Regulatory Independence, Investment and Political Interference: Evidence from the European Union

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Abstract

This paper examines the implications of "modern" regulatory governance - i.e. the inception of Independent Regulatory Authorities (IRAs) - for the investment decisions of a large sample of EU publicly traded regulated firms from 1994 to 2004. These firms provide massively consumed services, and this is why governments are highly sensitive to regulatory decisions and outcomes. We therefore analyse and empirically investigate if: i) the inception of IRAs reduces the time-inconsistency problems that lead regulated firms to underinvest, and ii) governments' political orientation and residual state ownership interfere with investment decisions. To control for potential endogeneity of the key institutional variables, we draw our identification strategy from the political economy literature. Our results show that regulatory independence has a positive impact on regulated firms' investment while private vs. state ownership is not significant. We also find that, under executives at the extreme of the political spectrum, government interference in the functioning of the IRA is likely to re-introduce instability and uncertainty in the regulatory framework, thus undermining investment incentives.

Keywords

Institutions; Firm Investment; Private and State ownership; Regulatory Independence; Government's Political Orientation

JEL Classification: D92, K23, L33, L51, L90

1. Introduction*

Since the early 1990's, the public utility sector in the European Union has gone through substantial structural reforms that include liberalization of the markets, privatization of state-owned firms and the institution of independent agencies to regulate the provision of utility services. When evaluating the effect of these reforms, infrastructure investment is perhaps the most important economic dimension because of its impact on welfare and dynamic efficiency. On the one hand, public utilities typically deliver essential services through a network, which must be constantly maintained and upgraded to provide them in appropriate quantity and quality, and at reasonable prices. On the other hand, infrastructure investment is an acknowledged driving force of the economy and a major determinant of economic growth, often used as a counter-cyclical policy tool.[1] Guthrie (2006), for example, estimates that network industries, like energy, telecommunications, railways, airports, ports and water supply contribute, on average, 5% of the GDP of OECD countries, while gross fixed capital formation in these industries adds up to almost 15% of total investment in the non agricultural business sector.

The implementation of market liberalization, privatization, and of regulatory reforms, however, differ considerably across member states and industries, because the European Commission set the general framework and the guidelines while national governments set the pace of the process. The most important of these reforms is perhaps the institution of Independent Regulatory Authorities (IRAs) that the European Commission urged national governments to set up, in order to regulate the activity of network industries and to discipline the potential conflict of interest between the executive and state owned utilities.[2] In this paper we study how varying regulatory institutions and ownership patterns affect regulated firms' investment decision. We contend that the establishment of Independent Regulatory Authorities has a positive influence on public utilities' investment and empirically investigate whether this influence is entwined with residual state ownership and government's political stance about state intervention in the economy.

Why is regulatory independence so critical? When regulators are "not independent", the government[3] can either directly force or indirectly influence them to ex-post modify their decisions, thus constraining their ability to commit to their regulatory policy. This lack of commitment leads to time-inconsistent regulatory decisions, undermining firms' investment incentives: if regulators ex post are induced to revise their decisions, capital expenditures in new infrastructure, typically large, specific and sunk, can be expropriated, or not fully recovered by the investing firm. Thus, uncertainty in the regulatory policy negatively affects firms' investment decisions. The rationale behind the institution of an independent authority lies in the attempt to insulate regulators from political interference aimed at influencing regulated firms' investment or employment decisions, particularly when the government has ownership stakes in the utility.[4] Institutions like central banks and IRAs, are typically designed to limit political interference and supposed to enhance

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1 For example, using a panel of OECD countries observed from 1996 to 2007, Czernich *et al.* (2011) find that a 10 percentage-point increase in broadband penetration, as a proxy of broadband deployment, raises annual per-capita growth by 0.9-1.5 percentage points.

2 The OECD (2002), for example, describes IRAs as "one of the most widespread institutions of *modern* regulatory governance".

3 In this paper, we address independence of regulators from politicians, not from the regulated firm's stakeholders, as this form of regulatory capture is beyond the scope of the paper.

4 That politicians may be "bad regulators" is eloquently described by Stigler (1971, p. 3): "the political process defies rational explanation: 'politics' is an imponderable, a constantly and unpredictably shifting mixture of forces of the most diverse nature, comprehending acts of great moral virtue (the emancipation of slaves) and of the most vulgar venality (the congressman feathering his own nest)".

regulators' credibility and commitment.[5] Therefore, the design of regulatory authorities, if credible, includes institutional arrangements that restrain the government from opportunistic expropriation of the utilities' investments.

Utility sectors, however, are a special case of interest because the services they provide are massively consumed by the citizenry, and governments have the latitude and the interest to influence the pace of liberalization, privatization and regulatory reforms, in line with their political stance and objectives. Therefore, despite EU driven product market reforms, and notwithstanding the presence of an independent authority, politicians may still try to pursue their partisan goals by interfering with (private and state owned) public utilities' decisions in order to be re-elected or simply because they want to achieve their favourite policy outcome.

The degree of independence and the credibility of newly set up authorities are likely to depend on how much power Governments are willing to delegate. A regulatory agency can be provided with formal independence, i.e. with the right to decide on specified matters, but this *formal* (*de jure*) authority not necessarily confers the *real (de facto)* authority, that is the effective control over the decisions, independent of politics or politicians. Aghion and Tirole (1997) present a theory of the allocation of formal and real authority within organizations which shows that an increase in real authority (through delegation of powers) enhances the regulator's incentive and initiative to acquire the relevant information on the regulated activity, but results in a loss of control by politicians. This trade-off affects the degree of delegation from politicians to regulators and, in turn, the credibility and effectiveness of regulatory intervention.

The complex nature of the link between independent regulation and politics motivates the following research questions, i.e. Does the creation of independent regulatory agencies affect public utilities' investment decisions, and do privatized and partially privatized firms respond differently? What is the interaction with politics? Does the IRA succeed in constraining political interference in public utilities' investment decisions? To answer these questions, we estimate an econometric model of firm investment in which we take explicitly into account (i) the degree of independence of regulatory agencies, as it varies across sectors, countries and time; (ii) the share of state ownership of regulated utilities, as it changes over time and across firms, and (iii) the change over time in the political orientation of national governments, as this may ultimately influence the regulatory climate to be either pro-firm or pro-consumers.[6]

Our paper belongs to the recent strand of the political economy literature that investigates the impact of either policy reforms or institutions on a variety of economic dimensions, addressing the potential endogeneity of reforms. One branch of this literature has a broad historical perspective to analyse how social and political institutions affect economic development.[7] Another branch investigates the micro-economic consequences of reforms. Among the others, Bertrand and Kramarz (2002) study the effect of labour market institutions on employment growth in France; Besley and Burgess (2004) investigate the impact of labour regulation reforms on the economic performance of manufacturing industry in India; Alesina *et al.* (2005) and Griffith et al. (2007) study the effect of product market reforms on liberalized sectors' aggregate investment and unemployment, respectively.

This study also is on firms' responses to institutional reforms, in that we study the effect of the institution of the IRA by national governments on regulated firms' investment decisions. To test this effect econometrically we construct a panel dataset of 80 EU-15 publicly traded firms which operate in energy,

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5 According to Alesina and Tabellini (2008), regulation of public utilities is an example of "policies that lend themselves to bureaucratic delegation, since they pit special interests against those of consumers as a whole" (page 444). Perino (2010) shows that delegation unambiguously increases credibility, especially when new information affects the ex ante policy.

6 See Friedman (1962) and Alesina and Rosenthal (1995) for the influence of partisan politics and ideology on economic policies. While leftwing parties are rarely associated with market-oriented policies, rightwing parties are generally viewed as more in favor of deregulation and less inclined to support consumers' interests (see also Benoit and Laver, 2006). This insight is consistent with empirical evidence on the effect of government's ideology on fiscal policy, suggesting that leftwing executives are more willing to increase the size of the government through taxation and public expenditure than rightwing one; see, among the others, Alesina *et al.* (1997) and Ticchi and Vindigni (2010).

7 See, among the others, Persson and Tabellini (1999), Acemoglu, Johnson and Robinson (2001), Persson (2002) and Tabellini (2010).

telecommunications, water and transport infrastructures and cover more than 85% of quoted European utilities from 1994 and 2004. The sample comprises 10 of the top 30 companies in terms of market capitalization within the European Industrial Sector (Mediobanca Investment Bank, 2009). Utilities and telecommunications companies in Europe play a much more prominent role within financial markets *vis à vis* the U.S. where only two firms (AT&T and Verizon) rank among the top thirty. We complement firm-level data with country and sector specific variables on the regulatory framework and the political environment. To measure regulatory independence we use two alternative variables: a dummy that equals 1 in the year the Independent Regulatory Agency (IRA) was set up and thereafter, and an index of formal regulatory independence (Gilardi, 2005) which is based on key dimensions of the regulatory framework.

This paper contributes to the existing literature along three directions. First, while most studies focus on utilities in developing countries, we provide evidence for regulated firms in Europe, which is particularly interesting but complex to analyse, due to its cross-country institutional and political differences that persist despite the single market program and the monetary union. Second, although other papers do examine the relationship between the regulatory framework and investment, they do not consider its interplay with firm ownership and government partisanship. Third, following Acemoglu (2005)'s argument that political institutions should be treated as endogenous, we use an identification strategy borrowed from the applied political economy literature to control for the potential endogeneity of the key variables that may affect the investment decisions of regulated firms – such as the establishment of the IRA, its interaction with the Government, and firm ownership. In fact, politicians may decide to set up an independent regulatory authority just because they seek to expand or modernize the country's infrastructure and, accordingly, delegate some power in order to make the regulatory environment more stable, reduce the threat of hold up and bolster the investment incentives of regulated firms. By the same token, if the budget constraint is hard, the decision to privatise state-owned monopolists is likely be influenced by the need to carry out huge investment programs. To identify the direction of the relationship between investments, independent regulation, firm ownership and politics, we rely on instrumental variables techniques, and use alternative sets of time-varying characteristics of the political and financial institutions.

Our results show that regulatory independence does matter for the investment of regulated firms. More specifically, investments increase when an IRA is in place, or the more independent is the regulator, and this effect does not depend on firm ownership or on the extent of market liberalization. We also find that government's political orientation does matter, as investment is found to increase under more conservative (pro-firm) governments, but this positive effect appears to shrink and even change its sign if an IRA exists, or the higher is regulatory independence. On the one hand, our results suggest that the IRA restrains political interference; on the other hand, they also suggest that political interference in the regulatory functions of the independent authorities can be detrimental to investment incentives. The tension arising between politicians and regulators is thus likely to bring back instability and uncertainty in the regulatory framework

The rest of the paper is organized as follows. In Section 2, we review the literature background. In Section 3, we describe the institutional context. In Section 4 we present our identification strategy and in Section 5 we describe the dataset and define the variables and the instruments. In Section 6, we present the econometric model and the estimation methodology while in Section 7 we present the results. Section 8 concludes.

2. Literature Background

Regulated firms have to sustain substantial investment expenditures to construct and operate network infrastructures. Since public utility services are used by a the population at large, their prices are an issue of public concern, and regulators may be urged by public pressure and politicians to revise regulated charges as soon as investment expenditures are sunk.

The importance of regulatory independence is closely associated to the problem of time-inconsistency in regulation, i.e. the well-known regulatory opportunism, or hold up, problem.[8] The theory shows that

[8] See, for example, the survey by Armstrong and Sappington (2007).

regulatory opportunism leads regulated firms to underinvest (Besanko and Spulber, 1992). Whenever regulators cannot commit to long-term regulated prices, they may have an incentive to reduce the regulated rates ex post – i.e. once the firm's investment is sunk - in order to benefit consumers at the expense of the firm's owners.[9] More recently, Strausz (2011) models regulatory risk as uncertainty about the regulator's objective function – the weight attached to firm profits and the cost of public funds - and studies its impact on investment incentives. The view of an independent regulatory authority as the necessary condition for policy credibility is by Levy and Spiller (1994), who show that "independence" improves the regulators' ability to make long-term commitments to regulatory decisions and, as a consequence, that sunk investments are less likely expropriated ex post. Interestingly for our purposes, they also show that the credibility and effectiveness of a regulatory framework varies with a country's political and social institutions. [10]

State ownership is another institutional factor that must be taken into account when assessing the merits of economic reforms in the public utility sector. State-owned enterprises tend to be less cost-efficient because their managers obtain only a fraction of the benefits from cost-saving activities, face soft-budget constraints and are more likely influenced by politicians (Hart *et al*., 1997; Shleifer, 1998). Governments may in fact demand regulators to use the assets of state-owned utilities for policy objectives (e.g. to extend the universal service obligation or to provide the service in geographically disadvantaged areas) rather than to pursue profit maximization (Laffont and Tirole, 1991). Politicians' interference may thus impair the ability of regulators to commit. As shown by Bias and Perotti (2002), however, the costs of regulatory opportunism can be raised by encouraging "widespread" privatisation and fragmented ownership structures, where investors/voters may urge governments not to reduce shareholders' value through political interference in regulatory policy. Privatisation may thus deliver benefits – in terms of commitment powers – similar to the establishment of an independent regulator, as in the seminal paper by Sappington and Stiglitz (1987), who also show that the promise not to intervene ex-post is more credible under private ownership.[11]

Very few empirical studies investigate the relationship among regulatory independence and investment and even less take firm ownership into account. Moreover, most of these studies look at the public utility sector in developing countries or at one individual sector. Gutiérrez (2003) finds, for telecom companies in Latin American and Caribbean countries from 1980 to 1997, that regulatory independence has a positive impact on the number of phone lines per capita. Cubbin and Stern (2005) show, for a panel of electric utilities in developing countries from 1980 to 2001, that the existence of an independent regulator is associated with higher generating capacity. Egert (2009), using industry level data from 13 OECD countries, shows that incentive regulation implemented jointly with an independent regulator has a sizeable positive impact on investment in network industries, though the two variables do not display any significant effect when taken separately. The empirical evidence on the impact of firm's ownership on investment is mixed. Early studies show, for a variety of countries and industries, that privatizations led to higher fixed investment and innovation.[12] More recently, Gupta (2005) finds that partial, but not full, privatisation of Indian state-owned enterprises had a positive impact on privatised firms' investment from 1990 to 2000. Cambini and Rondi (2010), investigating the effect of incentive regulation, find that firm ownership has no significant impact on the investment of energy utilities' in five large EU countries in the decade 1997-2007. Finally, Wallsten (2001) finds that the privatization of telecom providers in Latin America and Africa was positively related to larger investment in connection capacity and phone penetration, but only where an independent regulator exists. Notably, none of these studies includes government's political orientation to control for direct government's interference over investment decisions.

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9 Building on this, Spiegel and Spulber (1994) show that firms can strategically use financial leverage and bankruptcy risk to discipline regulatory opportunism in order to shield investment incentives. Bortolotti, Cambini, Rondi and Spiegel (2011; BCRS hereafter) provide empirical evidence to the strategic relationship between debt and regulated rates.

10 Further advantages of independent regulatory authorities include enhanced expertise, flexibility in decision-making and sector-specific knowledge that reduces asymmetric information problems. Altogether, these features promote stability and continuity of regulators' course of action, enhancing their credibility (Majone, 1997).

11 For a recent survey on the costs and benefits of privatisation see Martimort (2006)

12 See Megginson and Netter (2001) for a survey.

Similarly to regulatory independence, competition may, in principle, strengthen regulated firms' incentives to invest. The empirical evidence on the complementarity between competition and regulation, however, is mixed. Ai and Sappington (2002), find that the impact of incentive regulation on U.S. telecoms' investment between 1986 and 1999 is more substantial where competition is tougher. Alesina *et al.* (2005) show, for non-manufacturing industries in 21 OECD countries from 1975 to 1996, that more competitive and less intensely regulated markets have higher aggregate investment at sectoral level. Our paper differs because we focus on an EU-wide panel of firms in many sectors and use firm-level data.

Last but not least, we consider how political institutions are likely to affect regulated firms' decisions. Shleifer and Vishny (1994) theoretically analyse the behaviour of private and public enterprises in situations where politicians try to influence firms to pursue political objectives. They show that "an important determinant of whether politicians want firms to be private or public is their ability to get tangible political benefits out of public ownership. The greater the independence of public firms from politicians, the less attractive public ownership for politicians" (pp. 1022-1023). Their framework, however, does not encompass the role of independent regulation and its interplay with political partisanship. Henisz and Zelner (2001) and Zelner and Henisz (2006) analyse and empirically investigate the impact of political institutions on regulated firms' investment. More specifically, Henisz and Zelner (2001) use telecommunications operators in 147 countries during the period 1960–1994, and find that the credibility of the political regime as measured by political institution variables (such as the presence of low and upper chambers, judiciary and some federal institutions, the effective systems of checks and balances, etc.) imposes stronger constraints on managers' discretion that positively affect investment. Zelner and Henisz (2006) use a panel of state-owned electric utilities from 78 countries (1970-1994) to investigate if veto powers and interest group pressure influence the annual rate of deployment of electricity generating capacity. In their view, state owned enterprises (SOEs) may be driven by political actors to undertake excessive investment projects (the so-called "white elephants") that provide targeted economic benefits to their constituencies. The empirical results support the hypothesis that the impact on electrical infrastructure investment by political institutions that constraint the behaviour of political actors varies with the level of interest group competition (households vs. industrial users) faced by electric utilities. [13]

The recent empirical literature on regulation and politics focuses on how both governments' ideology and political systems affect market reforms in regulated industries. Li and Xu (2002) investigate the political economy of privatisation and competition in 45 countries from 1990 to 1998. They show that democratic countries with strong pro-reform and pro-market interest groups are more likely to privatise firms and liberalize markets within the fixed telephone sector than less democratic governments. Gilardi (2005) finds that, in West European countries, the need to improve credible commitment when privatising and liberalising increases the likelihood to set up an IRA and that this likelihood increases with political uncertainty and instability. Duso and Seldeslachts (2010), using data from the mobile telecom industry of 24 OECD countries in the period 1991-1997, show that executives in favour of de-regulation and small welfare states speed up market entry while pro-regulation governments slows down liberalization. Finally, Potrafke (2010), finds, for OECD countries from 1975 to 2003, that rightwing and market-oriented governments foster product market deregulation.

All these studies show that regulatory institutions and market reforms are influenced by political decisions according to the specific social and political goals of the government in charge. This evidence suggests that the decision to delegate specific powers to an independent authority, as well as the decision to privatise regulated utilities may be endogenous. To the best of our knowledge, our study is the first one in the recent literature on political economy of regulation that allows for the potential endogeneity of both the existence of independent regulation and the residual state ownership. To this aim we borrow from the recent

[13] A recent strand of the literature studies the institutional design of public organizations and the extent to which public officials – like regulators and judges - are subject to accountability. Besley and Coate (2003), for the US electric power industry, find that the way commissioners are selected - either appointed by the government or elected by citizenry - affects the regulatory outcomes: in States where regulators are elected, prices are lower, but investments are also lower than in states where they are appointed by the government. This result suggests that being subject to (re-)election makes regulators more inclined to follow public opinion than if they were appointed and therefore to pursue short-term rather than long-term goals..

literature on political economy and use characteristics of the political, legal and financial institutions to instrument potentially endogenous variables.

3. Two Decades of Regulatory Reforms in the EU

Until the early Nineties, public utilities in Europe, with the only UK exception, were largely characterized by vertical integration, state monopoly and public ownership. Ministries, governmental committees and local governments were in charge of the regulatory decisions, setting tariffs and imposing quality standards. In that period regulation was viewed more as a sort of "political negotiation" among the utilities and the Ministry itself rather than as an instrument to create competitive conditions while amending market failures. Regulated rates were mainly set to counterbalance the rise of inflation while utilities were often asked to absorb labour units whenever unemployment increased. The result of this "un-incentive regulation" was ill performing monopolies and inefficiency (Megginson and Netter, 2001).

The European Commission issued various Directives to prompt national reforms that redesigned the legal and regulatory frameworks in order to raise efficiency, service quality, and spur infrastructure investment within EU member states. The public utility sector was therefore gradually liberalized with the involvement of private investors in the ownership and control of assets. The Commission, however, though in favour of privatisation, left the decision about utilities' ownership structure entirely in the hands of national governments. As of 2010, privatisation of public utilities within EU member states is far from complete, and central and local governments still hold majority and minority ownership stakes in many regulated utilities (Bortolotti and Faccio, 2009).

In order to regulate the provision of utility services and to avoid the potential conflict of interest between the Government and state owned utilities, the European Commission urged national governments to delegate regulatory competencies to independent authorities, entitled to act on the behalf of the central government, but outside of any state department or ministry. The new regulatory bodies ought to operate with their own specialized staff, with specific and detailed tasks and independently of ministries or government departments. The European Commission, however, left to national executives the decision about the definition and the scope of the delegated powers. Typically, delegated regulatory tasks involve price setting decisions, both at retail and wholesale level - whenever access to essential facility is needed to develop market competition -, the definition of entry conditions, the imposition of quality standards and all the technical rules to use or access to existing infrastructures. National authorities implemented a variety of regulatory mechanisms - ranging from the typical cost-plus (rate of return) to incentive-based schemes - that changed over time differently across countries and sectors, so that the inception of the IRA cannot be related to the adoption of a specific scheme. Within this set of regulatory rules, utilities are free to make their own decisions about investments and their financing.

To summarize, the implementation of liberalization reforms varies considerably across countries and sectors. It is most advanced in the telecom industry where independent regulatory agencies (IRA) have been established in virtually all member states and most of the companies are (at least partially) privatised. Market liberalization is also quite advanced within the energy sector, where the majority of electric and gas utilities is regulated by an IRA. However, many large utilities are still controlled by the government, particularly in France, Germany, Italy and Portugal and especially so in the natural gas industry. In contrast, structural reforms are lagging behind in water supply and in transportation infrastructure (docks and ports, airports and freight motorways). With the exception of the U.K., most water and transportation utilities are still controlled by central and local governments and still subject to regulation by ministries or by other branches of the government rather than by IRAs.

4. Estimating Firm Investment with Independent Regulation, Politics and Mixed-Ownership

In this section we address the identification problems arising when the purpose is to estimate the impact of regulatory independence on regulated firms' investment, while taking government's (partial) ownership and political orientation into account. As explained in the literature review, the theory shows that time inconsistency, regulatory lack of commitment and opportunism undermine firm investment incentives. From

the empirical point of view, the main challenge is that "lack of commitment", or the "regulatory opportunism", are not observable and cannot be measured. However, the theory also shows that the discipline of regulatory opportunism is expected to alleviate the hold up problem and restore the incentives to invest. As the recent regulatory reforms within EU member states suggest, the positive answer to this normative problem is the introduction of independent regulatory agencies, with an institutional design that should ensure that regulators are insulated from politicians who might undermine their commitment. Therefore, ideally, *independent* regulatory agencies are expected to soften the lack of commitment problem, the more so the more independent the regulator is from the government and, if lack of commitment has a negative effect on investment, then its discipline should display a positive effect on investment. Our empirical strategy is thus to rely on the existence of an independent regulatory agency, or on the degree of independence of the agency, to estimate the effect of curbed opportunism on investment. For this reason, however, the presence, or the degree of independence, of the IRA, is likely to be endogenous to the investment decision, given that the decision to set up an IRA itself is closely related to the lack of commitment problem and probably motivated by the intent of disciplining the potential regulatory opportunism and so to reassure the firm that investment rents will not be expropriated as soon as investment expenditures are sunk. This likely[14] endogeneity is an identification problem that we tackle by exploiting major institutional features that differ across countries, sectors, and over time as well as by using appropriate instrumental variable methods.

The second challenge we face is the link between politics, the IRA and firm investment, since the decision to set up an independent regulatory agency is likely to be political. As long as politics *indirectly* influences public utilities' investment through the IRA, it provides a suitable instrument for IRA. However, politics may also have a *direct* effect on investment, to the extent that it promotes and mould infrastructure investment (think of the decision to set up nuclear or photovoltaic, or wind-power energy plants; to deploy a broadband telecom network, to expand the motorway or the railway transportation system, etc.) as well as the choice of the technology (labour- or capital-intensive). In our preferred specification, politics enters linearly and interactedly with the IRA to test whether the impact of the IRA on investment changes with Government's political orientation.

Finally, the direct effect of politics on investment decisions is likely to be stronger if the government holds ownership stakes in regulated firms, and the larger the stake, the stronger the effect. So our empirical models extend to control for the direct vs. indirect effects of politics while also accounting for the presence of government, as an investor, in regulated utilities.

To summarize our econometric methodology, we test the impact of the presence of the IRA on regulated utilities' investment decisions (as said, this may be viewed as the inverse test of the effect of lack of commitment), first assuming it is a strictly exogenous variable and subsequently accounting for its potential endogeneity by relying on internal (i.e. lags of the IRA) and/or external instruments (e.g. an index of the political orientation of the executive in charge). We then account for the *direct* effect of politics by including the political orientation index among the regressors, and, because the effect of the IRA is likely to vary with government's political orientation, we enter these variables linearly and with an interaction. We similarly proceed with government's ownership, first using our ownership variable as an excluded instrument and then including it as a regressor, both standalone and interacted with IRA. Because the Government's decision to fully or partly privatise the regulated utilities may also be endogenous to the decision to spur utilities' investments, we allow for endogeneity of this control variable. For robustness, we use alternative sets of institutional and political variables both as instruments and as regressors.

5. Data and Variable Definitions

For the empirical analysis we use an unbalanced panel of 80 publicly traded utilities and transportation infrastructure operators from EU 15 founding member states, tracked from 1994 to 2004. The data covers firms that are either regulated by independent regulatory agencies or by ministries, governmental

[14] As explained in section 3, the decision to set up independent regulatory authorities was promoted by the European Commission, but the timing of the inception and the latitude of the delegated tasks were left to national governments.

committees, or local governments, and with various degrees of state ownership. The sample firms operate in electricity and natural gas (both distribution and transmission), water supply, telecommunications, freight roads concessions, ports, and airports. In all, we have 37 energy utilities, 12 water supply companies, 15 fixed telecom incumbent operators, 6 freight roads concessionaires, and 10 transportation infrastructure operators (airport, ports and docks). Our sample is not large but representative, as it covers more than 85% of publicly listed European utilities that in the period 1994-2004 can be tracked for at least five consecutive years, as this is what we need to estimate our econometric models.

Firm level accounting data have been collected from *Worldscope*. Our dependent variable is the investment to capital stock ratio (I/K). In the econometric analysis we use the ratio of capital expenditures to capital stock at the replacement value.[15] Other key variables of the investment equation are the operating cash flow to capital stock ratio (Π/K), the output (real sales) to capital stock ratio (Y/K), and the financial debt to capital stock ratio (D/K). Table 1 summarizes the descriptive statistics of the main variables used in the analysis, for the full sample (Panel A), for firm-year observations when the IRA does, and does not exist (Panels B and C), for the two sub-sample of firms that, at a point in time, become regulated by an IRA (Panel D) and that are never subject to an IRA (Panel E). We notice that the average investment rate for both firm-year observations under an IRA in panels B and firms that experienced the change and eventually became regulated by an IRA in panel D is greater than the mean investment rate of their respective counterparts in Panels C and E, though the difference is not large. Figure 1 plots the investment to capital stock rates of the two groups of firms behind Panels D and E and we observe that in the initial years (1994-1997) the *I/K* rate for firms never under an IRA was even larger while the investment rate of firms undergoing a change began increasing in 1996 and kept growing until 2001, i.e. within the time range in which the IRAs occurred in most countries (see Appendix Table A1). After 2001, all firms reduced their investment activity, consistently with a generalised slowdown, but investment at firms never under an IRA proceed at a slower pace and began to fall much earlier. In Figure 2, we look into the investment activity of firms undergoing the change in the regulatory regime *before* and *after* the introduction of the IRA. The picture clearly shows that the introduction of the IRA brings about an increase in the investment rates compared to one-to-three years before the event. Going back to Table 1, we observe that firms, and firm year observations, under an IRA tend to have higher leverage, smaller cash flow to capital ratios and lower state shareholding.

To indicate ownership, we employ a continuous variable constructed by Bortolotti and Faccio (2009), which uses the weakest link approach to measure the government's ultimate control rights *(Government UCR)*.[16] Within our sample, 21 firms changed their ownership status from state controlled to privately-controlled (i.e. the government has less than 50% of the ultimate control rights).

All firms operate in regulated sectors, i.e. where entry and prices are subject to regulatory oversight either by a government committee or by a formally Independent Regulatory Agency (IRA). In order to study the effect of regulatory independence on firms' investment decisions, we use an IRA dummy that is equal to 1 in all years in which the firm was subject to regulation by an IRA, and 0 otherwise. The IRA dummy was constructed using data and information on IRAs' inception dates taken from Gilardi (2005) for the energy and telecommunications sectors. We used additional sources to obtain information about the presence of IRAs within freight roads, airports, port and docks, and water supply. We found that only the water industry in the UK has an independent regulatory agency. As an alternative to the IRA dummy, we use the *Gilardi Index of formal Regulatory Independence*, which allows us to control for differences in the regulatory

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[15] The accounting data from *Worldscope* only include historic cost valuations of fixed assets, which usually bear little relation to current replacement cost of long-lived fixed capital assets. Hence, we calculate the replacement cost of the capital stock using the perpetual inventory formula: $p_{t+1}K_{t+1} = p_tK_t(1-\delta)(p_{t+1}/p_t) + p_{t+1}I_{t+1}$, where p_t is the country-specific implicit price deflator for gross capital formation in period t sourced by the OECD, K_t is the fixed capital stock in period t, I_t is the investment flow in period t, and δ is the depreciation rate. We derived the sector specific depreciation rates from Bureau of Economic Analysis estimates reported in "Rates of Depreciation, Service Lives, Declining Balance Rates, and Hulten-Wykoff Categories" and used 4.4% for energy, gas and water supply, 3% for freight roads concessionaires, 8% for telecommunications, and 4.5% for ports and airports.

[16] See La Porta, Lopez-de-Silanes, and Shleifer (1999), Faccio and Lang (2002). According to this approach, the UCR of the state is simply equal to the minimum ownership stake along the control chain (i.e., the weakest link).

environment across countries and sectors where the IRA exists.[17] We focus on *formal* independence because, to our knowledge, no indexes exist that quantitatively measure *real* independence of European regulators. This index is obtained by taking the average of five key dimensions of the regulatory framework: (i) the status of the agency head (for example, term of office and appointment and dismissal procedure), (ii) the status of the members of management board, (iii) relationship with government and parliament, (iv) financial and organizational autonomy, and (v) regulatory competencies. It goes from 0 (no independence) to 1 (full independence). The index is time invariant and is not available for water utilities and for transportation infrastructures, where the IRA does not exist. Regulatory independence varies considerably across European countries and sectors. In telecommunications, Austria, Ireland, Portugal, and the U.K. appear to have the most independent regulators, while Belgium and Germany have the least independent regulators. Turning to the energy industry, Austria, Belgium, and Italy appear to have the most independent regulators, Spain seems to have the least independent regulators while Germany does not have an IRA for energy.

The *Political Orientation* Index is a continuous and time-variant measure of the government's political stance, i.e. from leftwing to rightwing, and under reasonable assumptions, can be used to capture whether the government in charge is more pro-firm (supposedly right-wing) or pro-consumer (left-wing). The index ranges from 0 (extreme left wing) to 10 (extreme right wing) and is equal to a weighted average of scores given in expert surveys supporting government (see Huber and Inglehart, 1995, and Bortolotti and Faccio, 2009). The data in Table 1 show that the average index is 5.662, while the minimum is 3.665 (corresponding to the German government led by Gerard Schroeder in the years 2003 and 2004) and the maximum is 8.025 (assigned to the Italian executive led by Berlusconi from 2002 to 2004), indicating that the distribution of observations is more skewed towards the right.[18] In Appendix 1 we report, for each country, the political orientation of the executives in charge when the IRAs in the energy and telecommunications sectors were established. The table shows that IRAs became operative when the government in charge was right-wing or center-right in 17 cases out of 28, and in 6 out 28 cases when the government was left-wing or center-left. This anecdotal evidence reveals that the pattern of the data is sufficiently heterogeneous, though it seems that the IRA is more likely to be set up by conservative governments. It is also true, however, that if IRAs tend to be set up in the wake of privatization programs then a hypothetical link "rightwing executive-IRA" may in fact conceal a more complex "rightwing executive-privatizations-IRA" link. This is a three-way relation that further justifies our choice to adopt an estimation strategy that allows for the interactions of independent regulation, mixed-ownership and political orientation.

In our analysis we allow for the likely endogeneity of the decision to establish an IRA, and of the IRA's degree of formal independence as well as of residual state ownership. We obtain external instruments by exploiting country features that help gauging the degree of accountability of domestic institutions, the probability that policy reforms and political decisions may be (more or less easily) reverted, and the extent to which property rights are effectively protected.

The *Investor Protection index* is the "anti-director rights" index developed by La Porta *et al.* (1999) and updated by Pagano and Volpin (2005). The index is time-varying and goes from 0 to 7 as shareholders' rights become more and more protected. We use this variable to proxy for the extent of protection and enforcement of property rights. Countries where investors' and property rights are strongly protected are likely to have more credible institutions since, for example, liability rules are clearer, disclosure and accountability requirements are tighter, risk of expropriation and likelihood of contract repudiation by the government are smaller.

To control for characteristics of institutional and political systems that may influence the decision to privatize utilities and to introduce the IRAs, we use the *Political Orientation index* (see above) and the *Political Institutional Gallagher Index of Disproportionality*, an index of political fragmentation that allows

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[17] To our knowledge, Gilardi (2005)'s Index is the only one covering all sectors regulated by an IRA across EU member states. Edwards and Waverman (2006) and Larsen *et al.* (2006) constructed sector- specific indexes that assess the degree of formal independence for European countries' telecommunications and electricity markets, respectively.

[18] As shown by the inter-quartilic distribution of the *Political Orientation Index*.the first quartile is at 4.43, the median is at 5.27 and the third quartile is at 7.44, which indicates a fat tail towards the center-left and a thinner (and longer) tail towards the right wing of the political spectrum.

a categorization of countries based on a majoritarian -consensual dimension and a measure of government stability and of the veto-power of minority parties (Gallagher, 1991, updated by Bortolotti and Faccio, 2009). The index is continuous and time varying; it equals zero when the apportionment of parliamentary seats is exactly proportional to electoral results, and it increases as disproportionality increases toward a majoritarian system. As argued in Henisz and Zelner (2001), when political fragmentation is high, policies are adjusted less often because reforms are more likely to be blocked within a multi-party system and coalition governments, as the number of independent institutional actors with potential veto power increases. This implies that within a fragmented political system, politicians are less able to interfere with regulatory decisions, and the regulator should be – at least in principle - more independent. [19]

To complement our analysis we also use a set of variables taken from the World Bank database on Political Institutions, which has been extensively used in the political economy literature (see Beck *et al.*, 2001) for a detailed description of the variables in the World Bank database). Here is the list of variables used as instruments. The index of *Government Stability* is a time-varying survey-based measure that assesses both the government's ability to carry out its declared program, and its ability to stay in office. It ranges from 0 (low stability) to 1 (high stability). Insofar as the executive is more stable and less subject to veto powers, lack of commitment and time inconsistency are likely to be less of a problem. *EXERLC* is a time-varying variable equal to 1 when the executive is leftwing, 2 when it is centre, and 3 when it rightwing and can be used as an alternative to the index of *Political Orientation*. *Election date* is a dummy variable that is equal to 1 if there was an executive election in that year. Finally, *Checks & Balances* is a time-varying index that measures the number of veto powers in a political system according to specific legislative and executive indexes of electoral competitiveness. Table 1(Panel A) reports descriptive statistics for the political and legal institutional variables we use in the empirical analysis.

6. Econometric Model and Estimation Methods

Company investment decisions are every difficult to model both theoretically and empirically due to the problem of controlling for its dynamic component, for expected future profitability and for the natural endogeneity of the other firm level variables. The recent microeconometric literature (Bond and Van Reenen, 2008) has often relied on structural approaches such as the Q model (see, Gugler *et al.*, 2003 and Asker and Ljungqvist, 2010 for recent examples) or the Euler equation, introduced by Abel (1980) and developed by Bond and Meghir (1994) (see Brown, Fazzari and Petersen, 2009, for a recent application). The Euler equation derives from the first-order conditions for the optimal capital stock and therefore describes the optimal path of firm investment. It is not an investment rule where investment is a function of predetermined or exogenous variables but, rather, a structural relation between investment rates in successive periods as derived from dynamic optimization in the presence of symmetric and quadratic adjustment costs that take the form of foregone production. The advantage of the Euler equation model is that it captures the influence of current expectations of future profitability on current investment decisions without having to rely on stock market valuations of the firm as in the usual Q model approach, an attractive feature because, with partially privatized, regulated utilities, stock market valuations are likely to be less reliable and lead to larger measurement errors.

To obtain an empirical model, the firm is assumed to maximize the present discounted value of current and future net cash flows. Let L_{it} denote variable factor inputs, w_{it} the price of variable factors, p_{it} the price of output, I_{it} fixed investment, K_{it} the capital stock, pI_{it} the price of investment goods, ρ_{t+j} the nominal discount factor between period t and period $t+j$, δ the rate of depreciation, $F(K_{it}, L_{it})$ the production function and $G(I_{it}, K_{it})$ the adjustment cost function and $E_t(.)$ the

[19] In fact, while proportional parliamentary regimes lead to multy-party systems and, therefore, to coalition governments, majoritarian ones lead to the formation of two-party systems where the executive power is typically concentrated in the hands of the prime minister. This implies that, in a system characterized by a unified government, control over bureaucrats will be stronger than in systems characterized by a divided government (Alesina and Rosenthal, 1996). Therefore, the probability of observing more independent agencies is higher in systems characterized by divided governments (Spiller and Urbiztondo, 1994; Spiller, 2004).

expectation operator conditional on information available at t.[20] The firm solves the following optimization problem:

$$\text{Max } E_t \left[\Sigma_{j=0} \rho_{t+j} \Pi(K_{it+j}, L_{it+j}, I_{it+j}\right] \qquad (1)$$

$$\text{s.t. } K_{it} = (1-\delta) K_{it-1} + I_{it}$$

where $\Pi_{it} = p_{it}F(K_{it}, L_{it}) - p_{it}G(I_{it}, K_{it}) - w_{it}L_{it} - pI_{it}I_{it}$. The Euler equation characterizing the optimal investment path relates the marginal adjustment costs in adjacent periods and can be written as follows:

$$- (\partial\Pi/\partial I)_{it} = - (1- \delta)\rho_{t+1} E_t (\partial\Pi/\partial I)_{it+1} +(\partial\Pi/\partial K)_{it}$$

The symmetric adjustment cost function for the capital stock can be described by $G(I_{it}, K_{it}) = b/2 [(I/K_{it} - c)]2K_{it}$, where b reflects the importance of adjustment costs and c is the "normal" rate of gross investment. Since we are dealing with imperfect market structures characterized by non constant returns to scale – i.e. natural monopolies or imperfectly competitive markets with dominant firms subject to regulatory agencies with the tasks of regulating, among the others, prices, entry and access to the network - the output price p_{it} is assumed to depend on the output, with a constant price elasticity of demand (□).[21] We therefore introduce the output to capital ratio $(Y/K)_{it}$ to account for imperfect competition in the market.

The Euler equation can then be expressed as:

$$(I/K)_{it} - \gamma_1(I/K)2_{it} = \gamma_2 E_t(I/K)_{it+1} + \gamma_3[(\Omega/K)_{it} - J_{it}] - \gamma_4(Y/K)_{it} + \alpha \qquad (2)$$

where $\Omega_{it} = p_{it}F(K_{it}, L_{it}) - p_{it}G(I_{it}, K_{it}) - w_{it}L_{it}$ is the gross operating profit and Jit is the real user cost of capital (with $J_{it} = (pI_{it}/p_{it})\{1- (1-\delta)\rho_{t+1}pI_{it+1}/ pI_{it} \}$), while the coefficients γ_1, γ_2, γ_3 and γ_4 can be shown to be positive.

To implement this model, the unobserved $E_t(I/K)_{it+1}$ is replaced by the realized $(I/K)_{it+1}$ plus a forecast error, and the $(I/K)_{it+1}$ term is then moved to the left-hand side to obtain an econometric model that is linear in variables. Finally, the cost of capital term can be replaced by time and firm specific effects. Time dummies also control for common macro shocks. The empirical specification that we estimate then takes the form:

$$(I/K)_{it+1} = \beta_1(I/K)_{\text{it}} - \beta_2(I/K)2_{it} - \beta_3(\Pi/K)_{it} + \beta_4(Y/K)_{it} + d_{it+1} + \eta_{\text{i}} + \nu_{it+1} \qquad (3)$$

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[20] Our concise exposition of the Euler equation approach closely follows Bond and Meghir (1994) and Bond, Elston, Mairesse and Mulkay (2003).

[21] This is in line with the so-called Ramsey prices, which represent the second-best solution that a benevolent regulator should implement in a regulated setting. According to this pricing rule, prices are inversely related to the degree of demand elasticity.

Where Π/K is rate of operating cash flow to capital stock, Y/K is the sales to capital stock ratio, η_i. are firm specific effects, d_{it+1} are the time dummies and ν_{it+1} is the expectational error.[22] It can be shown that $\beta_1 \geq 1$ and $\beta_2 \geq 1$, while $\beta_3 > 0$ under the null hypothesis of perfect capital markets and when internal and external sources of funds are perfect substitutes. The coefficient β_4 is positive under imperfectly competitive markets or when the company is facing increasing return to scale. In our setting, while it is true that utilities typically face non-constant returns to scale, they are also subject to price regulation and one goal of regulation is to ensure that the behaviour of public utilities is similar to that of firms operating in a competitive environment and that prices are aligned to marginal costs. Moreover, the demand of public utility services is typically price inelastic, hence $\varepsilon < 1$. Hence, even though the utilities markets are imperfect, the sign of the coefficient β_4 might become ambiguous in a regulated setting as the two effects might compensate each other.

As described in Section 4, our main purpose is to investigate the implications of independent regulation for the investment policy of regulated firms when residual state ownership and government's political orientation can both influence investment, either indirectly (through the IRA) or directly. We thus augment the Euler equation for investment by adding, in turn: the dichotomous IRA dummy which is equal to 1 if firm i was subject to regulation by an IRA in year t and is equal to 0 otherwise, *Government UCR*$_{it}$, the ultimate control rights held by the Government, and the *Political Orientation Index*$_{it}$. The latter two variables are used first as external instruments and then included as regressors in the equation, since they are likely to display an additional direct effect on investment and would therefore be invalid instruments, leading to biased estimates. We therefore estimate the following reduced-form empirical model in which we add, one at the time, the institutional variables:

$$\begin{aligned}(I/K)_{it} = \beta_0 + \beta_1 (I/K)_{it-1} - \beta_2 (I/K)^2_{it-1} - \beta_3 (\Pi/K)_{it-1} + \beta_4 (Y/K)_{it-1} + \\ + \alpha_1 IRA_{it-1} + \alpha_2 GovernmentUCR_{it-1} + \alpha_3 PolOrient_{it-1} + \eta_i + d_t + \varepsilon_{it},\end{aligned} \tag{4}$$

We then investigate whether the impact of independent regulation varies with residual state ownership and executive's political orientation, by including the interactions of *IRA* with *Government UCR* and with *Political Orientation* and estimating the following reduced-form empirical model:

$$\begin{aligned}(I/K)_{it} = \beta_0 + \beta_1 (I/K)_{it-1} - \beta_2 (I/K)^2_{it-1} - \beta_3 (\Pi/K)_{it-1} + \beta_4 (Y/K)_{it-1} + \\ + \alpha_1 IRA_{it-1} + \alpha_2 GovernmentUCR_{it-1} + \alpha_3 PolOrient_{it-1} + \\ + \alpha_4 GovernmentUCR_{it-1} * IRA_{it-1} + \alpha_5 PolOrient_{it-1} * IRA_{it-1} + \eta_i + d_t + \varepsilon_{it},\end{aligned} \tag{5}$$

When we estimate the models with the interacted terms, we can calculate, for any given value of *Government UCR* and of *Political Orientation*, the total effect of the presence of the IRA as $\partial(I/K)_{it}/\partial IRA_{it-1} = \alpha_1 + \alpha_4 * Government\ UCR_{it-1} + \alpha_5 * PolOrient_{it-1}$, conditional on different patterns of ownership and partisanship. The coefficient α_1 thus measures the (limit) effect of the IRA on investment as both the Government's shareholding and the Political Orientation indexes go to zero, i.e., the effect of IRA on investment for fully privately controlled firms and when the government in charge is (extreme) leftwing. The coefficient α_2 measures the direct effect of state ownership while the coefficient α_3 measures the direct effect of political orientation of the executive. Finally, the coefficient α_4 measures how the effect of IRA varies with ownership (from fully private to fully public) while the coefficient α_5 measures how the effect of IRA differs as political orientation shifts from extreme left to extreme right. The interaction terms *Government UCR*IRA* and *Political orientation*IRA* thus estimate whether the impact of the IRA on investment is different across state- and privately-controlled utilities, and different across utilities under left- and right-wing governments, respectively. For all estimated equations, we report the results of tests of significance of the sum of the coefficients in order to assess the partial effects of political orientation and state ownership, conditional on the presence of the IRA.

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[22] It is possible to show that $\beta_1 = (1+c\nu)/\psi$; $\beta_2 = (1+\nu)/2\psi$; $\beta_3 = \mu/b\psi$, and $\beta_4 = (\mu - \nu)/(b\psi)$, where $\psi = \rho_{t+1}\ (1-\delta)\ (p_{it+1}/p_{it})$ is treated as constant, $\mu = (1 - 1/\varepsilon)$ is the mark up coefficient in an imperfect market; and ν is the returns to scale of the gross production function.

To estimate a dynamic investment equation using panel data, the endogeneity problems affecting both the firm level variables in the baseline investment equation and the regulatory independence variables suggest that we use the Arellano and Bond (1991) and Arellano and Bover (1995) linear generalized method of moments (GMM) estimator, which is especially designed for models where the lagged dependent variable is included and some of the regressors are potentially endogenous. More specifically, we use the dynamic System-GMM estimator developed by Arellano and Bond (1991) and Blundell and Bond (1998), which deals with situations where the lagged dependent variable is persistent and the lagged levels of the dependent variables are weak instruments. This model estimates a system of level and first-differenced equations and uses lags of first-differenced variables as instruments for equations in levels and lags of variables in levels as instruments for equations in first-differences.[23] In addition to internal instruments, i.e. lags of variables in the estimating equation, we use two sets of external instruments, taken from the financial and political institutions variables described in Section 5. For the validity of the GMM estimates it is crucial, however, that the instruments are exogenous. We therefore report the Arellano and Bond (1991) autocorrelation test to control for first-order and second-order correlation in the residuals. In fact, if AR(2) is detected, instruments dated t-2 are invalid and only instruments dated t-3 and earlier can be used. Moreover, to test the joint validity of the instruments, we calculate the two-step Sargan-Hansen statistic and report the resulting p-values in all tables. Since the Sargan-Hansen test is robust, but may be weakened if there are too many instruments with respect to the number of observations (see, for example, Roodman, 2006), we follow a conservative strategy and use no more than three (but mostly two) lags of the instrumenting variables. Finally, we test the overidentifying restrictions in the specifications where we experiment with a variety of external instruments, and calculate the Difference-in-Hansen test of exogeneity of individual instruments to guide our choice of instruments. Standard errors are robust to heteroskedasticity and arbitrary patterns of autocorrelations within individuals.

7. Results

Tables 2 – 9 report the estimates of the Euler equation models for regulated firms' optimal capital accumulation. In Tables 7, 8 and 9 we present the results of the sensitivity analyses. In Table 7, we test for the presence of bankruptcy costs; in Table 8, we replace the IRA dummy with the index of formal *Regulatory Independence*; in Table 9, we account for the impact of market liberalization and competition on firm investments.

7.1 Investigating the Impact of Independent Regulation

We start in Table 2 with simple OLS regressions with time and firm fixed effects where we report robust standard errors clustered at firm level, at sector level, and then at country-sector level because the IRAs were set up to address industry specific issues, but then each country implemented it following its own institutional rules and procedures. In the next section, we will remove – more plausibly - the exogeneity assumptions for the firm variables in the investment model and then proceed by addressing the endogeneity of the IRA dummy.

The fixed effects results in Columns (1) and (2) show that the coefficients on the lagged investment and lagged investment squared terms have the right sign and are always significant. The coefficient on the output

[23] The system estimator combines the differenced equations with equation in levels, for which the instruments used must be orthogonal to the firm-specific effects. Blundell and Bond (1998) show that, in autoregressive models, first differences of the series can be uncorrelated with the firm-specific effects provided that the series have stationary means. For this reason, we tested the time series properties of our main variables by estimating simple AR(1) specifications using OLS and considering conventional t-tests (see also Bond et al. 2003). We report the results in the Appendix Table A2. We find that the unit root hypothesis can be rejected for the relevant firm level variables, i.e. the investment, the cash flow and the sales to capital ratios. The Table also reports the Within Group (WG), the first-differenced and the system GMM estimates for comparison. As shown by Blundell and Bond (1998), in AR(1) models a consistent estimate of the autoregressive parameter is expected to lie in between the OLS levels and the WG estimates. Moreover, if the first-differenced GMM and the WG estimates are close this is likely to point at a weak instrument problem, and the GMM-System estimator is recommended. This is what we find for all three variables.

to capital stock ratio is positively signed, but insignificant in all columns. As suggested in Section 6, this is probably due to the combined effects of imperfect competition in a regulated environment and inelastic demand of public utility services that may compensate each other and lead to an insignificant or even negative coefficient. All estimated models, however, show the same inconsistency with one theoretical assumption of the Euler investment equation, namely the positive and significant coefficient of the cash flow term. Since the cash flow was predicted to have a negative and significant coefficient, this result suggests the presence of imperfections in the capital markets such as information asymmetries or incentive problems (see Bond and Meghir, 1994, and the literature reviewed by Hubbard, 1998).

We now turn to our main variable of interest, the *IRA* dummy. We find that the coefficient on the lagged IRA term is positive and significant in all columns. This result indicates that the level of investment is higher when an independent regulatory agency exists, consistently with theory showing that regulatory independence enhances the investment incentives of regulated utilities (Levy and Spiller, 1994). We then add *Government UCR* to test the hypothesis that state ownership has a direct effect on the investment decisions of regulated firms. The direction of this influence, however, is ambiguous because privately-owned utilities are thought to have stronger incentives to invest (see, for example, Sappington and Stiglitz, 1987; Martimort, 2006), but state-owned utilities might be used by politicians to carry out "white elephant" investment programs for their own political benefits (see Zelner and Henisz, 2006). Our results reflect this ambiguity, as the coefficient on *Government UCR* is not significantly different from zero.[24]

In Columns (3) and (4), we focus on the sub-sample of regulated firms that at some point in time switched from forms of government regulation to independent regulation by an Agency, in order to compare their investment behaviour before and after they became subject to an IRA. The estimating sample consists of energy and telecom utilities for most EU countries as well as the water supply firms in the UK. The specifications are the same as in Columns (1)-(2) and, similarly, we report standard errors clustered at the firm, sector and country-sector level. The results are unchanged and the coefficients are similar in size and significance, the IRA dummy in particular, thus confirming, for European utilities, that the switch to an independent regulation regime had a positive effect on their investment decisions.

7.2 Controlling for Endogeneity of the IRA

In Section 4 we argued that independent regulatory agencies are likely to be set up because lack of commitment due to political interference may undermine investment incentives, a good reason to challenge the presumed exogeneity of the IRA. We will consider the *indirect* influence of politics by including a measure of the political orientation of the executive to instrument the IRA dummy and we will then also account for the potential endogeneity of both ownership and political orientation. The results are in Table 3.

In the first two columns of Table 3, we start by reporting the GMM-System estimates of our baseline model, where we allow for the potential endogeneity of the firm variables in the investment equation, but not of the IRA (nor of firm ownership). That is, we still assume that *IRA* and *Government UCR* are exogenous. Compared to Table 2, the main difference is that the point estimates of both (I/K) and $(I/K)^2$ are now closer to 1 in absolute value as the theory predicts, suggesting that the investment dynamics implied by the theory is supported by the data (in all columns, the t-tests on the point estimates cannot reject the hypothesis that the coefficients are one). The coefficient on the cash flow term is positive but insignificant while, more importantly, the IRA dummy is highly significant in both columns. State ownership remains insignificant. The robust Sargan-Hansen test of over-identifying restrictions cannot reject the validity of the instrument set.

[24] In the Appendix Table A3, we report the results of three very simple difference-in-difference specifications where the investment ratio is regressed on the lagged IRA dummy (Column(1)), on the IRA dummy and Government UCR (Column (2)), and then adding the firm level controls (i.e. the lagged investment term, the cash flow and the output to capital ratios). In all regressions we include firm and time specific fixed effects and report standard errors which are clustered at the firm, sector and country-sector level. The results show that estimated coefficient on the IRA dummy is positive and significant in all columns and the firm level controls also enter positively and significantly. It is worth noting, however, that Bertrand, Duflo and Mullaithan (2004) raise several concerns about the validity of differences-in-differences estimates as obtained by using OLS on panel data, because they tend to over-reject the null hypothesis of no effect because of serial correlation problems. In the following, we take care of these concerns.

However, the decision itself to set up an IRA may interact both with the residual state ownership in the public utility and with the executive's political stance. In the next two Columns, therefore, although the Sargan-Hansen test did not detect any problem in Columns (1)-(2), we allow for the potential endogeneity of the *IRA* and then of *Government UCR*. Columns (3) and (4) report the GMM-SYS estimates, where all variables are treated as endogenous and instrumented with their own lags as well as with external variables.[25] Under each column we also report the Difference-in-Hansen test of exogeneity of individual internal and external instruments. In Column (3), the instrument set includes the second lags of the *IRA* variable, and of *Government UCR* (lagged twice, because the (t-1) lag was rejected as an invalid instrument by the Difference-in-Hansen test), and *Political Orientation*. We also add *Investor Protection* and *Disproportionality*. The former gauges the extent to which the law protects and enforces investors' rights and is meant to proxy for the credibility of domestic institutions. The latter measures the fragmentation of the political system, and is meant to seize the power of politicians' to interfere with the regulator (see Section 5).

The results show that the IRA dummy enters with a significant coefficient, confirming its positive effect on regulated firms' investment decisions. The Sargan-Hansen test does not reject the validity of the instrument set, but recalling that the Diff-in-Hansen test found *Government* UCR_{t-1} an invalid instrument, we include state ownership in the regression in Column (4). We find that the coefficient of *Government* UCR_{t-1} is positive, suggesting larger investment by state-owned firms, but the p-value is 0.21, hence not significant at the conventional levels.

Finally, in Columns (5) and (6) we re-estimate the same specifications to test for the change in investment behaviour within firms that became subject to an IRA, hence excluding firms that did not experienced this change. The GMM-System estimates confirm that the switch to an IRA regime does have a positive and significant impact on the investment decisions of these firms. We also note that the relevant parameters of the Euler-equation investment model for the group of IRA regulated firms are very similar to the full sample, i.e. the lagged linear and squared investment terms are significant and of the expected size and sign while the cash flow and sales to capital ratios remain insignificant.

7.3 Introducing Politics and Interacted Effects

In Table 3, we included the once lagged *Government UCR* variable due to its rejection as an invalid instrument, but then we found that that the estimated coefficient did not reach significance at the conventional levels. This suggests that *Government UCR* might have a direct effect on investment, conditional on the presence of the IRA.[26] Table 4 explores the interplay between the IRA and firm ownership while also extending the analysis to test for the *direct* impact of the government's Political Orientation (as politicians may be interested in driving large investment programs) and for its interaction with the IRA. If one recalls that IRAs in Europe were prompted by the EU Commission to limit political interference on state controlled utilities, then the empirical question is whether the impact of residual state ownership and politics changes with the presence of the IRA. In other words, the presence of an IRA is expected to capture a "more" credible, or "less" opportunistic regulatory environment, but the investment-enhancing impact of the IRA might still differ with different levels of state ownership, or depending on the political stance of the executive.

The results support our strategy. In Column (1), the *Government UCR*IRA* interaction is positively signed, suggesting that, when the IRA exists, state-owned firms tend to increase their investment, but neither the linear nor the interacted terms are significant. Moreover, the IRA coefficient has turned insignificant (the p-value is 0.194), hinting at some misspecification in the identification of relationship between IRA and Government ownership. In particular, we notice that *Political Orientation* is now found to be an invalid

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[25] GMM estimation of dynamic panel data models is in line with what Bertrand, Duflo and Mullainathan (2004) suggest adopting when the main purpose is to identify the effects of specific policy interventions or treatment within a difference-in difference approach. They write: "We also hope that our study will contribute in generating further work on alternative estimation methods for DD models (such as GLS estimation or GMM estimation of dynamic panel data models) that could be more efficient in the presence of serial correlation" (p. 274).

[26] For example, Edwards and Waverman (2006) find, for the EU telecommunication industry, that wholesale charges are higher when the public telecom operator (PTO) is state-owned, but decrease when the state-owned PTO is subject to an IRA.

instrument, leading us to include it in the regression in Column (2). Here we find that the coefficient on the IRA dummy is highly significant again (p-value is 0.03), though both *Government UCR* and *Political Orientation* are insignificant. Comfortingly, however, the Sargan and the Diff-in-Hansen tests show that instruments are valid, both jointly and individually. In Column (3), we add the two interactions. We find that the IRA dummy is positive and significant while the *Government UCR* linear and interacted terms remain insignificant. More interestingly, both the standalone *Political Orientation* variable and its interaction with IRA enter significantly and with opposite signs, which suggests that the direct effect of political orientation on investment differs conditional on the presence of the IRA. The linear term is positively signed, suggesting that regulated firms tend to increase their investment when the executive is rightwing (the *Index* is high), hence, in principle, more market-oriented and pro-firm rather than pro-consumer. In contrast, *Political Orientation*IRA* is negatively signed, indicating that the positive effect of rightwing executives on investment shrinks when the IRA exists (or, alternatively, the positive effect of the IRA shrinks when the government is very conservative).[27]

To further probe the impact of political orientation on investment, in the Appendix Table A5, we focus on the sub-sample of firms and sectors that became subject to the IRA, confining the estimation to the years when the IRA is in place (i.e. hence there is no interacted term). If the result in Column (3) of Table 4 holds, i.e. when the IRA is in place, investments decrease as the executive becomes more and more rightwing, the estimated coefficient on political orientation should be significantly negative. This is what we find in Column (1) as well as in Column (2), where, as an alternative to the *Political Orientation Index*, we use *EXERLC*, the discrete partisanship index from the World Bank Political Institutions Database. With both variables, the estimated coefficient is negative and significant.

Because the significant interaction between the *IRA* dummy and *Political orientation* hints at negative spillovers on regulated firms' investment, we focus on the marginal effects of IRA and political orientation, and report them graphically. While the positive α_1 and α_3 coefficients imply that firms tend to invest more when the IRA exists and when the government is conservative, the negative α_5 coefficient suggests that the change in investment is less pronounced if the government is rightwing and the IRA is in place. If we test the significance of the sums of the coefficients (reported at the bottom of Column (3) in Table 4), we find that the sum of $\alpha_1 + \alpha_5 = 0.062$ is significantly different from zero while the sum $\alpha_3 + \alpha_5 = -0.006$ is insignificantly different from zero. The lack of significance of $\alpha_3 + \alpha_5$ is an indication that the presence of the IRA curbs the effect of the executive's political interference (which is *per se* statistically weaker than the effect of the IRA) in the investment decisions of the regulated firms. And this is consistent with the expectations of the EU Commission when it spurred governments to set up the independent regulatory authorities. However, symmetrically, the significance of the $\alpha_1 + \alpha_5$ sum suggests that political interference may weaken, and even revert, the positive influence of the IRA when *Political Orientation* reaches extreme values, a result we interpret below.

To illustrate how the impact of *Political Orientation* on firm investment varies conditional on the presence of the *IRA*, in Figure 3, we plot the partial effect of the sum: $\alpha_3 + \alpha_5$**IRA* and the corresponding 95% confidence intervals based on the estimated coefficients in Column (3). The figure shows that the increase in investment experienced by firms under rightwing governments vanishes if the IRA is in place. When the IRA dummy is equal to one, the total effect of *Political Orientation* is summarized by the statistically insignificant sum of the point estimates: +0.007 – 0.013 = -0.006, indicating that the effect of the IRA offsets the effect of the executive's political orientation. Figure 4 plots the partial effect of the IRA conditional on the executive's political orientation (i.e. the sum $\alpha_1 + \alpha_5$**Political Orientation)*. We notice

[27] To check the robustness of the result on political orientation, we also experimented with specifications including the linear and interacted *Government UCR* terms only in the instrument set and not in the regressions, and we found that the results on *Political Orientation* remain unchanged. We then added industry dummies both as regressors and as instruments, and found that again all the results hold. However, we prefer to exclude the industry dummies because the instrument count would outnumber individuals in the panel, and this may weaken the Sargan/Hansen test (Roodman, 2006). Results are available on request. Further we re-estimated the relevant specifications with the first-differenced GMM- estimator, which uses (lags of) variables in levels to instrument differenced variables and is therefore less efficient due to the weak instrument problem (Blundell and Bond, 1998). The results are reported in the Appendix A4 and very similar to those obtained with the GMM-System estimator. In particular the *IRA* dummy is positive and highly significant, the *Political Orientation* index is positive and not far from significance (the p-value is 0.135) and the *Political Orientation*IRA* interaction is negative and significant.

that the positive effect of IRA on investment reduces in size as the *Political Orientation* index increases, i.e. as the government becomes increasingly rightwing. If we calculate the impact of IRA at the average value of the political orientation index, which is 5.662 (see Table 1), we find that the investment increase is still around 1% (0.84%). As the political view of the executives becomes more and more conservative (when the index ranges between 0.082/0.013=6.308 and the maximum value 8.025), the effect turns negative.[28] Compared to leftwing governments, rightwing executives are typically viewed as more eager to contain state intervention and limit the bureaucrats/regulators intervention in the economy (see Alesina and Rosenthal, 1995, and Benoit and Laver, 2006). This result thus suggests that under highly conservative governments, the conflicts between the objective functions of the regulator and of the rightwing executive is such that the institutional and regulatory environment becomes more uncertain and unstable. The diverging goals of politicians – on one side - and bureaucrats/regulators – on the other side – may thus generate negative spillovers that eventually undermine investment incentives. Apparently, then, our results suggests that IRAs succeed in restraining political interference in investment decisions, but only up to a point, that is only if the beliefs, or the political views, behind the executive in charge are not in contrast with the institutional principles behind the creation of the IRA itself.

7.4 Further Controls on the Identification of the IRA

In Section 7.2, we handled the potential endogeneity of independent regulation to utilities' investment by instrumenting the *IRA* dummy with *Investor Protection* and *Disproportionality* and by treating *Government UCR* and *Political Orientation* first as excluded instruments and then as regressors as well as instruments (to be precise, two-years lags of the variables are used as instruments and one-year lags as regressors). In this section we check the robustness of our results by using an alternative set of external instruments, which captures additional features of the political institutional environment, and at the same time removing the internal instruments. The new variables are sourced from the World Bank's Database of Political Institutions and have been recently used in a similar vein by Pagano and Volpin (2005), Da Rin *et al.* (2010) and Ticchi and Vindigni (2010), among the others. Some of the variables seize the interaction between the IRA and the political environment. For example, if the decision to establish the IRA is politically motivated, then the *Election Date dummy* may capture a change in the executive that may have lead to the institution of the IRA. Because delegation is thought to be credible only when it cannot be revoked easily and the political system constraints executive discretion[29], the *Checks & Balances Index* is used to capture the credibility of regulatory independence. Other institutional characteristics are used to proxy or replace the variables in the original specification. The time-varying index of *Government Stability* is another proxy for commitment and credibility, while the *EXERLC* index, which is 1 when the executive is leftwing, 2 when it is centre, and 3 when it rightwing may be used to instrument the political orientation index. *EXERLC* varies over time like the *Political Orientation* index, but is less refined in graduating nuances in the partisanship of executives (see Section 5 for a detailed description).

Table 5 reports System-GMM estimates of the investment equation where the external variables described above are the only instruments for the IRA dummy (hence no lags of IRA are included as instruments, nor the *Investor protection* and *Disproportionality* Indexes). In Column (1) of Table 5, the estimated coefficient on the *IRA* dummy is positive and significant and its magnitude is similar to estimates in Table 4. In Column (2) we include firm ownership and political orientation, while in Column (3) we add the interacted terms. The instrument set does not include the lags of the (institutional) regressors, so no lags of the *IRA* dummy, *Government UCR* or *Political Orientation*, but only lagged external variables. Again the results are very similar to those in Table 4 and confirm the positive impact of independent regulation on regulated firms' investment and the disciplining of political interference by the IRA.

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[28] If we match the *Political Orientation* index values with the executives in charge in that range, we find the Governments led by Kohl in Germany, from 1994 to 1997 (the value of the index is 6.69), in Spain by Aznar from 1997 to 2003 (7.5), in the UK by John Major in 1994-1996 (7.8); in France by Chirac in 2003-2004 (7.8); in Denmark by Anders Rasmussen since 2002 (7.98), and in Italy by Berlusconi from 2002 to 2004 (the maximum value of the index: 8.025). The minimum value, 3.665, is assigned to the German executive led by Gerard Schroeder in the period 2002-2004.

[29] This is a quite robust result of the literature on central banks independence; see Keefer and Stasavage (2003).

Even though the Sargan and the Diff-in-Hansen tests have never, to this point, rejected the validity of our instruments, we perform an additional robustness test of the identifying assumptions (see for example Tabellini, 2010) and check the validity of the excluded instruments by including them directly in the regressions. If we are correct in excluding them, then they should display no direct effect on investment, and the estimated coefficient on IRA ought to remain statistically significant. The results are in Table 6. In Columns (1) and (2), we include *Investor Protection* and *Disproportionality* and in Columns (3) and (4) we include the entire set of World Bank political institutions variables (that we used to instrument IRA in Table 5).

The results support our identification strategy. In Columns (1) and (2), *Investor Protection* and *Disproportionality* are insignificant while the *IRA* dummy remain highly significant. The World Bank variables are also insignificant, except for *Government Stability*, which enters in Column (3) with a p-value of 0.087, but is insignificant in the specification with the interacted terms (Column (4)). *Political Orientation* is positive and significant in Column (2) while its interaction with IRA is negative and significant in both Columns (2) and (4). *IRA* is always positive and significant and the size of the coefficients is similar in all columns and also similar throughout the tables.

7.5 Sensitivity Analysis: Debt Finance, Formal Regulatory Independence and Competition

An attractive feature of the Euler equation approach is that it can be extended also to debt as a source of investment finance (Bond and Meghir, 1994). The model assumes that the rate of interest paid by the firm on debt finance may be an increasing function of debt issued, a situation that occurs whenever the firm faces a bankruptcy risk, because the probability of bankruptcy is an increasing function of the amount of the debt outstanding. This allows us to test for the impact of bankruptcy risk and financial distress on regulated utilities' investment, a feature that Spiegel and Spulber (1994) find to be of key importance if capital structure is strategically used to influence regulated rates. After including the institutional variables and the usual interacted terms, the augmented Euler equation for capital stock can be written as:

$$\begin{aligned}(I/K)_{it} = \beta_0 + \beta_1(I/K)_{it-1} - \beta_2(I/K)^2_{it-1} - \beta_3(\Pi/K)_{it-1} + \beta_4(Y/K)_{it-1} + \beta_5(D/K)^2_{it-1} + \\ + \alpha_1 IRA_{it-1} + \alpha_2 GovernmentUCR_{it-1} + \alpha_3 PolOrient_{it-1} + \\ + \alpha_4 GovernmentUCR_{it-1} * IRA_{it-1} + \alpha_5 PolOrient_{it-1} * IRA_{it-1} + \eta_i + d_t + \varepsilon_{it},\end{aligned} \tag{6}$$

where D/K is the financial debt to capital stock ratio. The additional term $(D/K_{it})2$ thus controls for the non-separability between investment and financial decisions. The sign on the debt coefficient, β_5, is expected to be negative if bankruptcy costs exist, and zero if there are no bankruptcy costs and debt and investment decisions are separable. The negative coefficient reflects that the expected cost of borrowing is not independent of the probability of bankruptcy and also that the probability of bankruptcy decreases as the firm size increases for a given level of debt.

The results are in Table 7. The point estimate of the coefficient on the debt term has the expected negative sign and is significant in all columns, suggesting that, also for this sample of regulated firms, the investment and financing decisions are not separable due to the presence of deadweight costs associated to bankruptcy. This result supports the idea of a strategic use of leverage that, through the bankruptcy threat, may induce the regulator to commit to the regulated rates, so as to allow the regulated firm to follow the optimal investment path (see BCRS, 2011, for empirical evidence on regulated rates). The remaining results hold, including the highly significant coefficient of the IRA dummy.

The next step is to replace the IRA dummy with the *Formal Regulatory Independence Index* (Gilardi, 2005), which graduates the formal level of regulatory independence from 0 (no independence) to 1 (full independence). Results are in Table 8. Although the index is time invariant, by using a continuous variable we can account for differing levels of regulatory independence across countries and sectors in which an IRA exists. This test allows us to investigate the effect that varying degrees of regulatory independence have on the sub-sample of firms that are actually subject to an IRA, e.g. the energy and telecommunications industries in most countries and, for the UK only, water supply. The results confirm the positive effect of

regulatory independence on investment and the negative externality of political interference. The coefficient on the *Regulatory Independence Index* is positive and significant in all columns, suggesting that the higher the formal regulatory independence the higher the investment. In Column (3), when we include the interacted term, the coefficient on the linear *Political Orientation* variable turns positive and significant while its interaction with the *Regulatory Independence Index* is significantly negative. The main difference with previous results is that *Government UCR* now enters significantly. The negative α_2 coefficient on the linear term indicates that the larger the Government's stake the lower the investment rate, but the positive α_4 coefficient on the interaction suggests that the effect of Regulatory Independence is to increase state-owned utilities' investment. Overall, the test which applies the index of *Regulatory Independence* to firms subject to IRA yields results consistent with those obtained when we used the IRA dichotomous dummy for the full sample.

Last but not least, we control for the effect of the increasing market competition that is expected to follow the product market reforms of the past decades. To capture the pace and intensity of liberalization and deregulation reforms in a variety of sectors and countries, we use an index sourced from the OECD International Regulation database by Conway and Nicoletti (2006). The index is an average of several indicators which vary from 0 to 6 (lower numbers indicate a greater degree of openness) and reflects entry barriers,[30] the vertical structure of the market, the state ownership in firms that operate in the relevant sector, the market share of the dominant player(s), and the presence of regulatory controls on retail prices and specific guidelines for its implementation. We eliminate the state ownership component from the index, because we already have a well-defined ownership variable, and recalculate the average over the remaining OECD sub-indicators (market entry, vertical integration and market structure). As in the original OECD index, high values of the index are associated with low degrees of liberalization. In Table 9, we thus add the new variable, *OECD Liberalization Index*, to the usual specification with the *IRA* dummy in Column (1). In Column (2) we test its interaction with IRA, and in Column (3) we include *Government UCR* and *Political Orientation*, and test the robustness of the *Political Orientation*IRA* interaction. Notably, the index does not exist for infrastructure industries such as ports and airports, and water supply, so we run the regressions for the subsample of firms operating in energy, telecoms, and freight roads.

The results in Columns (1) and (2) show that the coefficient of *OECD Liberalization Index* is insignificant, but when we include *Political Orientation* to allow for the political stance of the government, in Column (3), we find that the estimated coefficient on the *Liberalization Index* is almost significant (the p-value is 0.117) and negatively signed, suggesting that as long as liberalization makes progress and markets become more open and competitive, regulated firms increase their investments. This result is consistent with Alesina *et al.* (2005) who, using the above indexes, find that deregulation and liberalization spur investment in non-manufacturing sectors in OECD countries. Furthermore, in that the *OECD Liberalization Index* approaches significance only when we account for the government's political orientation, our results are in line with Duso and Seldeslachts (2010) and Potrafke (2010), who find that political partisanship is a driving force of product market deregulation within OECD countries. Comfortingly, both the IRA dummy and its interaction with Political Orientation remain highly significant, confirming that our main results are robust when we control for the intensity of market liberalization.

8. Conclusions and Implications

Over the last 20 years, in most European countries, regulatory competencies have been delegated to independent authorities mainly to reduce potential conflicts of interests that surface when politicians directly or indirectly control companies providing essential services for citizens. The expectation was that this new institutional arrangement would enhance the credibility of the regulatory commitments and positively affect public utilities' investment spending. Notwithstanding IRAs, politicians can still influence the regulatory policy to pursue their partisan interests, and government intervention might especially intensify when utilities are (totally or partially) controlled by the State and market liberalization is incomplete. Regulatory

[30] Low values of the entry barriers indicators are associated with competition in all segments of the relevant sector as well as with vertical separation between downstream and upstream firms. High values are associated with the existence of a vertically integrated legal monopoly.

independence, government's political orientation and residual state ownership are thus institutional features that, separately and interactedly, may affect investment spending in the public utility sector, which is acknowledged as a driving force of economic growth.

This paper investigates the investment decisions of a large panel of publicly traded European regulated firms from 1994 to 2004, taking the changing institutional environment into account, namely: (i) varying degrees of independence of regulatory agencies across different sectors; (ii) varying degrees of state ownership within regulated public utilities, and (iii) the government's political orientation, in that executives may ultimately influence the regulatory climate to be either pro-firm or pro-consumers. Motivated by the recent strand of applied political economy literature, we address the potential endogeneity of these institutional variables and rely on instrumental variables techniques and alternative sets of instruments to identify the direction of the relationship between investment, independent regulation and politics.

Our results show that when an Independent Regulatory Agency is in place, or when the regulator is more independent, investment does increase. This evidence implies that the gradual introduction of *modern* regulatory governance in Europe contributes to a more credible and stable environment that, as predicted by the theory, strengthens the regulated firms' investment incentives and generates positive effects on the economy as a whole.

As regulatory reforms were implemented in Europe, however, firm privatisation and market liberalization were also in progress. Our findings do not support a significant difference between the investment of privately controlled and partially privatised utilities, showing instead that market liberalization, after controlling for the presence of the IRA and for government political orientation, has a positive influence on regulated firms' investment.

Finally, our results show that politics still affect firm behaviour. Delegation to bureaucrats –to IRAs in our case - is preferable, from the normative point of view, when time inconsistency and short-termism may influence the decision process, or if vested interests have large stakes in the policy outcomes, as in the case of regulated utilities. However, from the positive point of view, politicians may not be willing to fully delegate policy powers to bureaucrats (Alesina and Tabellini, 2008). Incomplete delegation thus implies that a *formally* independent regulatory authority might not *per se* be the sufficient condition to create a more stable, less opportunistic regulatory environment, as long as politicians wish to retain some policy tools that they may use to make their re-election more likely (political rent-seeking) even at the cost of making the regulatory environment less stable and more uncertain. What are the implications for investment?

Our results shows that both formal regulatory independence and (rightwing) political orientation of the executive have a positive effect on investment, but also that the interaction between the two is negative, suggesting a negative spillover for high values of the index. Our interpretation of this negative spillover is that a conflict of policy objectives may arise whenever a formally independent regulator coexists with an executive at the extreme right of the political spectrum. This conflict would re-introduce instability and uncertainty in the regulatory framework and ultimately undermine the investment incentives of regulated firms.

Entering the black box of the relationship between regulators and politicians, while controlling for the direct government's ownership of the firm, is surely an interesting political economy question that deserves further empirical analyses.

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Table 1 - Summary Statistics

Variable	Mean	Std. Dev.	Min	Max	No. Obs.
Panel A: Full Sample					
Real Sales (in millions of 2005 dollars)	96,876.18	148,345.30	79.87	802,264.60	720
Real Total Asset (in mills. of 2005 dollars)	207,465.30	320,829.70	297.02	1,562,157	720
Investment Rate	0.111	0.072	0.000	0.674	703
Cash flow to Capital Stock	0.135	0.102	- 0.940	0.871	719
Sales to Capital Stock	0.742	0.804	0.020	6.191	684
Debt-to-Capital Stock	0.212	0.304	0.000	3.356	719
Independence Regulatory Agency dummy	0.585	0.493	0	1	720
Index of Regulatory Independence	0.618	0.114	0.36	0.83	421
Government's UCR	0.344	0.357	0	1	720
Political Orientation	5.662	1.481	3.665	8.025	720
Investor Protection	3.826	1.216	1	5	720
Disproportionality Index	10.527	8.222	0.428	33.739	720
Government Stability	0.156	0.320	0	1	720
EXERLC	1.960	0.942	1	3	720
Election Date	0.029	0.168	0	1	720
Checks & Balances	3.874	0.975	2	7	720
OECD Liberalization Index	2.708	2.042	0	6	521
Panel B: Firm-year observations under an IRA					
Real Sales (in millions of 2005 dollars)	93,213.56	133,725.90	355.70	802,264.60	421
Real Total Asset (in millions of 2005 dollars)	207,363.90	301,776.60	1,084.65	1,553,495	421
Investment Rate	0.114	0.071	0.008	0.673	408
Cash flow to Capital Stock	0.133	0.098	- 0.940	0.498	420
Sales to Capital Stock	0.730	0.863	0.020	6.191	403
Debt-to-Capital Stock	0.237	0.343	0.000	3.356	420
Government's UCR	0.285	0.341	0	1	421
Panel C: Firm-year observations without an IRA					
Real Sales (in millions of 2005 dollars)	102,033.30	166,872.60	79.869	752,871.10	299
Real Total Asset (in millions of 2005 dollars)	207,608.20	346,404.50	297.017	1,562,157	299
Investment Rate	0.107	0.073	0.000	0.537	295
Cash flow to Capital Stock	0.138	0.107	- 0.561	0.871	299
Sales to Capital Stock	0.758	0.709	0.093	4.670	281
Debt-to-Capital Stock	0.177	0.234	0.000	1.847	299
Government's UCR	0.402	0.368	0	1	299
Panel D: IRA regulated firms (before and after shifting to an IRA regime)					
Investment Rate	0.114	0.068	0.006	0.674	489
Cash flow to Capital Stock	0.133	0.106	-0.939	0.498	502
Sales to Capital Stock	0.723	0.823	0.020	6.191	473
Debt-to-Capital Stock	0.239	0.338	0	3.356	502
Government's UCR	0.321	0.353	0	1	503
Panel E: Regulated firms never under an IRA					
Investment Rate	0.105	0.080	0.000	0.536	214
Cash flow to Capital Stock	0.141	0.094	0.016	0.871	217
Sales to Capital Stock	0.783	0.758	0.093	4.670	211
Debt-to-Capital Stock	0.149	0.190	0	1.154	217
Government's UCR	0.362	0.365	0	1	217

Table 2 – Investment Euler-Equation with Independent Regulatory Agency (IRA) dummy and Government's Ownership: Within Groups Estimates

I/K_t	Full Sample		Sub-sample of Firms under IRA (before and after the IRA)	
	(1)	**(2)**	**(3)**	**(4)**
$(I/K)_{t-1}$	0.601	0.600	0.573	0.574
	*(0.095) ****	*(0.095) ****	*(0.134)****	*(0.134)****
	*(0.056)****	*(0.058)****	*(0.055)****	*(0.057)****
	*[0.128]****	*[0.128]****	*[0.188]****	*[0.186]****
$(I/K)^2_{t-1}$	-0.767	-0.765	-0.874	-0.876
	*(0.181) ****	*(0.181) ****	*(0.199)****	*(0.198)****
	*(0.165)****	*(0.171)****	*(0.189)***	*(0.194)***
	*[0.198]****	*[0.198]****	*[0.240]****	*[0.233]****
$(\Pi/K)_{t-1}$	0.113	0.113	0.083	0.083
	*(0.051) ***	*(0.051) ***	*(0.042)**	*(0.043)**
	(0.076)	*(0.076)*	*(0.067)*	*(0.068)*
	*[0.053]***	*[0.053]***	*[0.043]**	*[0.043]**
$(Y/K)_{t-1}$	0.012	0.012	-0.10	-0.010
	(0.013)	*(0.013)*	*(0.016)*	*(0.017)*
	(0.010)	*(0.011)*	*(0.012)*	*(0.013)*
	[0.012]	*[0.012]*	*[0.016]*	*[0.017]*
IRA Dummy$_{t-1}$ (α_1)	0.021	0.021	0.022	0.022
	*(0.010) ***	*(0.010) ***	*(0.011)***	*(0.010) ***
	*(0.008)***	*(0.008)***	*(0.006)***	*(0.006)***
	*[0.011]**	*[0.011]**	*[0.012]**	*[0.012]**
Government UCR$_{t-1}$ (α_2)	-	0.006	-	-0.002
	-	*(0.016)*	-	*(0.023)*
	-	*(0.015)*	-	*(0.015)*
	-	*[0.014]*	-	*[0.019]*
	-	-	-	-
Firm dummies	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes
R squared within	0.242	0.243	0.195	0.195
F-test (p-value)	12.93 (0.00)	12.11 (0.00)	16.06 (0.00)	15.46 (0.00)
N. Firms [N. Obs.]	80[582]	80[582]	55[400]	55[400]

Notes. Fixed effects estimates. The dependent variable (*I*/*K*) is the investment rate measured as the ratio between capital expenditures and capital stock at replacement value. *Π*/*K* is the ratio between operational cash flow and the capital stock at replacement value. *Y*/*K* is the sales to capital stock (at replacement value) ratio. *IRA* is a dummy equal to 1 if an independent regulatory agency (IRA) is in place and equal to 0 otherwise. *Government's UCR* measures the ultimate control rights held by the government. All regressions include year dummies both as regressors and as instruments. Standard errors in parentheses are robust to heteroschedasticity and to within group serial correlation, that is clustered at firm, sector and country&sector level, respectively. ***, **, * denote significance of the coefficients at 1%, 5% and 10%.

Table 3 – Investment Euler-Equation with IRA and Government's Ownership: GMM-System Estimates

I/K_t	**Exogenous IRA and Government's Ownership**		**Endogenous IRA and Government's Ownership**			
	Full Sample		**Full Sample**		**Sub-sample of Firms under IRA (before and after the IRA)**	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
$(I/K)_{t-1}$	0.910***	0.904***	0.972***	0.961***	0.854***	0.855***
	(0.148)	*(0.147)*	*(0.118)*	*(0.118)*	*(0.125)*	*(0.126)*
$(I/K)^2_{t-1}$	-1.021***	-1.021***	-1.205***	-1.199***	-1.071***	-1.084***
	(0.249)	*(0.247)*	*(0.168*	*(0.168)*	*(0.190)*	*(0.147)*
$(\Pi/K)_{t-1}$	0.037	0.036	-0.015	-0.017	0.041	0.035
	(0.033)	*(0.034)*	*(0.032)*	*(0.033)*	*(0.075)*	*(0.074)*
$(Y/K)_{t-1}$	0.002	0.002	0.004	0.004	-0.002	-0.002
	(0.004)	*(0.004)*	*(0.004)*	*(0.004)*	*(0.002)*	*(0.002)*
IRA Dummy$_{t-1}$ (α_1)	0.009**	0.010**	0.012*	0.013**	0.025**	0.028**
	(0.004)	*(0.004)*	*(0.005)*	*(0.006)*	*(0.012)*	*(0.011)*
Government UCR$_{t-1}$ (α_2)	-	0.008	-	0.009	-	0.009
	-	*(0.006)*	-	*(0.007)*	-	*(0.010)*
Firm dummies	Yes	Yes	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
Arellano-Bond test for AR(1) *(p-value)*	0.001	0.001	0.004	0.004	0.020	0.018
Arellano-Bond test for AR(2) *(p-value)*	0.624	0.618	0.86	0.855	0.988	0.974
Sargan-Hansen test *(p-value)*	0.366	0.321	0.363	0.246	0.537	0.695
Internal Instruments			**Difference-in-Hansen tests *(p-value)***			
IRA Dummy$_{t-2}$	-	-	0.136	0.213	0.291	0.606
Government UCR$_{t-2}$	-	-	-	0.216	-	0.992
	-	-				
External and Excluded Instruments						
Government UCR	-	-	0.573	-	0.095	-
Political Orientation	-	-	0.957	0.891	0.550	0.363
IP - Investor Protection	-	-	0.819	0.937	-	-
D – Disproportionality	-	-	0.461	0.278	-	-
N. Firms [N. Obs.]	80[582]	80[582]	80[521]	80[521]	53[288]	53[288]

Notes. Dynamic panel-data estimation, one-step system GMM estimates in columns (1)-(6). The dependent variable (*I*/*K*) is the investment rate measured as the ratio between capital expenditures and capital stock at replacement value. *Π*/*K* is the ratio between operational cash flow and the capital stock at replacement value. *Y*/*K* is the sales to capital stock (at replacement value) ratio. *IRA* is a dummy equal to 1 if an independent regulatory agency (IRA) is in place and equal to 0 otherwise. *Government's UCR* measures the ultimate control rights held by the government. *Political orientation* measures the government's political stance. *Investor Protection* and *Disproportionality Indexes* are defined in Section 5. All regressions include year dummies both as regressors and as instruments. Standard errors in parentheses are robust to heteroschedasticity and to within group serial correlation. AR(1) [AR(2)] tests the null hypothesis of no first-order [second-order] correlation in the differenced residuals. The Sargan-Hansen statistic tests the null hypothesis that the over-identifying restrictions are valid. ***, **, * denote significance of the coefficients at 1%, 5% and 10%.

Table 4 –Introducing Politics and Interacted Effects with the IRA

I/K_t	(1)	(2)	(3)
$(I/K)_{t-1}$	0.866***	0.958***	0.961***
	(0.132)	*(0.119)*	*(0.119)*
$(I/K)^2_{t-1}$	-1.060***	-1.193***	-1.210***
	(0.190)	*(0.169)*	*(0.170)*
$(\Pi/K)_{t-1}$	-0.036	-0.016	-0.006
	(0.034)	*(0.034)*	*(0.029)*
$(Y/K)_{t-1}$	0.005	0.004	0.003
	(0.005)	*(0.005)*	*(0.004)*
IRA Dummy$_{t-1}$ (α_1)	0.010	0.013**	0.082**
	(0.007)	*(0.006)*	*(0.033)*
Government UCR $_{t-1}$ (α_2)	-0.005	0.009	0.007
	(0.010)	*(0.008)*	*(0.010)*
Political Orientation $_{t-1}$ (α_3)	-	-0.001	0.007*
	-	*(0.003)*	*(0.004)*
Government UCR $_{t-1}$*IRA (α_4)	0.025	-	0.006
	(0.021)	-	*(0.019)*
Political Orientation $_{t-1}$*IRA (α_5)	-	-	-0.013**
	-	-	*(0.006)*
P-value test on $\alpha_1 + \alpha_4 = 0$	0.056		0.014
P-value test on $\alpha_1 + \alpha_5 = 0$	-		0.008
P-value test on $\alpha_3 + \alpha_5 = 0$	-		0.166
Arellano-Bond test for AR(1) *(p-value)*	0.004	0.004	0.003
Arellano-Bond test for AR(2) *(p-value)*	0.836	0.864	0.993
Sargan-Hansen test (p-value)	0.309	0.233	0.223
Internal Instruments	**Difference-in-Hansen tests *(p-value)***		
IRA Dummy$_{t-2}$	0.521	0.317	0.852
Government UCR $_{t-2}$	0.698	0.295	0.588
Political Orientation $_{(t-2)}$	-	0.246	0.440
External and Excluded Instruments			
Government UCR	-	-	-
Political Orientation	0.065	-	-
IP - Investor Protection	0.912	0.789	0.587
D – Disproportionality	0.903	0.372	0.162
N. Firms [N. Obs.]	80[521]	80[521]	80[521]

Notes. Dynamic panel-data estimation, one-step system GMM estimates. (*I*/*K*), *(Π/K)*, (*Y*/*K), IRA* dummy, *Government's UCR* and *Political orientation* are defined as in Table 2. All regressions include year dummies both as regressors and as instruments. *Investor Protection* and *Disproportionality Indexes* are defined in Section 5. Standard errors in parentheses are robust to heteroschedasticity and to within group serial correlation. AR(1) [AR(2)] tests the null hypothesis of no first-order [second-order] correlation in the differenced residuals. The *Sargan-Hansen* statistic tests the null hypothesis that the over-identifying restrictions are valid. The *Difference-in-Hansen* statistics tests the exogeneity of subsets or individual instruments. ***, **, * denote significance of the coefficients at 1%, 5% and 10%.

Table 5 –Investment Equation with Political Institution Variables as External Instruments

I/K_t	(1)	(2)	(3)
$(I/K)_{t-1}$	0.942***	0.926***	0.915***
	(0.127)	*(0.127)*	*(0.125)*
$(I/K)^2_{t-1}$	-1.154***	-1.141***	-1.161***
	(0.180)	*(0.181)*	*(0.186)*
$(\Pi/K)_{t-1}$	-0.006	-0.006	-0.001
	(0.031)	*(0.032)*	*(0.029)*
$(Y/K)_{t-1}$	0.003	0.002	0.003
	(0.004)	*(0.004)*	*(0.004)*
IRA Dummy$_{t-1}$ (α_1)	0.012***	0.014***	0.120**
	(0.004)	*(0.005)*	*(0.052)*
Government UCR $_{t-1}$ (α_2)	-	0.009	-0.011
	-	*(0.006)*	*(0.011)*
Political Orientation $_{t-1}$ (α_3)	-	-0.002	0.010*
	-	*(0.002)*	*(0.006)*
Government UCR $_{t-1}$* IRA (α_4)	-	-	0.039*
	-	-	*(0.022)*
Political Orientation $_{t-1}$* IRA (α_5)	-	-	-0.021**
	-	-	*(0.009)*
P-value test on $\alpha_1 + \alpha_4 = 0$	-	-	0.003
P-value test on $\alpha_2 + \alpha_4 = 0$	-	-	0.041
P-value test on $\alpha_1 + \alpha_5 = 0$	-	-	0.021
P-value test on $\alpha_3 + \alpha_5 = 0$	-	-	0.007
Arellano-Bond test for AR(1) *(p-value)*	0.004	0.004	0.003
Arellano-Bond test for AR(2) *(p-value)*	0.835	0.852	0.819
Sargan-Hansen test *(p-value)*	0.516[71]	0.445[69]	0.296[65]
	Difference-in-Hansen tests *(p-value)*		
External and Excluded Instruments			
Government UCR $_{t-2}$	0.840	-	-
Political Orientation $_{t-2}$	0.230	-	-
WB Political Institutions	0.907	0.571	0.903
N. Firms [N. Obs.]	80 [521]	80 [521]	80 [521]

Notes. Dynamic panel-data estimation, one-step system GMM estimates. (*I*/*K*), *(Π/K), IRA* dummy, *Government's UCR* and *Political orientation* are defined as in Table 2. All regressions include year dummies both as regressors and as instruments. *Government UCR $_{t-1}$*IRA* and *Political Orientation $_{t-1}$*IRA* are instrumented with *Government UCR$_{t-2}$*Government Stability$_{t-2}$* and EXERLC$_{t-2}$* *Government Stability$_{t-2}$*, respectively. The WB Political Institutions instruments include: *Government Stability, Checks & Balances, Election Date*, and *EXERLC,* as defined in Section 5. Standard errors in parentheses are robust to heteroschedasticity and to within group serial correlation. AR(1) [AR(2)] tests the null hypothesis of no first-order [second-order] correlation in the differenced residuals. The Sargan-Hansen statistic tests the null hypothesis that the over-identifying restrictions are valid. The *Difference-in-Hansen* statistics tests the exogeneity of subsets or individual instruments. ***, **, * denote significance of the coefficients at 1%, 5% and 10%.

Table 6 –Further Checks on the Validity of External Instruments

I/K_t	(1)	(2)	(3)	(4)
$(I/K)_{t-1}$	0.965***	0.963***	0.997***	0.947***
	(0.118)	*(0.114)*	*(0.130)*	*(0.138)*
$(I/K)^2_{t-1}$	-1.212***	-1.221***	-1.250***	-1.189***
	(0.172)	*(0.169)*	*(0.183)*	*(0.203)*
$(\Pi/K)_{t-1}$	-0.006	0.001	-0.011	-0.004
	(0.030)	*(0.027)*	*(0.033)*	*(0.031)*
$(Y/K)_{t-1}$	0.003	0.003	0.003	0.001
	(0.004)	*(0.004)*	*(0.004)*	*(0.004)*
IRA Dummy$_{t-1}$ (α_1)	0.013**	0.076**	0.014**	0.073**
	(0.006)	*(0.030)*	*(0.007)*	*(0.033)*
Government UCR $_{t-1}$ (α_2)	0.012	0.008	0.005	-0.007
	(0.010)	*(0.011)*	*(0.009)*	*(0.012)*
Political Orientation $_{t-1}$ (α_3)	0.000	0.008**	-0.006	-0.002
	(0.003)	*(0.004)*	*(0.006)*	*(0.005)*
Government UCR $_{t-1}$* IRA (α_4)	-	0.010	-	0.021
	-	*(0.019)*	-	*(0.020)*
Political Orientation $_{t-1}$* IRA (α_5)	-	-0.012**	-	-0.012**
	-	*(0.005)*	-	*(0.006)*
Investor Protection $_{t-1}$	0.0005	0.0003	-	-
	(0.003)	*(0.003)*	-	-
Disproportionality $_{t-1}$	0.0003	0.0002	-	-
	(0.0003)	*(0.0003)*	-	-
Government Stability $_{t-1}$	-	-	0.014*	0.011
	-	-	*(0.008)*	*(0.008)*
EXERLC $_{t-1}$	-	-	0.007	0.009
	-	-	*(0.005)*	*(0.007)*
Checks & Balance $_{t-1}$	-	-	0.007	0.002
	-	-	*(0.002)*	*(0.003)*
Election Date $_{t-1}$	-	-	-0.009	-0.009
	-	-	*(0.09)*	*(0.009)*
P-value test on $\alpha_1 + \alpha_4 = 0$	-	0.014	-	0.014
P-value test on $\alpha_1 + \alpha_5 = 0$	-	0.011	-	0.025
P-value test on $\alpha_3 + \alpha_5 = 0$	-	0.226	-	0.067
Arellano-Bond test for AR(1) *(p-value)*	0.003	0.003	0.004	0.004
Arellano-Bond test for AR(2) *(p-value)*	0.871	0.998	0.849	0.677
Sargan-Hansen test *(p-value)*	0.201[64]	0.325[65]	0.459[64]	0.359
N. Firms [N. Obs.]	80 [521]	80 [521]	80[521]	80[521]

Notes. Dynamic panel-data estimation, one-step system GMM estimates. (*I*/*K*), *(ΠI/K*), (*Y*/*K), IRA* dummy, *Government's UCR* and *Political orientation* are defined as in Table 2. All regressions include year dummies both as regressors and as instruments. *Investor Protection*, *Disproportionality*, *Election Date*, *Government Stability* and *EXERLC* are defined in Section 5. Standard errors in parentheses are robust to heteroschedasticity and to within group serial correlation. AR(1) [AR(2)] tests the null hypothesis of no first-order [second-order] correlation in the differenced residuals. The Sargan-Hansen statistic tests the null hypothesis that the over-identifying restrictions are valid. The *Difference-in-Hansen* statistics tests the exogeneity of subsets or individual instruments. ***, **, * denote significance of the coefficients at 1%, 5% and 10%.

Table 7 –Investment Equation with Debt Finance

I/K_t	(1)	(2)	(3)
$(I/K)_{t-1}$	0.939***	0.933***	0.944***
	(0.117)	*(0.118)*	*(0.117)*
$(I/K)^2_{t-1}$	-1.142***	-1.143***	-1.171***
	(0.157)	*(0.161)*	*(0.163)*
$(\Pi/K)_{t-1}$	0.003	- 0.005	-0.004
	(0.039)	*(0.041)*	*(0.038)*
$(Y/K)_{t-1}$	0.005	0.005	0.004
	(0.004)	*(0.005)*	*(0.004)*
$(Debt/K)^2_{t-1}$	-0.005***	-0.004***	- 0.005***
	(0.002)	*(0.002)*	*(0.002)*
IRA Dummy$_{t-1}$ (α_1)	0.012**	0.015**	0.081**
	(0.005)	*(0.006)*	*(0.035)*
Government UCR $_{t-1}$ (α_2)	-	0.008	0.011
	-	*(0.008)*	*(0.011)*
Political Orientation $_{t-1}$ (α_3)	-	-0.001	0.007*
	-	*(0.003)*	*(0.004)*
Government UCR $_{t-1}$* IRA (α_4)	-	-	-0.001
	-	-	*(0.018)*
Political Orientation $_{t-1}$* IRA (α_5)	-	-	-0.012*
	-	-	*(0.006)*
P-value test on $\alpha_1 + \alpha_4 = 0$	-	-	0.018
P-value test on $\alpha_1 + \alpha_5 = 0$	-	-	0.017
P-value test on $\alpha_3 + \alpha_5 = 0$	-	-	0.192
Arellano-Bond test for AR(1) *(p-value)*	0.003	0.003	0.003
Arellano-Bond test for AR(2) *(p-value)*	0.757	0.771	0.868
Sargan-Hansen test *(p-value)*	0.304[67]	0.226[65]	0.202[65]
Internal Instruments	**Difference-in-Hansen tests *(p-value)***		
IRA Dummy$_{t-2}$	0.630	0.479	0.181
Government UCR $_{t-2}$	-	0.771	0.208
Political Orientation $_{(t-2)}$	-	0.336	0.276
External and Excluded Instruments			
Government UCR	0.707	-	-
Political Orientation	0.693	-	-
IP - Investor Protection	0.227	0442	0.328
D - Disproportionality	0.958	0.933	0.759
N. Firms [N. Obs.]	80[521]	80[521]	80[521]

Notes. Dynamic panel-data estimation, one-step system GMM estimates. (*I*/*K*), *(Π/K*), (*Y*/*K) IRA* dummy, *Government's UCR* and *Political orientation* are defined as in Table 2. (*D*/*K)* is the ratio of financial debt to capital stock at replacement value. All regressions include year dummies both as regressors and as instruments. *Investor Protection* and *Disproportionality* are defined in Section 5. Standard errors in parentheses are robust to heteroschedasticity and to within group serial correlation. AR(1) [AR(2)] tests the null hypothesis of no first-order [second-order] correlation in the differenced residuals. The *Sargan-Hansen* statistic tests the null hypothesis that the over-identifying restrictions are valid. The *Difference-in-Hansen* statistic tests the exogeneity of subsets or individual instruments. ***, **, * denote statistical significance at 1%, 5% and 10%.

Table 8 –Investment Equation with Formal Regulatory Independence Index

I/K_t	(1)	(2)	(3)
$(I/K)_{t-1}$	0.753***	0.742***	0.735***
	(0.131)	*(0.146)*	*(0.135)*
$(I/K)^2_{t-1}$	-0.906***	-0.930***	-0.903***
	(0.180)	*(0.200)*	*(0.179)*
$(\Pi/K)_{t-1}$	0.091	-0.036	0.204**
	(0.075)	*(0.067)*	*(0.103)*
$(Y/K)_{t-1}$	-0.003	-0.003	-0.002
	(0.003)	*(0.004)*	*(0.004)*
Regulatory Independence Index$_{t-1}$ (α_1)	0.060*	0.161**	0.370**
	(0.037)	*(0.068)*	*(0.182)*
Government UCR $_{t-1}$ (α_2)	-	-0.005	-0.158**
	-	*(0.014)*	*(0.079)*
Political Orientation $_{t-1}$ (α_3)	-	-0.003	0.038**
	-	*(0.005)*	*(0.017)*
Government UCR $_{t-1}$* Regulatory Independence (α_4)	-	-	0.275**
	-	-	*(0.135)*
Political Orientation $_{t-1}$* Regulatory Independence (α_5)	-	-	-0.072**
	-	-	*(0.031)*
P-value test on $\alpha_1 + \alpha_4 = 0$	-	-	0.008
P-value test on $\alpha_2 + \alpha_4 = 0$	-	-	0.041
P-value test on $\alpha_1 + \alpha_5 = 0$	-		0.049
P-value test on $\alpha_3 + \alpha_5 = 0$	-		0.028
Arellano-Bond test for AR(1) *(p-value)*	0.033	0.024	0.031
Arellano-Bond test for AR(2) *(p-value)*	0.622	0.944	0.339
Sargan-Hansen test *(p-value)*	0.453[40]	0.615[43]	0.548[31]
Internal Instruments	**Difference-in-Hansen tests *(p-value)***		
Regulatory Independence Index$_{t-2}$	0.15	0.525	0.274
Government UCR $_{t-2}$	-	0.712	0.428
Political Orientation $_{t-2}$	-	0.752	0.147
External and Excluded Instruments			
IP - Investor Protection	0.752	-	-
D- Disproportionality	-	0.149	0.119
N. Firms [N. Obs.]	53[261]	53[261]	53[261]

Notes. Dynamic panel-data estimation, one-step system GMM estimates. (*I*/*K*), *(Π/K)*, (*Y*/*K) IRA* dummy, *Government's UCR* and *Political orientation* are defined as in Table 2. *Regulatory Independence* is an index of formal regulatory independence (Gilardi, 2005). All regressions include year dummies both as regressors and as instruments. *Investor Protection* and *Disproportionality* are defined in Section 5. Standard errors in parentheses are robust to heteroschedasticity and to within group serial correlation. AR(1) [AR(2)] tests the null hypothesis of no first-order [second-order] correlation in the differenced residuals. The Sargan-Hansen statistic tests the null hypothesis that the over-identifying restrictions are valid. The *Difference-in-Hansen* statistics tests the exogeneity of subsets or individual instruments. ***, **, * denote significance of the coefficients at 1%, 5% and 10%.

Table 9 – Investment Equation with Competition Effects

I/K_t	(1)	(2)	(3)
$(I/K)_{t-1}$	0.822***	0.800***	0.758***
	(0.084)	*(0.095)*	*(0.111)*
$(I/K)^2_{t-1}$	-1.021***	-0.989***	-0.954***
	(0.137)	*(0.149)*	*(0.146)*
$(\Pi/K)_{t-1}$	0.138**	0.138**	0.165**
	(0.063)	*(0.064)*	*(0.084)*
$(Y/K)_{t-1}$	-0.004	-0.004	-0.003
	(0.003)	*(0.003)*	*(0.006)*
IRA Dummy$_{t-1}$	0.019**	0.020*	0.132**
	(0.009)	*(0.011)*	*(0.056)*
OECD Liberalization Index $_{t-1}$	0.001	-0.0003	-0.006[1]
	(0.004)	*(0.002)*	*(0.003)*
OECD Liberalization Index $_{t-1}$* IRA	-	0.0001	- 0.0001
	-	*(0.004)*	*(0.004)*
Political Orientation $_{t-1}$	-	-	0.013
	-	-	*(0.008)*
Government UCR $_{t-1}$	-	-	0.016
	-	-	*(0.013)*
Political Orientation $_{t-1}$* IRA	-	-	-0.021**
	-	-	*(0.009)*
Arellano-Bond test for AR(1) *(p-value)*	*0.025*	*0.024*	*0.021*
Arellano-Bond test for AR(2) *(p-value)*	*0.492*	*0.499*	*0.245*
Sargan-Hansen test *(p-value)*	0.441 [48]	0.400 [34]	0.609 [35]
Internal Instruments	**Difference-in-Hansen tests *(p-value)***		
IRA Dummy$_{t-2}$	0.728	0.891	0.732
OECD Liberalization Index $_{t-2}$	0.785	0.574	0.213
Government UCR $_{t-2}$	-	-	0.569
Political Orientation $_{t-2}$	-	-	0.501
External Instruments			
IP - Investor Protection	0.950	0.749	0.298
D- Disproportionality	0.655	0.491	0.956
N. Firms [N. Obs.]	57[307]	57[307]	57[307]

Notes. Dynamic panel-data estimation, one-step system GMM estimates. (*I*/*K*), *(Π/K)*, (*Y*/*K), IRA* dummy, *Government's UCR* and *Political orientation* are defined in Table 2. The *OECD Liberalization Index* is a revised version of the OECD Index of Product Market Regulation by Conway and Nicoletti (2006). All regressions include year dummies. *Investor Protection* and *Disproportionality* are defined in Section 5. Standard errors in parentheses are robust to heteroschedasticity and to within group serial correlation. AR(1) [AR(2)] tests the null hypothesis of no first-order [second-order] correlation in the differenced residuals. The Sargan-Hansen statistic tests the null hypothesis that the over-identifying restrictions are valid. The *Difference-in-Hansen* statistics tests the exogeneity of subsets or individual instruments. ***, **, * denote significance of the coefficients at 1%, 5% and 10%.

[1] P-value = 0.117

Figure 1 – Investment Rate at Firms Under an IRA and at Firms Never Under an IRA.

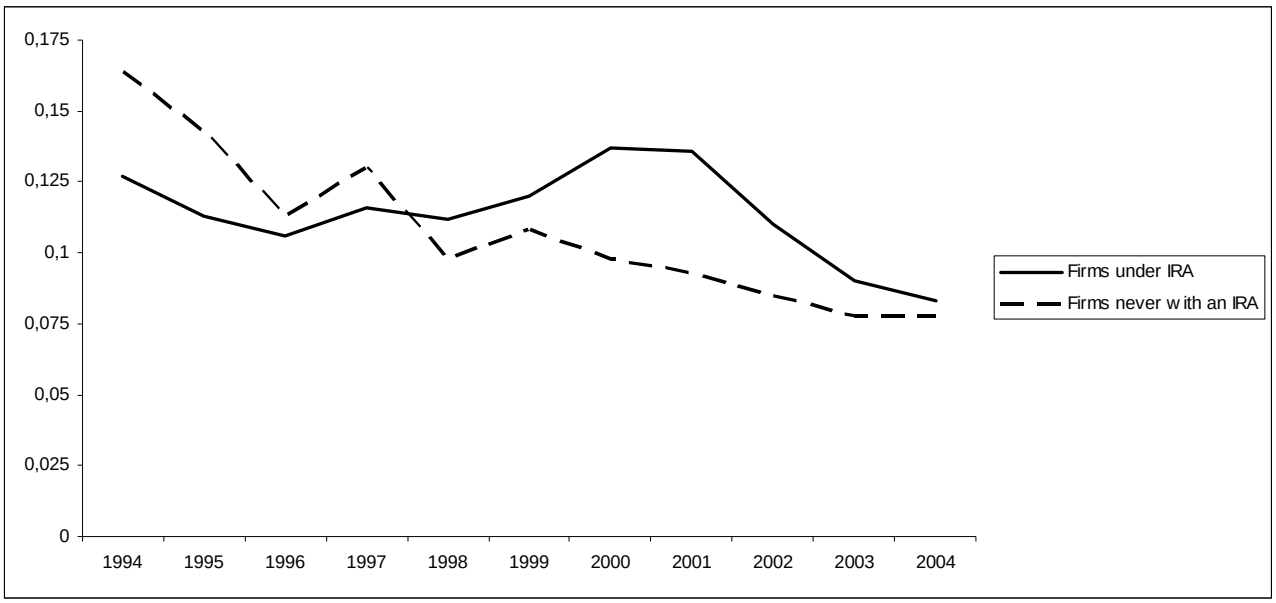


Figure 2 – Investment Rate at the IRA Inception, Before the Event and After the Event (sub-sample of firms undergoing the change in regulatory regime)

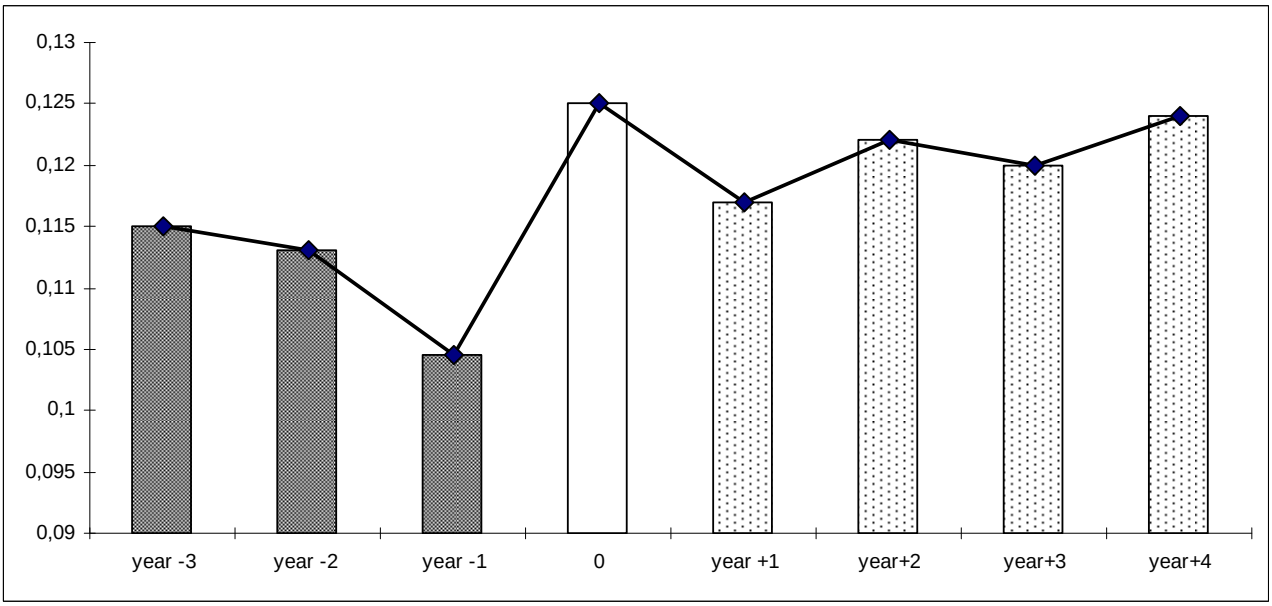


Figure 3 - Marginal Effect of Political Orientation on *IK* as the IRA is Set in Place

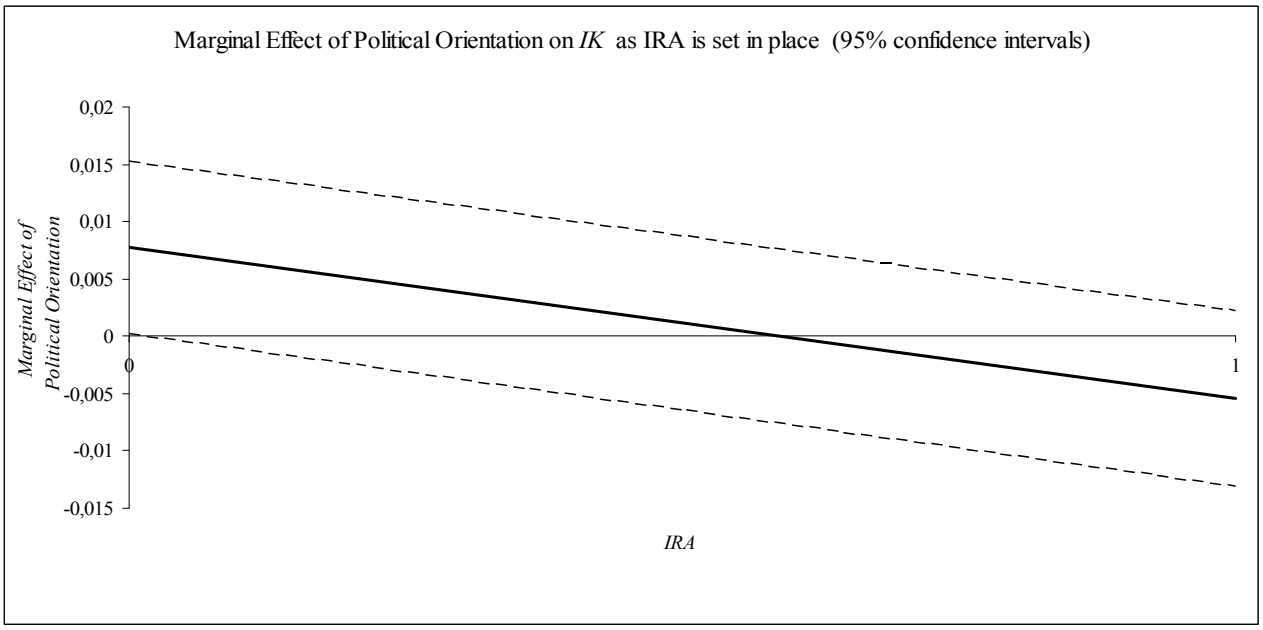
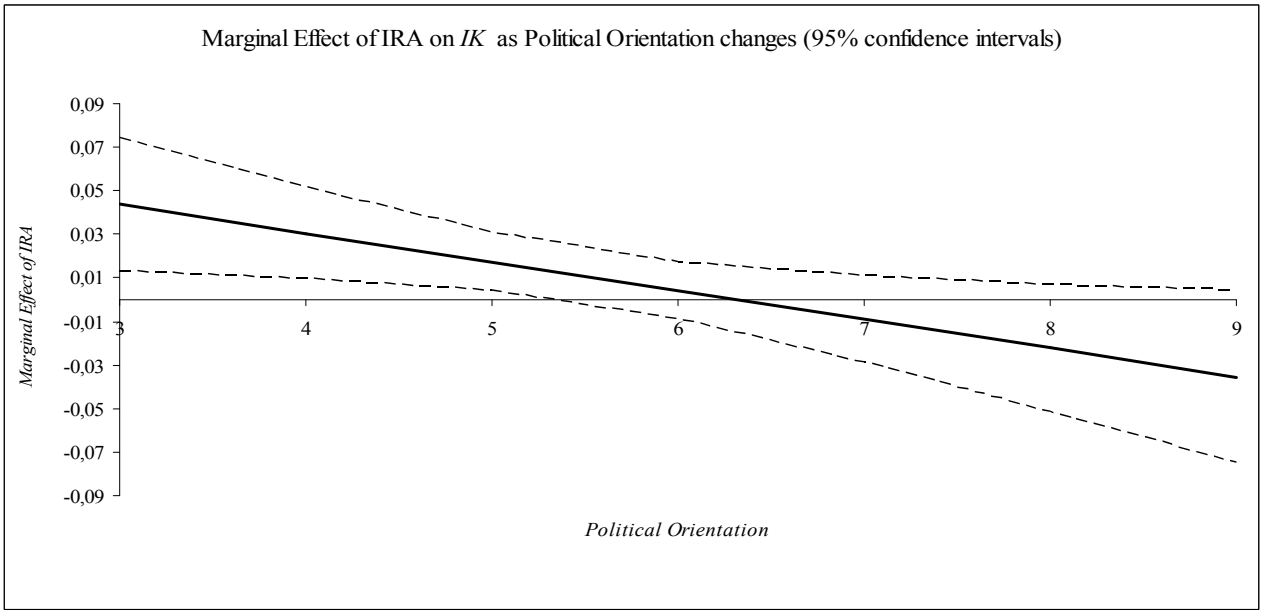


Figure 4 - Marginal Effect of IRA on *IK* as Political Orientation Shifts From Left to Right[2]



[2] We report values only for the range of variation of the *Political Orientation* variable, i.e. [3.665 – 8.025]. Note that the 80% of observations belongs to the range [4 – 7.71].

Appendix A1
Establishment of an Independent Authority and Government's Political Orientation

	Energy		Telecom	
Country	**Date of establishing an energy IRA**	**Leading Party/Coalition and political orientation of the Government when the IRA is established**	**Date of establishing a Telecom IRA**	**Leading Party/Coalition and political orientation of the Government when the IRA is established**
Austria	2000	Social Democratic Party run by Franz Vranitzky *Executive Or.*: Right	1997	Social Democratic Party run by Franz Vranitzky *Executive Or.:* Right
Belgium	1999	Dutch Christian Social Coalition run by Jean-Luc Dehaene *Executive Or.:* Center	1991	Dutch Christian Social Coalit run by Wilfred Martens *Executive Or.:* Center
Denmark	1999	Social Democratic Party run by Poul Nyrup Rasmussen *Executive Or.*:Left	2002	Liberal Party of Denmark run by Anders Fogh Rasmussen *Executive Or.:* Right
Finland	1995	Centre Party run by Esko Aho *Executive Or.:* Center/Right	1987	Social Democratic Party run by Kalevi Sorsa *Executive Or.:* Center/Right
France	2000	Socialist Party run by Lionel Jospin *Executive Or.:* Left	1996	Rally for the Republic run by Alain Juppe *Executive Or.:* Right
Germany	2006	CDU/CSU run by Angela Merkel *Executive Or.:* Right	1996	CDU/CSU run by Helmut Kohl *Executive Or.:* Right
Greece	2000	Pan-Hellenic Movement run by Costas Simitis *Executive Or.:* Center/Left	1992	New Democracy run by Constantine Mitsotakis *Executive Or.:* Right
Ireland	1999	Fianna Fail-Labour run by Bertie Ahern *Executive Or.:* Center/Right	1997	Fianna Fail-Labour run by Albert Reynolds *Executive Or.:* Center/Right
Italy	1996	Technical (Non-partisan) govn.'t run by Lamberto Dini *Executive Or.:* Center	1997	Socialist Party run by Romano Prodi *Executive Or.:* Center/Left
Netherlands	1998	Labour Party run by William Kok *Executive Or.:* Center/Right	1997	Labour Party run by William Kok *Executive Or.:* Center/Right
Portugal	1995	Social Democratic Party run by Anibal Cavaco Silva *Executive Or.:* Right	2001	Socialist Party run by Antonio Gutteres *Executive Or.:* Left
Spain	1998	Popular Party run by Jose Aznar *Executive Or.:* Right	1996	Socialist Party run by Felipe Gonzales *Executive Or.:* Left
Sweden	1998	Social Democratic Labour Party run by Göran Persson *Executive Or.:* Left	1992	Moderate Party run by Carl Bildt *Executive Or.:* Right
UK	1989	Conservative Party run by Margaret Thatcher *Executive Or.:* Right	1984	Conservative Party run by Margaret Thatcher *Executive Or.:* Right

Appendix A2
AR(1) Model Estimates for I/K, Π/K, Y/K

	(1) OLS	(2) Within Group	(3) GMM-Diff	(4) GMM-SYS
		I/K		
$(I/K)_{t-1}$	0.540	0.307	0.377	0.394
	(0.057)	*(0.076)*	*(0.110)*	*(0.100)*
Sargan-Hansen test *(p-value)*	-	-	*0.679*	*0.295*
		Π/K		
$(\Pi/K)_{t-1}$	0.651	0.444	0.553	0.692
	(0.055)	*(0.104)*	*(0.267)*	*(0.054)*
Sargan-Hansen test *(p-value)*	-	-	*0.488*	*0.156*
		Y/K		
$(Y/K)_{t-1}$	0.894	0.662	0.747	0.891
	(0.019)	*(0.057)*	*(0.086)*	*(0.019)*
Sargan-Hansen test *(p-value)*	-	-	*0.549*	*0.188*
Year dummies	Yes	Yes	Yes	Yes

Notes. Year dummies are included in all models. (*I*/*K*), *(ΠI/K*) and (*Y*/*K)* are defined in Table 2. Asymptotic standard errors in parenthesis. The Sargan-Hansen statistic tests the null hypothesis that the over-identifying restrictions are valid.

Appendix A3
Robustness: OLS Estimates of a Simple Investment Model
(Standard Errors Are Clustered at Firm, Sector and Country-sector Level)

I/K_t	(1)	(2)	(3)
IRA $Dummy_{t-1}$ (α_1)	0.029	0.029	0.023
	*(0.014)***	*(0.014)***	*(0.011)***
	*(0.011)***	*(0.010)***	*(0.008)***
	*[0.016]**	*[0.016]**	*[0.013]**
Government UCR_{t-1} (α_2)	-	0.008	0.009
	-	*(0.021)*	*(0.017)*
	-	*(0.024)*	*(0.015)*
	-	*[0.024]*	*[0.016]*
$(I/K)_{t-1}$	-	-	0.252
	-	-	*(0.076)****
	-	-	*(0.060)****
	-	-	*[0.096]***
$(\Pi/K)_{t-1}$	-	-	0.108
	-	-	*(0.047)***
	-		*(0.072)*
	-	-	*[0.046]***
$(Y/K)_{t-1}$	-	-	0.014
	-	-	*(0.013)*
	-		*(0.009)*
	-	-	*[0.013]*
	-		
Firm dummies	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes
R squared within	0.112	0.113	0.218
N. Firms [N. Obs.]	80 [625]	80 [625]	80 [625]

Notes. Fixed effects estimation. (*I*/*K*), *(Π/K*), (*Y*/*K), IRA* dummy, *Government's UCR* and *Political orientation* are defined as in Table 2. All regressions include firm and year dummies. Standard errors in parentheses are robust to heteroschedasticity and to within group – i.e. firm, sector and country*sector level - serial correlation. ***, **, * denote significance of the coefficients at 1%, 5% and 10%.

Appendix A4
Robustness: First-Differenced GMM Estimates of the Investment Equation

I/K_t	(1)	(2)	(3)
$(I/K)_{t-1}$	1.183***	1.014***	1.124***
	(0.252)	*(0.195)*	*(0.259)*
$(I/K)^2_{t-1}$	-1.467***	-1.240***	-1.411***
	(0.370)	*(0.259)*	*(0.378)*
$(\Pi/K)_{t-1}$	0.002	0.054	-0.010
	(0.103)	*(0.088)*	*(0.082)*
$(Y/K)_{t-1}$	0.019	0.009	0.015
	(0.020)	*(0.020)*	*(0.019)*
IRA Dummy$_{t-1}$ (α_1)	0.077*	0.068**	0.244***
	(0.042)	*(0.034)*	*(0.094)*
Government UCR $_{t-1}$ (α_2)	-	0.061	0.066
	-	*(0.052)*	*(0.106)*
Political Orientation $_{t-1}$ (α_3)	-	-0.009	0.007
	-	*(0.007)*	*(0.010)*
Government UCR $_{t-1}$* IRA (α_4)	-	-	-0.103
	-	-	*(0.097)*
Political Orientation $_{t-1}$* IRA (α_5)	-	-	-0.018*
	-	-	(0.010)
P-value test on $\alpha_1 + \alpha_5 = 0$	-	-	0.010
P-value test on $\alpha_3 + \alpha_5 = 0$	-	-	0.233
Arellano-Bond test for AR(1) *(p-value)*	*0.001*	*0.002*	*0.001*
Arellano-Bond test for AR(2) *(p-value)*	*0.779*	*0.801*	*0.894*
Sargan-Hansen test *(p-value)*	0.327 [47]	0.190 [59]	0.441 [44]
Internal Instruments	**Difference-in-Hansen tests *(p-value)***		
IRA Dummy$_{t-2}$	*0.772*	*0.529*	*0.753*
Government UCR $_{t-2}$	-	*0.578*	*0.498*
Political Orientation $_{t-2}$	-	*0.897*	*0.659*
External Instruments			
IP - Investor Protection	*0.177*	-	-
D- Disproportionality	*0.920*	*0.547*	*0.324*
N. Firms [N. Obs.]	79[435]	79[435]	79[435]

Notes. Dynamic panel-data estimation, one-step first-differences GMM estimates. (*I*/*K*), *(Π/K)*, (*Y*/*K), IRA* dummy, *Government's UCR* and *Political orientation* are defined as in Table 2. All regressions include year dummies. *Investor Protection* and *Disproportionality* are defined in Section 5. Standard errors in parentheses are robust to heteroschedasticity and to within group serial correlation. AR(1) [AR(2)] tests the null hypothesis of no first-order [second-order] correlation in the differenced residuals. The *Sargan-Hansen* statistic tests the null hypothesis that the over-identifying restrictions are valid. The *Difference-in-Hansen* statistics tests the exogeneity of subsets or individual instruments. ***, **, * denote significance of the coefficients at 1%, 5% and 10%.

Appendix A5
Robustness: The Impact of Politics for Firms Regulated by an IRA When the IRA is in Place

I/K_t	(1)	(2)
$(I/K)_{t-1}$	0.830***	0.856***
	(0.158)	*(0.154)*
$(I/K)^2_{t-1}$	-1.057***	-1.107***
	(0.222)	*(0.215)*
$(\Pi/K)_{t-1}$	0.106	0.124
	(0.069)	*(0.089)*
$(Y/K)_{t-1}$	0.001	0.0002
	(0.003)	*(0.003)*
Government UCR_{t-1}	0.015	0.017
	(0.012)	*(0.013)*
Political $Orientation_{t-1}$	-0.006*	-
	(0.003)	-
$EXERLC_{t-1}$	-	-0.013**
	-	*(0.006)*
Arellano-Bond test for AR(1) *(p-value)*	0.013	0.013
Arellano-Bond test for AR(2) *(p-value)*	0.769	0.906
Sargan-Hansen test *(p-value)*	0.446 [51]	0.433 [47]
Firms [N. Obs.]	55[306]	55[306]

Notes. Dynamic panel-data estimation, one-step system GMM estimates. (*I*/*K*), *(ΠI/K*), (*Y*/*K), Government's UCR* and *Political orientation* are defined as in Table 2. *EXERLC* is a measure of political stance of the executive and is equal to 1 when the executive is leftwing, 2 when it is centre, and 3 when it rightwing. All regressions include year dummies. Standard errors in parentheses are robust to heteroschedasticity and to within group serial correlation. AR(1) [AR(2)] tests the null hypothesis of no first-order [second-order] correlation in the differenced residuals. The *Sargan-Hansen* statistic tests the null hypothesis that the over-identifying restrictions are valid. ***, **, * denote significance of the coefficients at 1%, 5% and 10%.

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