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# TECHNOLOGICAL CHANGE AND CORPORATE GOVERNANCE

*Prof. Dr. Dr. Klaus Brockoff*  
Universidad de Alcalá de Henares



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# **Technological Change and Corporate Governance**

*Prof. Dr. Dr. Klaus Brockoff*

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**Author:** Prof. Dr. Dr. Klaus Brockhoff

**Abstract:**

*Los sistemas configuradores del "Gobierno Corporativo" de las empresas constituyen, sin duda, un elemento de competitividad empresarial y entre países ya que viene determinado por la legislación de cada país. Brockhoff plantea en este trabajo la grave interrelación entre el espacio que facilita las normativas reguladoras del "Gobierno de la corporación" y las exigencias de poder adaptarse estratégicamente a los cambios tecnológicos. La falta de adaptación tecnológica como consecuencia de las normas reguladoras del "Gobierno Corporativo" incide gravemente en el éxito de las empresas.*

*The configurative systems of businesses' "Corporate Governance" are undoubtedly an element of between-country business competitiveness since such systems are determined by each individual country's legislation. In this work Brockhoff examines the serious inter-relationship between the space created by regulatory norms on "Corporate Governance" and the demands placed on businesses' ability to adapt strategically to technological change. The lack of technological adaptation as a result of the regulatory norms on "Corporate Governance" has a serious effect upon the success of businesses.*

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**Consejo de Redacción:**

Santiago García Echevarría (Dirección)  
María Teresa del Val Núñez (Coordinación)  
Carolina Menor Navarro  
Yolanda María Sánchez Jiménez

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© Prof. Dr. Dr. Santiago García Echevarría

Dirección del I.D.O.E.: Plaza de la Victoria, s/n  
28802 - Alcalá de Henares  
MADRID - ESPAÑA  
Teléfono: 91. 885.42.00  
Fax: 91. 885.51.57  
E-mail: [idoeh@uah.es](mailto:idoeh@uah.es)  
<http://idoeh.gioupm.com> / [www.idoe.org](http://www.idoe.org)

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## 1. The general concept

It is not uncommon for companies to discuss what legal form to choose within a nation, and during recent years it was not uncommon in Europe to take regulatory authorities to courts in order to allow choosing a legal form from another European country to be used in the country where business is performed. This indicates that national systems of corporate governance impact on the competitive position of companies. In this paper, specific interrelationships of corporate governance with technological change are considered.

The general concept is sketched in Figure 1. It is well known that technological change can influence business success of companies, particularly if this technological change is unique for a particular company and for some period of time at least. Many summarizing studies on this relationship are available (Brockhoff, K., 1998; Brockhoff, K., 1999). Early work on corporate governance did not empirically look into potential impacts on business success (Bleicher, K.; Wagner, D., 1993). However, as a general hypothesis corporate governance scholars assume that by choosing systems that minimize transaction cost and agency cost for a particular firm within a national environment of regulations, it is possible to set the stage for business success (Witt, P., 2003a, 2, p. 11). The choice of the most efficient governance systems promises a head-start in systems competition. Empirical research on success models of corporate governance is mostly concentrated on financial performance data, and it takes control efficiency of managements by financial markets, by legal systems or by board structures into account (Daily, C.M.; Alton, D.R., 1992; Lehmann, E.; Weigand, J., 2000; Witt, P., 2003a; Gompers, P.J.; Ishii, J.; Metrick, A., 2003; Czarnitzki, D.; Kraft, K., 2004c; Drobetz, W.; Schillhofer, A.; Zimmermann, H. 2004). Also, supporting perceptual data that compare governance systems at an international level are available (Gedajlovic, E.R.; Shapiro, D., 1998; Demirag, I.PP.; Tylecote, A., 1998).

Taking these relationships for granted it is then important to explore whether technological change and corporate governance influence each other. As seen in Figure 1 there could be two types of influences. The "technological imperative", as it was called by Orlikowski (1992), would comprise any influences of technological change on governance structures or processes. The "strategic

choice" (Orlikowski, W.J., 1992) summarizes all influences that corporate governance can have on technological change. In this paper we want to explore these two types of relationships: Do they exist? Can influencing variables be identified?

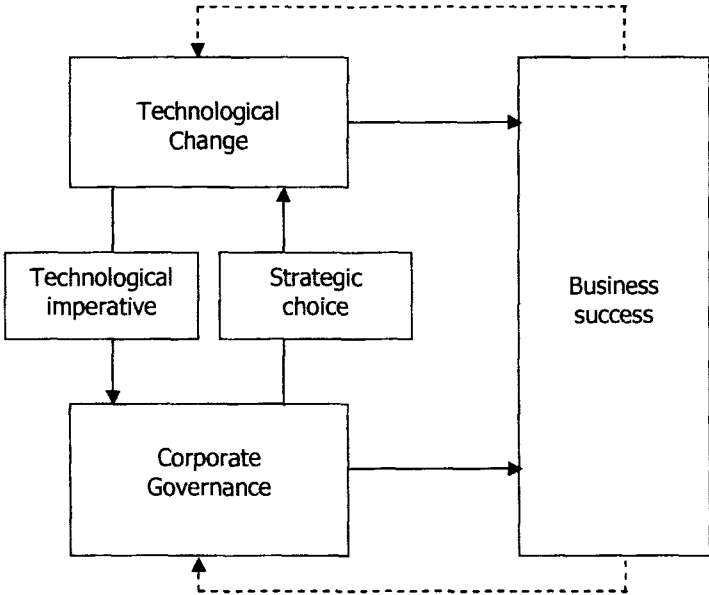


Figure 1: The concept of the relationships

Should such relationships be identified, it has a twofold importance. First, it is important for management to choose corporate governance structures that maximize corporate objectives, including technological change. Second, regulatory agencies should consider their responsibility to offer corporate governance models that help firms to optimize their objectives.

It goes without saying that the model presented above is overly simplistic. Other interacting variables on business success are not shown. Feedback loops from success to the variables shown (dotted lines in Figure 1) are not explicitly covered (Cho, M.H., 1998). No explicit mention is made of dynamics, which arise from feedbacks or

have other reasons. As will become clear later, empirical research that considers these issues is extremely scarce.

## 2. The variables

Figure 1 refers to three highly complex and interacting variables. None of the variables finds a generally accepted definition. Even if such definitions were available, one could not be sure whether their operationalization would be identical. No strict standards can be enforced to arrive at better comparisons of empirical research and its results. *Economic success*, for instance, could refer to achieved or to expected future success. Success itself could be measured for instance by stock market performance or by financial results. In this case, many special ways of calculation are available. Companies applying economic value added report on more than 150 adaptations of annual report data, many of which are company specific or industry specific, to arrive at the final result.

*Corporate Governance* is a construct variable as well. It is described as "a more-or-less country-specific framework of legal, institutional and cultural factors shaping the patterns of influence that stakeholders exert on managerial decision making" (Weimer, J.; Pape, J., 1999). These decisions influence "direction and performance of corporations" (Monks, R.A.G.; Minow, N., 2001, p. 1). Conflict resolution and power distribution are major tasks of corporate governance systems (Witt, P., 2003a, p. 1; Munari, F.; Sobrero, M, 2003, p. 3). A bit too narrow is the view that concentrates on minimizing the cost of supervising and controlling management by owners of a company (Richter, R.; Furubotn, E.G., 2003, p. 67). In Germany, the concept of "Unternehmensverfassung" or "company constitution" was used long before the corporate governance came into general use (Chmielewicz, K., 1991, p. 84; Hauschildt, J., 1999, p. 60).

Even if the broader definition is accepted it needs to be made operational. The "patterns of influence", however, can be manifold, they can be substitutive or complementary, and if influence is exerted by a group of people these can hold conflicting views on the course to travel (Hauschildt, J., 1999; Höpner, M., 2001).

One example of a possible operationalization of the concept is given by Weimer and Pape (1999). They suggest considering eight variables:

- a. The prevailing concept of the firm.
- b. The board system.
- c. The salient stakeholders able to exert influence on managerial decision-making.
- d. The importance of stock markets in the national economy.
- e. The presence or absence of an external market for corporate control.
- f. The ownership structure.
- g. The extent to which executive compensation is dependent on corporate performance.
- h. The time horizon of economic relationships.

Based on these variables, Weimer/Pape (1999) conclude that four groups of governance systems can be identified: The Anglo-Saxon Countries, the Germanic Countries, the Latin Countries and Japan. If such groups could in fact be clearly identified it would be very helpful to broaden the basis for comparative empirical research. Unfortunately, grouping countries is not quite as easy. An indication of this the authors' grouping of Switzerland, with a one-tier system of corporate boards, together with Germany and Austria with their two-tier systems. Furthermore, a more controlled procedure for clustering would have been advisable. Cluster analysis methodology is an interesting approach for this (Schmidt, R., 2003).

It should also be noted that the individual elements of a corporate governance system can be measured in different ways. Also, the elements may at least partially overlap with variables used in other subsystems of a corporate environment. This is shown in Figure 2. Even this view is not exhaustive, as can be concluded from the suggestion to look at tax systems and their impact on managerial behavior (Betz, 2004).

Furthermore, a description of corporate governance by using certain institutional elements covers procedural issues, such as transparency, only implicitly.



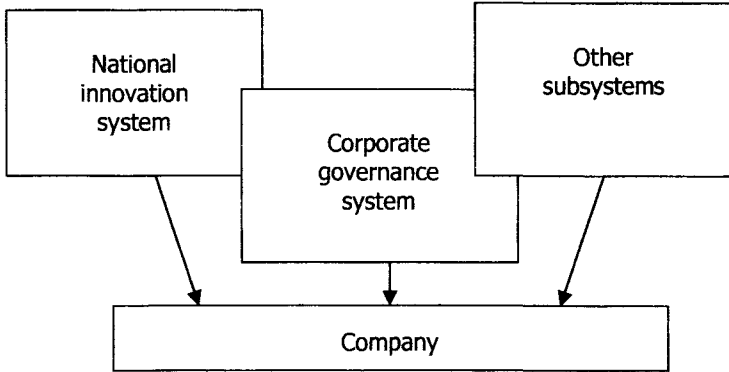


Figure 2: Overlapping environmental subsystems with potential influence on technological change and innovation at the company level

Consequently, comparing research results on corporate governance has to be taken with a grain of salt. No standardized construct is available.

The same has to be concluded with respect to the other construct, *technological change*. At first, this construct might be split into two major variables, namely technology and innovation. An indicator for technology could be research and development expenditures. It generates potentials for innovations as explanation for competitive strength just as seen in the resource-based view. A crude indicator for innovation could be a zero-one-variable that measures whether a company is able to introduce one or more new products or new processes during a specific period of time (Czarnitzki, D.; Kraft, K.; 2004b). While it is plausible to assume that corporate governance is influenced by innovations, governance itself might impact on technology or on innovation in different ways. To make the points more clear, we demonstrate the interplay of the terms technology and innovation in Figure 3.

		Innovation	
		Available	Not available
Internal technological knowledge as a basis for innovation	Available	Technology and innovation	Technology without innovation: Indication of interface problems or non-acceptance
	Not available	Innovation without a technological base or innovation dependent on external knowledge	No technology, no innovation

Figure 3: Relationships between technology and innovation

### 3. The technological imperative relationship

With these reservations on methodology in mind we now turn to the first of the interesting relationships, namely the imperative relationship. We intend to collect evidence for its existence.

#### 3.1. Examples

In limiting our scope we only ask whether examples can be found where product innovations have an influence on corporate governance. These products can be information technology or communication technology innovations in the first place.

1. Innovative IT-products, such as conference calls or video conferencing, could be used to increase the frequency of information exchange among managers, to speed up decision making, to tighten control and to reduce travel cost. In view of this, the German Governmental Commission on Corporate Governance suggested a change of law that in the past asked for personal presence for instance in board

meetings (Regierungskommission Corporate Governance, 2001, Rz. 247). Other countries permit making routine-type decisions at board level in virtual meetings (Noack, U.; Beurskens, M., 2002, p. 154). The plausible expectations raised here are not fully met in reality. In fact, a "telecommunication paradox" has been observed (Picot, A.; Reichwald, R.; Wigand, R.T., 1996, p. 94; Pribilla, P.; Reichwald, R.; Goecke, R.T., 1996, p. 236). It describes that most intensive users of IT are not able to substitute their use for personal presence. Any productivity gains from the use of electronic media is used for increased personal contacts. This is considered as the prerequisite for effective use of electronic media that due to their reduced capacity relies heavily on trustful relationships. Also, productivity gains might be eaten up by an expansion of management tasks, be that with respect to geography, product ranges, customer relations or hierarchy levels. The example shows that management processes are influenced by an innovation.

2. Shareholders can make use of information technologies to lower the cost of participation in annual general meetings, to participate in such meetings by on-line voting, to organize shareholder-groups of like interests to influence decisions, to make use of the instantaneous and equal availability of *corporate information for their investment decisions* (Regierungskommission Corporate Governance, 2001, Rz. 248, 249; Goedecke, C.; Heuser, F., 2001; Claussen, C.P., 2001; Pikó, R.; Preissler, T., 2002; Noack, U.; Beurskens, M., 2002). As before, these opportunities might come at a price. In Germany, some shareholders have effectively prohibited the on-line presence of a shareholders meeting beyond the opening and the address by the chairman of the management board. These shareholders argue that showing their presence in the meeting interferes with their personality rights (Noack, U., 2001, p. 17). Thus, "virtual" participants are unable to have immediate knowledge of the involvement of the agenda following the speech of the chairperson.

Lower cost of participation could also lead to a "race to the bottom" with respect to the quality and scope of

contributions to the debate during the meeting (Spindler, G.; Hüther, M., 2000). Even the term "anarchic democracy" has been used to describe possible developments that go far beyond behaviors observed in present annual general meetings (Euler, E., 2003). Both of these developments call for an extended catalogue of means to manage the meetings and to curb potential misuse. The ease of asking shareholders for their decisions might lead to a shift of power from the management to the shareholders. This would certainly change historically grown corporate governance structures and processes.

3. Corporations can use electronic media to establish closer contacts with their shareholders (Goeddecke, C.; Heuser, F., 2001; Claussen, C.P., 2001, p. 165; Heller, A. et al., 2002). Financial marketing and investor relations can thus be based on more up-to-date information or information not controlled by intermediate media. However, boards might be reluctant to accept this, since it increases the control possibilities of shareholders via the financial markets (Euler, E., 2003).
4. Increasing speed of technological change externally generated increases the demand for fast and flexible decision making at the board level. This could include to close down particular areas of technological knowledge generation within the firm, and to open up other. It is made plausible that the German governance structure together with labor-law rigidities is less able to cope with fast technology changes as compared with British governance structures and labor laws (Casper, PP.; Matraives, C., 2003). When Tobin's Q is accepted as an indicator of technology driven growth potentials, then it is relevant to observe that US companies with higher growth potentials chose a more long-term incentive structure for management, more management shareholdings and more insiders on the board (McGuire, J., 1992). While a number of methodological issues remain unresolved, such as whether median or marginal Q's are more appropriate, and causality is there only by assumption, the case generalized the observation of an influence of environmental complexity on governance structures (Zajac, E.J.; Westphal, J. D., 1994).

### **3.2. Results**

Considering the four groups of examples it is fair to conclude that a technological imperative exists. Extant studies, however, have not yet dealt with issues such as the changes in power structures and conflict regulation as a consequence of technological change. Could it be that present governance structures, which were principally defined many decennia ago, are better able to deal with less rapid technological change than with more rapid change? Could simulation models of process structuring be of help in answering questions relating to speed and quality of decision making? A number of unresolved questions remain beyond the more general observation.

## **4. The strategic choice relationship**

Let us now turn to the second relationship of interest. It deals with potential influences of corporate governance on technological change. This issue is by far more complex than the first one.

### **4.1. National comparisons**

Governance systems were defined as different between nations or, less stringently, between groups of nations. Therefore, a first attempt at exploring the strategic choice relationship is to make country comparisons. Certainly, a strong caveat arises from the fact that nations do not differ with respect to governance systems alone.

1. A very telling observation is that socialist economies have not proven to be as capable of initiating technological change as market economies. It was Chmielewicz (1991) who remarked very early after the German re-unification that the accompanying change of governance structures influences at the same time the conditions and problems of innovations. A more detailed analysis, however, is missing.
2. Therefore, it might be useful to turn to market economies with different corporate governance structures. Here, it is argued that some systems favor radical innovations, while

others favor incremental innovations. "Thus, British firms have a comparative advantage in radical innovation in new sectors and price competition in stagnating or declining sectors while German companies have a comparative advantage in so-called medium-tech sectors characterized by incremental innovation and large firm-specific human capital investments" (Vitols, P.P., 2001, p. 359). A similar conclusion was drawn by Casper/Matraves (2003).

Since the authors just mentioned draw on the same set of empirical data it is of interest to look for further independent sources. In an interview-based case study of Astra-Zeneca it is shown that the hybrid mixture of governance systems resulting from the two originally independent companies that were merged exhibits inside orientations of the Swedish origin that favor more incremental innovations as well as outside orientations of British origin that favors more radical innovations (Ramirez, P.; Tylecote, A., 2004). A second case deals with Lufthansa AG. For the 1980's it is argued that the relatively weak position of the chairman of the management board as well as co-determination hampered the strategic innovation potential of the firm: "...the German corporate governance system placed powerful restrictions on the CEO's ability to alter the power structure and technical orientation within Lufthansa" (Lehrer, M., 1997, p. 131). Corporate governance in Italy is thought to favor industries with "low novelty, low visibility, and low appropriability" (where appropriability refers to the shareholders ability to secure profits against competitors) (Schmidt, R., 2004, p. 317 referring to Visintin, 2001).

This line of argumentation has even led to the point where national differences in governance systems have been taken as an explanation for international trade with differently innovative products (Hall, P.A.; Soskice, D., 2001).

3. The national financial system has some overlap with the governance system. As a result of a 13 country study of financial systems it is concluded that outsider-dominated countries, like the US or Great Britain, corporations have a more short-term orientations as compared with insider-

dominated countries, like Japan or Germany (Demirag, P.P.; Tylecote, A., 1998). Outside orientation, in consequence, leads to favoring development over research. Furthermore, this should result in more incremental rather than radical innovations. Certainly, this result is in conflict with the one in the preceding paragraph.

In Germany, private equity financing received attention only relatively lately. Some authors consider this to be detrimental for fostering radical innovations (Kaiser, R.; Prange, H., 2004; indirectly also: Audretsch, D.B.; Lehmann, E.E., 2004).

Taking the last two paragraphs together it is obvious that none of the studies presents a summarizing evaluation of governance *and* financial system aspects on technology and innovation.

4. This lack of a summarizing view becomes even more obvious when governmental policy is included. A study on French industry indicates that in earlier years, when insider oriented governance was dominant, the French government tried to compensate an apparent lack of radical innovations by lending substantial development support to industry. In later years with more outside-oriented aspects, French industry used an acquisition strategy to support its innovative potential (Goyer, M., 2001). Unfortunately, the author fails to make the dependent variable explicit to the degree that one could follow his argumentation easily and eventually *rvrn* measure relative impact of different constructs.

## **4.2. Individual variables**

### **4.2.1. Composition of management boards**

1. In countries with one-tier board systems it is asked to what degree the share of insiders vs. outsiders effects innovative potential. Empirical research shows that "insider-dominated boards may be more effective in fostering innovation" (Munari, F.,; Sobrero, M., 2003, p. 21). A possible

explanation could be that insiders have better information on innovation opportunities and their risks. This is supported if outsiders have similar information and support the management. The information networks of outsiders appear to be of different kind, and their task of supervising management might reduce innovative potential. Note that the character of innovations is not addressed here. Thus, a larger number of incremental innovations might more than compensate a small number of radical innovations.

2. In Germany, co-determination on the supervisory board of the prevailing two-tier system is an issue with respect to its effect on innovation. Distributive effects of co-determination lead to a reduced return, which has been called negotiated shareholder value (Vitols, PP., 2001, p. 350). From very early on in the debate on German co-determination it was argued that more respect for social demands could lead to such negotiated shareholder value and thus reduce the incentives for innovation (Sachverständigenkommission, 1970, p. 42; Prosi, G., 1978, p. 48). On the other hand it was hoped that labor union representatives would use their power wisely (Albach, H., 1994, p. 345), and workers would make more contributions for improving processes and products because they enjoy more job security (Dilger, A., 1999, p. 210). Unfortunately, as was true more than ten years ago, we have only very scarce research on the effects of co-determination at the board level and within the companies on innovation potential (Hamel, W., 1993). In a summary of earlier research it is indicated that co-determination seems to lead to higher research and development expenditures but to lower product innovation rates (Hübler, O., 2003). The same study also makes clear that results depend on the way that co-determination is measured. If the quality of contributions by worker representatives in a firm is not only considered as a zero-one variable but measured on a five-step scale (antagonistic, difficult, non-interested, not considered, cooperative), it is argued that cooperative workers councils exist in companies with relatively higher innovation rates (Addison, J.T.; Schnabel, C.; Wagner, J., 1996; Dilger, A., 2002). This is not too surprising. Only 36% of the responding firms have a



cooperative workers council, the cooperation was identified by self-selection on the scale, and the results do not include process innovations that are more critical for workers councils as product innovations.

Summarizing, we find no indication for a supportive effect of co-determination on innovation.

#### **4.2.2. Owner-manager-structures**

1. Technological change and innovation depend on the type of corporate owners. This is supported in many ways, and it is certainly of interest to minority shareholders or other stakeholders of a company.

Hoskissen et al. (2002) can show that pension funds prefer a strategy that relies heavily on internal research and development and that prefers a high share of internally developed new products, while investment funds prefer acquiring new products or processes. The share of inside- vs. outside directors can have a moderating effect.

Investments, including those in research and development, are co-determined by the dividend policy of a corporation. This, in turn, is determined by majority shareholders, especially if one of these is a government. This observation was established for Austrian corporations (Gugler, K., 2003).

A high concentration of owners who are not managers is more strongly related with building high innovation potentials if these owners are institutions with long planning horizons rather than individuals with short planning horizons (Zahra, P.P.A., 1996).

Thus, owner preferences can have a strong influence on technology and innovation when they can exert their power.

2. Corporations with a high free flow of shares can not be influenced to follow the preferences of individual investors. Thus, the preferences of managers can determine technology and innovation strategies to a larger degree. It is

a standard assumption of principal agent models that the owners are risk-neutral due to their ability to spread their investment risks, while the managers are risk-averse because of their reduced ability to spread their employment risks. Following these assumptions it is no surprise to find a few studies indicating less innovative activities in manager-lead firms as compared with owner-lead firms (Fritz, W., 1986; Kraft, K., 1989). However, more recent studies come to contradictory results. Besides methodological aspects of industry choice or sample size, these contradictory empirical results might be explained by restrictions of owners investments, as in family business, on the one hand and particular management incentive structures on the other hand. Management compensation might be tied to company growth, which in turn can result from introducing more innovations. Risk considerations and growth expectations have to be balanced by such managers. Studies indicate that the growth motive seems to be given a relatively higher weight. In Germany and other European countries manager-led firms have higher patent output and higher relative sales from new products than owner-led firm (Czarnitzki, D.; Kraft, K, 2003; 2004a; 2004d).

3. The ability of highly concentrated owners to shape technology and innovation strategy might be curbed by close to perfect, and thus efficient financial markets. In fact it is found: Owner-led firms in Germany seem to experience a stronger constraint of capital, both internal and external (Haid, A.; Weigand, J., 2001). Less perfect financial markets allow concentrated owners to exert stronger influences on innovation strategy than more perfect financial markets (Lehmann, E.; Weigand, J., 2000).
4. Should highly concentrated ownership control management by financial ratios one observes less innovation potentials as compared with control by intensive exchange of other types of communication (Munari, F.; Sobrero, M., 2003). And even if owners are not concentrated but the share of equity is relatively low, creditors seem to use similar instruments to discipline managers with respect to their innovation strategies (Czarnitzki, D.; Kraft, K., 2004d).

5. More differentiation can be achieved by considering variables measuring technology on the one hand and innovation. In this respect, a number of observations can be added. More owner influence, including participation in management, leads to smaller shares of new product sales, higher returns, and lower research and development intensities (Czarnitzki, D.; Kraft, K., 2003; 2004 b; 2004 c). The authors admit that one of these studies is based on a rather unbalanced sample, extending beyond corporations. Also, some of the variables are relatively strongly correlated. It is not clear whether the results could be upheld should financial market influence be explicitly included in the modeling. However, if the dependent variable only measures whether innovations occur or not (a zero-one-variable) no relationship to owner influence vs. non-owner managers can be identified (Czarnitzki, D.; Kraft, K., 2004b).

Thus, owner-manager structures do have an influence on technology and innovation. These influences seem to be moderated by the influences exerted by the efficiency of financial markets, and the way that market stakeholders communicate with management.

#### **4.2.3 Characteristics of top management**

Personal characteristics of top management may be a moderating factor in determining technology and innovation strategies. Since owners or their representatives select top managers this choice can have an effect that interrelates with other variables.

1. Educational background of managers influences the partition of investment budgets. Thus, CEO's with a technical or science education spend relatively more on research and development, those with a marketing education spend more on advertising, and those with a manufacturing education support investment in production relatively more (Schrader, St., 1995, p. 257). Furthermore, past experiences or learning, the ability to shape the corporate strategy (Schrader, St., 1995) and

age (Bantel, K.A.; Jackson, P.P.E., 1989) of managers influence investment behavior and innovation behavior. Risk perception is shaped by the time spent in a corporation and the level of hierarchy achieved, both being indications for underlying variables such as learning and problem comprehension (March, J.G; Shapira, Z., 1987). This, in turn, should influence innovation strategy since this is a risky business.

2. All of this would not appear to be of relevance if personal characteristics could be compensated or made comparable by the proper choice of incentives. Planning, supervision and incentives are interacting variables in the control of management (Gedenk, K.; Albers, S., 1992). Still, supervisory board members are even more convinced than management board members that personality and professional experiences have much higher importance in explaining managerial behavior than incentive systems (Gedenk, K.; Albers, S., 1994; Gedenk, K., 1998). This casts doubts on the application of standard principal-agent-assumptions at the top management level. However, the results by Carnitzi/Kraft (2004) mentioned above let us believe that managers are receptive to incentives, may be to strong incentives only.

If personality and professional education of managers can override the influences of incentive systems one should be hesitant in defining corporate governance systems by structural variables only. It should be added that while moderating effects of the relationship of incentive systems on innovations are made plausible with respect to national differences (Eisenberg, J., 1999), no empirical research into these effects is available.

#### **4.2.4 Size of boards**

It is suggested that the decision quality of boards can be depicted with respect to size by a curvilinear function that has a maximum for medium-sized boards. If on top of this the quality of member contributions to a decision can be scaled it is possible to construct optimum boards at least theoretically (Brockhoff, K.,

1970). Since empirical research cannot experimentally vary the size of boards, one should either expect no relationship between size and decision quality if all boards are of equal size or a function that is declining if more boards are too large or increasing if the majority of boards are too small. Since board size is regulated by law in many countries depending on the size of the company, such as Germany, the legal regulation might not always indicate optimum choices.

For the US it is shown that Tobin's Q taken as a measure for innovative potential decreases with increasing board size (Yermack, D., 1996). The average board size in the sample is 12.25. Interestingly, no such relation is found between board size and research and development intensity. This could mean that larger boards are more interested in planning inputs than outputs or that larger boards are less concerned with improving the interface situation that arises between research and development and other downstream departments or that larger boards decrease the quality of project selection, possibly by more routine procedures.

A study of 5 European countries exhibits a similar, negative relationship; it is significant only for the Netherlands and Great Britain (Conyon, M.J.; Peck, S.I., 1998, p. 301). Interestingly, average board size in these countries (8.7) is smaller than that in the remaining three countries (10.9).

Earlier studies in Switzerland indicated a negative relationship as well (Loderer, C.; Peyer, U., 2002). Later studies, when the average board (Verwaltungsrat) size had decreased did not indicate any relationship (Beiner, St. et al., 2004). Also, no indication was found of a correlation of other control devices with the size of the board. In view of the results of Conyon/Peck (1998) it is hard to accept the explanation that corporations in Switzerland had been successful in searching for the optimum board size and found it at lower levels.

Supervisory board size in Germany is heavily criticized. Very large corporations have 20 supervisory board members, ten each representing shareholders and labor. To compare with one-tier systems, such as in Switzerland, one would have to add the

number of management board members to that of supervisory board members. If then, in fact, this constitutes a more than optimum size one could think of installing technology or innovation committees that report to the supervisory board to compensate ineffectiveness by specialization and division of labor. It is interesting to note that Procter & Gamble and Merlone Elettrodomestici seem to have such a committee (Schmidt, R., 2004). However, we do not know whether the committees were installed because of fear of moving beyond an optimum board size.

## **5. Implications**

### **5.1. Implications for regulatory institutions and companies**

1. We have collected a substantial number of indications for the existence of both the technological imperative and the strategic choice relations. However, knowledge is not deep enough to construct optimum corporate governance systems to meet specific corporate objectives. Also, corporations rightfully seek to try out different sets of objectives to support their competitive position. Therefore, regulators should observe the conclusion from a US business roundtable: "Good corporate governance is not a one size fits all proposition, and a wide diversity of approaches to corporate governance should be expected and is entirely appropriate" (Witt, P., 2004, p. 313).
2. In view of the implications of both, technological change and corporate governance on competitiveness corporations should look for the most appropriate governance structure. "Harmonization" is not supportive in this situation. Rather, as was argued for codes of good corporate governance (Bernhardt, W., 2004), competition among governance structures should be supported. Shareholders might be given the right to choose. The models they choose from could be those that are available in a designated set of countries, such as the European countries within the EU. This approach would avoid the high transaction costs that arise both from

harmonization and from unlimited systems competition (Demougin, D.; Witt, P., 2002).

3. Regulatory institutions should be aware of the fact that setting governance rules has an influence on innovativeness. While states might try to compensate detrimental effects by active "industrial policy" or other means (Casper, PP.; Lehrer M.; Soskice, D., 1999; Casper, 2000; Casper, PP.; Kettler, H.; 2001; Goyer, M.; 2001), the same cannot be expected from institutions like stock exchanges defining listing rules.
4. While empirical research does not establish save grounds for optimizing government structures in corporations, at least it offers indications and guidelines. Further improvement is necessary, and will be discussed in the next section.

## **5.2. Implications for research**

1. As was said above, our knowledge is far from advising optimum governance structures under a multitude of environmental conditions. Substantial improvements in research are necessary. At first, a standardization of constructs would be helpful to provide safer ground for comparison of study results. As in other fields, a catalogue of tested constructs would be a first step in the right direction. Singling out individual variables from complex constructs and testing these in one of many national environments falls short of identifying interdependences of governance variables and other environmental subsystems.
2. Panel analysis appears to be an approach that could help to test causality empirically, and including data from non-listed companies could help to avoid biases both in measurement and in interpretation. These, together with the demand for more specific error models in variables and for a more encompassing endogenization of variables, is called for since quite some time (Börsch-Supan, E.; Köke, J., 2002).
3. In view of the technological imperative an advancement in measuring follow-on effects of new technologies would be

helpful. Beneficial effects of new technologies are sometimes cut away by short planning horizons in companies, and sometimes fall prey to risk-aversion of managers. This risk-aversion is a personal characteristic, but at least to some degree it might be influenced by appropriate incentive systems.

4. Some indications were found that one particular governance structure can have different effects on technology vis-à-vis innovation. This can go even further by asking which type of innovation is preferred, for instance characterized by degree of novelty, visibility or appropriability of results. Even more far-reaching is the idea that over time some periods prefer particular types of innovations and other periods other types, which would call for different governance systems to support these. It is argued that "increasing tension between radical technical change and the institutional restructuring establish a new match between institutions and technologies to support renewed growth (Edquist, Ch.; Johnson, B., 1997, p. 55).
5. Many more dynamic effects can be imagined, going beyond the few instants where dynamics in research and development expenditures were considered in the empirical work. A similar argument refers to non-linear relationships which have mostly occurred only with respect to controlling company size. Other nonlinearities are plausible as well.
6. Some results shown varied with the type of method used. In the longer run one can observe that improvements in empirical methods discards earlier results. Multi-method studies can shed light on the validity of outcomes.
7. A topic of specific interest is the demand for more research into incentive systems at top management levels under different governance regimes. It is disturbing to observe that empirical results are unstable or in conflict with standard assumptions of principal-agent-theory. Since this is at the heart of the problem, it is of special importance.



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**Instituto de Dirección y Organización de Empresa (IDOE)**

**Universidad de Alcalá**  
Plaza de la Victoria s/n  
28802 Alcalá de Henares  
MADRID ESPAÑA  
Teléfono: 91 885 42 00  
Fax ☐ 91 885 51 57  
**idoe@uah.es**  
**www.idoe.org**  
**http://idoe.gioupm.com**