial disruption.[4]

The main analysis focuses on the model's ability to match the data on TFP and output for the non-financial corporate sector. I feed a credit shock into the model to produce the observed decline in the ratio of external finance to capital for the non-financial corporate sector between the end of 2007 and 2010. The calibrated model captures 80% of the decline in output and almost all of the decline in TFP observed in the data by the end of 2009. The model also captures the change in aggregate lobbying expenditure observed during the crisis both at the intensive and extensive margins, and partially captures the increase in the participation of the sectors that rely more on external finance in total lobbying expenditure. Regarding within sectors variation, the model delivers similar patterns as in the econometric framework.

The model I use for the analysis is a continuous time version of the two-sector economy in Buera et al. (2011). I augment this framework by introducing a government that grants tax benefits associated to capital that can be partly influenced by endogenous lobbying.[5] Agents are heterogeneous with respect to their productivity and wealth. Productivity is subject to idiosyncratic stochastic shocks, while wealth is determined by saving decisions. Producers face a collateral constraint on the amount of capital they can rent, preventing them from borrowing more than a fraction of their

[3] Here I list some important examples regarding the increase in resources to corporations. Bill H.R. 6049 approved by the House includes extensions of several temporary tax benefits (commonly referred as "extenders") as well as new tax cuts to corporations. The renewable energy tax incentives in this bill cost a total of $17 billion and the largest is the 3-year extension of the "section 45 tax credit" for the production of energy from renewable resources. As another example, bill H.R. 4853 extended many of the provisions to corporations that are known as "Bush tax cuts", and created new ones. For more examples, see the Tax Relief Act of 2008, among others.

[4] The adjustments of the economy to financial shocks have been studied by Khan and Thomas (2013), Buera et al. (2015), and Shourideh and Zetlin Jones (2016), among others.

[5] Consider the solar energy-specific tax break, the fossil and renewable energy tax break or the research and experimentation tax break. All of these benefits are associated with capital, and as a result are exploited by capital intensive firms.

wealth. Production in each sector is subject to decreasing returns to scale and a per-period sector-specific fixed cost, which generates the differences in financing needs across sectors to map the model and the data. A financial crisis in this framework is modeled as an exogenous, unforeseen tightening of the collateral constraint that slowly reverts over time.

Firms choose lobbying subject to variable and a fixed cost that is calibrated to match the fact that only a fraction of firms engage in lobbying. The tax benefit schedule per unit of capital consists of two components. The first component is exogenous and common to all firms, while the second is endogenous and increasing in lobbying effort. This implies that the tax benefits that firms receive are heterogeneous and depend on two factors: (i) firms that use more capital receive more tax benefits; (ii) conditional on capital, firms that pay the fixed cost receive tax benefits according to their lobbying effort. An implication of the tax benefit schedule is that lobbying affects the unconstrained optimal size of firms by changing the choice of capital. Since lobbying generates additional tax benefits per unit of capital, then unconstrained lobbying firms have incentives to increase the demand for this factor. As a result, there is a complementarity between lobbying and capital that increases the optimal firm size.

The tightening of the collateral constraint increases misallocation and unambiguously lowers TFP. Firms with low net worth and positive productivity shocks become constrained and have to downsize, reducing the demand for capital. In general equilibrium, the interest rate falls, and unproductive firms with high net worth expand. Capital reallocates from productive and constrained firms to unproductive and unconstrained firms.

The interaction between lobbying and financial frictions during a crisis introduces two opposing effects. On one hand, lobbying increases the misallocation of capital and lowers TFP. Since lobbying and capital are complementary, the increase in capital by unconstrained firms is accompanied by an increase in lobbying that reinforces the incentive to use more capital, amplifying the misallocation. On the other hand, there is a positive effect of lobbying: it provides additional cash flows that can be used to increase savings for firms that are financially constrained and choose to lobby. By being able to lobby, these firms can alleviate part of the misallocation caused by the financial shock by saving part of those resources to overcome the financing constraint.

In order to understand which of these forces dominates, I study the effect of the increase in distortions coming only from financial frictions. To that end, I analyze the response of a re-calibrated economy without lobbying when it is exposed to the same credit shock.[6] This exercise shows that lobbying amplifies the distortions arising from financial frictions, leading to one-third larger decline in output. Comparing impulse responses across models, the dispersion of the marginal product of capital—a measure of misallocation— increases to 12.6% with lobbying and to 10% without lobbying, all relative to the initial steady state. In addition, the quantitative results show that most of the increase in misallocation as a result of lobbying comes from adjustments at the intensive margin.

The model is also useful for understanding the long run implications of policies that change the

[6]The credit shock is re-calibrated in this model in order to match the observed decline in the ratio of external finance to capital for the non-financial corporate sector.

structure of the economy. In the first experiment, I study the effects of banning lobbying. Since the tax benefit acts as a subsidy on capital and lobbying changes how much these firms can claim, eliminating this component reduces the incentives to save. Compared to the pre-crisis economy, the new steady state output and capital decrease 1.2% and 4%, and TFP increases by 0.8%.[7] What are the welfare implications of this policy? Restricting lobbying implies welfare gains of 0.3% after accounting for the full transition between steady states. Finally, I also consider the implications of a fiscal reform. The experiment implies a removal of all capital tax breaks while at the same time keeping the revenue neutral by reducing the corporate tax rate.

The rest of the paper is structured as follows. Section (2) discusses the related literature. Section (3) presents the empirical evidence on corporate lobbying for taxation during U.S. the great recession. Section (4) lays out the model with financial frictions on the producer side and endogenous lobbying to obtain capital tax breaks. Section (5) presents the calibration strategy, both for the steady state and for the shock. Section (6) has three parts. First, I study the main quantitative exercises. Then I test the ability of the model to generate the empirical facts shown in section (3). Lastly, I discuss the long run implications of lobbying and some policy reforms, with special attention to the effects on TFP and on welfare. Section (7) concludes with some final remarks and policy implications.

2 Literature Review

This paper fits into a large body of papers that studies the role of financial market imperfections explaining business cycle fluctuations, following Bernanke and Gertler (1989), Kiyotaki et al. (1997), Jermann and Quadrini (2012) and Brunnermeier and Sannikov (2014). I share with papers like Khan and Thomas (2013), Buera et al. (2015) and Shourideh and Zetlin Jones (2016) the focus on the effects of financial frictions on the allocation of capital at the firm level, especially during a credit crunch. I differentiate my paper by introducing a firm level endogenous mechanism (lobbying) that interacts with the financial frictions, especially during a financial crisis. In addition, the model generates new testable implications at the firm level during those episodes, which closely match the patterns seen in the data.

The paper is also related to the important literature that stresses the role of misallocation of resources. Restuccia and Rogerson (2008) and Hsieh and Klenow (2009) focused on abstract distortions that affect the allocation of capital and labor across firms to explain the variability in the returns to those factors across countries. They show that the dispersion of marginal products caused by those micro-level distortions are the main drivers of the cross-country differences in TFP observed between the U.S. and developing countries. A derived implication of these studies is that an increase in a factor's return could be the result of increasing levels of distortions that affect the efficient allocation of resources, which negatively affect TFP. Continuing this line of research, a growing and active literature started to use quantitative general equilibrium models to quantify the

[7]The capital stock includes the capital used for production plus the fixed costs in this economy.

amount of misallocation particular frictions can produce and their effects on long run output.[8]

As in Oberfield (2013) and Sandleris and Wright (2014), this paper focuses on the dynamics of misallocation over time. Following an approach similar to Hsieh and Klenow (2009), they show that the misallocation of resources across firms accounts for a large portion of TFP losses during a financial crisis. Kehrig (2015) documents that the dispersion in revenue productivity in U.S. manufacturing increases during recessions, and especially during the last financial crisis.[9] I relate to this line of research by studying two mechanisms contributing to the increase in the dispersion of the marginal product of capital and revenue productivity: financial frictions and lobbying for capital tax breaks.

A closely related paper is Arayavenchkit et al. (2014). They show that lobbying for capital tax benefits is another mechanism that generates dispersion in the allocation of capital using a partial equilibrium model with complete markets. This paper integrates financial market imperfections with lobbying in order to understand whether lobbying amplifies or mitigates the misallocation coming from the credit market imperfection, both in the long-run and during a credit crunch.

The paper is also related to the empirical literature that looks at the cross-section implications of lobbying. This paper confirms most of the cross-section facts and extends our understanding by providing new evidence on lobbying for taxation along the business cycle.[10] Finally, the paper relates to the theoretical literature on rent-seeking. My contribution is twofold. First, I provide a quantitative model of one type of rent-seeking stressed in that literature (Murphy et al. (1993)), and I evaluate the long run implications. Second, after calibrating the model I quantify the welfare cost of this rent-seeking activity. To my knowledge, this is the first attempt.

3 Empirical Motivation

This section provides evidence on firm level lobbying activity for taxation issues during a financial crisis. I document four related facts based on the case event provided by the U.S. credit crunch in 2007-2009. In addition to contributing to the understanding of political participation during credit crunches, these facts also provide a guidance to construct the model in section (4).

First, during the crisis, lobbying activity increased substantially along both intensive and extensive margins. Second, effective tax rates (ETR) for both lobbying and non-lobbying firms declined significantly. Consistent with the fact that lobbying firms have lower ETR, the decline after the crisis was more drastic for lobbying firms. Third, the increase in lobbying activity for taxation was driven mostly by industries that depend more heavily on external finance (Rajan and Zingales, 1998).[11] In

[8] Hopenhayn and Rogerson (1993) study the effects on misallocation of having firing costs. Peters (2012) studies the implications of variable markups for misallocation and for firm level innovation. An important amount of attention has been devoted to financial frictions, which affect the allocation of capital. Prominent examples are Jeong and Townsend (2007), Amaral and Quintin (2010), Buera et al. (2011), Midrigan and Xu (2014) and Moll (2014).

[9] Complementary to this finding, Chen and Song (2013) find that the dispersion in the marginal product of capital for Compustat firms is also countercyclical. Since revenue productivity is a weighted average of the marginal product of capital and the marginal product of labor, these findings are mutually consistent.

[10] See Richter et al. (2009), Kerr et al. (2014), Igan et al. (2011), Arayavenchkit et al. (2014), and references therein.

[11] According to these authors, these sectors are larger in scale and more capital intensive. As discussed in the

particular, I show that these industries account for more than 50% of total lobbying expenditure, and that this participation increases during the credit crunch. Finally, I provide evidence of heterogeneity in lobbying behavior within sectors of external finance as large firms increased their lobbying expenditure relative to small firms during the crisis. Furthermore, this relative difference was once again stronger in sectors that depend more on external finance. In fact, small firms in externally financed sectors reduce their lobbying expenditure for taxation issues which is consistent with the idea that small firms should be more affected with the credit shock.

3.1 Data and Summary Statistics

In order to follow firms over time for the empirical part of the paper, I name-match lobbying expenditure data with firm level characteristics. In this section, I describe the main features of each dataset and the matching procedure.

Firm level lobbying data is based on more that 1,100,000 lobbying reports that became available under the lobbying Disclosure Act of 1995.[12] This act, together with the Honest Leadership and Open Government Act (2007) established a set of provisions to be followed by anyone lobbying the federal government at congress.[13] Firms, organizations, or individuals that want to lobby have to file a semi-annual report to the Secretary of the Senate's Office of Public records (SOPR) including the following information: (i) the name of the client, address and general business description; (ii) the total amount of income or expenditure in the lobbying activity, depending whether it is an in-house or an external lobbyist; (iii) all of the general issues for which they are lobbying. Firms that are trying to influence the government to modify the tax code and obtain tax benefits targeted to themselves have to declare that they are doing lobbying for taxation, allowing me to focus only on those firms.[14] Finally, since any non-profit organization, individual, or firm can engage in lobbying activity, I clean the original dataset to keep only those observations that correspond to firms. To do this, I scrape the data with text-parsing methods to look for keywords that allow me to eliminate entries that do not correspond to firms. After that, I manually check the remaining observations to eliminate non-profits or individuals.[15] The final dataset contains information from 2000 to 2014.

introduction, a firm's capital level is important because most of the tax benefits granted by the government are tied to capital.

[12]The information is provided by the Center of Responsive Politics (CRP), which collected the data from the Senate Office of Public Records. Data is available upon request at www.opensecrets.org/lobby/.

[13]A lobbyist is any individual who is employed or under a contract to lobby on behalf of a client. An In-House Lobbyist is an employee hired by an organization to lobby for them. An External Lobbyist is typically an organization or person that works under a contract for the lobbying organization. Organizations could be one of 3 types: non-profit associations, firms, or groups of individuals.

The Lobbying Disclosure Act defines "lobbying activity" as "lobbying contacts and efforts in support of such contacts, including preparation and planning activities, research and other background work that is intended, at the time it is performed, for use in contacts, and coordination with the lobbying activities of others".

[14]There are 77 issues such as trade, taxes, agriculture, etc. A list of all the issues can be found here: https://www.opensecrets.org/lobby/alphalist_issue.php. In online appendix C I include an example of a form filed by a lobbying firm.

[15]See the online data appendix for a description of the procedure, including the keywords used to eliminate observations.

However, for most of the analysis I restrict my attention to the period 2004-2014.

Financial data by parent firm is primarily taken from Compustat North America. This dataset contains information on publicly traded companies in the United States, including sales, employment, industry classification, assets, and useful information to compute effective tax rates, which I describe below. The balance sheet presentation in Compustat is consolidated at the parent level. This is a problem, because a single organization could have more than one entry. To deal with this issue, I aggregate the information at the ultimate owner level using parent-subsidiary identifiers from the NBER patent data project to assign each entry from Compustat to one unique parent. In addition, I also use the dataset ORBIS compiled by the by Bureau van Dijk Electronic Publishing (BvD) to check Parent-subsidiary relationships. After obtaining these relationships, I name-match the lobbying data with Compustat using "open refine", which provides a reconciliation service that uses a probabilistic matching algorithm to pair entries between the two datasets.[16]

Data on external financial dependence of 63 2-digit SIC sectors is computed with data from Compustat. To construct this measure (proposed by Rajan and Zingales (1998)), I follow the methodology described in Cetorelli and Strahan (2006). External financial dependence is defined as the fraction of capital expenditure that is not financed with internal cash flows from operations . A positive value implies that a firm must use external sources of funds to finance investment, while a negative value indicates that firms have enough cash flows to fund investments. Appendix C.4 contains the method used to construct the index and the measure of external financial dependence for each sector.

According to Rajan and Zingales (1998), the external finance measure varies across industries due to technological factors affecting initial project scale, gestation period, the cash harvest period, and the requirement for continuing investment. Consequently, these technological factors determine the demand for external financing and as a result, industries like metal mining or oil and gas extraction —heavily dependent on external fiannce— should be more affected by a credit shock than industries like leather. For the remainder of the paper, I exclude the financial sector and the agricultural sector.

Later in the paper, I will classify firms into two broad sectors: those producing in sectors that rely more on external finance and those producing in sectors that depend less on external finance. The former includes all the 2-digits SIC sectors with a measure of external financing need below 0. The rest of the sectors will be categorized as sectors that rely more on external finance.

Lastly, to compute effective tax rates I also use data from Compustat. To compute this measure, I use the definition provided by Gupta and Newberry (1997) and used in Richter et al. (2009) and Arayavenchkit et al. (2014). The effective tax rate for each firm is computed as

$$ETR = \frac{Income\ Taxes\ Current}{Pre\ Tax\ Income - Equity\ in\ Earnings - Special\ Items\ + Interest\ Expense}.$$

The numerator is a measure of how much a firm paid in taxes, while the denominator computes the taxable income coming from balance sheet data. In general, the effective tax rate will be below

[16] Open refine is available at www.openrefine.org. See online appendix C.2 for additional details of the procedure.

the statutory corporate tax rate of 35%.[17] In the next section, I discuss this feature in detail.

3.1.1 Cross-Section Facts and Summary Statistics

In this subsection I briefly describe the data and I provide some summary statistics. The raw data after matching Compustat and the CRP data for corporations gives a total number of 46,831 firm-year observations. Between 2004 and 2014, 1,544 firms lobbied for some of the 77 issues in at least one year. From those observations, there are 567 firms that lobbied for taxation issues at least one time between 2007 and 2014. The low participation of public firms in lobbying activity has been previously documented by Richter et al. (2009) and others. For this sample, the average fraction of lobbying firms is 8.9%. As shown in table (1) lobbying for taxation is the most important issue in terms of expenditure between 2004-2014. In fact, it is the top lobbying issue in each individual year of this sample. This ranking by issues is consistent with evidence provided by Kerr et al. (2014) and Arayavenchkit et al. (2014) for different periods of time, which shows that taxation is the most relevant issue for lobbying.

Table (2) shows summary statistics for firms lobbying for taxation issues in at least one year in the sample and for firms that did not lobby for taxation issues at all. The table also displays the well documented feature that lobbying firms are larger than non-lobbying firms. For example, the data shows that sales are almost 6 times larger for lobbying firms. This is also true for capital (12 times), assets (1.8 times) and employment (7 times). Another fact consistent with previous work is that lobbying expenditures are relatively small. For the sample, the average lobbying expenditure in the sample is close to $0.27 million with a standard deviation of 0.7 million. Considering that the returns for lobbying are thought to be quite large, the fact that lobbying firms are so few and that they spend so little money remains a puzzle for political scientists.

Table (2) also shows one of the key findings in this literature: lobbying firms pay lower effective tax rates. The tax code in the U.S. allows corporations to claim tax benefits, reducing their tax burden. According to the Government Accountability Office (GAO), in 2011 a third of the corporate tax revenue was lost in tax benefits rebated to corporations. In fact, special tax provisions for individual firms have been documented by Siegfried (1974), Barlett and Steele (1988) and McIntyre and Nguyen (2004). Consistent with this anecdotal evidence, Richter et al. (2009) and Arayavenchkit et al. (2014) have shown that firms that lobby for taxation issues pay lower effective taxes as a result of tax benefits targeted to them. The mechanisms through which firms obtain favorable tax benefits are the existence of narrow research and development credits, tax depreciation schedules tailored to specific types of capital and thorough numerous industry-specific tax breaks related to capital.[18] Based on this discussion, I compute the effective tax rates for lobbying and non-lobbying firms for the sample. The average effective tax rate for lobbying firms is 18.8%, while the average effective

[17] Appendix C contains information related to the computation of this variable and details about other measures from compustat.

[18] The fairness and implications of a system that grants tax benefits to corporations is a theme of continuous debate in the media and the political arena. See for example CNN Tax breaks. The concern for the existence of lobbying corporations has also been remarked by the president of the United States in the State of the Union speech in 2011.

tax rate for non-lobbying firms is equal to 21.4%.

3.2 Evolution of Lobbying Expenditure and Tax Rates

Now I turn my attention to aggregate patterns in the data for lobbying for taxation, focusing on the 2007-2009 credit crunch. I document that during the last U.S. credit crunch there was an unusual increase in lobbying activity for taxation, which holds at both extensive and intensive margins.[19] Figure (1) shows the evolution of aggregate lobbying expenditure for taxation between 2001 and 2014 as percentage deviation from linear trend.[20] By 2009 lobbying expenditure deviates 15% from trend suggesting an exacerbation of rent-seeking activity during this time. As mentioned before, this rise is due to the increase in the number of lobbying firms and the increase in the average expenditure that each firm is doing for that purpose. Between 2004 and 2007, on average 7.1% of firms in Compustat lobby for taxation, while for the period 2008-2011 the average fraction of firms was 10.35%, indicating an increase in lobbying activity on the extensive margin. The intensive margin follows a similar pattern. For the period 2004-2007, the average lobbying expenditure was \$0.26 million, but for the period 2008-2011 it increased to \$0.31 million. If we look at deviations from trend, we see a similar pattern. Figure (2) displays the evolution of the intensity of lobbying relative to the linear trend, and as expected there is an important increase in the values observed during the period of the study. This data raises a natural question: why do we observe such an increase in lobbying activity to influence the tax code?

One possible reason could come from the increase in rents that corporations can extract. Evidence provided by the Government Accountability Office (GAO,2013) shows that between 2007 and 2010 the amount of tax benefits that the government granted to corporations increased from 0.6% of the GDP to 1.2%. Even though we cannot argue that the government increased those resources due to the corporate pressure, we can certainly think that the allocation of some of those funds among firms was influenced by corporate lobbying.

If lobbying affects the tax code and benefits certain firms and sectors, we should observe that lobbying firms reduce their effective tax rate as a result of the increase in lobbying activity during the crisis. In order to show this feature in the data, I compute the average effective tax rate for lobbying and non-lobbying firms in my sample. The results between 2007 and 2014 are displayed in Figure (3). The figure shows that both groups of firms saw declines in tax rates. However, those that engaged in lobbying obtained a bigger decline, consistent with the increase in lobbying activity.

To test whether the tax rates of lobbying and non-lobbying firms diverged during the crisis, I run the projection of firm level effective tax rates on time dummies β_t, the interaction of those dummies with an indicator for lobbying for firm i in period t, and industry fixed effects ind_s,

[19] Unless otherwise noted, I will refer to “lobbying for taxation” as simply lobbying.

[20] Lobbying variables are deflated by the CPI with 2007 as base year. I use a linear trend since there is not enough data available to apply a Hodrick-Prescott filter. In the Online Appendix 4.1, I provide a similar figure with a quadratic detrending.

$$ETR_{it} = \sum_{t=2007}^{2014} \beta_t + \sum_{t=2007}^{2014} \beta_t lobby_{it} + ind_s + \epsilon_{it}$$

The coefficient for the interaction term of this regression with the confidence bands are plotted in figure (4). The figure shows the evolution of the difference between the effective tax rate for non-lobbying firms and lobbying firms. As with figure (3), we see that there is an increase in the difference between the tax rate paid by lobbying firms and the non-lobbying firms during the crisis. This indicates that, in a statistical sense, lobbying firms had a decline in effective tax rates relative to non-lobbying firms.

3.3 Sectoral variation

In this section, I provide evidence that the increase in lobbying activity was mostly driven by a particular group of firms. In principal, it is not clear which type of firms should increase their lobbying activity during financial crises. Previous work by Rajan and Zingales (1998) has shown that there are sectors that are more sensitive to variations in the supply of credit due to the reliance on external finance. It is natural to think that these sectors (and firms) would be more affected during a credit crunch and therefore would try to disproportionately influence the government to obtain tax benefits. To study this hypothesis I look at the lobbying expenditure of all firms in sectors that depend more on external finance as a share of total lobbying expenditure, focusing on taxation. I find that those firms tend to lobby more, both in the cross section and over time. Additionally, these firms increased their lobbying activity the most during the recent crisis. Figure (5) illustrates these two facts. The participation in total lobbying expenditure for taxation of the industries that rely more on external finance went from 53% at the bottom of 2007 to 63% at the peak of the time period, and coinciding with the crisis. Consistent with the fact that lobbying reduces the tax obligation, figure (6) shows the effective tax rates as a function of the Rajan and Zingales measure of financial dependence. The figure reveals that sectors that are more capital intensive and exert more lobbying tend to have a lower tax rate.

The evidence provided in these graphs, in principle, supports the original hypothesis: sectors and firms that are in more trouble tend to lobby more the government to try to obtain preferential tax treatment. However, it is not clear ex ante whether large or small firms were responsible for the increase in lobbying during the crisis. On one hand, small firms are more likely to be affected by monetary or financial shocks, especially in those sectors that depend more on external finance.[21] Following this argument, we should observe that these firms increased lobbying activity. On the other hand, large firms may have the necessary political connections or resources to spare during a crisis (Faccio (2006) and Faccio et al. (2006)). In the next section, I study this issue more closely.

[21] Gertler and Gilchrist (1994) find that the growth in sales, inventories, and bank debt of small manufacturing firms are more affected by monetary shocks. Sharpe (1994) found that small firms have a disproportional response, relative to large firms, to financial shocks. Using CPS data Duygan-Bump et al. (2015) find that the 2007-2009 credit shock increased the probability of going to the unemployment pool for workers in small firms in sectors that depend more on external finance.

3.4 Within Sector Variation

In the previous section, I established that the increase in lobbying activity observed during the 2007-2009 financial crisis was driven by firms in sectors that depend more on external finance. These sectors are therefore more likely to obtain tax benefits targeted to them.

In order to understand which firms are behind the increase in lobbying activity, I use a triple difference approach to show the differential effect of the credit shock across sectors with different degrees of external dependence, accounting for differences in size. The econometric specification is the following:

$$
\begin{aligned}
lobby_{sit} = \delta_0 + \delta_1 SME_{sit-1} + \delta_2 T_t + \delta_3 Fdep_{si} + \delta_4 \left(SME_{sit-1} \times Fdep_{si}\right) + \delta_5 \left(Fdep_{si} \times T_t\right) \\
+ \delta_6 \left(SME_{sit-1} \times T_t\right) + \delta_7 \left(SME_{sit-1} \times Fdep_{si} \times T_t\right) + X^{'}_{sit}\beta + \omega_{st} + \varepsilon_{sit},
\end{aligned} \tag{1}
$$

where $lobby_{sit}$ is the log of lobbying for taxation of a firm i in sector s at period t (lobbying intensity).

The variable denoted by ω_{st} is a set of industry-state fixed effects that controls for industry-state time invariant observable and unobservable factors affecting the lobbying decision of firms. On the other hand, X_{sit} is a vector of firm level characteristics measured in $t-1$. This vector includes assets, sales, and capital.

In the proposed regression, the three key variables are T_t, SME_{t-1} and $Fdep_{si}$. Following the recommendation of the Trade Commission, I assign the label SME to those firms with fewer than 500 employees. According to this definition, I construct the dummy variable SME_{it-1} that takes a value of 1 if the firm in the previous period was considered a small-medium firm. This variable captures the fact that lobbying intensity is different in the cross section depending on size. The variable T_t is an indicator that takes a value of 1 in the years 2008-2010 and 0 between 2005-2007. This allows me to focus on a 3 year window around the crisis. Finally, $Fdep_{si}$ is an indicator variable that takes a value of 1 for firms in sectors that depend more on external finance and 0 otherwise. This variable allows me to account for the differences in lobbying observed across sectors based on financial needs.

To study the effect of the financial crisis on the incentives of corporations to lobby , I also include all the interaction terms between the main three variables. The coefficient δ_6 captures the effect of the crisis on lobbying for small firms relative to large firms in industries with low external financial dependence (this is the difference-in-difference coefficient). On the other hand, the coefficient δ_7 measures how much small firms relative to large firms are affected in sectors that depend more on external finance on top of the effect found in sectors with low external financial dependence. This estimate uses variations in three margins: time (before and after the crisis), firm size (small vs large), and external financial dependence (low and high).

I estimate equation (1) using an ordinary least squares regression on a balanced panel of 3,402 parent companies and 20,412 firm-year observations. To evaluate the significance of the coefficient, I cluster the standard errors by state and industry to allow for correlations among firms in the same industry and state. The results of the estimation of equation (1) are displayed in table (3). To simplify the exposition, I show the results based on size and financial dependence along the columns. An important first observation is that large firms in both sectors increased lobbying activity during the crisis, and large firms in sectors with high external dependence had a higher increase. In addition, small firms in industries with high external dependence reduce the amount of lobbying relative to pre-crisis. It follows that the difference between large and small firms in both sectors increased with the crisis, indicating that the observed rise in aggregate lobbying is driven by large firms.[22]

The second observation to notice is that this increase in lobbying intensity by large firms relative to small firms is larger in sectors with high external dependence. This is shown in the second row. Finally, the third row of the table is the triple difference (DDD) estimate, or simply δ_7. This estimate indicates that the relative effect of the crisis for large and small firms on lobbying in the second sector (high dependence) is 0.18 percentage points bigger than in the first sector (low dependence). In other words, large firms relative to small firms increased an additional 0.18% over the relative increase of large and small in the first sector.

Similar results are obtained by looking at the probability of starting to lobby during the crisis rather than the intensity. For this specification, I replace $lobby_{sit}$ by and indicator function that takes value of 1 if the firms i in sector s at period t is lobbying and 0 otherwise. The results of this regression are displayed in table (4). The results are similar in sign to the ones obtained in table (3).

All of these results are consistent with the idea that large unconstrained firms are wealthier and have more resources to spare during the crisis in order to extract more rent. On the other hand, small firms, especially those in sectors more affected by the shock, have more trouble operating during these episodes and have to reduce their expenditure on lobbying.

The results presented in this section provide a set of useful guidelines for a model that attempts to explain the effect of lobbying on the economy. First, given the fact that only a small fraction of firms are doing lobbying, I propose a model with endogenous lobbying decision subject to a fixed cost required to influence the government. In this way, since lobbying entails fixed costs, larger and wealthier firms will be the ones engaging in this activity. Second, given that I observe that sectors that depend more on external finance tend to lobby more, I will have an economy with two sectors that will have differences in their scale of production to capture the differences in financing needs. Third, given that I observe a different response to the crisis based on size and the sector of operation of each firm, I will allow for firm level heterogeneity in terms of productivity and wealth, that together with decreasing returns to scale generate the different impulse responses of lobbying. Finally, and related to the previous point, I will introduce financial frictions in the form of a collateral constraint. This assumption will allow me to hit the economy with a credit supply shock that will

[22] The negative value is due to the dummy SME being an indicator for small and medium firms. A negative value means that small firms are reducing the intensity of lobbying relative to large firms, so large firms are doing relatively more.

have different effects on firms of different sizes and producing in different sectors.

4 The Model

In this section, I present a model in which the misallocation of capital arises endogenously due to the existence of financial market imperfections and lobbying for capital tax benefits. The aim of the model is to measure to what extent the proposed mechanisms explain the dynamics of total factor productivity and output, as well as understand the implications for economic recovery during a credit crunch. To this end, I propose a variant of the standard span of control framework of establishment size as in Lucas (1978) extended to allow for financial frictions following Kiyotaki and Moore (1997), Albuquerque and Hopenhayn (2004) and Buera et al. (2011). I depart from those papers in the following way: (i) there is a government that collects taxes and grants capital tax benefits to firms, (ii) firms can choose to lobby the government to receive preferential treatment and obtain more tax benefits that reduce the tax burden, and (iii) because lobbying is costly, firms have to decide whether to pay a fixed cost to engage in lobbying activity or just receive the common component of the tax benefit. In order to capture the observed differences in external financial dependence across sectors, I introduce sector specific fixed costs as in Buera et al. (2011).

4.1 Environment

Time is continuous. There are two intermediate goods, which are the only factors of production required to produce a single final good.

The economy is populated by a unit mass of infinitely-lived households/agents that have a homogeneous endowment of time to be used either as a worker or in running a firm. I assume that a fixed measure q of the population has the ability to produce in sector 1 (type 1 agent), and a fraction $1-q$ has the ability to produce in sector 2 (type 2 agent).[23]

Individual preferences are described by the following expected utility from consumption of the final good C_{st}

$$\mathbb{E}_0 \int_0^{\infty} e^{-\rho t} u(C_{st}), \tag{2}$$

where $\rho \in [0,1]$ is the impatience rate and $s \in \{1,2\}$ denotes the type of agent. The instantaneous utility function $u(C_{st})$ is isoelastic with the inverse elasticity of intertemporal substitution equal to θ

$$u(C_{st}) = \frac{C_{st}^{1-\theta}}{1-\theta}.$$

Agents of type $s \in \{1,2\}$ are heterogeneous with respect to their productivity to produce z_{st}, and

[23]This is an extreme version of Buera et al. (2011). In their paper, agents have a pair of productivities that come from independent draws from the same distribution. Each productivity is used to produce in one sector. Given those draws, they select into one of those sectors based on which productivity generates higher income. To simplify my quantitative part, I assume only one productivity and I separate agents on types.

with respect to their financial wealth a_{st}. The evolution of the ability is determined stochastically. When born, each agent receives an ability coming from an invariant distribution $G_s(z)$,which evolves based on a continuous time analog of a markov process

$$dz_{st} = \mu(z_{st})dt + \sigma(z_{st})dW_{st}, \tag{3}$$

where W_{st} is a wiener process, $\mu(z_{st})$ and $\sigma(z_{st})$ are the drift and diffusion of the process respectively. Given an initial level of wealth when born, the evolution of this variable is determined in general equilibrium as an outcome of savings decisions. In this economy, savings take the form of risk-free claims on physical capital. As discussed below, savings will serve two purposes: as self-insurance against idiosyncratic shocks, and as a collateral to finance working capital requirements. As in Aiyagari (1994), agents also face a borrowing constraint, which implies that $a_{st} \geq 0$ at each point in time.

At the beginning of the period, an agent of type s chooses his occupation based on his productivity z_{st} and his wealth a_{st}. They can work for a competitive market wage w_t or they can operate the technology in sector s for a profit $\tilde{V}_s^p$. To operate in sector s, agents have to pay a fixed cost f_s in units of capital every period. This fixed cost is specific to each sector, and I assume that $f_1 < f_2$. This assumption is motivated by the fact that capital intensity is higher in sector 2, and it helps to map the theory with the data in terms of financial dependence. After paying the fixed cost, the technology available in sector s is given by a decreasing return to scale technology in labor and capital, adjusted by productivity or ability z_{st},[24]

$$y_{st} = z_{st}\left(k_{st}^{\alpha} l_{st}^{1-\alpha}\right)^{\eta}. \tag{4}$$

The production of the final good used for consumption, investment and lobbying is generated by a set of competitive firms that use the two intermediate inputs denoted by y_{1t} and y_{2t} . These two inputs are combined using a constant returns to scale technology,

$$Y = \left[\gamma y_{1t}^{\frac{\epsilon-1}{\epsilon}} + (1-\gamma)\, y_{2t}^{\frac{\epsilon-1}{\epsilon}}\right]^{\frac{\epsilon}{\epsilon-1}}, \tag{5}$$

where $\gamma \in (0,1)$ and $\epsilon \in [0,\infty)$. All producers in this sector are homogeneous with respect to productivity, and they are not subject to financial constraints. The problem of these firms can be reduced to the following relationship coming from the first order condition:

$$y_{1t} = \left[\frac{p_2}{p_1}\frac{\gamma}{1-\gamma}\right]^{\epsilon} y_{2t}. \tag{6}$$

[24]This assumption implies that there is an optimal size for firms, and it is a way of introducing a meaningful firm size distribution. Alternatively, one could choose to work with monopolistic competition and constant returns to scale.

Finally, there is free entry in the sector, and therefore zero profits. If this is the case,

$$P = \left[p_1^{1-\epsilon}\gamma^{\epsilon} + (1-\gamma)^{\epsilon} p_2^{1-\epsilon}\right]^{\frac{1}{1-\epsilon}}.$$

From now on, we assume that the final good is the numeraire of the economy.

The economy features two mechanisms affecting the intermediate producers that distort the economy in steady state, and especially during a credit crunch. The first one is related to financial frictions, which restrict how much capital an agent running a firm can borrow. The second one is the existence of capital tax benefits and the possibility to lobby the government to obtain preferential tax treatment. I describe them separately. After that, I describe the problems and constraints involved in the economy in detail.

Financial Markets

In this economy, productive capital is the only asset. There is a perfectly competitive financial intermediary that receives deposits and rents capital to firms. The return on the deposits is given by the interest rate r_t. The zero profit condition of the financial intermediary implies that the rental rate is equal to the user cost of capital: that is $R_t = \frac{r_t+\delta}{1-\tau}$ where δ is the depreciation rate of the economy and τ is the tax rate that the government charges on operating income.[25]

Capital rented k_{st} has to be returned at the end of the period, and due to the existence of limited commitment, the amount of capital that the firm can rent is partly determined by wealth. This assumption implies that agents running the firm are subject to a collateral constraint of the form $k_{st} \leq \lambda_t a_{st}$, where $\lambda_t \geq 1$ summarizes the credit constraints in the economy.[26] A low value for λ_t is associated with low access to credit. In particular, in the case where $\lambda_t = 1$ firms have to self-finance all their capital rental and therefore there is a strong incentive to save in order to allow production. On the other extreme, when $\lambda_t \to \infty$ there are perfect capital markets. In this case, saving decisions are independent of production decisions and the only motive for saving in this economy is consumption smoothing.

Lobbying For Capital Tax Benefits

The second source of distortion comes from the existence of capital tax benefits that can be influenced through lobbying. As a result, corporate lobbying distorts the allocation of this input relative to an

[25] The structure of the rental market is standard in the financial friction literature. See Buera and Shin (2011), Blaum (2013), Midrigan and Xu (2014) and Moll (2014) among others. Moll (2014) shows that this representation is equivalent to having a firm owning capital in a model with financial frictions and no government. The Online Appendix D.3 shows that this equivalence continues to hold when the government collects taxes and grants capital tax benefits. The proper rental rate emerges from this problem.

[26] A way to rationalize the constraint is the following: firms have access to a competitive financial intermediary who receives deposits and rents capital to firms. In this economy, lending directly to firms is not possible. After the production process, the firm could default on its loan with probabily $\frac{1}{\lambda}$, and if they do that, they keep the remaining undepreciated capital stock. On the other hand, the financial intermediary can seize the financial assets of the firm (the deposits), without any other cost imposed to the defaulter. This simple model implies that the firm can only borrow at most λa_{st}.

economy where the government does not offer these type of tax benefits.

After selling in the market, firms have to pay a tax rate τ on operating income. However, the government grants tax benefits associated with capital that allow firms to reduce their tax burden. Before production, operating firms in each sector can decide to engage in lobbying activity by paying an upfront cost in units of capital f_l. As discussed by Kerr et al. (2014), this cost could include the initial cost of searching for and hiring the right lobbyist, educating these new hires about the details of the firm's interest, or finding out which legislature should be targeted.[27] Paying the upfront cost f_l gives firms the ability to influence the government through costly lobbying in order to get tax benefits tailored to them. The cost of lobbying represents all the variable costs that firms have to pay in order to contact legislators at congress, and it is assumed to be given by

$$\Upsilon(e_{st}) = he_{st}, \tag{7}$$

where e_{st} is the lobbying effort of an agent of type s in period t, and $h > 0$. As in Arayavenchkit et al. (2014), tax benefits are composed of two parts: 1) A part that is standard and applies to all firms, even those that did not pay the fixed cost f_l; 2) A second part that is influenced by lobbying effort e_{st}, which is only available to firms that are paying f_l.[28] Furthermore, given that most of the tax benefits that the government grants are associated with capital, the tax benefit schedule depends positively on the capital used by the firm. Taken together, the tax benefits are given by

$$\bar{\tau}(k_{st}, \phi, e_{st}) = (1-\tau)\, k_{st} \left(\mu e_{st}^{\nu} + \phi\right). \tag{8}$$

The term $(1-\tau)\, k_{st}\phi$ captures the returns that all firms are getting without any expenditure on lobbying.[29] However, if they do decide to hire a lobbyist, firms obtain preferential treatment that is increasing in the lobbying effort e_{st}. The amount of benefits per unit of lobbying depends on two parameters: the parameter $\nu \in (0,1)$, which is the elasticity that maps lobbying effort into changes in the tax benefits (and therefore the effective tax rate); and the parameter μ, which is a scale parameter.

In order to be consistent with the fact that the effective tax rates are bounded from below , the amount that firms can claim as tax benefits on capital is at most a fraction of the tax obligation with the government. Therefore, firms incorporate the following constraint when taking production

[27] From a modeling point of view, the fixed cost f_l is introduced to capture the empirical fact that only a fraction of public firms are engaging in lobbying for taxation issues as we saw in section 3. Bombardini (2008) also used fixed costs to rationalize this fact in the context of international trade.

[28] Compared to that paper, I use a modified version of the tax benefit schedule. In their paper, they do not have this fixed cost and the government selects who is receiving the tax benefits based on the amount of lobbying expenditure. As a result, there is a cutoff lobbying effort such that if you cannot reach that level you will not spend resources in equilibrium. In addition, they provide a partial equilibrium analysis without financial frictions and with differences in the timing of decisions.

[29] We can think of ϕ as tax advantages that were introduced when the statutory tax on firms was set. The scaling by $1-\tau$ allows me to keep tractability when solving the problem of a lobbying firm.

and lobbying decisions:

$$(1-\tau)\, k_{st}\left(\mu e_{st}^{\nu}+\phi\right) \leq \ominus\tau\tilde{\pi}_{st}, \tag{9}$$

where $\tilde{\pi}_{st}$ is the operating income to be defined below and is a positive scale parameter.

4.2 Intermediate Firm

Now that we are familiar with the distortions affecting the operation of intermediate firms, we focus on their optimization problem. The timing of events is as follows: 1) conditional on running a firm in sector s, the agent has to decide whether or not to lobby the government by paying the fixed cost f_l; 2) the rental market opens, production is decided and lobbying takes place for those that paid the fixed cost. In equilibrium, and given the fixed cost of lobbying f_l , there is selection into lobbying activity depending on the flow of income generated in that activity. Next, I formulate and solve the problem of an intermediate firm for each case.

Lobbying Firm

Suppose the agent of type s has decided to produce in sector s. Given his productivity and wealth, (z_{st}, a_{st}), the profit when a firm is engaging in lobbying activity is a slight modification of the standard problem of an firm facing financial frictions. First, define pretax income by $\tilde{\pi}_{st}$,

$$\tilde{\pi}_{st} = \left[p_{st}y_{st} - w_t l_{st} - R_t\left(k_{st}+f_s\right)\right], \tag{10}$$

where $y_{st} = z_{st}\left(k_{st}^{\alpha} l_{st}^{1-\alpha}\right)^{\eta}$. After producing and selling the output, firms have to pay a statutory tax τ. However, this tax burden is reduced by the capital tax benefit $\bar{\tau}(k_{st}, \phi, e_{st})$ that depends on the lobbying effort e_{st}. As described at the beginning of this section, the amount of capital tax benefits that a firm can claim is subject to the inequality (9). Putting everything together, the problem to solve is the following

$$\pi^{lob}(a_{st}, z_{st}, \Omega_t) = \max_{k_{st}, l_{st}, e_{st}} \, (1-\tau)\,\tilde{\pi}_{st} + (1-\tau)\, k_{st}\left(\mu e_{st}^{\nu}+\phi\right) - h e_{st} - f_l R_t$$

$$st \;\; k_{st} + f_s + f_l \leq \lambda a_{it}$$

$$0 \leq \ominus\tau\tilde{\pi}_{st} - (1-\tau)\, k_{st}\left(\mu e_{st}^{\nu}+\phi\right).$$

Here, Ω_t is the set of aggregate variables that the firm takes as given when making decisions, and $\pi^{lob}(a_{st}, z_{st}, \Omega_t)$ is the profit obtained after lobbying.

Non-Lobbying Firm

Suppose the agent of type s has decided to produce in sector s. Given his productivity and wealth, (z_{st}, a_{st}), the profit when the firm is not participating in lobbying activity is almost identical to the previous one. However, because firms are not spending resources on lobbying activity, the reduction in the tax burden is given by $\bar{\tau}(k_{st}, \phi, 0) = (1-\tau)\, k_{st}\phi$. Considering this result, the problem for a non-lobbying firm is

$$\pi^{nlob}(a_{st}, z_{st}, \Omega_t) = \max_{k_{st}, l_{st}} (1-\tau)\left[p_{st}y_{st} - w_t l_{st} - R_t\left(k_{st} + f_s\right)\right] + \bar{\tau}(k_{st}, \phi, 0)$$

$$st \;\; k_{st} + f_s \leq \lambda a_{st}$$

$$0 \leq \ominus\tau\tilde{\pi}_{st} - (1-\tau)\, k_{st}\phi,$$

where $\pi^{nlob}(a_{st}, z_{st}, \Omega_t)$ is what the agent can obtain if he is not doing lobbying.

Discussion: Interaction Financial Frictions, Capital Tax Benefits and Lobbying

The existence of financial frictions, capital tax benefits and lobbying have implications for the allocation of capital in the economy (misallocation). Additionally these factors have the potential to alter occupation choices, introducing a second channel of distortion. Below, I discuss each margin.

In order to understand the key mechanisms that produce misallocation of capital, it is useful to resort to the first order condition.[30] Letting δ^* be the lagrange multiplier on the collateral constraint we have,

$$[k_{st}] \qquad MPK(k_{st}) \;\; = \left[R_t - \mu e^{\nu}_{st} - \phi\right] + \frac{\delta^*_{st}}{(1-\tau)}, \tag{11}$$

Following Hsieh and Klenow (2009), there is capital misallocation when the marginal product of capital (MPK) is not equal to the rental cost cost capital R_t. In the right hand side of (11) we have the three mechanisms at play: the financial frictions (in red), the existence of capital tax benefits (in blue) and lobbying for those benefits (in green). I first describe the effects having only financial frictions, and then I add each mechanism individually to reach all the elements of the right hand side of equation (11).

Only Financial Frictions In an economy where there are no tax benefits and firms cannot lobby the government, the first order condition for capital is given by,

$$MPK(k_{st}) = R_t + \frac{\delta^*_{st}}{(1-\tau)}. \tag{12}$$

As is well known, the existence of financial frictions distorts the allocation of capital across firms. The key insight from the misallocation literature is that higher dispersion in the marginal product of capital indicates higher degree of misallocation of that factor. In other words, a reallocation of capital from unproductive and wealthy firms towards productive and constrained firms would allow a higher level of output, keeping the level of aggregate capital constant. The distortion in

[30] The complete set of first order conditions and derivations can be found in Online Appendix D. Here, for simplicity, I assume that the collateral constraint on the tax benefits that firms u can claim is not binding. For the calibrated version of the model, this constraint is not relevant for most of the firms.

the allocation of capital can be inferred from the presence of the lagrange multiplier δ^*_{st} in equation (12). For a given level of productivity, a firm that is financially constrained has a strictly positive multiplier δ^*_{st}. This means that the MPK is higher relative to a firm with the same productivity that has enough wealth to operate at the optimal scale of production. As a result, constrained firms have a lower level of capital, labor, production and profits other things equal. A reallocation of capital from firms with low MPK to firms with high MPK would be beneficial for the economy.

Financial Frictions and Capital Tax Benefits Now, as a second step, suppose the economy has tax benefits but it does not allow for lobbying. The first order condition in this modified version would be

$$MPK(k_{st}) = [R_t - \phi] + \frac{\delta^*_{st}}{(1-\tau)}. \tag{13}$$

The introduction of tax benefits adds an extra term that affects the MPK. The capital tax benefits change the optimal scale of production because now there is an additional source of revenue coming from the tax rebate. Figure (7) illustrates this point. A firm that is not financially constrained chooses capital to maximize operating income, which is equivalent to maximizing profits in the absence of tax benefits. The optimal value before tax benefits is given by k_1. However, the introduction of tax benefits implies that firms will not maximize operating income $\tilde{\pi}_s$, and instead will be maximizing considering that they have to pay taxes and receive tax benefits that depend on capital. In figure (7), that corresponds to k_2.

With financial frictions, the tax benefit has a different impact for firms that are close to the constraint. For those firms that are financially constrained absent the tax benefit, the financial situation is worsened because they require much more capital in order to produce at the new optimal scale. There is a second group of firms that absent the tax benefit would not be financially constrained. However, once we introduce this tax advantage they become constrained, worsening the misallocation of capital. Finally, there is a group of firms that are wealthy enough so that this mechanism causes an increase in their size, leading to a higher level of capital and lower MPK. Combining the three effects, the introduction of capital tax benefits increases the dispersion of the MPK and therefore the allocation of resources in this economy is worse than in the first case.

A final comment is worth mentioning. In the case of a tightening of the collateral constraint (the financial crisis), the common component will not play a role since it affects all firms symmetrically and does not vary with the crisis. Therefore, it will not have an effect on the allocation of resources.

Full Model Finally, we include lobbying as the the last mechanism in the model. By introducing lobbying we generate another source of variability in the marginal product of capital, and therefore it is an amplifier of the effects described before. Financially unconstrained firms can now invest resources to obtain additional tax benefits, reducing the marginal product of capital even further. Financially constrained firms would also like to expand, making the financial friction more severe. Finally, those firms that without lobbying were producing at the optimal scale, could now become financially constrained due to fact that with lobbying there is a new optimal level of production. Notice that lobbying will play a role during the financial crisis. Because lobbying varies across individual firms and reacts to changes in the environment, it will have an effect on the allocation of capital during a credit crunch. I will discuss the implications of lobbying during a financial crisis in section (6).

The second channel through which the economy can be affected is selection, i.e the decision to run a firm. At the beginning of the period each agent of type s has to decide an occupation based on the maximum earning available at that time, given his productivity and his wealth. In other words, his decision is based on $max\left\{w_t, \tilde{V}_s^p(a_{st}, z_{st}, \Omega_t)\right\}$ where w_t is the market wage and $\tilde{V}_s^p(a_{st}, z_{st}, \Omega_t)$ is the profit obtained by running a firm after the lobbying decision,

$$\tilde{V}_s^p(a_{st}, z_{st}, \Omega_t) = max\left\{\pi^{lob}(a_{st}, z_{st}, \Omega_t), \pi^{nlob}(a_{st}, z_{st}, \Omega_t)\right\}.$$

In an economy without financial frictions, tax benefits, and lobbying, the decision to run a firm only depends on the productivity z_{st}. Those agents that generate profits above the market wage choose to run a firm, the rest sort into the labor market. With financial frictions, wealth is also a determinant of the decision to run a firm. Productive but poor agents end up working for a wage instead of running a firm, until they overcome the financial constraint through savings. On the other hand, unproductive but wealthy entrepreneurs remain in business. The incorporation of tax benefits and lobbying introduce new margins that distort the decision to run a firm. Wealthy but unproductive firms now have another source of revenue coming from the tax benefit and the possibility of lobbying. This feature could make some firms stay in business for a longer period of time. On the other hand, without tax benefits the unique source of cash flow for financially constrained firms is production. The introduction of tax benefits increases the current period profit, generating more resources that could be used for saving. With these additional funds, agents could overcome their financing constraint through self-financing much faster and therefore they could operate at the optimal scale.

Overall, the aggregate effect of having financial frictions and capital tax benefits that can be influenced through lobbying is not unambiguously determined. In order to understand the aggregate implications of these mechanisms, a quantitative assessment is necessary.

4.3 The Problem of the Agent and Aggregation

Given financial wealth a_{st}, productivity z_{st} and state variables Ω_t, the agent of type s maximizes expected utility by choosing consumption, financial wealth, his occupation, amount of lobbying, and production input choices (conditional on running a firm) subject to a sequence of budget constraints and financial constraints. The budget constraint for period t is given by

$$da_{st} = \left[max\left\{w_t, \tilde{V}_s^p(a_{st}, z_{st}, \Omega_t)\right\} + r_t a_{st} - C_{st} + T_t\right] dt, \tag{14}$$

where Ω_t is the vector of the aggregate states of the economy, r_t is the return on wealth and T_t is a lump sum transfer from the government. Here, the max operator is reflecting the fact that the agent is choosing his occupation by comparing the earnings from each activity.[31]

Given preferences and budget constraints, the stochastic optimal control problem of the agent that can operate in sector s is given by

$$V_s(a_{s0}, z_{s0}) = \underset{\{C_{st}\}_{t=0}^{\infty}}{max} \; E_0 \int_0^{\infty} e^{-\rho t} u(C_{st}) \quad s.t. \tag{15}$$

$$\frac{da_{st}}{dt} = max \left\{ w_t, \tilde{V}_s^p(a_{st}, z_{st}, \Omega_t) \right\} + r_t a_{st} - C_{st} - T_t$$

$$dz_{st} = \mu(z_{st})dt + \sigma(z_{st})dW_t$$

$$a_{st} \geq 0, \quad t \geq 0, \quad a_{s0} \quad and \quad z_{s0} \quad given$$

$$\tilde{V}_s^p(a_{st}, z_{st}, \Omega_t) = max \left\{ \pi^{lob}(a_{st}, z_{st}, \Omega_t), \pi^{nlob}(a_{st}, z_{st}, \Omega_t) \right\}$$

$$s \in \{1, 2\}.$$

The value function of the optimal control problem satisfies the Hamilton-Jacobi-Bellman (HJB), which can be used to characterize the solution of the agent's problem

$$\rho V_s(a_{st}, z_{st}, t) = \underset{C_{st}}{max} \; u(C_{st}) + \frac{\partial}{\partial a} V_s(a_{st}, z_{st}, t) M_{st}(a_{st}, z_{st}, t) + \tag{16}$$

$$+ \frac{\partial}{\partial z} V_s(a_{st}, z_{st}, t)\mu(z_{st}) + \frac{1}{2}\frac{\partial}{\partial z^2} V_s(a_{st}, z_{st}, t)\sigma^2(z_{st}) + \frac{\partial}{\partial t} V_s(a_{st}, z_{st}, t),$$

where $\mu(z_{st})$ and $\sigma^2(z_{st})$ are the drift and difussion process of z_{st}, and where $M_{st}(a_{st}, z_{st}, t)$ is the optimal saving rule in period t,

$$M_{st}(a_{st}, z_{st}, t) = max \left\{ w_t, \tilde{V}_s^p(a_{st}, z_{st}, \Omega_t) \right\} + r_t a_{st} - C_{st} - T_t.$$

The HJB equation is a second order differential equation. The value function V_s depends on t due to the fact that prices may be changing along the transition path.

For the quantitative part, I will assume that $log\ z_{st}$ follows a mean reverting diffusion process given by

$$dlog\ z_{st} = -\psi \left(log\ \bar{z} - log\ z_{st} \right) dt + \sigma dW_{st},$$

where as before W_{st} is a Brownian Motion. In this particular process, the parameter ψ measures the speed of reversion and $log\ \bar{z}$ is the long run mean. One particular property of the process is the

[31] In order to do this computation, agents need to know the aggregate state of the economy. In particular, they need to know prices, and how the different choices that they are making will affect earnings. In a more complicated model with uncertainty about those variables, the agent would be choosing based on expectations about potential earnings.

fact that the autocorrelation is given by

$$corr\left[log\ z_{st}, log\ z_{st+k}\right] = e^{-\psi k} \in (0,1).$$

That is, the autocorrelation depends on ψ and the time interval. In addition, this process features a long run stationary distribution with mean $log\ \bar{z}$ and variance $\frac{\sigma^2}{2\psi}$. Both properties will be useful for the calibration of the model in section (5).[32]

In this economy, the aggregate state of the economy is represented by the joint distributions of productivities and wealth $G_s(a,z,t)$ for each type of agent s. The evolution of the distribution of type s agents over time is given by the the Kolgomorov forward (or Fokker-Planck) equation

$$\frac{\partial g_s}{\partial t}(a,z,t) = -\frac{\partial}{\partial a}\left[M_s(a,z,t)g_s(a,z,t)\right] - \frac{\partial}{\partial z}\left[\mu(z)g_s(a,z,t)\right] + \frac{1}{2}\frac{\partial}{\partial z^2}\left[\sigma^2(z)g(a,z,t)\right],$$

where I am omitting the sub-indexes on the state variables to save notation. Here, I denote $g_s(a,z,t)$ the density of the distribution $G_s(a,z,t)$.

For future reference, I denote $g_s^*(a,z,t)$ to the density scaled by the fraction of agents of type s. That is, $g_1^*(a,z,t) = qg_1(a,z,t)$ and $g_2^*(a,z,t) = (1-q)g_2(a,z,t)$.

4.4 Government

The government in this model is passive and the amount of tax benefits granted to corporations is such that the budget is balanced in steady state

$$ROI_t = \sum_{s=1}^{2}\left\{\int_{z\in Z}\int_0^{\infty}\bar{\tau}(k_{st},\phi,e_{st})\right\}g_s^*(a,z,t)dadz + T_t, \tag{17}$$

The left hand side is the total revenue from the government, which for simplicity is only composed by taxes on operating income ROI_t. Those sources of funds need to be equal to the \ tax benefits granted to firms and the lump sum transfer to consumers T_t. Taxes on operating income are defined as

$$ROI_t = \tau\left\{\sum_{s=1}^{2}\int_{oc_{st}=\{s\}}\tilde{\pi}_s(a,z)\right\}g_s^*(a,z,t)dadz, \tag{18}$$

where $oc_{1t} = \{1\}$ and $oc_{2t} = \{2\}$ denotes an agent operating a firm in sector 1 and sector 2 respectively.[33] Out of steady state, transfers T_t adjust every period in order to keep the budget balanced.

[32] See Dixit and Pindyck (1994) and Stokey (2008) for details about these two properties of the process.

[33] To be more specific, $oc_{st} = \{s\}$ is an indicator function that takes the value of 1 if agent of type s is operating a firm and a value of 0 if it is a worker, for any period of time t.

4.5 Equilibrium

In this section, I describe the equilibrium conditions for this economy. Most of the features are standard definitions with the exception of the lobbying expenditure and the government budget constraint that considers tax benefits. For simplicity, I avoid explicitly denoting the dependence of all variables with respect to a_{st} and z_{st}.

Given an initial joint distribution of wealth and entrepreneurial ability $G_s(z, a, 0)$, and a marginal stationary distribution $G_s(z)$, a recursive stationary equilibrium in this economy consists of: 1) policy functions for consumption, asset accumulation and occupational choices for each type of agent s, $\{C_{st}, M_{st}, oc_{st}\}_{t=0}^{\infty}$; 2); profits for lobbying and non-lobbying firms in each sector s $\left\{\pi_{st}^{lob}, \pi_{st}^{nlob}\right\}_{t=0}^{\infty}$ and a sequence of demand functions for each intermediate; 3) a sequence of prices for the intermediate goods $\{p_1, p_2\}_{t=0}^{\infty}$; 4) labor demands, capital demand, lobbying participation and lobbying spending in each sector s, $\{l_{st}, k_{st}, lob_{st,} e_{st}\}_{t=0}^{\infty}$; 5) a sequence of wages, interest rates, aggregate prices, gross interest rates, financial state and transfers $\{w_t, r_t, P_t, R_t, \lambda_t, T_t\}_{t=0}^{\infty}$; 6) a sequence of distributions $\{G_s(z, a, t)\}_{t=0}^{\infty}$ for each type of agents s and the corresponding probability density functions $g_s(z, a, t)$, such that

1. Given $\{p_1, p_2\}_{t=0}^{\infty}$ and $\{w_t, r_t, P_t, R_t\lambda_t\}_{t=0}^{\infty}$, $\{l_{st}, k_{st}, lob_{st,} e_{st}\}_{t=0}^{\infty}$ solves the problem of intermediate firms, and $\left\{\pi_{st}^{lob}, \pi_{st}^{nlob}\right\}_{t=0}^{\infty}$ are generated in each sector s,

2. Given $\left\{\pi_{st}^{lob}, \pi_{st}^{nlob}\right\}$ and $\{w_t, r_t, P_t, R_t, \lambda_t, T_t\}_{t=0}^{\infty}$, $\{C_{st}, M_{st}, oc_{st}\}_{t=0}^{\infty}$ solves the problem of each agent

3. Labor market, capital market, and intermediates market clear

$$\sum_{s=1}^{2}\left[\int\limits_{oc_{st}=\{s\}} l_s(a,z)g_s^*(a,z,t)dadz\right] = \int\limits_{[1-oc_{st}]=\{s\}} g_s^*(a,z,t)dadz$$

$$\sum_{s=1}^{2}\left[\int\limits_{oc_{st}=\{s\}}\left(k_s(a,z) + f_s + \int\limits_{lob_{st}=\{s\}} f_l +\right) g_s^*(a,z,t)dadz\right]$$
$$= \int\limits_{z\in Z}\int_0^{\infty} a g_s^*(a,z,t)dadz$$

$$\int\limits_{oc_{1t}=\{1\}} y_1(a,z)g_1^*(a,z,t)dadz = \left[\frac{p_2}{p_1}\frac{\gamma}{1-\gamma}\right]^{\epsilon}\int\limits_{oc_{2t}=\{2\}} y_2(a,z)g_2^*(a,z,t)dadz$$

4. The evolution of the density function $g_s(a, z, t)$ over time is given by the the following Kolgomorov forward equation:

$$\frac{\partial g_s}{\partial t}(a,z,t) = -\frac{\partial}{\partial a}\left[M_s(a,z,t)g(a,z,t)\right] - \frac{\partial}{\partial z}\left[\mu(z)g_s(a,z,t)\right] + \frac{1}{2}\frac{\partial}{\partial z^2}\left[\sigma^2(z)g_s(a,z,t)\right]$$

which in steady state implies

$$0 = -\frac{\partial}{\partial a}\left[M_s(a,z)g_s(a,z)\right] - \frac{\partial}{\partial z}\left[\mu(z)g_s(a,z)\right] + \frac{1}{2}\frac{\partial}{\partial z^2}\left[\sigma^2(z)g_s(a,z)\right]$$

5. The government satisfies the fiscal budget.

$$ROI_t = \sum_{s=1}^{2}\left\{\int_{z\in Z}\int_0^\infty \bar{\tau}(k_{st},\phi,e_{st})\right\} g_s^*(a,z,t)da, dz + T_t,$$

where $g_1^*(a,z,t) = qg_1(a,z,t)$ and $g_2^*(a,z,t) = (1-q)g_2(a,z,t)$.

5 Calibration

All parameters are calibrated to the U.S. economy prior to the great recession using an annual frequency. For the sake of clarity in the explanation, I will classify the parameters into four groups: 1) $\{\rho,\theta,\delta,\}$ are the standard parameters; 2) $\{\eta,\alpha,f_2,\gamma,\epsilon,\psi,\sigma\}$ are technological parameters ; 3) $\{h,\phi,\nu,\mu,f_l\}$ are parameters related to the lobbying activity and tax benefits; 4) $\{\lambda_t,\tau,\ominus\}$ are the institutional parameters for the U.S. economy.

The strategy used to calibrate the parameters in steady state has 3 parts. First, I estimate the elasticity of substitution ϵ based on aggregate data using a reduced form equation coming from the model. Second, given the number of parameters to calibrate and the computational burden of this process, I set some of them according to existing microeconomic and macroeconomic evidence. Finally, given that the mapping between the model and the targeted data moments is multidimensional, I do a joint calibration of the remaining parameters. In subsection (5.1) I explain the numerical procedure to calibrate the model. Subsection (5.2) discusses the targeted moments and the relevance of each parameter to affect each moment. Subsection (5.3) evaluates the performance of the model to match moments of the data that are not targeted during the calibration. The last part of this section is devoted to the calibration of the credit shock that is used in the quantitative results.

5.1 Procedure for Calibration

For those parameters that are not taken from the literature or estimated using a reduced form equation, I implement a Simulated Method of Moments (SMM). Suppose we have a vector A^d of $1\times n$ moments from the data that corresponds to moments from the steady state distribution coming from the model.[34] Given a vector Θ of parameters to estimate, the model produces a vector of n corresponding moments $A^m(\Theta)$. The SMM estimator $\hat{\Theta}$ minimizes the weighted square sum of the distances between the model simulated moment and the corresponding counterpart in the data.

[34] In particular, these n moments include the market clearing conditions and budget constraint from the model.

Explicitly, it solves

$$\hat{\Theta} = argmin_{\Theta} \left[A^d - A^m(\Theta)\right] W_d \left[A^d - A^m(\Theta)\right]',$$

where W_d is a weighting matrix, which may be a function of the data. For now, the weighting matrix is going to be the identity matrix. As a result, the estimates are consistent, but not efficient.[35]

The implementation of the estimation is as follows: for a given vector of parameters Θ, I simulate the model and as a first step to find the vector $\hat{\Theta}$ that minimizes the objective function I use an annealing algorithm. This is a global optimization routine that jumps randomly around the parameter space while at the same time decreasing the frequency of landing in non-optimal ares in each iteration. After reaching a certain number of iterations where the objective function seems to be reaching a global maximum, I use a local search method to obtain the calibrated parameters.[36] In the next subsection, I describe the selected moments and the data used for the calibration.

5.2 Estimation and Moments

First, I explain the methodology and results to estimate the elasticity of substitution of the intermediate inputs ϵ and then describe a set of relevant moments chosen to calibrate the remaining parameters. Even though all parameters affect the value of all moments, I also discuss the effects of each parameter on each moment individually.

5.2.1 Estimation of the Elasticity of Substitution between Intermediates

To calibrate the elasticity of substitution ϵ between the two sectors, I follow a similar approach to Acemoglu and Guerrieri (2008). Using equation (6) and taking logs we obtain an equation that allows for estimation

$$log\left[\frac{p_{1t}Y_{1t}}{p_{2t}Y_{2t}}\right] = log\left(\frac{\gamma}{1-\gamma}\right) + \left(\frac{\epsilon-1}{\epsilon}\right) log\left(\frac{y_{1t}}{y_{2t}}\right). \tag{19}$$

I exploit time variation in relative value added at current prices for the low and high financially dependent sector, and variations in the ratio of real value added $\frac{y_{1t}}{y_{2t}}$ to estimate the elasticity of substitution between intermediates ϵ.

The data used to estimate equation (19) comes from EUKLEMS. I use data for the U.S. from 1970 to 2005. First, I separate the 2-digit SIC industries provided in EUKLEMS in low and high external dependence following the measure of Rajan and Zingales (1998) for manufacturing and services, excluding the financial sector. To construct sectoral value added at constant prices, I divide each industry current price value added by the corresponding price deflator and I sum across sectors to construct the low and high financially dependent sectors.[37] Using those two inputs, I

[35] If the model is overidentified, the weighting of each moment is extremely relevant as in the standard GMM. In particular, we need to put more weight on better identified moments. This would be implemented by using the inverse of the variance-covariate matrix of the data moments.

[36] To be more specific, I use the matlab function *fminsearch* that comes with the optimization toolbox.

[37] Refer to the Online Appendix C for all the steps in the procedure.

estimate ϵ using OLS with robust standard errors. The resulting value for ϵ is 0.67, which is in line with the estimates of Acemoglu and Guerrieri (2008) for a similar group of industries.[38] Table (5) presents the results.

5.2.2 Moment Selection and Calibration

Standard Parameters The impatience rate ρ is calibrated to match the real interest rate for the period 2004-2007. Given an annual nominal interest rate for the period of 5% and a core annual inflation of 3%, I target a real interest rate r of 2%. This implies a calibrated impatience rate of 0.05. The depreciation rate δ is taken to imply an average investment to capital ratio of approximately 6%, which corresponds to the average value for the private capital stock in the U.S. fixed asset tables, after considering growth. Finally, I use a constant relative risk aversion coefficient σ equal to 1.5, which is in the range of values used in quantitative studies with heterogeneous agents. The values of these parameters can be found in table 6.

Technological Parameters Given ϵ, we have 6 remaining technological parameters to calibrate: $\{\eta, \alpha, f_2, \gamma, \psi, \sigma\}$. Based on empirical evidence on estimates of the degree of returns to scale at the firm level, I set $\eta = 0.78$, in line with Thomas (2002), Pavcnik (2002) and Restuccia and Rogerson (2008).[39] As usual, α controls the share of payments to capital observed in the data, which is equal to 0.3. However, due to the presence of fixed cost and financial frictions, that share of payments will no longer be equal to α.[40] In particular, the aggregate capital income share could be lower than the value of α.

To capture the sector specific fixed costs I match the relative capital intensity between the low and high financially dependent sectors. If there were no fixed costs, the capital intensities would be equalized across sectors since the financial frictions and lobbying fixed cost affect both sectors in the same way. Given a fixed value for f_1 and using the fact that $f_1 < f_2$, an increase in f_2 implies that the sector 2 is more capital intensive, that is, $(k_2 + f_2)/l_2 > (k_1 + f_1)/l_1$.[41]

In this economy, the production of the intermediate sectors y_1 and y_2 are the only contributors to value added since the final producer only "bundles" those goods. In addition, they do not require any other intermediate good to produce. This implies that $p_j y_j$ can be interpreted as value added in sector j. Following this logic, we can think of $1 - \gamma$ driving the share of the externally dependent sector in GDP. Using the same data and the same classification for sectors used to estimate the elasticity of substitution of intermediates ϵ, on average during the period 1970 to 2005 the share in

[38] They estimate ϵ using data from NIPA for 22 industries classified with NAICS. Then, they separate those industries by capital intensity and they run the same regression.

[39] Values for this parameter used in the literature range from 0.7 to 0.9. See references in Restuccia and Rogerson (2008) and in Atkeson and Kehoe (2005).

[40] Even with no financial frictions this statement would be true due to the presence of rents to entrepreneurship. However, if we assume as in Gollin (2002) that those rents are split evenly between workers and capitalists, we return to a world with capital share of 1/3.

[41] See Blaum (2013) for a discussion of partial versus general equilibrium identification of fixed costs in these types of models.

GDP of the high externally dependent sector is 70.4 %. I use this moment to calibrate γ.

Finally, we have two parameters related to the stochastic process of productivity: $\{\psi, \sigma\}$. The parameter ψ measures the persistence of the process and therefore it has a direct impact on the wealth share of the top 10 % of households. I target the 2007 wealth share, which was equal to 73.1%.[42] In the case of σ, it is calibrated to match the fraction of labor employed by the top 10 % of establishments, which is equal to 63% according to the U.S. Census in 2012. The calibrated technological parameters can be found in table (7).

Lobbying and Tax Benefit Parameters To calibrate $\{h, \phi, \nu, \mu, f_l\}$, I resort to the microdata on lobbying and effective tax rates analyzed in section (3).

Although lobbying is in principle available to all firms, based on the micro data, there is a striking difference between public and private firms: most of the lobbying firms are public firms. In fact, as a share of private firms, lobbying firms are negligible in number. For this reason, I assume that there is a fraction $m \in [0, 1]$ of all firms in the model that map to the "private" firms in the data. The difference between m and all the firms in the model is going to be defined as "public firms". These firms will be used as a reference sample to match the moments related to lobbying activity.[43]

To choose m, I compute the domestic (U.S.) gross value of production by public firms in Compustat and I compare this aggregate of public firm output against the value of production of the non-financial corporate sector from the BEA. Using those numbers, I find that 57% of the production in the non-financial corporate sector is carried out by public firms for the pre-crisis period. In other words, 43% of the production of the non-financial corporate sector is due to private firms. Given that private firms usually have low level of employment and that in the model small firms do not choose to lobby, the set m of firms is going to be composed of the smallest non-lobbying firms that accumulate 43% of the production in the model.[44]

The fixed cost of lobbying f_l has a first order effect on the share of lobbying firms in the economy. By increasing this parameter, the number of firms that can afford this costly activity is reduced. Given that in Compustat the number of lobbying firms for taxation issues is 7.1% on average between 2004 and 2007, I calibrate f_l to obtain that fraction over the sub-sample of public firms from the model. The scale parameter h controls how lobbying effort translates into lobbying expenditure. For this reason, I choose to match the average lobbying expenditure to sales from the microdata, which is equal to 0.08%.

The common component associated to the tax benefit ϕ is targeted to match the average effective tax rate of non-lobbying firms in Compustat, which is equal to 21.4%. The parameter ν controls

[42] This moment is taken from Wolff (2012). Using data from the Survey of Consumer Finance (SCF) he computed wealth distributions for a series of periods of time. For an intuition of the relationship between wealth concentration and persistence of the process refer to Moll (2014). To calibrate these parameters, I exploit the fact that the autocorrelation of the process depends on ψ and that given ψ,the stationary variance is given by $\frac{\sigma^2}{2\psi}$.

[43] We can think of m as the fraction of potential agents that could start a private firm. In general, these agents will not have the connections or the information necessary to lobby at congress, at least for the short run.

[44] For a discussion of the main firm level characteristics of private firms versus public firms in the U.S. see Davis et al. (2007) and Asker et al. (2011).

the tax benefits that lobbying firms are obtaining from the government. Consequently, I target the effective tax rate of public lobbying firms, which in the data is equal to 18.8%. Finally, the parameter μ is the scale parameter of the tax benefit policy, which controls the amount of resources the government is losing due to tax benefits tied to capital. Based on statistics from the IRS, 33% of all the corporate tax revenue is lost in tax benefits. I calibrate μ such that in the pre-crisis steady state that relationship holds. The values used for these parameters can be found in table (8).

Institutional Parameters There are 3 parameters to calibrate. I set the tax rate for firms to be equal to 35% in the benchmark economy. The parameter $\ominus$ determines the fraction of the firm level tax collection from the government that a firm can claim on tax benefits. In the benchmark calibration I set this to 1. The parameter that measures the degree of credit depth of the economy, λ_t, governs the aggregate ratio of external finance to capital. To measure this statistic in the data, I take the ratio of the stock of credit market liabilities to non-financial assets of the non-financial corporate sector. The numerator corresponds to credit market liabilities of the non-financial corporate sector, line 5 from table $D.3$ from the flow of funds coming from the Federal Reserve.[45] The stock of non-financial assets is constructed using the net stock of fixed assets for the corporate non-financial sector from the U.S. Bureau of Economic Analysis (BEA). I adjust the value to level it to 2007 using current values. To calibrate λ in steady state (pre-crisis), I target a ratio of external finance to non-financial assets of 0.65, which is the value at the peak of the pre-crisis period in 2007. The values of these parameters and moments can be found in table (9).

To sum up, there are 11 parameters that are jointly calibrated, given that ρ is solved in general equilibrium for a given value of ϵ:[46]

$$\{\alpha, f_2, \gamma, \psi, \sigma, \lambda, h, \phi, \nu, \mu, f_l\}.$$

Despite solving a rather complicated multidimensional mapping, the model targets all moments quite closely. The only two moments that the model finds difficulty to match are the effective tax rate paid by lobbying firms, which is lower than the same moment in the data, and the right tail of the distribution of wealth that I am targeting with σ.

5.3 Model Testing

We have seen that the model hits the proposed targets quite closely after the calibration. Here, I evaluate the performance of the model using additional moments that were not targeted during the calibration. Table (10) shows some selected moments. Overall, the model behaves extremely well in matching the targeted moments and the non-targeted moments. For example, the model

[45] Line 5 is the total credit market liabilities of the non-financial corporate business (series LA144104005.Q). It includes the stock of bank loans, and the stock of commercial papers, municipal securities and corporate bonds of the corporate sector.

[46] As a reminder, this parameter has been estimated using a reduced form equation coming from the first order conditions of the model.

does a particularly good job in matching effective tax rates across sectors and in accounting for the dispersion in capital and marginal product of capital for public firms. In summary, I consider the results coming from this table as a success of the calibration strategy. Next, I discuss the calibration of the shock.

5.4 Credit Crunch Shock

Evidence

Between the second quarter of 2008 and the second quarter of 2010, small business loans made by commercial banks declined by over $40 billion (Duygan-Bump et al. (2015)). While this could be a result of a change in the demand for credit, evidence provided by Ivashina and Scharfstein (2010) suggests that there was a change in the supply of credit. Using data on syndicated new loans they find strong evidence of a reduction in lending around the 2007-2009 recession.[47] Between 2007 and 2008 they found that loans targeted for investment in equipment and machinery fell 48%. Another piece of evidence can be found in the responses to the Federal Reserve's Senior Loan Officer Survey on Bank Lending Practices. The surveyed banks indicated that they significantly increased the requirements to approve new commercial or industrial loans to firms around that period of time. More convincing evidence of an exogenous shock to the supply of credit is provided by Almeida et al. (2009), Duchin et al (2010) and Huang and Stephens (2011). Based on the evidence, I take a stand on the nature of the shock and model it as a credit supply shock that will affect the collateral constraint in the model.

Calibration

In order to replicate the dynamics of the credit conditions of the economy, I hit the model with an aggregate financial shock modeled as an unexpected decrease in the collateral constraint parameter λ. After the initial shock, the future path of λ_t is perfectly known by all agents. This experiment is similar to the credit crunch in Khan and Thomas (2013), Buera et al. (2015) and Shourideh and Zetlin Jones (2016).

The calibrated shock reduces the value of λ upon impact and the effect of this shock decays over time until the economy returns to the pre-crisis level (under perfect foresight). The initial shock implies a reduction of almost 20% to the value of the parameter λ, which is consistent with the actual decline in the ratio of external finance to capital observed in the data between the end of 2007 and the first quarter of 2010.[48] Figure (8) depicts the evolution of the credit conditions in the model and in the data. The left panel shows the ratio of external finance to capital stock using the definitions described in subsection (5.1). For the model, I compute percentage deviations from steady state values. For the data, I show the difference with respect to the value in the fourth quarter of 2007 of the percentage deviation from HP-filter trend (in Q4-2007, the ratio was 4.8% above the HP trend).

[47] This market is the main vehicle through which banks lend to large corporations.

[48] The values for the collateral constraint are, $\{4.21, 2.95, 2.21, 2.71, 3.8\}$. After that, $\lambda_t = \lambda_{t-1} + 0.2\,(\lambda_{t-1} - \lambda^*)$ where λ^* is the steady state value, which is equal to 4.21 in $t = 0$. The first period of the transition is 2007.

In comparison with the data, the model reproduces the qualitative path of the the external finance ratio quite well. Between 2008 and 2009, the model captures almost all the decline in the ratio of external finance to capital that is observed in the data, and therefore the calibration of the credit shock appears to be successful. However, the model goes back to the steady state much faster than in the data. The implied series of λ_t used in the quantitative part is shown in the right panel of Figure (8).

6 Quantitative results

This section provides the main results of the paper. First, I discuss some of the main features of the model economy in steady state. After that, in section (6.2) I discuss the main findings of the paper in three parts. In the first, I ask whether the model can account for the decline in TFP and the evolution of other aggregates relevant to the dynamics of the economy in the aftermath of the financial crisis. In the second part I study whether an economy with lobbying for capital tax benefits amplifies or mitigates the effects of the credit crunch. Lastly, I compare the micro implications for lobbying coming from the model and those found in section (3). I use this comparison as a test of the model. Section (6.3) evaluates the long run implications of lobbying for capital tax benefits, proposes some policy counterfactual and evaluates the implications of those policies in terms of welfare.

6.1 Benchmark Economy Steady State

Although the results presented in this subsection are not novel, I describe the main features from the benchmark stationary equilibrium for completeness. Two of the most important outputs of the stationary equilibrium of the benchmark economy are the stationary distribution for productivity and the wealth distribution. In particular, the model features a log-normal stationary distribution for productivity where an important proportion of the population have low levels of productivity (left panel in figure (9)). On the other hand, the distribution of wealth is also highly skewed, a result that is common in models with incomplete markets and with financial frictions, and that is derived from the optimal saving decisions of agents. One important consequence of this distribution of assets, is the fact that the model features agents that are financially constrained when operating the production technology. In order to produce, agents need to rent capital and to do so, they have to collateralize their wealth. Given that the distribution is skewed to the left and that there are decreasing returns to scale in production, an important fraction of the economy is operating at sub-optimal levels. As a result, total factor productivity, output and capital stock will be lower relative to an economy with no financial frictions (see Greenwood and Jovanovic (1990), Jeong and Townsend (2007), Buera et al. (2011) and Moll (2014) among others).

Figure (10) shows the policy functions for saving for three types of agents in sector s. A feature of models with financial frictions is that the pattern of savings differ across agents. An economy without financial frictions generates saving decisions that are decreasing in wealth for all levels of productivity. However, when financial frictions are introduced, a non-linearity in the saving function arises. Highly productive agents (green dashed line) cannot operate the technology when poor and have to select into the labor market. After saving some funds, they are able to run a firm but under financing constraints. For this reason,they will start saving even more as they increase the scale of production, generating the increasing part of the saving policy function. At some level of wealth, agents running a firm reach their optimal level of production and the return to an extra unit of saving is equal to the prevailing interest rate in the market. After that point, consumption is more important than saving and the policy function starts decreasing. Notice that the non-linearity does not emerge for low productivity agents. Independently of the level of wealth, these agents are not productive enough to run a firm that generates profits higher than the current market wage.

6.2 Dynamics

In this section I examine the response of the model economy to an aggregate financial shock modeled as a tightening of the credit conditions in the economy. The evolution of the credit conditions are determined by the path of λ, which I have calibrated in (5.4). After the initial shock, credit conditions in the economy recover slowly to the steady state value. In subsection (6.2.1) I study the behavior of the model in comparison with the data for the full model. Section (6.2.2) evaluates the role of lobbying to explain the dynamics of TFP and output for the non-financial corporate sector. In particular, I show that lobbying amplifies the aggregate effects generated due to the financial frictions when facing a financial shock. Finally, in subsection (6.2.3) I test whether the calibrated model can generate the patterns described in (3).

6.2.1 Benchmark Economy

Figure (11) displays the evolution of aggregate output, measured productivity (TFP), investment rate and lobbying expenditure for the data and the simulated economy. The data for output and TFP have been detrended using a Hodrick-Prescott filter with a quarterly frequency. For lobbying expenditure, the data has been detrended using a linear trend. In the case of output, TFP and lobbying expenditure, the impulse responses from the model are deviations from steady state. For the data, the figure shows differences with respect to the value of each series in the fourth quarter of 2007. In the case of the investment rate, the figure shows differences with respect to the steady state for the model, and the difference with respect to the fourth quarter of 2007 for the U.S. data.[49]

The blue line in each panel represents the full model with financial frictions, tax benefits, and lobbying. The model generates GDP dynamics close to the one observed in the data, explaining most of the decline in output. The credit crunch in the model generates a reduction in output of almost 80% of the decline observed in the data between 2007 and 2009. By the end of 2009, the model predicts a fall of 5.9% of GDP relative to the steady state. For the same period of time the data showed a decline of 7.5%.

[49] Appendix C.7 explains in detail the data used for the construction of each variable.

A second observation is that the model is able to generate TFP dynamics matching the data: a large fall at the beginning, followed by a slower but steady recovery. The TFP in 2009 was 4.2% below the level of the fourth quarter of 2007, and the model generates a decline of 4.4%. However, relative to the data, the model seems to converge to the steady state more quickly.

The reduction in output comes from two forces: the aforementioned decline in the aggregate productivity of the economy, and a small decrease in the stock of capital. The downward movement in TFP is the result of a sudden increase in the misallocation of resources in the economy, which is reflected in the increase in the dispersion of the marginal product of capital across firms in the right panel of figure (12).[50] With the credit shock, the fraction of firms that are financially constrained rises, inducing a reduction in the demand for capital and labor. The fall in the demand for these factors of production translates into a decrease in the interest rate (figure (12)) and the wage of the economy. In response to this general equilibrium effect, large unconstrained firms expand and choose to produce at the new optimal scale, particularly the "public" firms in the model. By demanding more capital, large firms reduce their marginal product of that input, while those that have to downsize will increase their misallocation due to worsening credit conditions. Combining these effects, the disperison in the marginal product of capital increases.

For investment, the model generates a decline of almost 6% at its lowest point. This prediction is slightly counterfactual, since the the decline in the data is close to 5%. To understand the U-shape pattern of investment, it is useful to look at the evolution of the interest rate in the economy at figure (12). With the credit crunch, the return on asset accumulation for the agents decreases, inducing a reduction in the supply of capital and a decrease in the investment rate of the economy that bottoms out in 2010. When the credit conditions start to go back to normal levels around 2010, the incentive to accumulate assets reappears and the investment rate turns around to return to steady state values. Overall, the model seems to be capturing extremely well the behavior of this agreggate, as well as TFP and output.

What is the role of the capital tax benefit and lobbying in this adjustment? The fact that we have capital tax benefits and a lobbying decision makes the reallocation of capital even stronger. In section (6.2.2) I show quantitatively that the dispersion in the marginal product of capital, hence the misallocation, is larger in a model with lobbying. Here, I discuss the implications of the credit crunch on aggregate lobbying, which is driven by the public firms in the model. This dynamic is influenced by three forces. Firms that were lobbying the government prior to the shock and that are still financially unconstrained increase lobbying expenditure due to the drop in the interest rate. Notice that these firms are public firms. Since lobbying and capital are complementary for unconstrained firms, the increase in the capital stock for these firms induces an increase in lobbying that generates

[50] The increase in dispersion in the model is consistent with evidence provided by Bloom et. al (2009) and Chen and Song (2013). The first one shows that various measures of firm level dispersion increase during the last crisis. Chen and Song (2013) show that the dispersion in the marginal product of capital went up during the last U.S. recession using data from Compustat. Using plant level data, Kehrig (2015) finds that the dispersion in revenue productivity (TFPR) is greater in recessions. Given that TFPR is a weighted average of the marginal product of capital and marginal product of labor, this is also consistent with an increase in MPK.

a second round effect on their demand for capital. We can see this from the first order conditions for capital and lobbying for firms that are not financially constrained,

$$MPK(k_{st}) = \left[R_t - \mu e_{st}^{\nu} - \phi\right], \tag{20}$$

$$e_{sit} = \left[\frac{(1-\tau)\,\nu\mu}{h}\right]^{\frac{1}{1-\nu}} k_{sit}^{\frac{1}{1-\nu}}. \tag{21}$$

From equation (20) it is easy to see that when the interest rate drops, unconstrained firms increase capital. The second round effect is through equation (21). Since tax beneftis are tied to capital, when capital increases firms try to increase lobbying expenditure in order to extract more tax benefits.

On the other hand, there is an increase in the fraction of firms that are lobbying the government as it becomes more profitable to pay the fixed cost and start lobbying as a result of the decline in factor prices. Lastly, the credit shock has a negative effect on firms that were engaging in lobbying activity but are now financially constrained. For these firms, the crisis induces a reduction in lobbying expenditure. This effect can also be seen from equation (21). For a constrained firms capital is determined by the collateral constraint. Since there is a decline in the amount a firm can rent during the crisis, the capital stock declines together with the lobbying effort. However, as we can see in figure (11), this reduction is not sufficiently strong to force an aggregate drop. Since lobbying firms in the model are the largest firms that are on average financially unconstrained, it is natural that the total effect during the crisis is a rise in aggregate lobbying. Overall, the model predicts an increase in lobbying expenditure that is close to the one observed in the micro-data: by 2010, the model accounts for 75% of the increase in lobbying expenditure.

An implication coming from this adjustment in aggregate lobbying is that the dispersion in lobbying expenditure increases during a financial crisis. Do we observe that in the data? The answer for this lies in figure (13). As expected, the data confirms that during the crisis there was an increase in the dispersion of lobbying expenditure for taxation issues. Also, notice that when the economy starts recovering around 2009 the dispersion almost reaches its maximum and starts declining. This pattern is also observed in the model.

Before studying the role of lobbying in the adjustment of the economy, it is worth mentioning some evidence related to the mechanism described in the previous paragraphs. We have discussed that the largest firms are on average public and financially unconstrained firms. We have also mentioned that these are the firms that are driving the increase in lobbying as a result of the increase in production. If this is true, we should observe in the data that public firms expand during the credit crunch. Evidence provided by Shourideh and Zetlin Jones (2016) goes in this direction. Consistent with this mechanism, they show that the production of public firms increased during the last financial crisis.

6.2.2 Lobbying for Capital Tax Benefits and Misallocation

To evaluate the role of lobbying for capital tax benefits for the dynamics of the economy, I simulate a credit crunch of a similar magnitude to the benchmark economy but abstract from the possibility of lobbying. In order to do this counterfactual, I set the lobbying fixed cost $f_l \rightarrow \infty$ and re-calibrate the model to compute the counterfactual steady state and the corresponding transition after the credit crunch. The results of this experiment for GDP are displayed in the left panel of figure (14) under the label "No Lobbying" (green dotted line). The model without the lobbying mechanism predicts a milder recession in comparison to the benchmark economy. Relative to each particular steady state, the model without lobbying generates a decline of GDP by the end of 2009 of 4.5% versus a reduction in the full model of 5.9%. This result indicates that lobbying for capital tax benefits amplifies the aggregate effect of the credit crunch by 1.4% of GDP, or that almost 24% of the reduction of the GDP by 2009 can be attributed to the lobbying mechanism.

The differences between the two dynamics for GDP can be mainly attributed to the aggregate productivity of the economy. The right panel of figure (14) contrasts the evolution of the benchmark economy with the one coming from the model without lobbying. The latter has a decline at the trough of the recession of 2.65% relative to the steady state, while the benchmark model suffered a reduction of 4.4%. This means that 1.77% of the decline in TFP would be associated with the amplification effect of lobbying.

In order to understand the forces driving the differences across these two models, it is useful to look at the reallocation of capital that results from the credit crunch in both models. As seen in figure (15), the difference in the dispersion in the marginal product of capital generates much of this difference. The green dotted line in the figure is the counterfactual dynamics of the model in the absence of lobbying for capital tax benefits. We see that the dispersion increases in both models, but the reallocation of capital triggered by the credit crunch is larger when we allow firms to lobby for capital tax benefits. With the reduction in the interest rate, unconstrained firms that were doing lobbying prior to the credit shock now increase their demand for capital. Because lobbying is an increasing function of the amount of capital and firms can extract more rents according to lobbying, the marginal product of capital of these firms goes down even further and capital expands even more (see equation (11)). On the other hand, in a model with lobbying, constrained firms are facing tighter financial conditions after the shock: in an economy with perfect capital markets, they would like to expand relatively more in a model with lobbying than in a model without lobbying. Finally, there is an extensive margin of lobbying. The reduction in the interest rate makes lobbying profitable for some firms, generating an additional source of variation of the marginal product of capital given that these firms now expand relatively more than in a model without lobbying for capital tax benefits. The model predicts that the fraction of public firms doing lobbying increases to 9.7% by 2009, consistent with the surge in lobbying activity at the extensive margin documented in section (3.1). Combining these effects, the disperison in the marginal product of capital increases relatively more with lobbying.

In order to decompose the effects of the extensive margin and the intensive margin of lobbying, I propose another counterfactual. Because the credit shock induces an increase in lobbying at the intensive margin as a result of the decline in the interest rate and the subsequent increase in the demand for capital, to study the contribution of this change in lobbying intensity on misallocation I propose a counterfactual where I keep the level of lobbying constant at the initial steady state values. In other words, I allow firms to lobby for capital tax benefits, but I prevent them from reacting to the new environment by changing the level of lobbying. What the model captures with this exercise is the increase in misallocation that results only from the increase in the fraction of lobbying firms. As we can see in figure (14), the effects are almost identical to the case where we do not have lobbying. Even though the fraction of lobbying firms increases and the dispersion of the marginal product of capital increases as a result of more firms doing lobbying, the effects on TFP and output are negligible. This result suggests that almost all the increase in misallocation from the model with lobbying is generated by the intensive margin.

6.2.3 Testing Implications for Lobbying and Tax Rates

We have discussed the ability of the model to reproduce some of the most salient features of the U.S. credit crisis of 2007-2009, including the aggregate lobbying behavior in the economy. Here, I assess the performance of the calibrated model to match the empirical patterns documented in section (3).

Changes of Effective Tax Rates

Using data from Compustat, Section (3) established that after the financial crisis the effective tax rates paid by lobbying and non-lobbying firms declined sharply. In addition, consistent with the observed increase in lobbying activity for taxation, the decline is more drastic for lobbying firms.

Figure (16) compares the data and the model. For the model, I compute the effective tax rates for lobbying and non-lobbying public firms and I compute the cumulative change with respect to the value in 2007 for each case.[51] The data shows differences with respect to the tax rate in 2007.

In the case of the effective tax rate of lobbying firms, the left panel of figure (16) shows that the model fits the general pattern of the average tax rate for lobbying firms after the credit shock. In particular, it captures 53% of the decline in the effective tax rate by 2009. With the credit shock, lobbying firms start increasing their lobbying activity and as a result the amount of tax benefits they are obtaining is bigger. In addition, the amount of capital these firms are using is also higher, which also reduces the effective tax rate. As a result, the tax rates for those firms start declining until 2009. After bottoming in that year, the model converges to the steady state faster than in the data. This is explained partly because the interest rate returns to the steady state level after that period, inducing a reduction of the capital demand for public firms and in lobbying effort. Following that retraction in capital and lobbying, the amount of tax benefits goes down.

[51] In order to map the model to the data, I use the procedure described in section 5 to assign firms to the private and public groups.

For the effective tax rate of non-lobbying firms, the general picture applies. The model captures the evolution of the average tax rate for that group pretty well until 2009. Similarly to lobbying firms, public non-lobbying firms on average expand. Because these firms are richer than private firms, typically they are not financially constrained and they react to the decline of prices with an expansion of production. Consequently, the demand for capital after the credit crunch increases and the amount of tax benefits claimed accompanies the pattern of capital until 2009. After that, it returns back to steady state while the data keeps falling for one additional period of time. At that point, we see that the tax rate of non-lobbying firms turns around and starts returning to the pre-crisis value. Overall, the model performs surprisingly well in accounting for the decline in tax rates for lobbying and non-lobbying firms.

Increase of the share of Lobbying Expenditure of Sector 2

Using data on lobbying for taxation issues, section (3) established that sectors that rely more on external finance increased their participation in total lobbying expenditure during the last financial crisis.

In the model, the presence of the fixed cost $f_2 > f_1$ affecting the collateral constraint makes sector 2 more dependent on external funds and more capital intensive. We have seen in table (10) that the model over predicts the share of lobbying expenditure in that sector (65% in steady state versus 53% in the data). Here, I evaluate the performance of the model over time after the crisis. Figure (17) displays the difference with respect to the steady state for the model, and the difference from 2007 for the U.S. data. As in the data, the model generates an increase in the participation of the sector that depends more on external finance (sector 2) after the credit shock. In addition, the model also picks the same year in comparison with the data. However, it cannot capture the magnitude of the change: for the data, by 2010 the share of lobbying expenditure for taxation issues increases by 9.1%, while the model increases by 2.3%. In other words, the model accounts for almost 25% of the change in the share of lobbying expenditure incurred by those sectors that rely more on external finance. Finally, note that the model is successful in capturing the inverted U-shaped pattern of the data. However, and once again, it seems to be returning to the levels of the pre-crisis period in a shorter period of time.

Size-Dependent responses

In section (3.4) I showed that the response of firms with different sizes depends on external financial dependence (EFD). In particular, large firms in both sectors as well as small firms in sectors less dependent on external finance increase their lobbying expenditure relative to the pre-crisis period. Only small firms in sectors that rely more heavily on external finance exhibit a reduction in lobbying activity. In addition, sectors that depend more on external finance have larger differences in the change to lobbying expenditure due to the crisis. Next, I test the ability of the model to deliver those results based on a simulated model-based regression.

To consider the firm-level implications of the model for lobbying after a credit crunch, I simulate a sample of 500,000 firms from the model and follow them for four periods after the shock, keeping track of the size in terms of employment. In section (3.4) I use the small-medium firm (SME) label for a firm with fewer than 500 employees following the classification used by the Trade Commission. The data from the Business Dynamics Statistics (BDS) for 2007 shows that the employment share of firms with fewer than 500 employees was equal to 50.4%, which is almost equal to the median of employment. In order to map my model to the size variable I look for the employment size such that below that level the employment share is equal to 50.4%. Then, I classify those firms below that level as SME and those above that as a large firms. As before, sector one in the model is represents sectors that rely less on external finance and sector two represents the remaining.

Table (11) reports the results of running the regression on equation (1) using the simulated data and it reproduces the same results from section (3.4). To run this regression, I control for the same variables as in the empirical regression (capital, asets and sales). The table decomposes the results into two groups, low external dependence and high external dependence sectors. The model delivers almost all the signs of the regression, but misses the change in lobbying expenditure for small-medium firms in the sectors that relies less on external finance. While the data delivers a positive correlation, the model displays a negative one. Nevertheless, that coefficient is not statistically significant in the data. The model captures the sign of the changes for lobbying expenditure before and after the crisis for 3 groups: large firms in sectors that depend less on external finance; small-medium firms in sectors that rely more on external finance; and large firms in sectors that rely more on external finance. The model-based regression finds that the change in lobbying expenditure for small-medium firms in the sectors that rely less on external finance should be negative. In the data, the coefficient was found to be negative. However, given that the coefficient is not statistically significant and close to zero, the negative coefficient coming from the model it is certainly possible.

In the model, a reduction in input prices implies an increase in capital demand and lobbying activity for unconstrained public firms in both sectors. This mechanism drives the signs in the model based regression for the change in the intensity of lobbying in column (4) for firms in the low external dependence sector and in the high external dependence sector. On the other hand, with the credit crunch some public firms become financially constrained in the model and therefore the amount of capital used is lower than before. According to the model, the lobbying expenditure of those firms is also smaller and this effect drives the signs in columns (3) for both groups of firms.

To summarize, the evidence provided in this section shows that the modeling strategy is successful in capturing the micro level implications of lobbying during a financial crisis. In addition, it reinforces the validity of the calibration strategy. Together, these two features imply that the model could be used to study policy relevant questions with the certainty that the model represents closely the most salient features of this activity.

6.3 Normative analysis: Long-Run Counterfactuals

In the previous sections I discussed the implication of lobbying at the business cycle frequency for output, TFP and micro-level implications. However, the model is also useful to answer questions related to the long run behavior of the economy. To that end, I propose several exercises that are relevant for policy and normative analysis.

6.3.1 Role of Misallocation in the Long-Run

In this experiment I try to assess the impact of lobbying on total factor productivity in the long run. Since lobbying acts as a subsidy on capital, eliminating this distortion has an impact on capital accumulation. Considering that firms can no longer get access to the preferential tax treatment that made them larger, there will be a reduction in the demand of capital. As a result, the capital stock in the economy would go down. To counterbalance this aggregate effect, and in the spirit of Restuccia and Rogerson (2008), I adjust the corporate tax rate τ so that the capital stock in the new steady state is the same as the initial value. In this sense, I am focusing on the TFP effects associated with the elimination of lobbying through reallocation of capital and selection. Operationally, I take the fixed cost of lobbying (f_l) to infinity so that no firm can do lobbying in the new steady state and at the same time I reduce the corporate tax rate.

Column 2 in Table (12) shows selected statistics such as aggregate output, capital, consumption, wage and total factor productivity (TFP) for this experiment relative to the benchmark economy when both are in steady state. We can see that output and TFP increase by 0.7% and 0.9% respectively without lobbying. As discussed in section (4.2), lobbying increases the dispersion of the marginal product of capital relative to an economy without lobbying. Then, banning this activity implies gains in efficiency on the production side. An important point to stress is that the gains are larger in the second sector, which is the one where lobbying is more intensive. Because of this differential intensity of lobbying, the dispersion in the marginal product of capital is larger in that sector. Finally, notice that the combination of these policies increases the number of firms in the economy. Although wages are going up and therefore labor is more expensive, the reduction in the tax rate that the government is proposing makes running a firm more profitable for a group of agents.

6.3.2 Institutional Reform: Banning Lobbying

In the previous exercise I discussed the effects of banning lobbying while at the same time reducing the corporate tax rate in order to keep the level of capital constant. In this counterfactual I propose to analyze the full effect of banning lobbying without adjusting the corporate tax rate.

The results for the first experiment in the new steady state are shown in column 2. Relative to the benchmark steady state we observe that output decreases 1.2%, capital used for production is 4% lower, TFP has an increase of 0.8%, and consumption goes up almost 1%.

The outcomes from this experiment follow from differences at both the intensive and the extensive margins of production. At the intensive margin, incumbent firms are negatively affected due to the elimination of the lobbying activity that was used in the benchmark equilibrium by constrained and unconstrained firms. As I previously discussed, the capital stock in this economy declines due to the lower incentive to accumulate assets in order to exploit the tax benefit schedule. The reduction in capital accumulation comes from three forces. Because lobbying generates an increase in the optimal size of firms, without this force firms reduce capital demand and therefore there has to be a downward adjustment in savings for these firms. Second, with lobbying, some firms accumulate wealth with the expectation that at some point they will be able to lobby. Abstracting from this activity removes this force and therefore there is a reduction in savings. Third, lobbying allows some financially constrained firms to increase saving in order to overcome financing constraints. Absent lobbying, those firms reduce their saving decisions and reduce capital accumulation.

In section (4.2) I discussed the implications of the tax benefit schedule on misallocation and selection. Without lobbying, we see that TFP in the economy goes up, indicating some misallocation as a negative consequence of lobbying. This is reflected in the decrease in the marginal product of capital in the counterfactual scenario.

At the extensive margin, there is a small increase in the number of firms in the economy, explained by the decline in wages and interest rate resulting from the reduction in inputs. However, this increase in new producers is counterbalanced with a decline of the average size of firms (measured using labor or capital, since both are complements) and in the capital to labor ratio of the economy as a whole and in both sectors.

Finally, lobbying seems to be welfare improving as suggested by the decrease in total consumption when we move from the benchmark economy to an economy without lobbying. Lobbying increases factor demands, drives up wages and profits that more than compensate the increase in savings. However, we need to be careful about this last statement, which only considers consumption levels between steady states. In order to consider the implications for welfare, we should also take into consideration the transition from one steady state to the other. I consider this in section (6.3.4).

6.3.3 Fiscal Reform: No Heterogeneity in Effective Tax Rates

The evidence shows that effective tax rates that public firms pay are lower than the 35% that the law establishes. In addition, there is a lot of heterogeneity even within this set of wealthy and large producers. Since the government is losing a considerable amount of resources to this group of firms that could be used for health, social security or foster small business growth, lobbying policy is an issue of constant debate in the media and the policy arena.[52] Other arguments point to the ‘unfairness’ of lower tax rates for big corporations and the distortions that tax breaks generate to the economy.

In order to contribute to this debate, the second experiment proposes to take out all the sources of

[52] See the report by the Goverment Accountability Office (GAO 2013) or McIntyre et al. (2011) as examples in this debate.

variation in the effective tax rate while at the same time keeping the government's revenue constant. The economy starts in steady state, and the government decides to restrict lobbying ($f_l \to \infty$) and abolish the existence of common components of capital tax benefits. Because this implies that firms now face a higher effective tax rate, the government lowers the corporate tax rate in order to keep the revenue constant taking in consideration the revenues generated during the transition to the new steady state. Technically, the government keeps the revenue constant in present value terms.

This experiment measures the aggregate effects of equalizing the effective tax rate for all firms. In other words, if all firms face the legal corporate tax rate, what would be the macroeconomic consequences. According to the quantitative results, the corporate tax rate necessary to satisfy the same present value of revenue is equal to 31%. Column 3 of table (12) presents the results for this experiment. This counterfactual implies a reduction in long run output of 2.5%, an increase of 1.1% in TFP, and an increase in consumption of 1.3%. We see that misallocation is reduced due to the decrease in the dispersion of marginal product of capital, which is reflected in the increase in TFP. As discussed in (4.2), the introduction of the tax benefit schedule increases the dispersion of the marginal product of capital relative to an economy with financial frictions. Then, by making all firms pay the same effective tax rate we are abstracting from that source of variation and increasing efficiency in production.

Regarding capital, we see that in this economy it declines 9.4% for the same reason studied before: without any tax rebate associated to capital the optimal size of all firms shrink. With a lower optimal size, the demand for capital of firms will be lower in the aggregate, the incentives to save will be smaller, and the capital stock of the economy contracts.

Different from the previous case, we observe that consumption in this economy rises 1.3% as a result of the decline in savings. Because the optimal size of firms is smaller, it is not necessary to keep the levels of assets as in the benchmark economy.

6.3.4 Welfare

In this subsection, I turn my attention to the computation of welfare. First, I analyze the welfare implications for banning lobbying. Then, I compute the welfare implications for the fiscal reform.

For the case where we ban lobbying, we have seen that consumption in the new steady state declines. From there, we would be tempted to infer that welfare in this economy would be lower. However, in order to compute welfare, the correct comparison should consider the full transition path between steady states since that implies a sequence of consumption that are not incorporated when looking at steady states.

Denote the aggregate welfare in the benchmark stationary equilibrium by W_∞^{full}. This value is computed by integrating the individual value functions with respect to the invariant distribution of wealth and ability, accounting for each type of agent:

$$W_\infty^{full} = q \int v_1^{full}(a,z) g_{1\infty}^{full}(a,z) da dz + (1-q) \int v_2^{full}(a,z) g_{2\infty}^{full}(a,z) da dz,$$

where $v_s^{full}(a,z)$ for $s \in \{1,2\}$ is the individual value function in steady state of the benchmark model of agent of type s, and $g_{s\infty}^{full}(a,z)$ for $s \in \{1,2\}$ is the joint probability distribution function for agents of type s in the stationary equilibrium of the benchmark model.

To compute the welfare change Θ from eliminating lobbying, I construct the permanent consumption compensation necessary to make an individual indifferent between the benchmark stationary equilibrium and an economy with no lobbying but with financial frictions and capital tax benefits, accounting for the transition. This expression is given by

$$\Theta = \left(\frac{W_{Tr}^{nlob}}{W_{\infty}^{full}}\right)^{\frac{1}{1-\theta}} - 1,$$

where W_{Tr}^{nlob} is the lifetime welfare of transitioning from the benchmark economy to an economy that forbids lobbying. This welfare value is given by

$$W_{Tr}^{nlob} = q \int v_1(a,z) g_{1\infty}^{full}(a,z)dadz + (1-q) \int v_2(a,z) g_{2\infty}^{full}(a,z)dadz,$$

where $v_s(a,z)$ for $s \in \{1,2\}$ is the value function that takes into account the transition from the benchmark stationary equilibrium to the new stationary equilibrium. In other words, $v_s(a,z)$ is the instant value after the change in policy.

The quantitative results show that there is welfare gain of 0.3% while banning lobbying, or a welfare cost of 0.3% of keeping it. By comparing steady states, we obtain that welfare decreases by 0.9%. The inclusion of the transition implies an offsetting effect over the welfare calculation derived from comparing steady states.

In the case of the fiscal reform, if one looks at the steady state we observe that consumption increases. Then, welfare goes in the same direction as the transition and the fiscal reform generates a welfare gain of 1.1%.

7 Conclusions

In this paper, I document the increase in lobbying activity to affect the tax code that took place during the 2007-2009 U.S. financial crisis. Based on Compustat data matched with lobbying expenditure at the firm level, I show that this increase in rent-seeking behavior was driven by large firms in sectors that rely more on external sources of funds to finance capital expenditure. Based on this evidence, and given the creation and extension of tax provisions during that time, I study whether lobbying amplifies the misallocation created by the financial frictions when the economy suffers a credit crunch.

To address this question, I use a model with financial frictions in the form of collateral constraint and a government that grants tax benefits associated to capital and can be influenced through costly lobbying pressure. In this economy, all firms can claim tax benefits that are tied to capital. However, firms that decide to lobby can also modify the tax code to obtain preferential tax treatment on top of a common component. In order to lobby, firms have to pay a fixed cost, and as a result there is selection into lobbying activity where only a small fraction of firms engage in this activity.

The presence of lobbying in an environment with financial frictions simultaneously generates positive and negative effects on misallocation. Consequently, the effects are not unambiguously determined and depend on which force dominates. To study the aggregate effects of the credit shock, I calibrate the model using micro-data on lobbying expenditure and effective tax rates that corporations paid before the crisis, and I calibrate the credit shock to replicate the observed decline in the ratio of external finance to capital for the non-financial corporate sector.

One of the main findings of the paper is that lobbying increases the misallocation of resources that arises with financial frictions when the economy receives a financial shock. The presented model accounts for 80% of the decline in output and almost all the decline in TFP observed in the data by the end of 2009. Compared to an economy without lobbying, I find that the lobbying economy amplifies the distortions produced by financial frictions, leading to a one-third larger decline in output. The model is also able to capture the increase in lobbying activity observed in the data, as well as the impulse responses of firms according to size and industry financial dependence.

A derived implications is that, not only it is important to have policy tools during these events, but it is even more important how the policy is designed in order to be effective. As we have seen, the government provides tax advantages, but most of those resources are assigned to unproductive and wealthy firms, enhancing the misallocation of resources. In this environment, and given the same fiscal cost, policies that subsidize credit to those firms in distress are more effective to foster the recovery.

Finally, the paper also discussed long run implications of lobbying and policy reforms, focusing on output and TFP. Banning lobbying implies that in the long run output is lower due to a decline in capital accumulation, and TFP increases as a result of lower misallocation of capital. From a welfare perspective, this institutional change implies a gain of 0.3%. In terms of policy, an elimination of all capital tax breaks while keeping the revenue neutral through reductions in the corporate tax rate have similar results in terms of signs, but the magnitudes are magnified. In this case, welfare increases by 1.1%.

One limitation of the analysis is the fact that firms can only adjust the production margin with the financial shock, which is a direct result of the perfect competition framework. However, the empirical evidence suggests that market power is a relevant feature in modern economies and therefore firms can also adjust prices during a downturn. The interaction between financial conditions and market power has been studied by Giuliano and Zaourak (2015) and by Gilchrist et al. (2015). The incorporation of market power in this framework is left for future research.

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A Tables

Table 1: Percentage Lobbying Expenditure by issue (Top 5)

Issue	%
Taxes	11.1
Health	6.7
Energy	6.1
Trade	5.5
Budget/Appropriations	5.4

Table 2: Summary Statistics

	Lobbying	Non-Lobbying
Sales ($ Million)	7396.58	1239.18
	(19852.22)	(3882.16)
Capital ($ Million)	10551.09	816.22
	(20047.52)	(5934.68)
Assets ($ Million)	29321.21	15728.29
	(26109.74)	(3563.91)
Employment (Thousands)	43.32	5.96
	(120.35)	(25.63)
Mean Lobbying exp. ($ Million)	0.27	
	(0.7)	
Mean ETR(%)	18	21.1
Observations	2322	18090

Table 3: Intensity of Lobbying

	Low External		High External	
	SME	Large	SME	Large
Crisis	0.010	0.226**	-0.054*	0.342**
Small-Large		-0.216***		-0.396***
DDD	-0.180***			
Observations		20412		

Note: Standard Errors clustered by SIC-2digits. Controls: Assets, sales, fixed effects at industry-state. * Significance at 10%; ** Significance at 5% ***1%.

Table 4: Probability of Lobbying

	Low External		High External	
	SME	Large	SME	Large
Crisis	0.002*	0.020**	-0.003*	0.032**
Small-Large		-0.019***		-0.035***
DDD	-0.0161***			
Observations	20412	20412	20412	20412

Note: Standard Errors clustered by SIC-2digits. Controls: Assets, sales, fixed effects at industry-state. * Significance at 10%; ** Significance at 5% ***1%.

Table 5: Estimation of the elasticity of intermediate inputs ϵ

Dep. var.	Ratio nominal value added
Real value added	-0.4744***
	(0.1274)
Constant	0.7745***
	(0.0658)
R^2	0.2686
Observations	35

Note: Robust standard are shown in parenthesis.
* Significance at 10%; ** Significance at 5% ***1%

Table 6: Standard Parameters

Parameter	Value	Target/Source
Discount rate (jointly)	$\rho = 0.05$	$r = 0.02$
Coef. relative risk aversion	$\theta = 1.5$	
Depreciation rate	$\delta = 0.06$	

Note: In this table, ρ is the only parameter that is jointly calibrated.

Table 7: Technological Parameters

Parameter	Value	Target/Source	Data	Model
Share of income to capital	$\alpha = 0.38$	NIPA accounts	0.3	0.3
Fixed cost in sector 2	$f_2 = 1.15$	Capital intensity between sectors	1.5	1.4
Weight of sector 2 in GDP	$\gamma = 0.23$	Share sector 2 in Val. Added (%)	70.4	70.4
Persistence of log z_{sit}	$e^{-\psi} = 0.89$	Top 10% of wealth share (%)	73.6	68.3
var. of log z_{sit}	$\frac{\sigma^2}{2\psi} = 0.43$	Employment share of top 10% (%)	63	61.3
Return to scale	$\eta = 0.78$			

Table 9: Institutional Parameters

Parameters	Value	Target/Source	Data	Model
Collateral	$\lambda = 4.21$	External Financing	0.65	0.65
Maximum Benefit	$\ominus = 1$	Lower Bound ETR		
Tax rate	$\tau = 0.35$	IRS		

Table 8: Lobbying Activity and Tax Benefit

Parameter	Value	Target/Source	Data	Model
Cost scale	$h = 1.2$	Lobbying expend. to sales (%)	0.08	0.06
Common tax benefit	$\phi = 0.02$	Avg. ETR non-lobbying firms (%)	21.4	21.4
Tax benefit, exponent	$\nu = 0.2$	Avg. ETR of lobbying firms (%)	18.8	16.2
Fixed cost of lobbying	$f_l = 0.7$	Share of lobbying firms (%)	7.1	7.1
Tax benefit, scaling	$\mu = 0.003$	33% tax revenue lost %	33	33

Table 10: Non-Targeted Moments

Moment	Data	Model
Share of Lobbying Expenditure High External Dependence sector	53.6%	65.2%
Effective Tax Rate sector 1	20%	19.6%
Effective Tax Rate sector 2	16%	15.3%
std(MPK) for Public Firms	1.81	2.1
std(k_i/K) (lobbying firms over all public firms)	0.72	0.87

Table 11: Intensity of Lobbying

	Data		Model	
	SME (1)	*Large* (2)	*SME* (3)	*Large* (4)
Low External Dependence				
Crisis	0.010	0.226**	-0.137	0.713
$SME - Large$		-0.216***		-0.85
High External Dependence				
Crisis	-0.054*	0.342**	-0.361	0.981
$SME - Large$		-0.396***		-1.342
$(SME - Large)^{High} - (SME - Large)^{Low}$	-0.180***		-0.492	

Note: Standard Errors clustered by SIC-2digits. Controls: Assets and sales for the model and the data. Fixed effects at industry-state included for the data.* Significance at 10%; ** Significance at 5% ***1%.

Table 12: Misallocation Effect

	Benchmark Economy ($\phi = 0.021,\ f_l = 0.7$)	Constant Capital No lobbying ($\phi = 0.021, f_l = \infty$)
Output	100	100.7
TFP	100	100.9
TFP sector 1	100	100.6
TFP sector 2	100	101.2
Consumption	100	100.7
Wage	100	100.6
Aggregate capital (K)	100	100
Firms	100	100.5
std. MPK	100	94.6

Note: All results are relative to the benchmark economy where the financial friction parameter is $\lambda = 4.21$

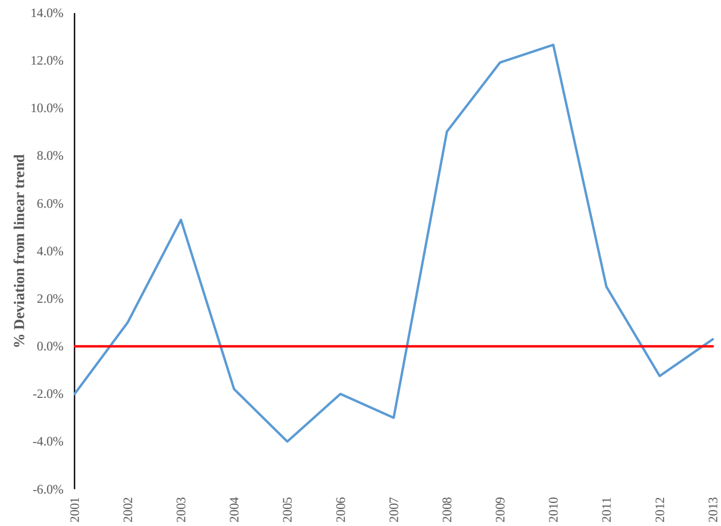
Table 13: Policy Reforms

	Benchmark Economy ($\phi = 0.021,\ f_l = 0.7$)	No Lobbying Economy ($\phi = 0.021, f_l = \infty$)	No Heterogeneity in Tax Rates ($\phi = 0.0, f_l = \infty$)
Output	100	98.8	97.5
TFP	100	100.8	101.1
TFP sector 1	100	100.3	100.8
TFP sector 2	100	101.1	101.5
Consumption	100	99.2	101.3
Wage	100	98.8	97.6
Aggregate capital (K)	100	95.9	90.6
Firms	100	100.3	101.6
std. MPK	100	93.4	90.8

Note: All results are relative to the benchmark economy where the financial friction parameter is $\lambda = 4.21$

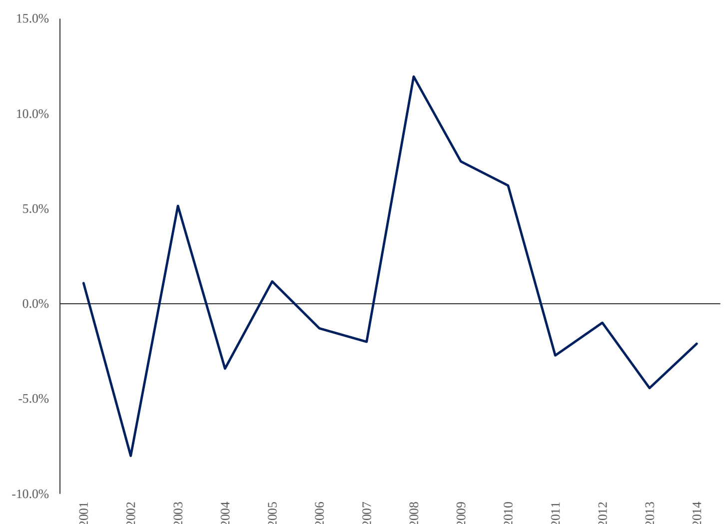
B Figures

Figure 1: Lobbying Expenditure for Taxation



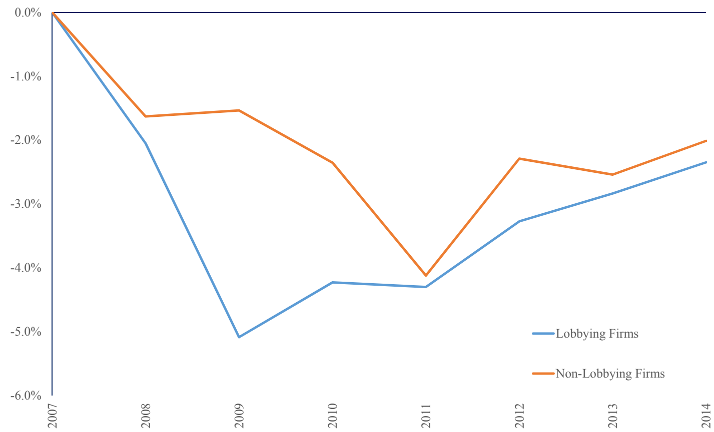
Note: The figure shows deviations from linear trend for the period 2001-2013.
The raw data is in constant prices of 2007, deflated with the GDP deflator.

Figure 2: Intensity of Lobbying for Taxation Issues



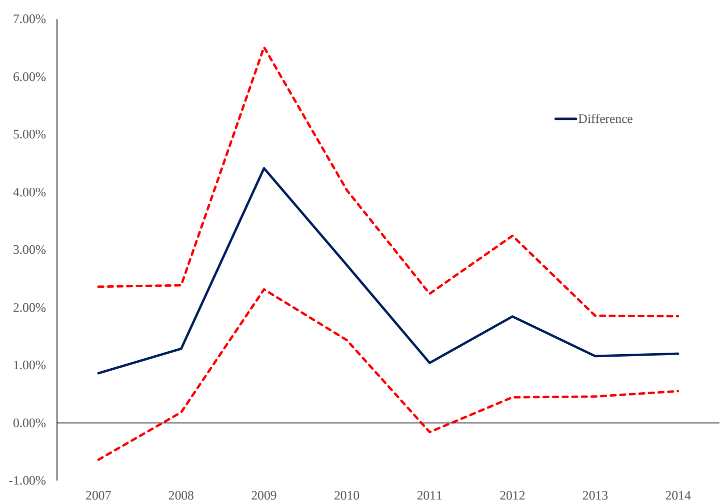
Note: Intensity of lobbying for taxation issues is average lobbying expenditure. The figure shows deviations from linear trend for the period 2001-2013. The raw data is in constant prices of 2007, deflated with the GDP deflator.

Figure 3: Evolution of Effective Tax Rates



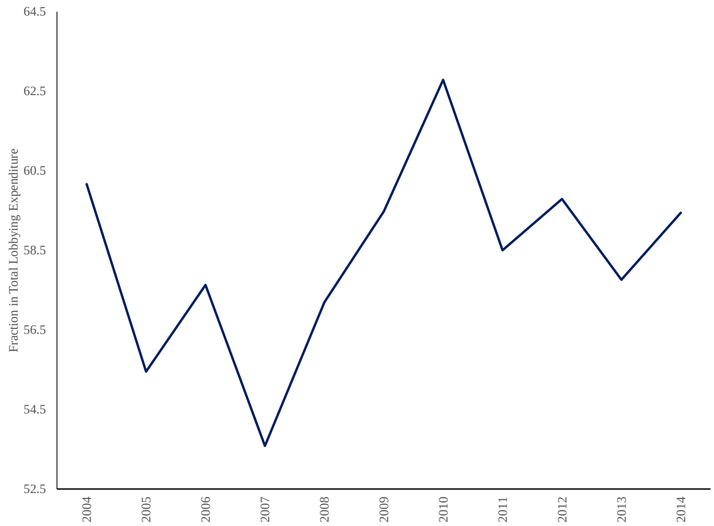
Note: This Figure shows the evolution of the effective tax rate payed by lobbying and non-lobbying firms

Figure 4: Difference in ETR of Lobbying and Non-Lobbying Firms



Note: This figure shows the interaction term coefficient of the lobbying for taxation dummy and a time dummy for each of the years after 2007. The dashed red lines are the confidence intervals for each particular coefficient.

Figure 5: Lobbying Expenditure and Financial Dependence



Note: the figure displays the total lobbying expenditure for taxation of sectors that rely more on external finance as a share of total lobbying expenditure for taxation.

Figure 6: Effective Tax Rate and Financial Dependence

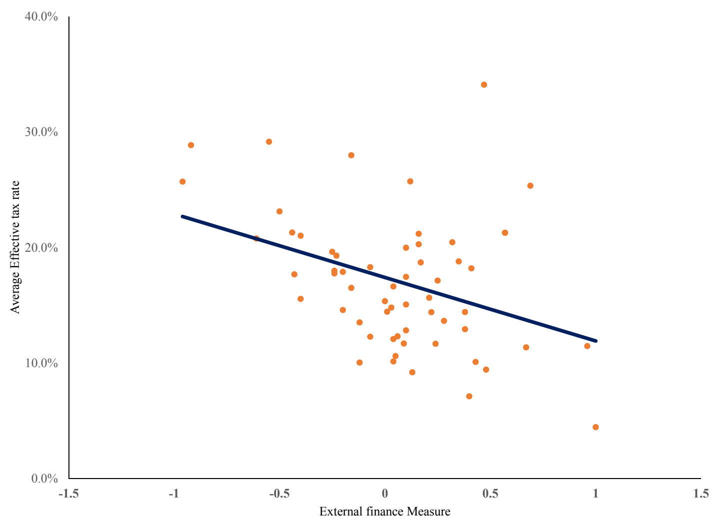


Figure 7: Operating Income with Tax benefits

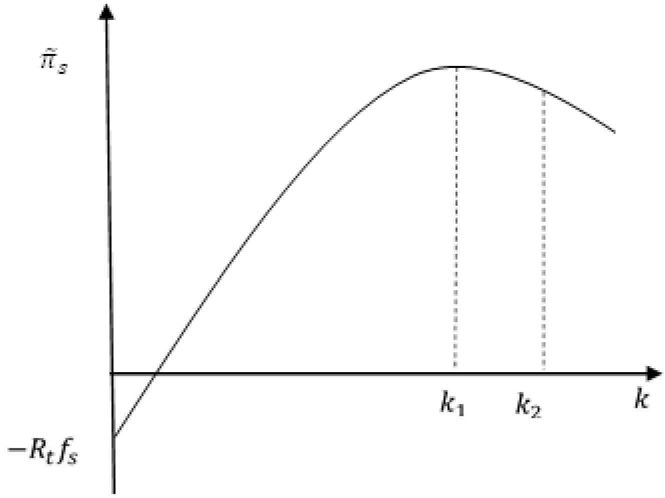
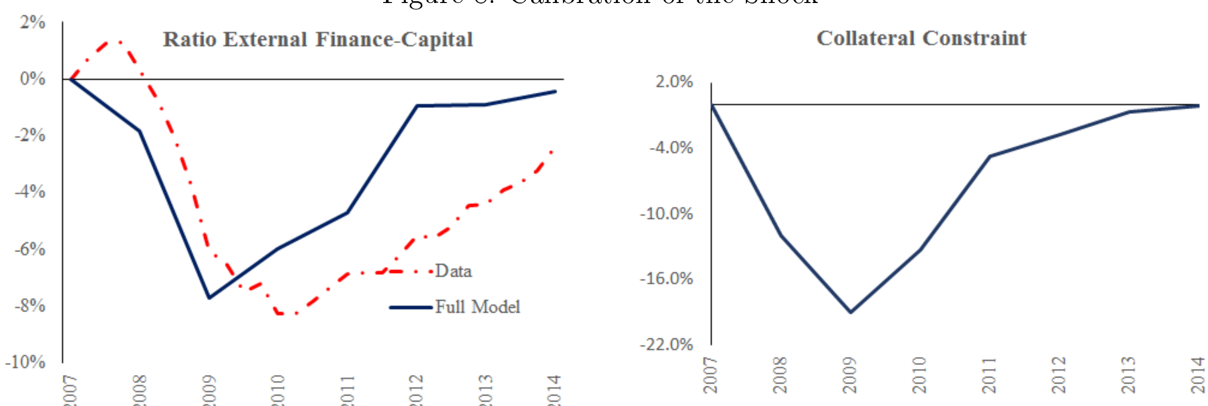


Figure 8: Calibration of the Shock



Note: The frequency for the external finance to capital ratio data is quarterly. The model frequency is yearly. I plot percentage deviations from steady state for the model. I compute percentage deviations from HP-trend for the data and I plot that series relative to the value obtained in the fourth quarter of 2007.

Figure 9: Stationary Equilibrium distributions

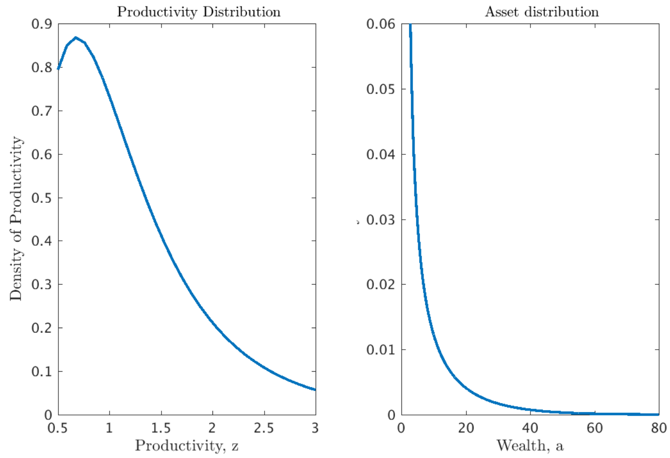
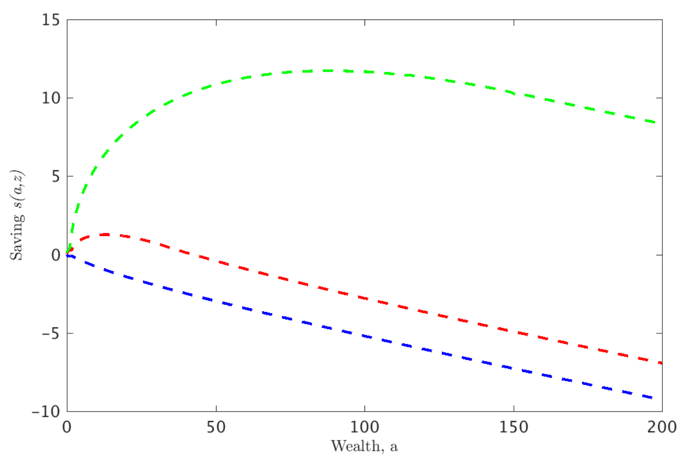
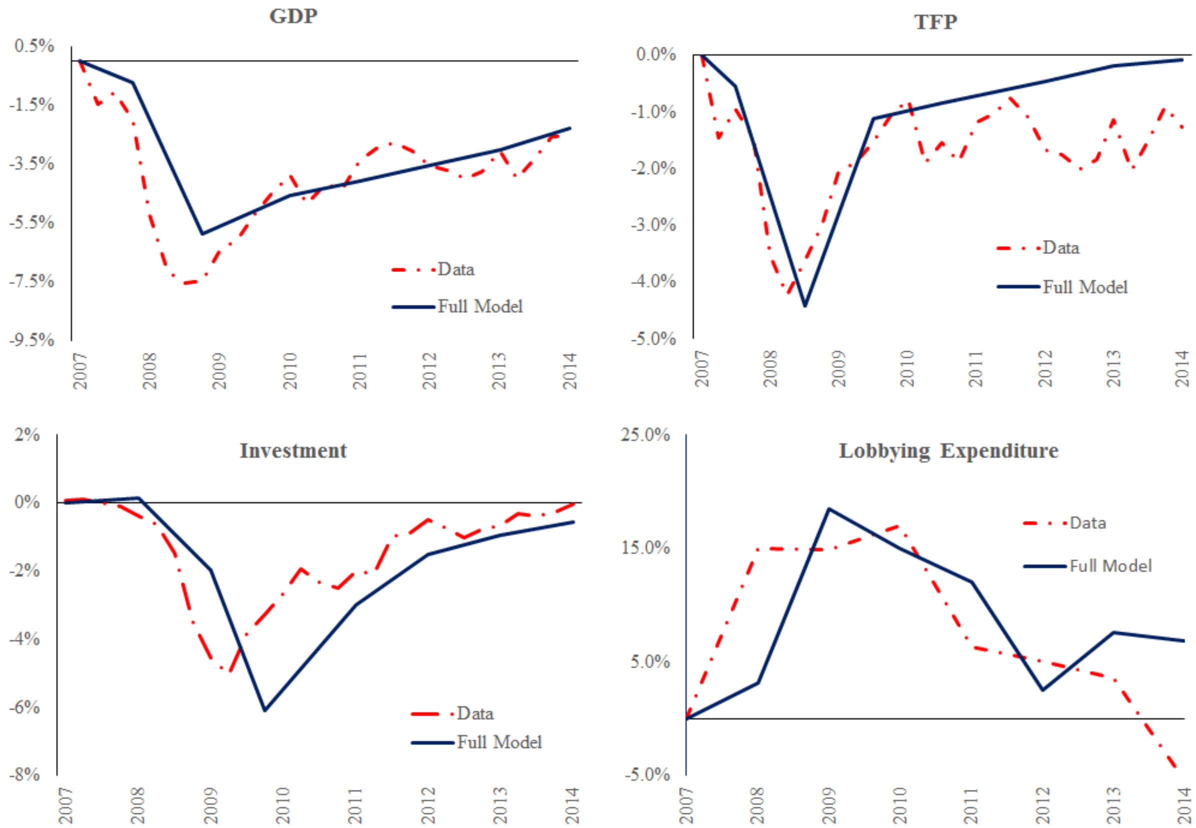


Figure 10: Saving Policy Function



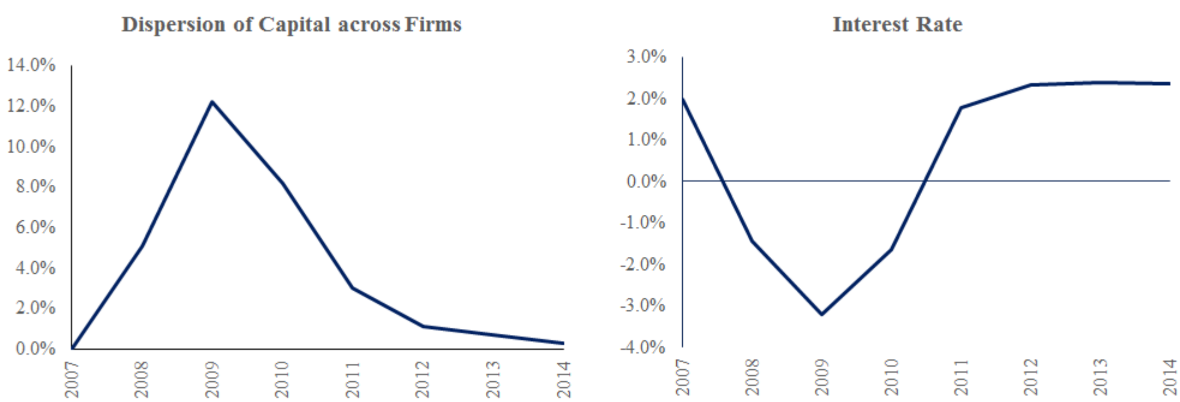
Note: This figure displays savings for three different types of productivities: low (blue), medium(red), and high (green).

Figure 11: Dynamics in the Data and Full Model after a Credit Crunch



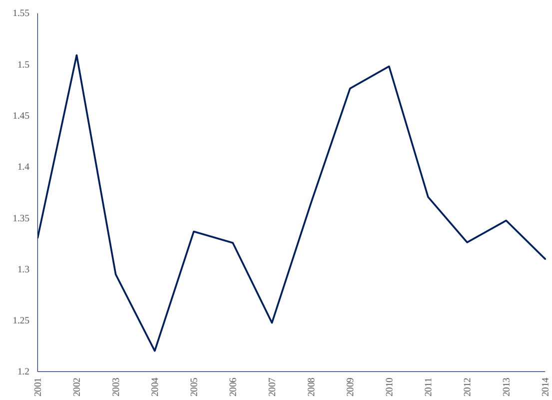
Note: For the model, I plot deviations from steady state for output, TFP and lobbying. In the case of investment, I take the difference with respect to steady state. For the data , I compute percentage deviations from HP-trend and I plot that series relative to the value obtained in the fourth quarter of 2007 for output, TFP and lobbying. In the case of investment, I take the difference with respect to fourth quarter of 2007.

Figure 12: Dispersion in Firm Level Capital and Interest Rate



Note: The left panel of this figure shows the percentage change relative to the value in steady state of the standard deviation of the marginal product of capital in the model. The right panel shows the evolution of the interest rate coming from the model.

Figure 13: Dispersion in Lobbying Expenditure for Taxation



Note: Own elaboration based on matched from Compustat and lobbying data from CRP.
The figure plots the evolution of the log of lobbying expenditure for taxation.

Figure 14: Decomposition of Effects of the Credit Crunch with Lobbying

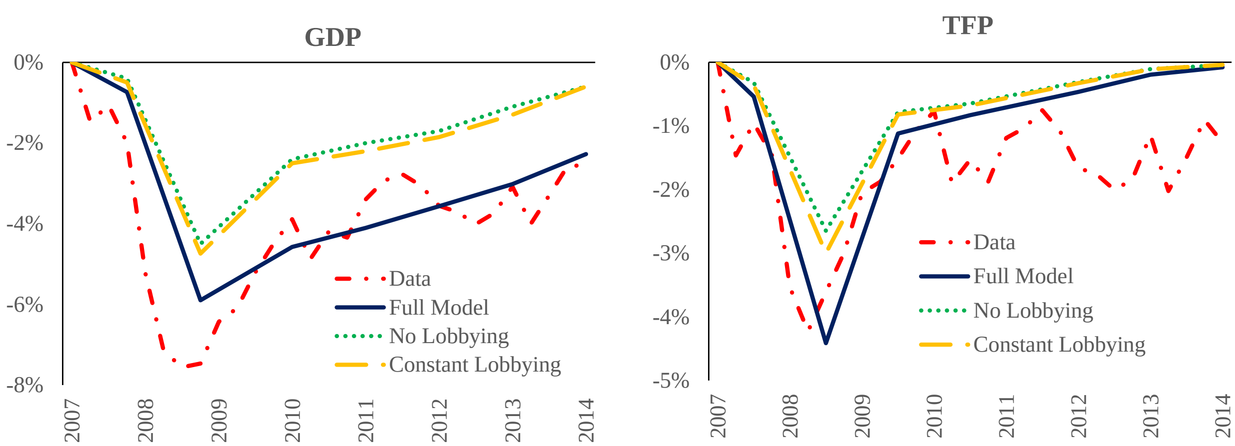
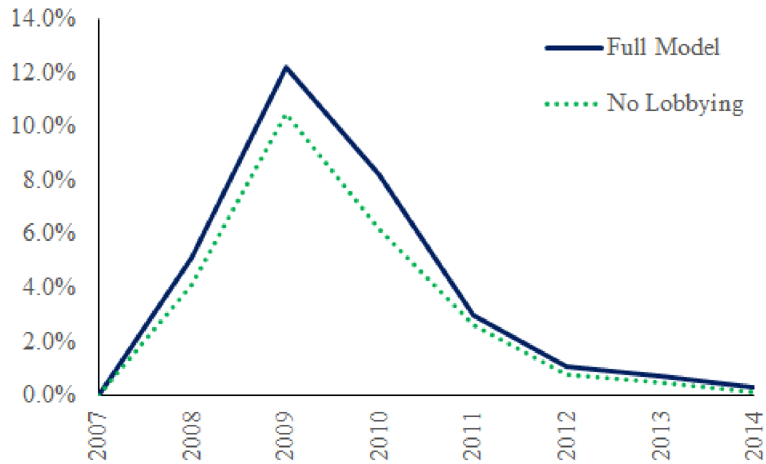
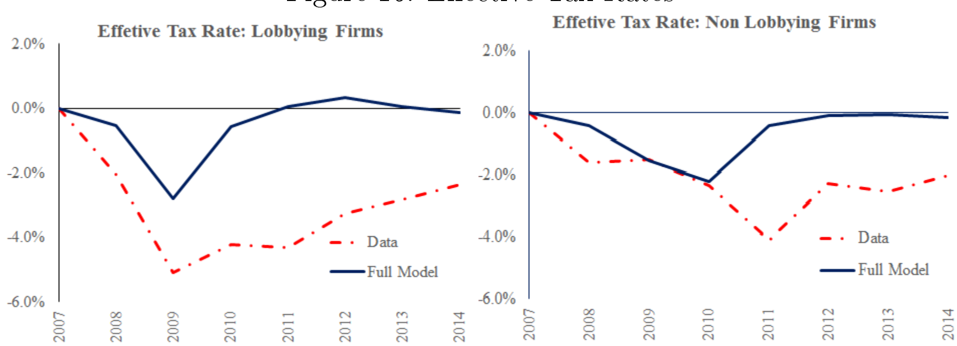


Figure 15: Counterfactual Dispersion of Capital



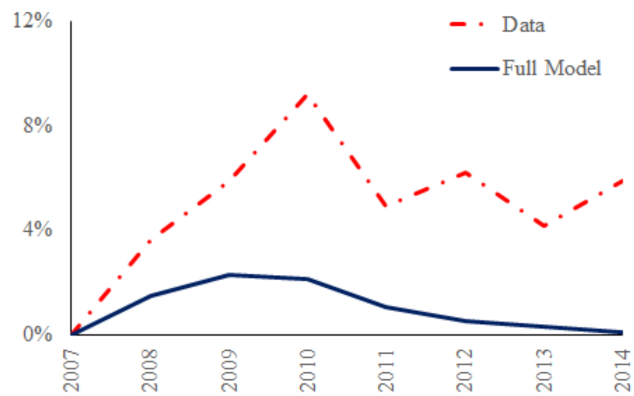
Note: the figure displays the evolution of the logarithm of the dispersion in the marginal product of capital relative to 2007 for the full model and the model without lobbying.

Figure 16: Effective Tax Rates



Note: The figure shows the cumulative change of the effective tax rate for public firms relative to the value of 2007 for the data and with respect to steady state in the model. The left panel shows values for lobbying firms, and the right panel for non-lobbying firms.

Figure 17: Share of Total Lobbying Expenditure by Sector 2



Note: The figure shows the cumulative change with respect to 2007 of the share of total lobbying expenditure by sector two.

C Online Appendix

You can find the appendix here