Ownership and innovation:
Evidence from Swiss listed firms[1]

PRELIMINARY AND INCOMPLETE DRAFT,

PLEASE DO NOT SHARE WITHOUT AUTHORS' PERMISSION.

(June 11)

Marcello Puca

(Università della Svizzera italiana; Webster University Geneva)

pucam@usi.ch

Massimiliano Vatiero

(Università della Svizzera italiana)

vatierom@usi.ch

Abstract

This paper conducts a causality test of the relation between ownership concentration of firms and their innovation, measured by patents and citations. Exploiting the introduction of a new takeover law in Switzerland in 1998 as an instrument for an exogenous reduction in firm ownership concentration, we find an increase of innovation for those firms affected by the reform. Using a sample that contains annual data about the ownership structures of about 150 Swiss companies over the 1990-2010 period, we report an average increase of both patents' applications and citations per patent of about, respectively, 10% and 12%. Our results are consistent with the view that dispersed ownership increases incentives to innovate.

Key-words: Takeover law, innovation, patents, corporate ownership, natural experiment.

JEL Code: D21, G32, G34, K22, O31.

---

1. Introduction

Although innovation establishes competitive advantage of firms (Porter (1992)) and drives economic growth (Aghion and Howitt (1992)), both theoretical and empirical literature produces ambiguous findings on determinants of innovation. In this paper, we investigate whether ownership concentration or de-concentration spurs firm innovation. Does the rise of large shareholder—otherwise known as blockholder—increase firm incentives to invest? Or does it undermine incentive to innovate? Several different and mixed explanations may answer these questions.

Publicly traded firms with diffused corporate ownership span the risk of innovation over many small shareholders. This system that is prevalent in the United States encourages innovation because it allows corporate actors to diversify the risk of innovation across a large number of investors. Yet, the problem is that small shareholders own tiny fractions of a firm's shares and, therefore, have little or no incentive to monitor management or seek to influence decision-making within the firm. The problem arises when small shareholders' innovation agenda is at odds with managers' agendas. Management, when shareholders are fragmented, may care about more private, short-run, benefits than innovative, long-run and value maximizing outputs.[2] Conversely, a large shareholder may have both the incentive and the ability to expend resources to monitor and influence managers, and, therefore, address the firm towards more innovative outputs. Yet, there are private benefits of control which are available only to large shareholder (via pyramidal groups, directly manage the firm, etc.) and may be negative for small shareholders. For instance, the large shareholder might attempt also to shift innovation agenda from what is the best for the corporation and small shareholders to what is the best for itself. In addition, because innovation entails risk for investors, the lack of financial or industrial diversification may be a source of large shareholders' reluctance to innovate. Hence, the large shareholder is not an unequivocally positive force to spur innovation from the perspective of the small shareholder.

Even though private contracting and laws can go a long way towards tempering these conflicts between the controlling agent (manager or large shareholder) and non-controlling agents (typically small shareholders), the possibility that the former will use their control over the company's resources to their own advantage and to the detriment of latters, will produce sub-optimal outcomes in terms of innovation. The issue whether innovation comes more likely from a dispersed or concentrated ownership remains theoretically and empirically ambiguous and is far from being established.

---

[2] Adam Smith first noted in his *Wealth of Nations* that managers will follow interest "rather than of other people's money that of their own".

Since Frank Knight (1921), economists recognized that contracts are incomplete. Because of transaction costs, agents cannot foresee all future contingencies. When contracts are incomplete, returns on investments are vulnerable to ex-post renegotiation. Such phenomenon—known as *hold-up* —arises, in particular, in the case of innovation, a risky investment with unpredictable returns. This uncertainty reduces the ex-ante incentives to innovate. An appropriate assignment of residual right of control can help as it affects the ex-post division of surplus in the case of renegotiation (Grossman and Hart (1986), Hart and Moore (1990), Hart (1995), and Zingales (1997)). Since a firm can be seen as a nexus of contracts (e.g., Jensen and Meckling (1976)), where each contract is incomplete, the corporate ownership structure matters, especially when investments and innovation are involved (e.g., Williamson (1985), Hart (1995), Burkart *et al.* (1997), and Aghion *et al.* (2013)). More recently, many authors contributed to the broader debate about the effect of corporate governance on innovation (e.g. Acharya et al. (2009, 2013, 2014), Manso (2011), Atanassov (2013), Nanda and Rhodes-Kropf (2013), and Griffith and Macartney (2014)). Our contribution is to offer evidence that the concentrated ownership, calculated as sum of five main shareholders, discourages patents' applications and citations.

In this respect, the theoretical literature produced mixed predictions. One view, based on Coase (1937), Klein *et al.* (1978) and Williamson (1979), emphasizes the benefits of control in situations in which there are difficulties in writing or enforcing complete contracts and predicts that concentrated firm ownership stimulates innovation. That is, concentration of ownership leverages up incomplete contracts. The number of authors supporting the view that a concentrated owner has the incentive to collect information, to monitor managers, to acquire enough voting power to exert pressure on management is huge.[3] This strand of the literature predicts that a concentrated owner may push the firm towards more innovative outputs. Conversely, when firm ownership disperses among several shareholders, the owner's incentive to monitor managers or other corporate actors diminishes.

Another strand of the literature predicts, instead, a negative relationship between ownership concentration and innovation. There are costs associated with removing control from those who manage productive assets for concentrating it in the hands of one actor, even if she is the most efficient residual control right agent (cf. Grossman and Hart (1986)). There is the very serious problem that large shareholder can use the firm for their own private benefit, expropriating rents at the expense of minority shareholders. The concentrated ownership structure, indeed, increases the incentives in investing for dominant owner but reduces them for non-dominant owners (i.e. small shareholders).

---

[3] For example, Jensen and Meckling (1976), Demsetz and Lehn (1985), Shleifer and Vishny (1985), (1997), Stiglitz (1985), Black (1992), Pagano and Röell (1998), Boot *et al.* (2006), Edmans and Manso (2011).

More specifically, the risk of a shift in value from small owners to the concentrated owner reduces the formers' incentive in long-term investments. Second, a concentrated owner bears the cost of forgoing alternative investments opportunities (Rajan and Zingales (1998)). Because concentrated ownership commits assets in specialized and long-term relationships, innovative projects are associated to the loss of potential outside options. This loss reduced the concentrated owner's ex-ante incentive to invest.

Another reason for combining de-concentrated ownership with more innovation follows an extension of the hold-up theory to financial constraints (Aghion and Bolton (1992), and Aghion and Tirole (1994)). When a firm is cash constrained, innovative activities require outside financing (e.g. going public). Due to the contract incompleteness associated to innovation, however, the firm cannot commit to return the full value of the investment to its financiers. Relinquishing control to external financiers raises the pledgeable income needed to obtain financing and, hence, raises the firm incentives to invest (Tirole (2006)). A similar argument pertains to the diversification of risk. Because of risk aversion, a single entrepreneur may not be willing to risk enough resources required to innovate. For instance, one party may be reluctant to finance entirely an investment project because she would bear all the risk associated to innovation. Raising external funds from financial markets reduces the party's individual risk sharing it over several shareholders.

The objective of this paper is to shed light on effect of ownership and innovation. Because the literature offers several predictions on the impact of ownership concentration on innovation, which channel prevails remains an empirical question. Adopting a quasi-experimental research design, we collected annual data of about 150 Swiss listed firm and their ownership structure over the 1990-2010 period. Following Acharya *et al.* (2013, 2014) and Aghion *et al.* (2013), the variance of investment returns can proxy the risk involved in an innovative project. In this respect, authors emphasize, patents represent better outcome-based measures of risky innovation than capital expenditures (CAPEX) and R&D expenditures, which are input-based measures of innovation.[4] Furthermore, unlike CAPEX and R&D expenditures, it is possible to measure the quality of the risky investment using the trail of citations to patents. Put it differently, citations capture the economic importance and drastic nature of innovative activities (cf. Acharya et al. (2013:1007)). Accordingly, Griffith and Macartney (2014) measure the radicalness of innovation in terms of citations. Following this literature that uses patents and citations as proxies for innovative activity, we collected data from the OECD Patent Quality Indicators database (2015).

---

[4] As noted years ago by Porter (1992), though the patent is an easily measurable indicator, innovation composes also by unaccountable components such as corporate trainings and long-term commitments among stakeholders that could not produce patents.

The non-parametric estimation of the relation between ownership concentration and innovation shows a negative slope, as reported in Figure 1. The negative relation holds for both patents (Panel A) and citations per patent (Panel B).

[INSERT FIGURE 1 HERE]

Switzerland is an interesting environment to study incentives for innovation. Figure 2 shows that, over the 1990-2010 period, Switzerland outperformed most developed countries in terms of patents applications over GDP.

[INSERT FIGURE 2 HERE]

Moreover, Switzerland has highest market capitalization as a percentage of GDP, as reported in Figure 3. This fact fits awkwardly with a "legal origin" perspective (Roe (2006:508)), which predicts that a civil-law country like Switzerland should not have a well-developed financial market. Its fiscal and political federalism, in addition, makes Switzerland a country with institutions lying between most European countries and United States.

[INSERT FIGURE 3 HERE]

Another advantage of focusing on Switzerland is the possibility of taking into account possible endogeneity biases between ownership and innovation. The source of endogeneity may arise from the external effect of innovation on shares value and, consequently, on firm ownership. For example, a firm producing many successful patents may raise the firm expected share price and increase its market value, attracting more small shareholders. This and other possible unobservable factors, therefore, may create a reverse causality issue. We address these concerns adopting an instrumental variable approach (IV). Exploiting the introduction of a takeover reform introduced in Switzerland in 1998 (i.e. the Swiss Stock Exchange Act (SESTA)) as an instrument for a variation in ownership concentration, we test whether firm ownership affects the quantity and quality of innovation of listed companies, measured by patents and patents' citations.

We report results from the estimation in two steps. First, in a reduced-form fashion, we estimate the variation of innovation coding the takeover reform as a dummy variable. Second, we use the traditional two stages least squares (2SLS) estimator. Our results suggest a negative relationship between firm ownership and innovation. After the Swiss takeover reform, we find an average increase of both patents' applications (about 10%) and citations (about 12%). Our findings suggest that, in Switzerland, higher levels of contestability in the market for the control of firms and the increased minority shareholder protection resulting from the new takeover law spurred firm level innovation.

The paper structures as follows. In Section 2, we review the main literature on the topic. Section 3 describes the SESTA reform and our choice to use this reform as a natural experiment. We describe our dataset and explain how we constructed the main variables of interests in Section 4. In section 5, we propose our empirical strategy. Section 6 describes the results. Section 7 concludes.

2. Related literature

Our paper relates to several strands of the literature on the governance of innovation. Mayer (2000), Hall and Soskice (2001), and Carlin and Mayer (2003) affirm that the type of corporate ownership is complementary to the type of innovation. This literature advances the idea that while a large insider shareholder supports innovative outputs with a "modular" step-by-step progression, i.e. incremental innovation, dispersed owners stimulate all-or-nothing innovation that requires greater flexibility and less commitment, i.e. radical innovation.[5] Consistently, we find that that there is a positive relation between a diffused ownership and radical innovation as measured, according to Griffith and Macartney (2014), in terms of citation per patent.

Our paper also relates to the "Law and Finance" studies (e.g., La Porta *et al.* 1998), which argue that for the economy the quality of institutions and enforcement matter. A bad or good enforcement determines what rights security holders have and how these rights are protected. Since the protection of investors determines their readiness to finance firms, corporate finance may critically turn on these legal rules and their enforcement. According to this literature, which relies on cross-country analysis, concentrated ownership may be a reasonable response to a lack of investor protection among nations. Because our analysis focuses on one country, we are able to control for a range of factors and influences

---

[5] The distinction between these two kinds of innovation hinges on the importance of innovation. Radical innovation implies substantial shifts in production and the elaboration of totally new goods. In contrast, incremental innovation is based on constant but small-scale improvements to existing products and production processes (cf. Hall and Soskice (2001)).

that cannot be as convincingly controlled for in cross-country data. For this reason, we contribute to this line of research in assessing rules and their enforcement without the risk of ecological fallacy.[6]

Our study relates also to literature on how motivating innovation. Holmstrom (1989) and Manso (2011) argue that incentive schemes that motivate innovation must exhibit tolerance for failures. For Holmstrom (1989), because the performance measures for innovative activities are noisier, the incentive scheme to motivate innovation should be not similar to standard pay-for-performance contracts. Manso (2011), who illustrates the tension between explorative innovation (i.e., the exploration of new untested innovative actions) and exploitative innovation (i.e. the exploitation of well-known innovative actions), develops a theoretical model to show that lower pressure on innovators and tolerance for failure in the short run leads to more explorative innovation. Nanda and Rhodes-Kropf (2013) extend theoretically Manso's (2011) argument. They show that a failure tolerant strategy leads to fund less radical innovations, namely ones where the value of options is low. Hence, the tolerance has the price to frustrate innovations that are more radical. Barrot (2016) finds analogous result looking at the contractual horizon of venture capitalists financing innovative firms. Similarly, a number of empirical papers shows the positive impact on innovation of "tolerant policies", namely that reduce short-term pressures, such as higher institutional owners (Aghion *et al.* (2013)), debtor-friendly bankruptcy laws (Acharya and Subramanian (2009)), laws that impose restrictions on dismissal of employees (Acharya *et al.* (2013), (2014)). Likewise, Larcker et al. (2011) and Cremers *et al.* (2014) report a positive effect of strong antitakeover protection – such as *staggered boards* – on firm value. Burkart *et al.* (1997), on the contrary, show empirically that managerial discretion resulting from a dispersed ownership may be beneficial to encourage managerial initiatives, which can favour firm-specific investments. Indeed, because the manager is less inclined to such initiative when interferences are likely, dispersed shareholders can more credibly commit than concentrated ownership not to interfere in the running of the firms. Accordingly, our results suggest that takeover laws, which induce dispersed ownership and diminish large shareholders' interferences, stimulates innovation.

Finally, our study complements the findings in "inconclusive" literature on effects of takeovers and takeover law on innovation.[7] Atanassov (2013:1098) writes,

"[p]revious research has provided inconclusive evidence partly because of the difficulties in

---

[6] Similar works that study the relationship between corporate governance and innovation, but focusing on Italy, are Minetti *et al.* (2011), and Belloc *et al.* (2016).

[7] Jensen (1986) speaks about the *takeover controversy* (cf. also Atanassov 2013:1124-1125; Enriques *et al.* 2014:86-87). Pro-takeover commentators argue that takeovers are generally beneficial for corporations because they can displace poorly performing managers. Other observers argue, on the contrary, that they can encourage short-termism of corporate actors (especially, managers).

establishing a causal link from hostile takeovers to innovation, in measuring the threat of takeovers, and in the ability to properly capture the creation of valuable innovation."

In this respect, the relation between innovation and takeover pressure can be positive,[8] negative[9] or U-shaped.[10] We contribute to this debate exploiting the introduction of SESTA to study the impact of corporate concentrated ownership on corporate innovation and reporting a negative impact of the former on the latter. Our result is also consistent with the literature supporting the negative link between antitakeover protection and firm value (e.g., Johnson and Rao (1997), Bebchuk and Cohen (2005), Faleye (2007), Guo *et al.* (2008)).

3. The Swiss Stock Exchange Act as a natural experiment

The relationship between corporate ownership and innovation may be driven by characteristics that are observable to the shareholders but not to the econometrician. For example, firms that innovate more may attract more shareholders because they expected a higher share price in future. This might imply that the firm innovative behavior induces a less concentrated ownership and not the reverse. Another possible source of endogeneity arises if we measure our variable of shares ownership with error.

To address these concerns of endogeneity of the ownership structure for factors that may also affect innovation, we adopt the Swiss Stock Exchange Act (SESTA, artt. 22-33, in particular) as an exogenous source of variation in ownership. Policy-makers typically design takeover provisions to ensure the protections of small, distant and minority shareholders in the case of variation of controlling shareholder. Scholars argue that organized interest groups, such as managers (cf. Roe (1994), Culpepper (2011)), or coalitions of interest groups, such as the coalition between managers and workers

---

[8] In accordance with the so-called "moral hazard view", the threat of hostile takeovers disciplines managers and keeps them focused on pursuing the most innovative and valuable projects (e.g. Grossman and Hart 1980, Shleifer and Vishny 1997). Atanassov (2013) finds a significant decline in the number of patents and citations per patent for firms incorporated in countries that pass antitakeover law relative to firms incorporated in countries that do not. Moreover, the author finds that most of the impact of antitakeover laws on innovation occurs two or more years after they are passed, indicating a causal effect. Finally, Atanassov reports that the negative effect of antitakeover laws is mitigated by the presence of large shareholders and product market competition.

[9] The theory of "managerial myopia", following Holmstrom's (1989) notably intuition that capital markets, by pressuring top managers, force managers to focus on short-term projects and neglect innovation, predicts that takeover will reduce investments and innovation. Managers will sacrifice long-term interests and investments to boost current profits, i.e. managers will tend to invest less in innovative outputs and put more effort in routine tasks that offer quicker, more certain (but also myopic) returns (cf. Stein 1988). Chemmanur and Tian (2013) test these hypotheses and find that firms with a larger number of antitakeover provisions are more innovative.

[10] Innovation may vary non-monotonically with takeover pressure (Sapra *et al.* 2014). Broadly, authors' study suggests that innovation is fostered either by takeover laws that permit an unhindered market for corporate control, or by anti-takeover laws that are severe enough to effectively deter takeover.

(cf. Roe and Vatiero 2015)), affect takeover law. Because corporate governance has an impact on innovation, as the abovementioned literature predicts, one could suppose, therefore, that these organized interest groups could ask for takeover provisions in accordance with their private returns on innovation. However, even admitting this causation from innovation to takeover law, it would involve transversal-corporate interest groups (e.g. managers) and not individual firms. As clarified by Atanassov (2013:1099), takeover law is exogenous to corporate innovation because it is outside the control of each individual firm. More in detail, Comment and Schwert (1995:23) note that takeover laws are passed to protect a very small number of firms in play; Garvey and Hanka (1999) find that only nine firms in their sample of 1203 firms had this potential endogeneity problem. Consistently, there is no evidence to support a political economy explanation of takeover legislation (Romano 1987:111, Atanassov 2013:1100). We therefore assume, as they do, that takeover laws are orthogonal with respect to innovation and, therefore, the passage of these laws provides a natural exogenous shock to the corporate ownership structure. Figure 4 shows the reduction in corporate ownership concentration, calculated as percentage of shares with voting rights of the first five shareholders, after the introduction of SESTA.

[INSERT FIGURE 4 HERE]

The SESTA rules the procedures applicable to public tender offers. Important provisions are:
- The mandatory public tender in the SESTA applies to each Swiss corporation listed on a Swiss stock exchange (i.e. target company) and to all the listed equity securities of the target company.
- The offer price must at least match the stock exchange price.
- The Swiss Takeover Board, which supervised by the Swiss Financial Market Supervisory Authority (FINMA), ensures compliance with takeover provisions and reviews all public offers subject to SESTA.

To define our treatment and control groups, particularly relevant are further two provisions:

1. The obligation to submit a public tender offer arises whenever a shareholder or group of shareholders directly or indirectly acquires equity securities in a target company and thereby exceeds

the threshold of 33.33% of the voting rights of the company, whether such voting rights are exercisable or not.[11]

2. The obligation to submit a public tender offer also arises when there are two other conditions: (i) before 1998, a shareholder (or group of shareholders) held shares exceeding the 33.33% threshold and (ii) after 1998, this shareholder (or group of shareholders) directly or indirectly acquires shares exceeding the 50% voting rights threshold. Because the public tender offer never applies for shareholders holding more than 50% of the shares after and before 1998, we exploit this discontinuity in a differences-in-differences estimation. Section 5 discusses the empirical strategy in detail.

4. Data sources and main variables description

Our dataset contains in particular information on ownership and innovation of listed companies over the 1990-2010 period.

INNOVATION

The main dependent variables are *Patents* and *Citations*. We follow the literature on innovation (Atanassov 2013, Acharya *et al.* 2013, 2014) using:

a)   the number of patents' applications to measure the *quantity* of innovation produced by a firm; and

b)   the number of citations per patent to measure the *quality* of such innovation.

We collected patents and citations data from the European Patent Office, produced by the OECD. In particular, we refer to the OECD Patent Quality Indicators database (February 2015). To avoid the typical censored-data issues of these datasets, we follow the so-called "fixed-effects procedure" (Hall *et al.* 2001, Atanassov 2013). Specifically, to construct the variable *Patents*, for each year, industry and firm, we first divide the raw number of patents for the average number of patents for that industry and year and then take the logarithm. Similarly, we construct the variable *Citations* dividing, for each year, industry and firm, the number of citations received by each patent in the following five years by

---

[11] Statutes of target companies may provide for a higher threshold of up to 49% of the voting rights (opting-up) or may declare the mandatory tender offer obligations to be inapplicable at all (opting-out). Note that, an opting-up or opting-out clause must be introduced in the articles of incorporation *after* the listing of the target company.

the number of patents of that firm for that year and, in addition, by the average number of citations for that year and then take the logarithm.

OWNERSHIP

The main explanatory variable is the firm level of ownership.[12] Information on corporate ownership comes from the Swiss Stock Guide yearbook, published by *Finanz Und Wirtshaft* (FUW), the main Swiss financial newspaper.[13] This report contains information on public companies' shares ownership of the first five shareholders that hold at least 3% of the total outstanding shares.[14] From this information, we construct the variable *Blockholding* to indicate a concentration of ownership. It is the sum of the shares with voting rights of the first five shareholders. We identify each firm in this dataset through its International Securities Identification Number (ISIN), which allows us to match the ownership dataset on ownership with the financial information coming from the Compustat database. Finally, we use the two-digit SIC industries as the industry identifier for each firm.

In the IV estimation, we use as instrumental variable a dummy variable that codes the SESTA reform. Because the obligation to submit a public tender offer never applies to shareholders holding more than 50% of the shares at the year 1998, we coded SESTA reform as a dummy variable. The variable *SESTA* is equal to 1 for those firms whose sum of first five shareholders (our *Blockholding* variable) is less than 50% of the shares in year 1998 (i.e. the treatment group), and zero otherwise (i.e. the control group).

OTHER CONTROL VARIABLES

To control for firm-level characteristics, we collect data on assets, cash, EBIT, liabilities, revenues and R&D expenses from Compustat. All continuous variables are winsorised at the 1st and 99th percentiles to remove any outliers' bias.

[INSERT TABLE 1 HERE]

---

[12] On mistakes and biases of shareholder database, see Dlugosz *et al.* (2006).

[13] See Schnyder and Kern (2015) for more details.

[14] Many firms in this dataset report zero ownership. This is because the obligation to report the level of ownership applies only to shareholders holding more at least 3% of the shares with voting rights. We assume, therefore, firms with zero ownership are just below the 3% threshold and we artificially fix their level of ownership to 2.9%. Our results are qualitatively similar without this manipulation.

5.   Empirical strategy

We aim at testing the theoretical predictions on innovation and ownership using a multivariate fixed effects OLS model. The simplest model to study the relationship between ownership and innovation writes as:

$$(1) \quad Innovation_{ij(t+1)} = \beta_t^0 + \beta_i^1 + \beta^2 \, Blockholding_{ijt} + \beta^3 \, X_{ijt} + \varepsilon_{ijt}$$

where i indexes the firm, j indexes the industry, t indexes time, *Innovation* is the dependent variable, which is either *Log(Patents + 1)* or *Log(Citations + 1)*, and *Blockholding*, the main independent variable, indicates the sum of the shares with voting rights of the first five shareholders. Table 1 contains a detailed description of the variables used in the empirical analysis.

Model (1), however, raises concerns of endogeneity. While firm concentration affects firms' innovation, indeed, the corporate innovative output may also affect its own ownership structure (for example, more innovation has a positive "signaling" effect on financial markets; this may induce investors to buy more shares of the most innovative companies and, therefore, impact on the ownership structure of the firm). To address these concerns, we test our theory using an instrumental variable approach (Imbens and Angrist 1994), in which we use a reduced-form model:

$$(2) \quad Innovation_{ij(t+1)} = \beta_t^0 + \beta_i^1 + \beta^2 \, SESTA_{ijt} + \beta^3 \, X_{ijt} + \epsilon_{ijt}$$

where *SESTA* is a dummy variable which is equal to 1 when the variable *Blockholding* is less than 50% in year 1998, and zero otherwise. Moreover, we adopt a two-stage least squares (2SLS) model:

$$(3) \quad Blockholding_{ijt} = \beta_t^0 + \beta_i^1 + \beta^2 \, SESTA_{ijt} + \beta^3 \, X_{ijt} + v_{ijt}$$

$$(4) \quad Innovation_{ij(t+1)} = d_t^0 + d_i^1 + d^2 \, Blockholding_{ijt} + d^3 \, X_{ijt} + k_{ijt}$$

where, before estimating equation (4), we instrument the level of ownership with the dummy *SESTA*.

6. Results

SUMMARY STATISTICS

We present in the Table 2 the summary statistics for the key variables of the analysis. Panel A) contains summary statistics about firms with at least one patent in the observed period. Panel B) refers to firms without patents. All differences (except ASSETS) between Panel A) and Panel B) are statistically significant at the 1% level. Firms producing patents, on average, have more dispersed ownership, more liabilities and higher revenues. There is a great variation in the number of patents' application, which shows great heterogeneity in firms' attitude to innovate. Most firms, moreover, have either very concentrated or very dispersed ownership.

[INSERT TABLE 2 HERE]

OWNERSHIP VS. INNOVATION

We report in Table 3 the results from the estimation of equation (2).

[INSERT TABLE 3 HERE]

As highlighted above, the OLS estimation of equation (1) may suffer from endogeneity bias. To address this concern, we perform an IV estimation in two steps. First, in a reduced-form fashion, we estimate the level of innovation using the *SESTA* dummy as an instrument. Second, we use the traditional 2SLS estimator.

REDUCED FORM VS. IV

Using the exogenous variation in the level of ownership induced by the SESTA reform, in the most demanding models, we report an average patents' applications increase of about 10% (column (3)) and average citations' increase of about 12% (column (6)). This latter result is, however, only slightly significant (*i.e.*, the p-value is approximately equal to 0.10). The level of assets is also statistically significant associated to higher future number of patents' applications, while it does have any

association with patents citations. This may suggest that incremental innovation requires a more structured and prominent infrastructure. Conversely, the level of cash is significantly associated to radical innovation (i.e. citations), suggesting that more innovative projects absorb high levels of cash.

We conclude our results section discussing the results of the 2SLS estimation, which we report in the Table 4. In columns (1) and (2), we document the first-stage regressions between the level of ownership of the first five shareholders and the SESTA dummy. As expected, we find a very significant negative effect of the reform on the ownership levels. In columns (3) and (4), we report the second stages estimations of equations (4). As predicted by the reduced-form approach, there is a strong causal link between ownership concentration and the production of patents. The more concentrated the ownership, the lower the attitude of the firm to produce patents in the next year.

On the other hand, we can document a slightly significant effect on the quality of innovation, that is, on the citations. The low significance is probably attributable to the higher variation observed for the *Citations* variable.

[INSERT TABLE 4 HERE]

7. Conclusion

In this paper, we analyse the effect of ownership concentration on corporate innovation. We develop our testable hypotheses based on different strands in the theoretical literature that produce mixed predictions regarding how corporate ownership affects firm innovation.

Focusing on Switzerland and using the SESTA as a natural experiment, we documented a negative relation between ownership concentration and innovation. In particular, we report an average patents' increase of about 10% and an average increase of citations per patent of about 12%.

BIBLIOGRAPHY

Acharya V.V. and K.V. Subramanian (2009), "Bankruptcy Codes and Innovation," *Review of Financial Studies*, 22: 4949-4988.

Acharya V.V., R.P Baghai, and K.V. Subramanian (2013), "Labour laws and innovations," *Journal of Law and Economics*, 56(4): 997-1037.

Acharya V.V., R.P Baghai, and K.V. Subramanian (2014), "Wrongful Discharge Laws and Innovation," *Review of Financial Studies*, 27(1): 301-346.

Aghion P. and P. Bolton (1992), "An incomplete contracts approach to financial contracting," *Review of Economic Studies*, 59: 473-493.

Aghion P. and P. Howitt (1992), "A model of growth through creative destruction," *Econometrica*, 60: 323-351.

Aghion P. and J. Tirole (1994), "The management of innovation," *Quarterly Journal of Economics*, 109: 1185-1209.

Aghion P., J. Van Reenen, and L. Zingales (2013), "Innovation and institutional ownership," *American Economic Review*, 103: 277-304.

Atanassov J. (2013), "Do hostile takeover stifle innovation? Evidence from antitakeover legislation and corporate patenting", *Journal of Finance*, 68(3): 1097-1131.

Barrot J. (2016), "Investor Horizon and the Life Cycle of Innovative Firms: Evidence from Venture Capital," available at SSRN: http://ssrn.com/abstract=2024601.

Bebchuk L. A. and A. Cohen (2005), "The cost of entrenched boards," *Journal of Financial Economics*, 78: 409-433.

Belloc F., E. Laurenza, and M.A. Rossi (2016), "Corporate governance effects on innovation when both agency costs and asset specificity matter," forthcoming on *Industrial and Corporate Change.*

Boot A.W.A., R. Gopalan and A.V. Thakor (2006), "The Entrepreneur's Choice between Private and Public Ownership," *The Journal of Finance,* 61(2): 803-836.

Burkart M., D. Gromb, and F. Panunzi, (1997), "Large Shareholders, Monitoring, and the Value of the Firm," *Quarterly Journal of Economics*, 112: 693-728.

Carlin W. and C. Mayer (2003), "Finance, investment, and growth," *Journal of Financial Economics*, 69(1): 191-226.

Chemmanur T. and X. Tian (2013), "Do anti-takeover provisions spur corporate innovation?", available at SSRN: http://ssrn.com/abstract=1572219.

Coase R.H. (1937), "The nature of the firm," *Economica*, 4:386-405.

Comment R. and G. Schwert (1995), "Poison or placebo? Evidence on the deterrence and wealth effects of modern antitakeover measures," *Journal of Financial Economics*, 39:3-43.

Compustat database, S&P Global Market Intelligence, available at: http://www.spcapitaliq.com/our-capabilities/our-capabilities.html?product=compustat-research-insight.

Cremers M., L.P. Litov and S.M. Sepe (2014), "Staggered boards and firm value, revisited," available at SSRN: http://ssrn.com/abstract=2364165.

Culpepper P.D. (2011), *Quiet politics and business power: Corporate control in Europe and Japan*, Cambridge: Cambridge University Press.

Demsetz H. and K. Lehn (1985), "The structure of corporate ownership: Causes and consequences," *Journal of Political Economy*, 93:1155-1177.

Dlugosz J., R. Fahlenbrach, P. Gompers, and A. Metrick (2006), "Large blocks of stock: Prevalence, size, and measurement," *Journal of Corporate Finance*, 12:594-618.

Edmans A. and G. Manso (2011), "Governance through trading and intervention: A theory of multiple blockholders," *Review of Financial Studies*, 24(7):2395-2428.

Enriques L., D. Gilson and A. Pacces (2014), "The case for an unbiased takeover law", *Harvard Business Law Review*, 4:85-127.

Faleye O. (2007), "The costs of entrenched boards", *Journal of Financial Economics*, 83(2): 501-529.

Garvey G. and G. Hanka (1999), "Capital structure and corporate control: The effect of antitakeover statutes on firm leverage," *Journal of Finance*, 54: 519-546.

Griffith R. and G. Macartney (2014), "Employment protection legislation, multinational firms, and innovation," *Review of Economics and Statistics*, 96(1): 135-150.

Grossman S.J. and O.D. Hart (1980), "Takeover bids, the free-rider problem, and the theory of the corporation", *Bell Journal of Economics*, 11:42-64.

Grossman S.J. and O.D. Hart (1986), "The costs and benefits of ownership; A theory of vertical and lateral integration," *Journal of Political Economy*, 94(4): 691-719.

Guo R. J., T. A. Kruse and T. Nohel (2008), "Undoing the powerful antitakeover force of staggered boards," *Journal of Corporate Finance*, vol. 14, issue 3, pages 274-288.

Hall B., A. Jaffe, and M. Trajtenberg (2001), "The NBER patent citations data file: Lessons, insights and methodological tools", *NBER Working paper* 8498.

Hall P.A. and D. Soskice (2001), "An introduction to varieties of capitalism," in P.A. Hall and D. Soskice (eds.), *Varieties of capitalism: The institutional foundation of comparative advantage*, Oxford: Oxford University Press, pp. 1-68.

Hart O.D. (1995), *Firms, contracts and financial structure*, Oxford: Oxford University Press.

Hart O.D. and J. Moore (1990), "Property rights and the nature of the firm," *Journal of Political Economy*, 98(6): 1119-1158.

Holmstrom B. (1989), "Agency costs and innovation," *Journal of Economic Behavior and Organization*, 12: 305-327.

Imbens G. and J. Angrist (1994), "Identification and estimation of local average treatment effects," *Econometrica,* 62(2): 467–476.

Jensen M.C. (1986), "The takeover controversy: Analysis and evidence", *Midland Corporate Finance Journal*, 4(2) (also in J. Coffee and S. Rose-Ackerman (eds.), *Knights, Raiders and Targets: The Impact of the Hostile Takeover*, Oxford: Oxford University Press, 1988).

Jensen M. and W. Meckling (1976), "Theory of the firm: Managerial behaviour, agency costs, and ownership structure," *Journal of Financial Economics*, 3: 305-360.

Johnson M.S. and R.P. Rao (1997). "The impact of antitakeover amendments on corporate financial performance," *Financial Review*, 32(3): 659-690

Klein B., R.G. Crawford and A.A. Alchian (1978), "Vertical integration, appropriable rents, and the competitive contracting process," *Journal of Law and Economics*, 21:297-326.

Knight F.H. (1921), *Risk, Uncertainty, and Profit*, Kissimmee (FL): Signalman Publishing.

La Porta R., F. Lopez-de-Silanes, A. Shleifer and R.W. Vishny (1998), "Law and Economics," *Journal of Political Economy*, 106(6):1113-1155.

Larcker D.F., G. Ormazabal and D.J. Taylor (2011), "The market reaction to corporate governance regulation," *Journal of Financial Economics*, 101(2): 431–448.

Manso G. (2011), "Motivating innovation," *Journal of Finance*, 66: 1823-1869.

Mayer C. (2000), "Ownership matters," *mimeo*, Universitè Libre de Bruxelles.

Minetti R., P. Moro, and M. Paiella (2012), "Ownership structure, governance, and innovation: Evidence from Italy," *Government of the Italian Republic (Italy), Ministry of Economy and Finance, Department of the Treasury Working Paper* No. 10.

Nanda R. and M. Rhodes-Kropf (2013), "Innovation and the Financial Guillotine," *NBER Working Paper*, No. 19379.

OECD Patent Quality Indicators database February (2015), available at http://www.oecd.org/sti/inno/intellectual-property-statistics-and-analysis.htm.

Pagano M. and A. Röell (1998), "The Choice of Stock Ownership Structure: Agency Costs, Monitoring, and the Decision to go Public," *Quarterly Journal of Economics*, 113(1): 187-225.

Porter M.E. (1992), "Capital disadvantage: America's failing capital investment system," *Harvard Business Review*, September-October issue.

Rajan G.R. and L. Zingales (1998), "Power in a theory of the firm," *Quartely Journal of Economics*, 113(2): 387-432.

Roe M. (1994), *Strong managers, weak owners: The political roots of American corporate finance*, Princeton: Princeton University Press.

Roe M.J. (2006), "Legal Origins, Politics, and Modern Stock," *Harvard Law Review*, 120(2): 460-527.

Roe M. and M. Vatiero (2015), "Corporate governance and its political economy," *John M. Olin Center for Law, Economics, and Business*, Discussion paper n. 827, available at http://ssrn.com/abstract=2588760.

Romano R. (1987), "The political economy of takeover statutes," *Virginia Law Review*, 73:111-199.

Sapra H., A. Subramanian, and K. Subramanian (2014), "Corporate governance and innovation: Theory and Evidence", *Journal of Financial and Quantitative Analysis*, 49(4): 957-1003.

Shleifer A. and R. Vishny (1985), "Large shareholders and corporate control," *Journal of Political Economy*, 94:461-488.

Shleifer A. and R. Vishny (1997), "A survey of corporate governance", *Journal of Finance*, 52:737-783.

Schnyder G. and Kern P. (2015), "Law and Agency: The Micro-Foundations of Institutional Change in National Corporate Governance Systems," Colchester, Essex: UK Data Archive: 10.5255/UKDA-SN-851977.

Stein J. (1988), "Takeover threats and managerial myopia," *Journal of Political Economy*, 96: 61-80.

Stiglitz J. (1985), "Credit markets and the control of capital," *Journal of Money, Credit and Banking*, 17:133-152.

Tirole J. (2006), *The theory of corporate finance*, Princeton: Princeton University Press.

Williamson O.E. (1979), "Transaction-cost economics: The governance of contractual relations," *Journal of Law and Economics*, 22:233-261.

Williamson O.E. (1985), *The Economic Institutions of Capitalism*. New York: Macmillan.

Zingales L. (1997), "Corporate governance," in *The New Palgrave Dictionary of Economics and the Law*.

TABLES

VARIABLES	DESCRIPTION	SOURCE
PATENTS	Logarithm of the raw number of patent applications granted to a firm, divided by the average number of patents for each industry and year, plus one.	European Patent Office
CITATIONS	Logarithm of the cumulative number of citations received after 5 years from the firm patent grant, divided by the average number of citations for each industry and year, plus one.	European Patent Office
BLOCKHOLDING	Sum of the share percentages with voting rights of the first five shareholders.	Finanz und Wirtshaft
ASSETS	Logarithm of the total assets of a company at each year, plus one.	Compustat
CASH	Logarithm of any immediately negotiable medium of exchange or any instruments normally accepted by banks for deposit and immediate credit to a customer's account, plus one.	Compustat
EBIT	Logarithm of the sum of sales minus cost of goods sold minus selling, general and administrative Expense, minus depreciation/amortization, plus one.	Compustat
LIABILITIES	Logarithm of current liabilities plus long-term debt plus other noncurrent liabilities, including deferred taxes and investment tax credit, plus one.	Compustat
REVENUE	Logarithm of the gross income received from all divisions of the company, plus one.	Compustat
R&D EXPENSES	Logarithm of all costs incurred during the year that relate to the development of new products or services, plus one.	Compustat

Table 1. Variables description. This table contains the description of the variables used in the empirical analysis and their sources.

Panel A) $Patents > 0$						
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	MEAN	SD	MIN	MAX	MEDIAN	OBS.
PATENTS	34.02	60.61	1	263	9	600
CITATIONS	17.37	31.44	0	132	3	600
BLOCKHOLDING	0.352	0.247	0.0290	0.958	0.332	600
ASSETS	15,151	35,567	130.2	307,287	2,571	557
CASH	1,111	2,212	1	16,936	232.4	552
EBIT	1,195	2,621	-336.9	14,065	195.8	551
LIABILITIES	9,605	28,337	31.90	274,985	1,380	557
REVENUE	8,690	15,584	7.397	78,362	2,429	557
R&D EXPENSES	354.5	911.9	0	4,246	32.60	600

Panel B) $Patents = 0$						
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	MEAN	SD	MIN	MAX	MEDIAN	OBS.
BLOCKHOLDING	0.435	0.284	0.0290	0.958	0.460	1,477
ASSETS	19,307	61,105	130.2	389,344	2,580	1,151
CASH	796.2	2,485	0.700	16,936	171.7	1,138
EBIT	477.8	1,598	-336.9	14,065	131.9	1,129
LIABILITIES	17,177	56,767	31.90	360,166	1,433	1,151
REVENUE	4,325	10,470	7.397	78,362	1,004	1,151
R&D EXPENSES	8.861	45.19	0	1,060	0	1,477

Table 2. Summary statistics. This table reports summary statistics for the key variables used in the analysis. Panel A) contains data on patents, citations and firm characteristics of those firms with at least one patent. Panel B) refers to firms without patents. Data on patents and citations come from the European Patent Office (EPO), provided by the OECD. This data set includes the number of applications for patents by each firm and the number of citations received by each patent. Data on ownership come from the Swiss Stock Guide yearly report, published by *Finanz Und Wirtshaft* newspaper. *Blockholding* is the sum of the shares with voting rights of the first five shareholders. Data on assets, cash, EBIT, liabilities, revenues and R&D expenses come from Compustat. All differences (except ASSETS) between Panel A) and Panel B) are statistically significant at the 1% level. All data refer to the 1990-2010 period.

VARIABLES	(1) PATENTS$_{t+1}$	(2) PATENTS$_{t+1}$	(3) PATENTS$_{t+1}$	(4) CITATIONS$_{t+1}$	(5) CITATIONS$_{t+1}$	(6) CITATIONS$_{t+1}$
SESTA	0.116***	0.120***	0.105***	0.132*	0.132*	0.120
	(0.0325)	(0.0362)	(0.0400)	(0.0676)	(0.0750)	(0.0785)
ASSETS			0.186***			-0.0300
			(0.0688)			(0.118)
CASH			0.0347			0.0444**
			(0.0272)			(0.0217)
EBIT			0.00258			0.0232
			(0.0208)			(0.0200)
LIABILITIES			0.0102			0.0748
			(0.0333)			(0.0527)
REVENUE			-0.0260			0.0833
			(0.0631)			(0.105)
R&D EXPENSES			0.0138*			0.00594
			(0.00740)			(0.0131)
CONSTANT	0.326***	0.754**	-1.272**	0.354***	0.701*	-0.901
	(0.0633)	(0.370)	(0.550)	(0.0687)	(0.360)	(0.618)
OBSERVATIONS	1,465	1,465	1,171	1,274	1,274	1,016
R-SQUARED	0.005	0.049	0.159	0.006	0.041	0.112
NUMBER OF ID	167	167	134	160	160	127
CONTROLS	NO	NO	YES	NO	NO	YES
YEAR FE	YES			YES		
INDUSTRY-YEAR FE		YES	YES		YES	YES

Table 3. Innovation vs. SESTA reform (reduced-form OLS model). This table reports results from multivariate OLS regressions relating *Patents$_{t+1}$* (columns (1)-(3)) and *Citations$_{t+1}$* (columns (4)-(6)) to *SESTA*, *i.e.* the interaction between the treatment dummy *Z* and the year-dummy for 1998. Specifically, we estimated a reduced-form OLS model where the independent variable *SESTA* is a dummy variable which is equal to 1 when the sum of first five shareholders of a firm owned less than 50% of the shares with voting rights in year 1998, and zero otherwise. All models include firm fixed effects. We clustered all standard errors at the firm level. Data are for the period 1990-2010. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

VARIABLES	1ST STAGE		2ND STAGE			
	(1) BLOCKHOLDING	(2) BLOCKHOLDING	(3) PATENTS$_{t+1}$	(4) PATENTS$_{t+1}$	(5) PATENTS$_{t+1}$	(6) PATENTS$_{t+1}$
BLOCKHOLDING			-1.270**	-1.625**	-1.371**	-1.422*
			(0.556)	(0.777)	(0.631)	(0.727)
SESTA	-0.0910***	-0.0770***				
	(0.0285)	(0.0296)				
ASSETS		-1.47e-06		-6.51e-07		-3.18e-06
		(1.74e-06)		(5.70e-06)		(6.37e-06)
CASH		5.18e-07		1.43e-05		2.10e-05
		(7.33e-06)		(2.15e-05)		(2.23e-05)
EBIT		8.31e-06***		-2.89e-06		-3.14e-06
		(3.00e-06)		(1.55e-05)		(1.75e-05)
LIABILITIES		8.05e-07		8.25e-06		1.15e-05
		(1.76e-06)		(6.53e-06)		(7.53e-06)
REVENUE		-2.05e-06		-2.91e-06		-1.53e-06
		(2.06e-06)		(7.00e-06)		(7.88e-06)
R&D EXPENSES		3.46e-05		0.000235**		0.000190**
		(3.68e-05)		(0.000103)		(8.35e-05)
Observations	1,450	1,230	1,450	1,230	1,450	1,230
R-squared			-0.305	-0.366	-0.268	-0.132
Number of id	152	124	152	124	152	124
Controls	YES	YES	NO	YES	NO	YES
Year FE	YES	YES	YES	YES	NO	NO
Industry-Year FE	NO	NO	NO	NO	YES	YES
Kleibergen-Paap			10.21	6.67	8.59	6.99
15% Critical value			(8.96)	(8.96)	(8.96)	(8.96)

Table 4. Innovation vs. SESTA reform (2SLS estimator). This table reports results from multivariate IV regressions. The first stage (columns (1) and (2)) relates *Blockholding*, *i.e.* the sum of the shares with voting rights of the first five shareholders, to *SESTA*, *i.e.* the interaction between the treatment dummy *Z* and the year-dummy for 1998. The second stage (columns (3)-(6)) relates *Patents* to the instrumented *Blockholding*. Specifically, we estimated an IV model where the instrumental variable *SESTA* is a dummy variable which is equal to 1 when *Blockholding* is less than 50% in year 1998, and zero otherwise. All models include year and firm fixed effects and all standard errors are clustered at the firm level. Control variables include firm's assets, cash, EBIT, liabilities, revenues and R&D expenses. We address weak-instruments concern reporting, for each model, the Kleibergen-Paap statistics (15 % critical value in parenthesis). Data are for the period 1990-2010. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.
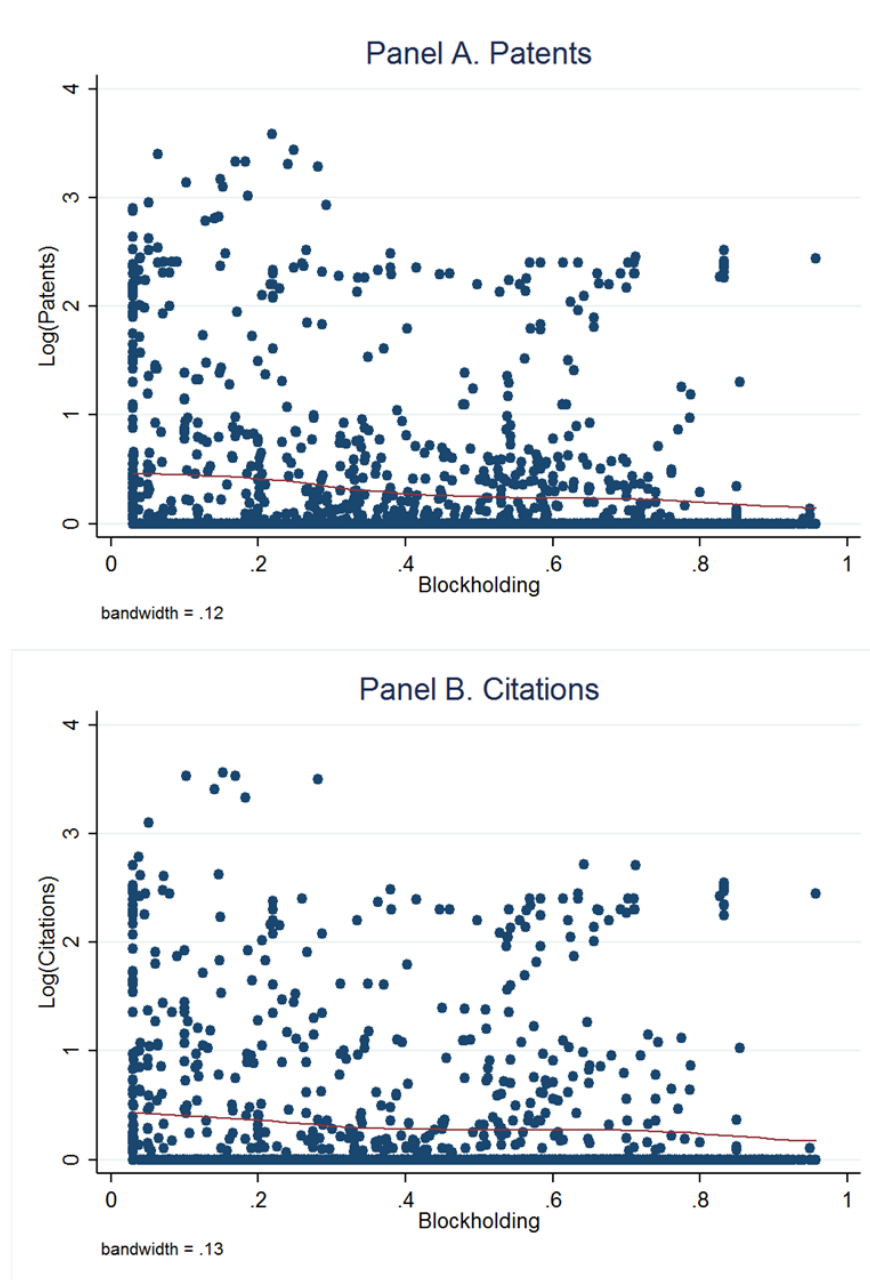
Figure 1. Nonparametric regression of firm innovation and percentage of shares with voting rights of the first five shareholders (i.e. *Blockholding*)
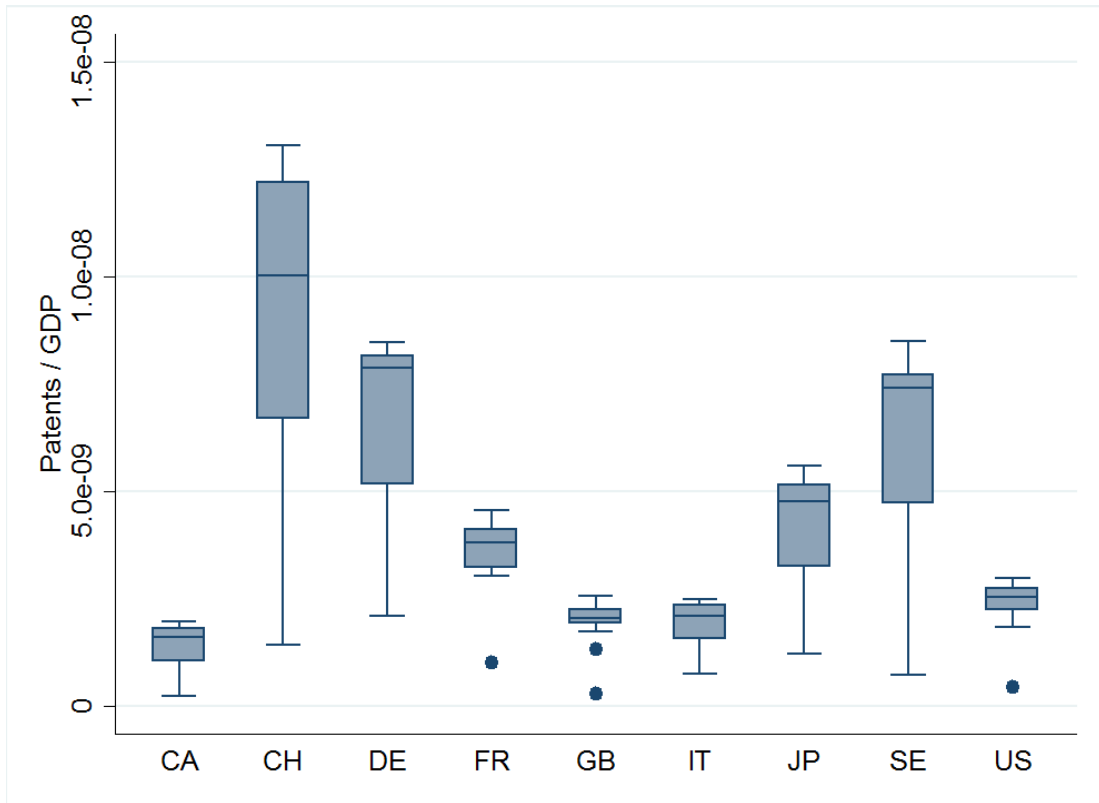
Figure 2. Patents over GDP ratio, by country. Specifically, CA = Canada, CH = Switzerland, DE = Germany, FR = France, GB = Great Britain, IT = Italy, JP = Japan, SE = Sweden, US = United States.
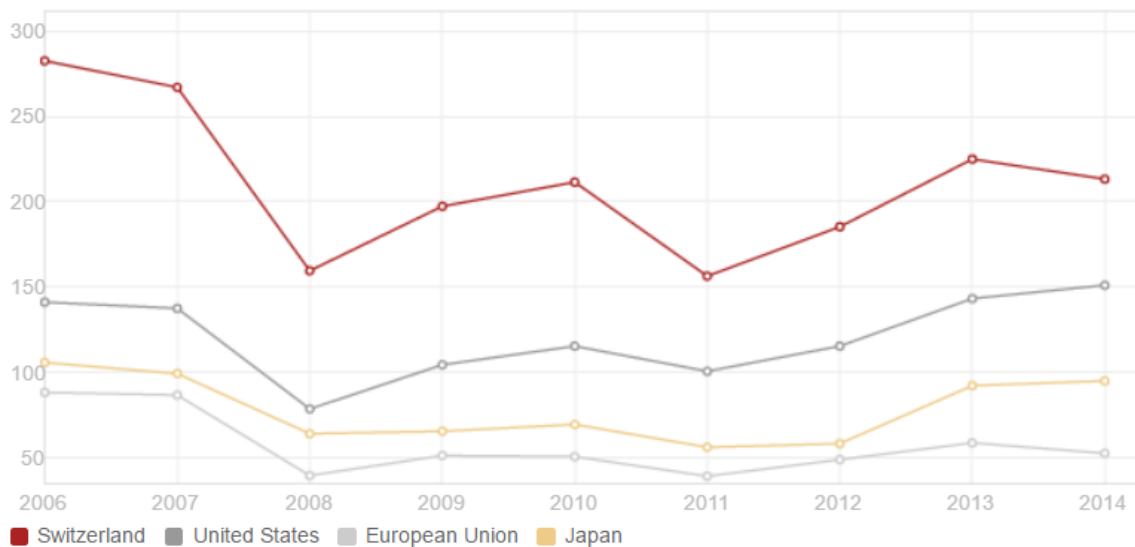

Figure 3. Market capitalization of listed domestic companies as a percentage of GDP (source: World Bank).
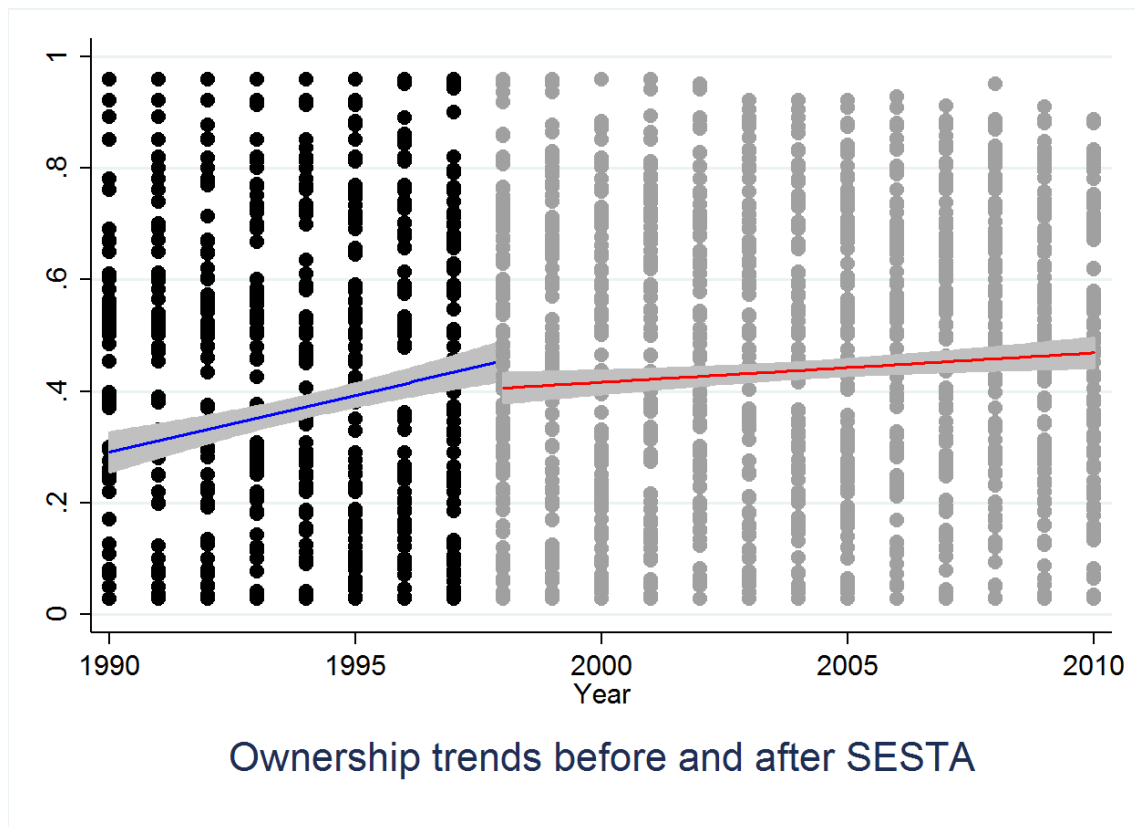
Figure 4. Percentage of shares with voting rights of the first five shareholders (i.e. *Blockholding*) of each firm, before and after the SESTA reform.