

Shall the law set them free? The formal and actual independence of regulatory agencies

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Abstract

Regulation by independent agencies rather than ministries is believed to result in better policy outcomes. Yet this belief requires one to accept a complex causal chain leading from formal independence to actual independence from politics, to policy decisions and, ultimately, to policy outcomes. In this study, we analyze the link between the formal and actual independence of regulatory agencies in Western Europe. New data on the appointment of chief executives of these agencies are used to create a proxy for the actual independence of agencies from politics. The analysis demonstrates that formal independence is an important determinant of actual independence, but the rule of law and the number of veto players matter as well.

Keywords: independence, regulation, regulatory agency, rule of law, veto players

Introduction

Politicians in Europe have granted considerable independence to regulatory agencies because of the widespread belief that having more independent agencies results in better policy outcomes. Scholars emphasize that independent regulatory agencies (IRAs) resolve problems of time-inconsistent policy preferences which politicians face, thus producing Pareto-improving regulatory decisions (cf. Kydland & Prescott 1977; Majone 1996). Governments themselves indicate that the creation of IRAs has allowed “central ministries to concentrate on policy-making”, resulting in “increased efficiency and innovation” (OECD 2002, p. 21). However, for independence to lead to better policy outcomes, a complex causal chain needs to operate, leading from statutory provisions granting independence to behavioral patterns demonstrating independence, to policy decisions and, ultimately, to policy outcomes.

We know much about the determinants of formal independence – the grant of independence found in statutes (e.g., Gilardi 2002; Elgie & McMenamain 2005; Yesilkagit & Christensen 2010). However, studies on the next link in the chain, connecting regulatory agencies' formal independence to their actual independence, have been less conclusive.¹ The natural presumption that higher degrees of formal independence also imply higher degrees of actual independence has not yet been demonstrated convincingly. Here we test this presumption, examining the relationship between the formal (*de jure*) and actual (*de facto*) political independence of regulatory agencies. By the political independence of an agency, we mean the degree to which the agency takes day-to-day decisions without the interference of politicians – in terms of the offering of inducements or threats – and/or the consideration of political preferences. While formal political independence refers to the degree of independence from politics inherent in the legal instruments which constitute and govern the agency, actual political independence refers to the degree to which the agency operates independently from politics in practice.

The study focuses on IRAs operating in seven sectors (competition, financial markets, energy, telecoms, pharmaceuticals, food safety, the environment; cf. Gilardi 2005a), in seventeen West European countries. As these countries are all established democracies, with clear procedures for the delegation of authority to unelected bodies, the question of how politicians deal with independent regulatory agencies is particularly significant. By independent agencies, we mean bodies which possess public authority, but are not hierarchically subordinate to directly or indirectly elected politicians (cf. Thatcher & Stone Sweet 2002, p. 2). Independent regulatory agencies are preoccupied with the creation of rules, the evaluation and scrutiny of economic behavior, and the application of sanctions for non-compliance.

We present two innovations in this study. First, we introduce new data on the appointment of chief executives of West European IRAs, using these to create a proxy for the actual political independence of agencies. Second, we use a new measure of formal independence which builds upon many of the same items as previous indices, but which is constructed using a different method of aggregation. We then use these

measures to assess the impact of formal independence on actual independence, accounting for such factors as the rule of law, political salience, coordination of the economy, and the number of veto players in the polity.

The paper proceeds as follows. In the next section, we set out how formal independence is hypothesized to affect actual independence. Subsequently, we introduce other hypotheses which have been discussed in prior literature. We then introduce our new measures of formal and actual independence, and describe the operationalization of the other variables. The importance of the different variables is then analyzed, followed by a discussion of the results.

Formal and actual independence

In delegating to regulatory agencies, politicians not only decide on the competences of these organizations, but also on the degree to which these competences can be exercised independently from politics. The preferred degree of independence will be reflected in statutory provisions on the appointment and removal of the head and board members, the possibility for politicians to overrule the agency's decisions, the legal status of the organization, and its financial and organizational autonomy. The overall degree of formal independence which results from these provisions is usually regarded as the main determinant of the actual independence with which an agency exercises its competences. Hence, politicians would only interfere in the business of regulatory agencies if the law allowed them to do so.

Politicians may, indeed, have good reasons to respect the formal independence of regulatory agencies. First of all, they may be 'affected' by the widespread belief that having IRAs results in better policy outcomes. Regulatory agencies which are insulated from politics would be better able to enhance the credibility of long-term policy commitments (Majone 1996), and they would be able to develop higher levels of specialization and expertise (Bawn 1995; Vibert 2007). As a consequence, they would make more efficient and effective regulatory decisions. For these desired outcomes to be achieved, politicians would not only need to introduce statutory provisions for

independence, but they would also need to respect that independence in practice. Second, the insulation of regulatory agencies from politics enables politicians to shift both the responsibility and the eventual blame for regulatory decisions to these organizations (Fiorina 1982). Hence, by introducing and adhering to provisions for independence, politicians can use the insulation of regulatory agencies as a blame-shifting instrument. Third, politicians may respect the formal independence of regulatory agencies because they find it inappropriate to interfere in the business of organizations which have been placed at arm's length. And finally, even if politicians themselves do not consider interfering in the business of independent agencies inappropriate, they may be concerned about the negative reactions which could follow from such actions. When having independent regulatory agencies is the norm, politicians may fear being criticized for not respecting regulators' independence.

Yet the relation between formal and actual independence may not be that straightforward. First, the practice of the law may depart substantially from the text of the law, making formal provisions unreliable indicators. The practice of the law may be more beneficial for agency independence than the text of the law implies. For example, statutory drafters in Commonwealth countries typically grant ministers broad discretionary powers not intended to be used regularly by the minister, but allowing for ministerial action in the event of unexpected scenarios (Thornton 1987, p. 275).² In other countries, it is more common for the practice of the law to be less beneficial for agency independence, since politicians may be accustomed to ignoring onerous provisions.

Second, there may be important non-legal determinants of actual independence. Carpenter (2001) traces the actual independence of US government agencies in the Progressive Era back to successful bureaucratic practices of the 'politics of legitimacy', consisting of building reputations for the agency and grounding these in broad and diverse networks. Ringquist *et al.* (2003) conclude that political salience and policy complexity are the main determinants of the propensity of legislators to intervene in regulatory decisions. Maggetti (2007) demonstrates that the actual independence of regulatory agencies in ten West European countries is determined by the age of agencies, membership of European networks, and the number of veto players in the polity.

Egeberg and Trondal (2009) find that Norwegian agencies pay less attention to political signals than do ministerial departments, but other factors such as political salience and task discretion also matter. Finally, studying Norwegian, Irish and Flemish agencies, Verhoest *et al.* (2010, pp. 249-69) conclude that the structural design of these organizations matters for actual independence, but that other, non-legal factors, such as the country's politico-administrative tradition, the organization's size, and its political salience, are also important.

Admitting a role for non-legal determinants of independence does not mean that formal independence is irrelevant. Though some studies do not find it to be an important determinant (Carpenter 2001; Lægreid *et al.* 2008; Maggetti 2007), and others present mixed results (Yesilkagit & Van Thiel 2008), many scholars do trace actual independence back to formal independence (Furlong 1998; Hayo & Voigt 2007; Egeberg & Trondal 2009; Verhoest *et al.* 2010). Therefore, we expect that:

H1. IRAs with higher degrees of formal independence possess higher degrees of actual independence.

Other potential explanatory factors

The rule of law

The specific statutory provisions of the legislation establishing a regulatory agency may be less important than the general orientation of a society towards law itself. In particular, we should expect societies where the rule of law is more firmly established to be societies where agencies operate more independently from politics. One of the central components of the rule of law is the presence of a judiciary which is independent of the executive of the day, and which can defend citizens' legally guaranteed rights against those who transgress them – including the executive. IRAs are not judicial bodies, but they often act in a quasi-judicial fashion. Consequently, we might expect that in countries where judicial bodies' decisions are respected, decisions of other independent bodies acting in a quasi-judicial fashion will also be respected, and thus IRAs will enjoy

actual independence. In other words, in countries where the rule of law is well established, IRAs may benefit from a displaced tolerance of independent institutions acting in a judicial manner. We therefore hypothesize that:

H2. *The more firmly the rule of law is established in a country, the higher the degree of actual independence of IRAs.*

Veto players

Actions taken by politicians to reward or sanction regulators may often require the agreement of multiple actors. This may be because the action in question requires the formal passage of an act in parliament, and because no single party has a majority, or because the action in question can be taken by the executive or an individual ministry, but cabinet and intra-ministry decision making procedures require agreement between coalition members in order to prevent the coalition from breaking down. The more veto players – actors whose agreement is necessary for an action to be taken (Tsebelis 1995, p. 293) – the more difficult it will be for politicians to sanction or reward the regulator through legislative or executive measures. The more difficult it is for politicians to sanction or reward, the more independent the regulator will be in practice (cf. Maggetti 2007). Consequently, we expect that:

H3. *The more veto players in a polity, the higher the degree of actual independence of IRAs.*

Political salience

As politicians have only limited time and resources, they will pay more attention to some agencies than to others, and they will also prioritize controlling some agencies rather than others (Calvert *et al.* 1989, pp. 589-90). Political salience plays an important role in the process of prioritization, and is an important determinant of political efforts to control the behavior of agencies (Dudley 1994; Ringquist *et al.* 2003). As Calvert *et al.* (1989, p. 590) explain, “in those areas in which they care the most, politicians will

expend greater effort and resources in reducing the uncertainty that affords bureaucrats the opportunity for discretion.” Hence, we propose:

H4. *The greater the salience of the policy area covered by the regulatory agency, the lower the degree of actual independence of IRAs.*

Coordination of the economy

As coordinated market economies (CMEs) are characterized by extensive networks linking business and governments, and as these networks are usually taken to be inimical to independent policy-making, we may expect regulatory agencies to be less independent in such systems. As the networks in CMEs primarily coordinate firms, and only secondarily link business to government, they need not play a role for semi-detached parts of government. Nonetheless, Maggetti (2007, p. 274) has hypothesized that CMEs will have less independent regulatory agencies. In the same study, however, not only was this hypothesis not confirmed, but the link ran precisely in the opposite direction. One explanation is that while the types of networks found in CMEs are inimical to independence *simpliciter*, they are particularly harmful to independence from regulatees; but dependence on regulatees may bolster independence vis-à-vis politicians. “An agency cannot be a servant of two masters: if it is scarcely independent from the politicians, it should be highly independent from those being regulated” (Maggetti 2007, p. 281). Hence:

H5. *The more coordinated the market economy in a country, the higher the degree of actual independence of IRAs.*

Operationalization

Measurement of actual independence

Before discussing how to operationalize the actual independence of regulatory agencies from politicians, it is worth setting out what our operationalization attempts to measure,

and why it is different from some other literature on this subject. Our root concept, independence from politics, is narrowly drawn. We define political independence of an agency as the degree to which that agency takes day-to-day decisions without the interference of politicians – in terms of the offering of inducements or threats – and/or the consideration of political preferences.³ Formal political independence refers to the degree of independence from politics inherent in those legal instruments which constitute and govern the agency. Actual political independence, on the other hand, refers to the degree to which the agency, in practice, makes its decisions independently from politics. We consider the scope of the powers of an agency – an element which is often included in measures of independence – a separate feature of agencies (Hanretty and Koop 2012). A second important point is that we consider independence from politicians to be unidimensional in practice, even if for analytical purposes it may be helpful to distinguish aspects of independence such as financial independence, managerial independence, and so on.⁴ This does not exhaust the idea of agency independence: agency independence from regulatees, as opposed to politicians, is a classic area of study, and it may be that these two types of independence form part of a multidimensional schema. Focusing exclusively on independence from politics, we stick to measurement in one dimension.

Even restricting ourselves to one dimension, precise measurement of actual independence of regulatory agencies is extremely difficult. While it is possible (see Maggetti 2007), it is exceedingly complex to produce comparable measures for enough agencies to permit statistical analysis. We therefore rely on two proxy measures of independence which have been developed in the literature on central bank independence (Cukierman *et al.* 1992; Cukierman & Webb 1995): a measure of political vulnerability (VUL), and a measure of the average turnover of the chief executive of the agency (TOR). Our political vulnerability proxy, VUL, is the percentage of government changes followed within six months by a change in the agency chief executive.⁵ Our turnover proxy, TOR, is the reciprocal of the average tenure, in years, of chief executives of an agency. These two proxy measures have a long history of application in the literature on central bank independence (Sturm & De Haan 2001; Keefer & Stasavage 2003; Dreher *et al.* 2008), and are now being applied to the independence of regulatory agencies

(Montoya & Trillas 2009; Jordana & Ramió 2010) and public broadcasters (Hanretty 2010). Elements of these proxies – in particular turnover – have also been applied to other non-majoritarian institutions such as supreme courts (Hayo & Voigt 2007). Hanretty explains the logic behind VUL as follows:

“If, following a new government, there is a change in the chief executive, then either the chief executive reached the end of her term, or left early. If she reached the end of her term, it may be that the terms of chief executives are designed so as to coincide with changes in government.... If this is the case, then one may assume that the chief executive is, in some sense, the expression of a government choice. If the terms do not coincide by design, then the fact that they did so may create this impression in any case. If, by contrast, the chief executive left early, she was either constrained to resign, or did so of her own accord. If she was constrained to resign, this may represent the introduction of some new constraint connected to the government. If she left of her own accord, this may reflect a belief that the government should have a ‘clean slate’ to influence the forthcoming selection of a chief executive” (2010, p. 77).

Figure 1 plots a histogram of gaps between government formation and agency head termination. The six month window is indicated by the solid vertical line.⁶

FIGURE 1

The logic behind TOR is less rigorous. Rates of turnover reflect multiple influences: the attractiveness of exit options, the average age at which executives are appointed, or country- or sector-specific expectations about when to call time on a career in regulation. For our purposes, one important influence on higher rates of turnover is political (dis)satisfaction with the chief executive. While dissatisfaction may result from non-partisan considerations, such as the quality of chief executives, it may also result from chief executives not following the wishes of their political principals. Given such dissatisfaction, politicians may either dismiss the chief executive, or decline to re-appoint her. Or, anticipating this, the chief executive may resign or refuse to be

considered for re-appointment. Given our earlier definition of actual independence, such a situation would indicate low levels of independence. The converse scenario, of low rates of turnover, may either reflect high levels of independence, or continued political satisfaction with the current chief executive which results from subservient behavior. In theory, this poses a problem of observational equivalence. To use TOR as a proxy measure, we must therefore make two assumptions: first, that non-political factors affecting turnover are unrelated to political factors affecting turnover, and thus do not systematically bias the use of turnover as a proxy for independence; and second, that low rates of turnover are, *ceteris paribus*, always a sign of high degrees of independence rather than deferential chief executives.

These are strong assumptions, but we believe they are warranted in the cases we study. In particular, our measure is highly correlated with other measures which are expressed in terms of early exit, rather than turnover. Maggetti (2007) uses as a measure of actual independence the percentage of executives who left before two-thirds of their stated term had expired. Our measure is highly correlated with his measure (Pearson's $r = 0.67$). The strong correlation between our measure, and measures expressed in terms of early exit, would be unlikely if our measure was tapping, for instance, national variation in executive longevity rather than national and sectoral variation in political independence.⁷

Whilst concerns about observational equivalence have a sound basis, this concern has typically been dealt with by noting the paucity of long-serving chief executives. Following Cukierman (1992, p. 385) in examining executives who have served terms of twelve years or more (three times the modal legislative term), there are only 26 such executives, eighteen of whom served agencies with scores of zero for VUL, and which are therefore unlikely to have been subservient. The biographies of the remaining executives do not at all suggest subservience. Jens Kampmann, head of the Danish environmental regulator (TOR = 0.18; VUL = 0.13) between 1978 and 1990, was a former Social Democrat, and was unlikely to have been subservient to the Conservative-led Schlüter governments of 1982-1993. Another environmental regulator, Valfrid Paulsson, is the longest serving chief executive in our sample, and was the first director-general of the Swedish *Naturvårdsverket* (TOR = 0.07; VUL = 0). Though he began his

career under the Social Democrats, he was “no political appointee” (Sjö 2006), and never acted as a “government rubber stamp” (Hennéus 2006). Rather, he protested (successfully) against the Palme government's plans to dam a river, and later served under two conservative governments. Finally, Sir Gordon Borrie was head of the UK Office of Fair Trading (TOR = 0.16, VUL = 0.25) for sixteen years, which might suggest subservience. Yet, following his long period under Conservative government, he was nominated to the House of Lords to sit as a Labour peer, hardly likely if Borrie had slavishly followed the Conservative wishes while in office.

Turnover rates are more closely related to some statutory provisions for independence than to others. In particular, they are linked to appointment and dismissal procedures. We believe though that this is not a problem for our analysis. Our starting point has been that institutional design does not always translate into institutional practice. Indeed, we have come across numerous examples of chief executives who left their agency before the end of their term, suggesting that there is a gap between formal and actual term length. Furthermore, as will be discussed later, only a few of the indicators of formal independence are related to the appointment and dismissal of chief executives. Hence, an empirical link between formal and actual independence is unlikely to be the consequence of a straightforward link between provisions for turnover and turnover practices.

By combining these two proxies, we can mitigate the error found in each. The two measures are only weakly correlated (Spearman's $\rho = 0.33$), but this is largely due to a number of cases where VUL is stuck at zero, sometimes because of a limited number of government changes.⁸ We scaled the two measures to have zero mean and unit standard deviation, and then averaged them and subtracted the result from one in order to give a measure of independence (since independence increases as TOR and VUL decrease). To calculate TOR and VUL, we gathered data on the tenure of 321 chief executives of 87 IRAs in Europe, using information from press releases from agencies and governments, and from newspaper searches using Lexis-Nexis.⁹ Where information on the day or month of appointment was missing, we imputed the first day of the month, and January. Since the inclusion of recently appointed chief executives might unfairly bias TOR downwards, we included currently-serving chief executives' tenure in the calculation of

TOR only if TOR would not decrease as a result. Figure 2 plots values of our measure by country and by sector; countries are plotted in ascending order of mean actual independence; sectors are plotted left to right in increasing order of mean actual independence.

FIGURE 2

We demonstrate our measure with a number of representative examples of situations in which chief executives have been replaced for political reasons. The first set of examples is related to situations where the chief executive has been replaced following a change of government, and largely concerns VUL. This was the case for the Greek financial markets regulator, the Hellenic Capital Markets Commission. While only one of the five government changes during the period resulted in a change in the chief executive of the regulator, the change was drastic: following the March 2004 general election and the formation of Karamanlis' first government, the entire board of the regulator was replaced, and a new chief executive, Alexis Pilavios, was appointed. Shortly after the chief executive under the PASOK governments, Stavros Thomadakis (who was married to a minister in the Simitis government), was prosecuted for negligence (Athens Newswire 2004). Above-average rates of turnover corroborate the impression of a low-independence regulator.

The second set of examples comes from situations where the chief executive has been dismissed by government at any point, thereby affecting TOR. There are relatively few examples of clear-cut dismissal: most chief executives tend to jump before they are pushed. The example just given, of the Hellenic Capital Markets Commission, is an example which affects both VUL and TOR.

It is far more common for chief executives to resign for political reasons: such cases form our third set of examples. These cases are relatively common, and are by no means confined to those countries which have a generally poor record for independence, such as Greece. The director-general of the Norwegian financial markets authority, Svein

Aasmundstad, left his post in May 1992 after a dispute with the agency board and the Ministry of Finance; his successor was only appointed after parliament re-affirmed the agency's position as "an independent and strengthened organisation for financial supervision".¹⁰ A similar politically-inspired resignation took place in the Danish environment agency two years after the formation of a center-right government which was viewed by the then-director-general, Steen Gade, as wishing to starve funding for the environment (Kristeligt Dagblad 2003).

By far the largest set of examples comes from cases where the government chose not to re-appoint an outgoing chief executive because it wished to impose its own political direction on the agency. This is one way in which low political independence translates into higher executive turnover, though the effect is rather indiscriminate. It is also the most openly discussed way. There was a slew of non-reappointments following Labour's return to government in 1997 – re-appointments which only arose three years later. Commenting on the non-reappointment of Kevin Bridgeman as head of the Office of Fair Trading, Brown (2000) reported that:

"Few quibble with ministers' desire to replace a Conservative appointee with their own man. There is also some sympathy for suggestions that Mr Bridgeman was not up to the job (though others disagree). But many observers - including some other regulators - are unhappy about the way Mr Bridgeman was undermined by a whispering campaign. This was apparently endorsed by ministers, though not by Mr Byers [the minister responsible]. The real reason they got rid of him, some say, is that he was robust enough to refuse politically inspired demands for inquiries into sectors where there was no evidence of anti-competitive practices."

A similar story took place in Portugal, where the government decided not to reappoint competition authority chairman Abel Mateus after Mateus lost support from President Cavaco Silva, and after Mateus rowed with ministers over his aggressive anti-trust measures aimed at former state-owned utilities (Thomson Financial News 2007). Not all cases of resignation, still less of non-reappointment, indicate low levels of actual independence, nor would we claim as much. Rather, by offering these examples we demonstrate how low levels of political independence can affect the values of our proxy

measures, and that we can therefore use information about turnover rates and replacements following government change as proxies for independence.

Measurement of formal independence

Measures of formal independence have been proposed for central banks, supreme courts, and regulatory agencies. Most of these measures share a large number of index items which relate to the method by which members of the board or court are appointed; their tenure in office; the provisions for their dismissal, and the relationship between the organization and the legislature and the executive respectively, in particular concerning the reporting requirements faced by the organization. The most important index of formal independence for our purposes is the index created by Gilardi (2002, 2005a), which in turn incorporates many index items found in earlier work on central bank independence by Cukierman *et al.* (1992). A list of these items, and the response categories for each item, is found in Table 1.

TABLE 1

There are, however, some issues with the items and the scoring used in the Gilardi index which prevent it from being used directly. In a previous article, we have argued that this index, and others like it, suffer from at least three problems: they assume an order for certain response categories which is only weakly justified, or not at all; they weight items according to criteria which are either arbitrary or which are based on rational ignorance about the contribution of each item; and they assume that response categories are scale variables (and not just ordinal categories). To deal with these problems, we developed a latent trait model of formal independence. This latent trait model can also be described as a type of factor analysis for ordinal rather than interval level data. This latent trait model allowed us to test (a) which item response categories were poorly ordered; (b) which items did not fit the latent trait at all (which was often a result of poor ordering); and (c) the contribution made by each item, in terms of its ability to

discriminate with respect to the latent trait; and (d) the distance (in terms of the latent trait) between each response category within an item. We found that four items – the agency’s reporting requirements to the legislature, whether or not the agency had exclusive competence; and the appointment method used for the head of the agency and the agency board – were either unrelated to the latent trait of formal independence, or were poorly ordered. We therefore dropped these items to calculate the trait scores for formal independence for each agency, using data from a wide range of agencies in Europe and in the rest of the world. In this paper, we use the same data gathered by Gilardi (2005a), but we calculate the degree of formal independence by using (a) the items which performed as expected in, and (b) the parameter estimates we obtained from, our previous model. Note that using slightly older data may exert a downwards bias on the effect of formal independence if there has been a general increase in the formal independence of agencies. The items and their discrimination parameters – which are analogous to weights in a normal index – are reported in Table 1.¹¹

Measurement of the other independent variables

Let us now turn to the operationalization of the remaining variables. First of all, there are a variety of measures of the *rule of law*; one review noted at least seven (Skaaning 2010). Of these seven, only three measures – the PRS Group’s Law and Order measure, the Freedom House measure of Rule of Law, and the World Bank’s composite index of Rule of Law, released as part of their Governance Matters indicators – cover all of the countries we analyze. We discarded the measure from the PRS group, as it is not publicly available and thus causes problems for replication. We have not used the Freedom House measure for the reason that there is no information available on coder reliability and on whether respondents in different countries have interpreted the questions similarly. The remaining measure – the World Bank measure – aggregates information from seventy-seven other indicators from thirty-one different sources. In the belief that aggregating multiple measures can reduce the error in each, we use the World Bank measure of the rule of law in the analysis (Kaufmann *et al.* 2009).¹²

The hypothesis on the *number of veto players* was tested using the number of veto players as calculated following Tsebelis (1995, pp. 305-308). A major part of the data

were taken directly from Tsebelis' website.¹³ The remainder were calculated manually. We averaged these figures out over the period of the agency's lifetime.¹⁴ To assess the effect of *political salience*, we used data gathered by Laver and Hunt (1992). These authors report salience scores for ministerial portfolios in established democracies. For each regulatory agency, we took the score of the ministry to which the agency is linked. For Switzerland, which was not included in the Laver and Hunt study, we imputed the scores for Austria for the reason that the two countries are rather similar in terms of size and political system.¹⁵ Finally, to test the hypothesis on *coordination of the economy*, we used data by Hall and Gingerich (2009). Two of our countries are not included in the dataset of these authors. Based on their corporatism scores (Siaroff 1999), we ascribed Greece a value half-way between the United Kingdom and the United States, and Luxembourg the same value as Belgium. We view these theoretically driven imputations as better than mean imputation or other multiple imputation strategies.

We control for the effect of country size and real GDP per capita. We control for country size because of the more exposed position of regulators in smaller states. Small states spend a disproportionate amount of their national product on public services, both because of fixed costs in public service provision and because of increased electoral pressure in smaller states (Remmer 2010). As a result, the role of the state in small states may be overwhelming, and "such state ubiquity... can foster nepotism, cronyism, patronage, and political clientelism", as opponents and supporters are more easily identified and (proportionally) more easily rewarded (Srebrnik 2004, pp. 334-335). Each of these practices is inimical to independence. Finally, we control for real GDP per capita to test for differences between richer and poorer economies.¹⁶ The summary statistics for the different variables are reported in Table 2.

TABLE 2

Analysis

We carried out a multilevel regression analysis on the 87 regulatory agencies for which we had data on formal and actual independence, with varying country-intercepts. We opted for a multilevel model rather than an ordinary least squares regression because there is a hierarchical structure in the data: regulators are nested within countries, and so are not independent of each other. The results of our models are shown in Table 3.¹⁷ The table shows six models with three different dependent variables: our measure of independence, and the component parts of that measure, TOR and VUL. Note that variables which increase actual independence should have a positive sign in the first two columns, but a negative sign in the third to sixth columns, since higher turnover (TOR) and higher political vulnerability (VUL) mean less independence.¹⁸

TABLE 3

The first model for each dependent variable is the full model with all predictors included: this model is somewhat overspecified. The second model for each variable is a reduced model, which shows a number of significant variables. This reduced model is necessary to reduce the risk of a saturated model. As the table shows, each of the models perform moderately well in explaining variation in our measure of independence, with the two models explaining actual independence performing better than those explaining turnover or political vulnerability. Formal independence, contra skeptical predictions, turned out to be a significant predictor of actual independence. This was true in all models, though in the models for executive turnover (TOR), formal independence was only significant at the 10 percent. The independent effect of rule of law itself was far more important, substantively and statistically, being significant at the 0.05 level in all of the six models, and affecting actual independence in the hypothesized way.

Our political system variable – the number of veto players – was significant, and in the expected direction. Hence, a larger number of veto players make it more difficult to sanction the agency, and thus make it more independent. No support for this is found,

however, in the model of executive turnover (TOR). The salience of the policy area in which each agency operates was not statistically significant in any model. The same is true of the degree of coordination in the market economy, which does not increase degrees of actual independence. Although the degree of coordination is associated with longer-lasting chief executives in our model of TOR, there is no sign of any effect on political vulnerability or on the aggregate measure.

Finally, the control variable for country size, in terms of population, does have an effect on actual independence: increases in population are associated with higher degrees of actual independence. This supports the argument that the omnipresence of the state in smaller countries leads to closer ties between politicians and regulators. This finding may, however, be artefactual – a model which includes our three favored variables (veto players, rule of law, and formal independence) together with country size has country intercepts that are all equal to zero, suggesting a saturated model.

We can go beyond hypothesis testing to examine the substantive impact of each of these variables. Figure 3 shows the effect on actual independence of a change in one standard deviation of each variable. We can see that a one standard deviation change in formal independence increase actual independence by around 0.2, more than comparable changes in the number of veto players or population. Still, the substantive effect of changes in formal independence is only modest. Thus, incorporating more provisions for independence in the statutes of regulatory agencies should not be expected to lead to major changes in actual independence. A one standard deviation change in the rule of law – about the difference between Spain and the United Kingdom – has by far the largest effect.¹⁹ Nevertheless, formal independence is by far more tractable than making changes in the rule of law. That is, while legislators can increase the formal independence of a regulatory agency by changing the statutes of the organization, there is no such ‘simple’ solution for improving the rule of law.

FIGURE 3

The substantive importance of formal independence becomes even clearer when we consider concrete examples of the changes in each variable that are necessary to secure a desired change in actual independence. Returning to the Greek financial markets regulator, suppose that we wished to make the Greek regulator as independent from politics as the German regulator, BaFin. To achieve this change – a change of almost 2.25 units on our measure – how would our key variables need to change? No single change in a variable can achieve an effect of this magnitude. To surpass the level of actual independence shown by the BaFin, Greece would need to become as law-abiding as Norway, and grant the Hellenic Capital Markets Commission the third-highest degree of formal independence seen in our sample. The first of these changes seems difficult to achieve; the second is possible but would not secure such a dramatic improvement alone.

Conclusion and discussion

So far, we have shown that we can arrive at reasonable interval-level measures of the actual independence of regulatory agencies, and that the independence of these agencies can be explained reasonably well by four main variables – the degree of formal independence of the agency, the rule of law, the size of a country, and the number of veto players. These findings can, of course, be contested, and we recognize that not all readers will be convinced by our use of proxies and the assumptions that the effects of these variables are ever-present and monotonically increasing. Our data refer to independence over the life of these agencies, which presents both benefits and challenges: as these institutions age, they acquire a longer track-record which is a more reliable indicator of their degree of independence. At the same time, however, static measurements of independence may belie the extent to which independence varies over time in response to developments which are internal or external to the agency (and which may also explain why our findings differ from other scholars who find no link between formal and actual independence).

Although our study has been limited to IRAs in seventeen established West European democracies, we expect our findings to be relevant for other established democracies as

well. Moreover, given the importance of the rule of law for actual independence, we believe that our findings also have considerable relevance for regulators operating in newer democracies where the rule of law is less well-established. Jordana and Ramió (2010) have demonstrated, on the basis of proxy measures related to turnover, that regulatory agencies in Latin America are, on average, less independent than regulators in Western Europe. The gap between Latin American regulators and West European ones is consistent with the difference in the rule of law between the two regions. In other words, although the dynamics of independence may be different in newer democracies, we expect the rule of law to be an important explanatory factor of the variation in actual independence in these countries as well.

Our findings on the effect sizes of each of these variables imply an optimistic view for institutional engineering. Olsen (2003) has written that institutional engineering requires that decision makers know what they want, know how to achieve it, and have the power to do what is needed to achieve a desired result. We cannot speak to politicians' desires and preferences, though the benefits of agency independence – whether extrinsically, in terms of greater efficiency, or intrinsically, in terms of greater propriety – are usually taken to self-recommending. Nor still can we speak to whether politicians have the power necessary to achieve changes in agency's formal independence – though here, too, the tide seems to flow inexorably in the direction of greater independence (Gilardi 2005b). But we do suggest that our findings offer knowledge about how to achieve the desired outcome which is relatively independent of contextual features – like limited rule of law – which might make engineering more difficult.

References

- Alesina A, Summers LH (1993) Central Bank Independence and Macroeconomic Performance: Some Comparative Evidence. *Journal of Money, Credit and Banking* 25, 2, 151-162.
- Athens Newswire (2004) Former Bourse, Capital Market Heads Stand Trial For Breach Of Duty. *Athens Newswire*, June 24th.
- Bawn K (1995) Political Control versus Expertise: Congressional Choices about Administrative Procedures. *American Political Science Review* 89, 1, 62-73.

- Brown K (2000) Keeping Watchdogs on a Short Leash: The Government's Approach to Competition Has Increased Suspicions That It Will Not Tolerate Truly Independent Regulators. *Financial Times*, 10th March, p. 23.
- Busuioac M, Curtin D, Groenleer M (2011) Agency Growth between Autonomy and Accountability: The European Police Office as a 'Living Institution'. *Journal of European Public Policy* 18, 6, 848-867.
- Calvert R, McCubbins MD, Weingast BR (1989) A Theory of Political Control and Agency Discretion. *American Journal of Political Science* 33, 3, 588-611.
- Carpenter DP (2001) *The Forging of Bureaucratic Autonomy: Reputations, Networks, and Policy Innovation in Executive Agencies, 1862-1928*. Princeton University Press, Princeton.
- Cukierman A (1992) *Central Bank Strategy, Credibility, and Independence*. MIT Press, Cambridge, MA.
- Cukierman A, Webb SB (1995) Political Influence on the Central Bank: International Evidence. *The World Bank Economic Review* 9, 3, 397-423.
- Cukierman A, Webb SB, Neyapti B (1992) Measuring the Independence of Central Banks and Its Effect on Policy Outcomes. *The World Bank Economic Review* 6, 3, 353-398.
- DeFond ML, Hung M (2004) Investor Protection and Corporate Governance: Evidence from Worldwide CEO Turnover. *Journal of Accounting Research* 42, 2, 269-312.
- Down I (2004) Central Bank Independence, Disinflation, and the Sacrifice Ratio. *Comparative Political Studies* 37, 4, 399-434.
- Dreher A, Sturm JE, De Haan J (2008) Does High Inflation Cause Central Bankers to Lose their Job? Evidence based on a New Data Set. *European Journal of Political Economy* 24, 4, 778-787.
- Druckman JN, Warwick PV (2005) The Missing Piece: Measuring Portfolio Salience in Western European Parliamentary Democracies. *European Journal of Political Research* 44, 1, 17-42
- Dudley G (1994) The Next Steps Agencies, Political Salience and the Arm's Length Principle. *Public Administration* 72, 2, 219-240.
- Egeberg M, Trondal J (2009) Political Leadership and Bureaucratic Autonomy: Effects of Agencification. *Governance* 22, 4, 673-688.
- Elgie R, McMenamin I (2005) Credible Commitments, Political Uncertainty or Political Complexity? Explaining Variation in the Independence of Non-Majoritarian Institutions in France. *British Journal of Political Science* 35, 3, 531-548.
- Fiorina MP (1982) Legislative Choice of Regulatory Forms: Legal Process or Administrative Process? *Public Choice* 39, 1, 33-66.

- Furlong SR (1998) Political Influence on the Bureaucracy: The Bureaucracy Speaks. *Journal of Public Administration Research and Theory* 8, 1, 39-65.
- Gilardi F (2002) Policy Credibility and Delegation to Independent Regulatory Agencies: A Comparative Empirical Analysis. *Journal of European Public Policy* 9, 6, 873-893.
- Gilardi F (2005a) The Formal Independence of Regulators: A Comparison of 17 Countries and 7 Sectors. *Swiss Political Science Review* 11, 4, 139-167.
- Gilardi F (2005b) The Institutional Foundations of Regulatory Capitalism: The Diffusion of Independent Regulatory Agencies in Western Europe. *The Annals of the American Academy of Political and Social Science* 598, 84-101.
- Hall PA, Gingerich DW (2009) Varieties of Capitalism and Institutional Complementarities in the Political Economy: An Empirical Analysis. *British Journal of Political Science* 39, 3, 449-482.
- Hanretty C (2010) Explaining the De Facto Independence of Public Broadcasters. *British Journal of Political Science* 40, 1, 75-89.
- Hanretty C, Koop C (2012) Measuring the Formal Independence of Regulatory Agencies. *Journal of European Public Policy* 19, 2, 198-216.
- Hayo B, Voigt S (2007) Explaining de facto judicial independence. *International Review of Law and Economics* 27, 3, 269-290.
- Hennés M (2006) Valfrid Paulsson död. *Dagens Nyheter*, December 19th.
- Jordana J, Ramió C (2010) Delegation, Presidential Regimes, and Latin American Regulatory Agencies. *Journal of Politics in Latin America* 2, 1, 3-30.
- Kaufmann D, Kraay A, Mastruzzi M (2009) Governance Matters VIII: Aggregate and Individual Governance Indicators 1996–2008. World Bank Policy Research Working Paper No. 4978.
- Keefer P, Stasavage D (2003) The Limits of Delegation: Veto Players, Central Bank Independence and the Credibility of Monetary Policy. *American Political Science Review* 97, 3, 407-423.
- Kydland FE, Prescott EC (1977) Rules Rather Than Discretion: The Inconsistency of Optimal Plans. *Journal of Political Economy* 85, 3, 473-492.
- Kristeligt Dagblad (2003) Steen Gade går i protest. *Kristeligt Dagblad*, June 12th.
- Læg Reid P, Roness, PG, Rubecksen K (2008) Controlling Regulatory Agencies. *Scandinavian Political Studies* 31, 1, 1-26.
- Laver M, Hunt WB (1992) *Policy and Party Competition*. Routledge, New York.
- Maggetti M (2007) De Facto Independence after Delegation: A Fuzzy-Set Analysis. *Regulation & Governance* 1, 4, 271-294.

- Majone G (1996) Temporal Consistency and Policy Credibility: Why Democracies Need Non-Majoritarian Institutions. EUI Working Paper, RSC No 96/57.
- Montoya MA, Trillas F (2009) The Measurement of Regulator Independence in Practice: Latin America and the Caribbean. *International Journal of Public Policy* 4, 1, 113-134.
- OECD (2002) *Distributed Public Governance: Agencies, Authorities and Other Government Bodies*. Paris: OECD.
- Olsen JP (2003) Reforming European Institutions of Governance. In: Weiler JH, Begg I, Peterson J (eds) *Integration in an Expanding European Union: Reassessing the Fundamentals*, pp. 45-65. Blackwell, Oxford.
- Olsen JP (2009) Democratic Government, Institutional Autonomy and the Dynamics of Change. *West European Politics* 32, 3, 439-465.
- Pollack, MA (2002) Learning from the Americanists (Again): Theory and Method in the Study of Delegation. *West European Politics* 25, 1, 200-219.
- Remmer KL (2010) Why do Small States have Big Governments? *European Political Science Review* 2, 1, 49-71.
- Ringquist EJ, Worsham J, Eisner, MA (2003) Saliency, Complexity, and the Legislative Direction of Regulatory Bureaucracies. *Journal of Public Administration Research and Theory* 13, 2, 141-164.
- Siaroff A (1999) Corporatism in 24 Industrial Democracies: Meaning and Measurement. *European Journal of Political Research* 36, 2, 175-205.
- Sjö B (2006) Ledde Naturvårdsverket i ett kvarts sekel. *Sydsvenskan*, December 20th.
- Skaaning S-E (2010) Measuring the Rule of Law. *Political Research Quarterly* 63, 2, 449-460.
- Srebrnik H (2004) Small Island Nations and Democratic Values. *World Development* 32, 2, 329-341.
- Strøm K, Müller WC, Bergman T (2010) *Cabinets and Coalition Bargaining: The Democratic Life Cycle in Western Europe*. Oxford University Press, Oxford.
- Sturm JE, De Haan J (2001) Inflation in Developing Countries: Does Central Bank Independence Matter? *Cesifo Studien* 47, 4, 389-403.
- Thatcher M, Stone Sweet A (2002) Theory and Practice of Delegation to Non-Majoritarian Institutions. *West European Politics* 25, 1, 1-22.
- Thomson Financial News (2007) Portugal Govt Not to Renew Competition Regulator Chairman's Mandate – Report. *Thomson Financial News*, 14th September.
- Thornton GC (1987) *Legislative Drafting*. Butterworths, London.

- Tsebelis G (1995) Decision Making in Political Systems: Veto Players in Presidentialism, Parliamentarism, Multicameralism and Multipartyism. *British Journal of Political Science* 25, 3, 289-325.
- Verhoest K, Roness PG, Verschuere B, Rubecksen K, MacCarthaigh M (2010) *Autonomy and Control of State Agencies: Comparing States and Agencies*. Palgrave Macmillan, Basingstoke.
- Vibert F (2007) *The Rise of the Unelected: Democracy and the New Separation of Powers*. Cambridge University Press, Cambridge.
- Voigt, Stefan (2009) The Effects of Competition Policy on Development – Cross-Country Evidence Using Four New Indicators. *Journal of Development Studies* 45, 8, 1225-1248.
- Yesilkagit K, Christensen JG (2010) Institutional Design and Formal Autonomy: Political versus Historical and Cultural Explanations. *Journal of Public Administration Research and Theory* 20, 53-74.
- Yesilkagit K, Van Thiel S (2008) Political Influence and Bureaucratic Autonomy. *Public Organization Review* 8, 2, 137-153.

Notes

- 1 Studies on the link between independence and better policy outcomes – mainly in the area of central banking – have also been inconclusive (Cukierman et al. 1992; Alesina & Summers 1993; Down 2004).
- 2 With only two common law countries in the analysis – Ireland and the United Kingdom – we cannot disentangle the impact of such a system from the effect of other institutional features associated with the two countries, such as the administrative traditions they share.
- 3 Our definition of independence resembles definitions of autonomy. Verhoest *et al.*, for instance, define agency autonomy as “the extent to which an agency can decide itself about matters that it considers important” (2010, p. 18-19), and Busuioc *et al.* indicate that agents have autonomy “when they have the capacity to manage their own affairs, acting and deciding unbound by the preferences and interests of their principals” (2011, p. 850). Yet, for some authors, independence is more narrowly defined. Olsen, for example, defines autonomy as “both the absence of external interference and the capability of an agency or institution to exploit available spaces to manoeuvre” (2009, p. 442).
- 4 More specifically, we consider independence from politics to be a latent trait which affects the probability that agency decisions in different areas – financial decisions, management

decisions, and so on – are made without the interference of politicians and/or the consideration of political preferences.

- 5 Following Strøm *et al.* (2010), we judge a new government to have started if there has been an election, a change in the prime minister, or a change in the partisan composition of the government.
- 6 We also ran the models with time windows of nine and twelve months. The results of these models are largely similar to the ones presented in Table 3, but the p-values of the coefficients for formal independence are slightly higher than 0.10. This is also the case for the p-value of the coefficient for population in the model with the twelve-month window. We present the results of the alternative models in the on-line appendix.
- 7 Note however that national average levels of chief executive turnover (DeFond & Hung 2004) are not significantly correlated with TOR (Pearson's $r = -0.08$).
- 8 The correlation between TOR and VUL is higher for cases where VUL is greater than zero: Pearson's $r = 0.56$.
- 9 In most cases, we have information from the founding of the agency until the present day. In the on-line appendix, we have included the list of regulatory agencies and the period for which we have data on the chief executives of these agencies.
- 10 Personal communication from Bjørn Skogstad Aamo, director-general, *Finanstilsyn*.
- 11 We also estimated the final OLS model using the original Gilardi scores instead of our latent trait scores. The same variables are significant in both specifications. The results with the alternative measure are reported in the on-line appendix.
- 12 We also ran the analyses with the Freedom House measure; results do not differ substantially. See the on-line appendix.
- 13 See http://sitemaker.umich.edu/tsebelis/veto_players_data (consulted on June 22, 2012).
- 14 We re-ran the models with measures for actual independence, veto players, population, and GDP per capita, which are averaged over a shorter period of time, using a maximum of twenty years (1990-2010). These models also served to, at least partially, deal with the issue of changes in the statutory provisions for independence. Quite a number of IRA statutes have been changed in the 1990s, in which case the impact of formal independence is better captured using the adjusted measure of actual independence. The results of these models are similar to those presented in Table 3, with the exception of the effect of the population variable in the first model, which is no longer significant. The results of the models are presented in the on-line appendix.

- 15 We also ran the analyses with the Druckman and Warwick (2005) measure of portfolio salience, which excludes Greece and the UK. The results – which do not differ substantially – are in the online appendix.
- 16 Following Maggetti (2007), we initially tested for agency age. It does not appear here because it was not a significant predictor of actual independence, and because our cross-sectional data does not allow a proper test of the dynamic effects of agency age.
- 17 In the on-line appendix, we report the results from OLS regression with Huber-White standard errors clustered by country. All variables significant in our multilevel models are also significant in these models.
- 18 The correlation between formal independence and the three measures of actual independence is not very strong: for the aggregate measure, Pearson's $r = 0.03$; for TOR, Pearson's $r = 0.03$; and for VUL, Pearson's $r = -0.08$.
- 19 Findings are similar for the TOR and VUL models. In the on-line appendix, we include the figures with the effect on these variables of a change in one standard deviation of the three independent variables.

Table 1 Formal independence items, adapted from Gilardi (2002)

| Item | Response category | β |
|---|--|---------|
| If the head has a fixed term, how long is it? | Fixed < 4 years <4 years <5 years <6 years <Over 6 years | 0.55 |
| Does the head of the agency serve for a fixed term? | No/Discretionary <Yes | 1.16 |
| Can the head of the agency be dismissed? | Can be dismissed for a variety of reasons < Can be dismissed, but only for reasons unrelated to policy <Cannot be dismissed | 0.58 |
| Are there provisions for dismissal of the head? | No <Yes | 0.16 |
| May the head of the agency hold other offices in the public administration? | Yes <Yes, but only with permission of the executive branch <No | 1.52 |
| Are there provisions for the head holding other offices? | No <Yes | 1.38 |
| Is the appointment of the agency head renewable? | Yes, more than once <Yes, once <No | 1.06 |
| Is independence a formal requirement for the appointment? | No <Yes | 0.96 |
| If the board members have a fixed term, how long is it? | Fixed < 4 years <4 years <5 years <6 years <Over 6 years | 1 |
| Do board members serve for a fixed term? | No/Discretionary <Yes | 1.06 |
| Can board members be dismissed? | Can be dismissed for a variety of reasons <Can be dismissed, but only for reasons unrelated to policy <Cannot be dismissed | 0.50 |
| Are there provisions for dismissal of the board? | No <Yes | 0.35 |
| May board members hold other offices in the public administration? | Yes <Yes, but only with permission of the executive branch <No | 1.25 |
| Are there provisions for board members holding other offices? | No <Yes | 1.42 |
| Is the appointment of the board members renewable? | Yes, more than once <Yes, once <No | 1.35 |
| Is independence a formal requirement for the appointment? | No <Yes | 1.17 |
| Is the independence of the agency formally stated in legislation or in statute? | No <Yes | 1.09 |
| What are the agency's formal obligations to the executive? | Agency must present reports more than once a year for approval < Agency must present an annual report which must be approved < Agency must present an annual report for information only < No formal reporting obligations | 0.36 |
| What is the source of the agency's funding? | Government grants only <Fees levied on the regulated industry and government grants <Fees levied on the regulated industry | 0.13 |
| How is the agency's budget controlled? | By the executive and/or the legislature <By an accounting office, court or non-elected body <By the agency only | 0.16 |
| Which body decides upon the agency's internal organization? | The executive only <Both the agency and the executive <The agency only | 0.48 |
| Which body is in charge of the agency's personnel policy? | The executive only <Both the agency and the executive <The agency only | 0.13 |

Table 2 Descriptive statistics

| Variable | Mean | SD | Min | Max |
|-------------------------|-------|-------|-------|-------|
| De facto independence | 1 | 0.82 | -2.03 | 1.88 |
| TOR | 0.19 | 0.12 | 0.05 | 0.73 |
| VUL | 0.09 | 0.14 | 0 | 0.66 |
| Formal independence | 0.45 | 0.22 | 0 | 0.99 |
| Rule of law (1998-2008) | 1.56 | 0.40 | 0.62 | 1.94 |
| Number of veto players | 2.63 | 1.40 | 1 | 6.13 |
| Political salience | 5.6 | 3.20 | 1 | 13.5 |
| Coordination | 0.62 | 0.26 | 0.06 | 1 |
| Population ('000) | 24150 | 25800 | 447 | 82240 |
| GDP per capita | 28210 | 7071 | 17610 | 59440 |

Table 3 Regression results: actual independence

| | Full model | Reduced model | Full TOR | Reduced TOR | Full VUL | Reduced VUL |
|----------------------|---------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| Intercept | -3.315 (3.554) | -1.852*** (0.419) | 0.133 (0.583) | 0.511*** (0.069) | 1.405* (0.655) | 0.515*** (0.079) |
| Formal independence | 1.118** (0.340) | 1.047** (0.342) | -0.100† (0.056) | -0.094† (0.056) | -0.198** (0.063) | -0.184** (0.064) |
| Rule of law | 1.400*** (0.218) | 1.226*** (0.191) | -0.155*** (0.036) | -0.152*** (0.032) | -0.210*** (0.040) | -0.163*** (0.036) |
| Veto players | 0.171** (0.063) | 0.200*** (0.058) | -0.004 (0.010) | -0.015 (0.010) | -0.044*** (0.012) | -0.039*** (0.011) |
| Population (log) | 0.155* (0.067) | | -0.004 (0.011) | | -0.039** (0.012) | |
| GDP per capita (log) | -0.048 (0.333) | | 0.047 (0.055) | | -0.044 (0.061) | |
| Market coordination | 0.382 (0.292) | | -0.133** (0.048) | | 0.056 (0.054) | |
| Saliency | 0.004 (0.021) | | 0.001 (0.003) | | -0.002 (0.004) | |
| Log-likelihood | -87.985 | -86.874 | 54.748 | 62.659 | 45.578 | 52.056 |
| Deviance | 155.500 | 164.326 | -158.874 | -149.154 | -138.678 | -126.926 |
| AIC | 195.970 | 185.748 | -89.496 | -113.318 | -71.157 | -92.113 |
| BIC | 220.629 | 200.544 | -64.837 | -98.523 | -46.498 | -77.318 |
| N | 87 | 87 | 87 | 87 | 87 | 87 |

*** = significant at 0.001 level; ** = significant at 0.01 level; * = significant at 0.05 level; † = significant at 0.1 level.