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Michael Beckmann, Kathrin Armbruster

The Author(s):

Prof. Dr. Michael Beckmann

Department of Human Resources and Organization (WWZ), University of Basel

Peter Merian-Weg 6

CH - 4002 Basel

michael.beckmann@unibas.ch

Kathrin Armbruster, Assistant

Department of Human Resources and Organization (WWZ), University of Basel

Peter Merian-Weg 6

CH - 4002 Basel

kathrin.armbruster@unibas.ch

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Contact:
WWZ Forum | Peter Merian-Weg 6 | CH-4002 Basel | forum-wwz@unibas.ch | www.wwz.unibas.ch

Business environment, managerial strategies, and the allocation of decision-making authorities in Swiss firms

Kathrin Armbruster *

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Abstract

The allocation of decision-making authorities may be seen as the last link in a causal relationship starting from changes in environment and continuing to business strategy. Changes in task complexity, which can be measured by the introduction of a diversification or an outsourcing strategy, are expected to result in a shift towards a more centralized or decentralized allocation of decision-making authorities. Using nationally representative Swiss firm data, OLS, Propensity Score Matching as well as a combined matching and difference-in-differences approach in order to account for endogeneity and unobserved heterogeneity are applied. Estimates using all three approaches show a highly significant positive impact of outsourcing on a decentralized decision rights assignment, whereas a diversification strategy yields no influence. The conclusion therefore is that a lower delegation risk due to a decline in complexity results in decentralized decision-making authorities in Swiss firms.

JEL Classification: C21 - D21 - L22 - M50
Key words: Allocation of decision-making authorities - Diversification - Outsourcing - Average treatment effect - Propensity score matching estimators - Combined matching difference-in-differences estimator

*University of Basel, Center of Business and Economics (WWZ), Department for Human Resources and Organization, Peter Merian-Weg 6, CH - 4002 Basel Switzerland, kathrin.armbruster@unibas.ch

1 Introduction

Structure follows strategy - this famous statement by Alfred Chandler (1962) describes, according to the economically oriented management literature, the guiding principle in organizational architecture. Correspondingly, the structure of a firm doesn't develop randomly but is built as adaption to the selected strategy (e.g., Brickley et al. 2008, Cabrera et al. 2003, Camps and Luna-Arocas 2009, Osterman 1994). A strategy, in turn, is chosen as a best response on conditions a firm is faced with, and therefore a function of environmental conditions (Douma and Schreuder 2002, Miller 1987). So, it is assumed that there is a causal relationship leading from business environment over strategy to organizational structure (Acemoglu et al. 2007, Alonso et al. 2008, Bauer 2003, Caroli et al. 2001, Colombo and Delmastro 2002, Colombo and Delmastro 2004, Foss and Laursen 2002, Garicano 2000, Grøgaard 2006, Lindbeck and Snower 2000, Nickell et al. 2001, OECD 1999, Porter 1998). Therefore, reorganization can be seen as a consequence of changes in the firm environment which, in turn, lead to strategic decisions (Brickley et al. 2008, Cabrera 2003, Osterman 1994).

The allocation of decision-making authorities may take different degrees of delegation ranged on a continuum between centralization, where the principal decides on his own, and decentralization, where a decision is delegated to the agent (Jensen and Meckling 1995, Hart and Moore 2005). The optimal degree of allocation of decision-making authorities depends (1) on the importance of local information, which can be used when a better informed agent decides instead of the principal and (2) incentive problems due to principal agent situations. This trade-off results in the dilemma of organizational theory (e.g., Acemoglu et al. 2007, Aghion and Tirole 1997, Brickley et al. 2008, Melumad et al. 1995, Mookherjee 2006 Osterman 1994).

The structure of a firm denotes a number of measures of organizational architecture. Examples for strategies, which serve the primary goal of a firm to create and capture value, are diversification, internationalization or vertical integration. Finally, there are plenty of environmental conditions firms are faced with like technological progress, degree of competition, fluctuations in demand or governmental regulation.

The aim of the paper is to empirically test, which environmental factors affect certain firm strategies and to what extent those firm strategies influence the allocation of decision-making authorities as an instrument of organizational architecture. Appropriate variables

are delivered by the wave 2008 of the survey "Innovation activities, information technologies and work organization" and the wave 2000 of the survey "Organizational change and the adoption of information and communication technologies", which were both conducted by the Swiss Institute for Business Cycle Research (KOF) of the ETH Zurich. These surveys contain comprehensive information about environmental conditions (degree of competition, fluctuations in demand, technological progress), strategies (diversification and outsourcing) and the allocation of decision rights in Swiss firms.

For the adaptation of the research questions, firstly OLS regressions for the determinants of the allocation of decision rights are used. These estimation results could be biased due to endogeneity and unobserved heterogeneity. Therefore in a second part Propensity Score Matching estimation to account for the potential endogenous nature of the key explanatory variables is applied. In a third step, a combined matching and difference-in-differences approach is employed to account for unobserved heterogeneity.

The paper is composed in the following way: In section 2 the theoretical background is presented. Afterwards in section 3, main publications concerning the determinants of the allocation of decision-making authorities relating to firm environment and the causal relationship between environment, strategy and organizational architecture are shown. The data set will be described and the econometrical modelling for the research questions will be laid out in the subsequent part 4, followed by a detailed demonstration of the results. The paper is completed by a conclusion in section 5.

2 Theoretical Background

The organizational architecture of a firm consists of the three components (1) assignment of decision rights, (2) a system to reward employees and (3) systems to evaluate the performance of individuals and business units (e.g., Brickley et al. 2008, Jensen and Meckling 1995, Milgrom and Roberts 1992, Robey 1991). Reorganization of the organizational architecture in firms is permanently observable. Behind many different reorganization measures a trend towards Holistic work organizations, which began in the 1950s in Japanese automobile manufacturing, is still visible. After firms concentrated on generating economies of scale in mass production in Tayloristic work organizations, now new manufacturing is aligned on economies of scope. These shall be generated by the use of cost advantages through the utilization of synergy effects between subtasks. Transfer

lines and interchangeable parts are increasingly getting replaced by flexibility, speed and core competencies (Milgrom and Roberts 1995).

The allocation of decision-making authorities as an instrument of organizational architecture may take different degrees of delegation ranged on a continuum between centralization, where the principal decides on his own, and decentralization, where a decision is delegated to the agent (Jensen and Meckling 1995, Hart and Moore 2005). The optimal degree of allocation of decision-making authorities depends in general on two aspects. According to the first aspect, firms face advantages when they are able to use local knowledge due to decentralized decision making. In following their primary goal, which is to supply products at minimum costs that accord to the consumer's preferences, firms face generally the problem that consumer preferences as well as production conditions are specific information and not generally available. Like markets are mechanisms to expose information, also firms need instruments where specific information gets laid open. In the case where a firm faces increased complexity, the principal has indeed the formal power to decide, but possibly only limited information in light of the extensive situation. Decentralized decision-making leads to an effective use of local knowledge and results therefore in faster decisions, which is especially important in quickly changing markets (Baker et al. 1999, Baron and Besanko 1992, Colombo and Delmastro 1999, Melumad et al. 1992, Melumad et al. 1995). There are some further advantages of decentralized decision-making: Firstly, managers can concentrate on strategic decisions instead of operational day-to-day business. Moreover, it motivates workers and trains employees for future leading tasks. Finally, using decentralized structures, especially high-skilled workers can be attracted and retained, which is important in times of war for talents. In summary, the delegation of decisions to subordinates is an instrument to expose local information (Dessein 2002, Baker et al. 1999).

This leads to the second aspect, which can be summarized under the heading of principal agent problems: better informed employees are not necessarily willing (1) to share their information and (2) to act in favour of the principals interests (Melumad et al. 1995). One could for example imagine a situation, where employees hold back their superior information compared to the CEO's state of knowledge in order to avoid higher work load. Therefore, firms need incentive mechanisms so that employees (1) expose the relevant information and (2) work in favour of the firm (Holmstrom and Milgrom 1994, Melumad et al. 1995, Mookherjee 2006). Having the relevant information is also important for other employees in order to work effectively. They need incentives to use this information effectively (Brickley et al. 2008, Holmstrom and Milgrom 1994). A further problem could

be that central information is possibly used less effectively when decisions are delegated (Aghion and Tirole 1997). To conclude, decentralization requires more coordination and bears a risk of failures compared to centralized allocation of decision-making authorities.

The resulting optimal degree of decentralization therefore depends on the importance of local information and the costs to use it: With a lack of information, a principal will delegate decisions to the agent instead of communicating, as long as the incentive problem is small (Brynjolfsson and Mendelson 1993, Dessein 2002, Hart and Moore 2005).[1] Hereby, finally a trade-off arises (e.g., Acemoglu et al. 2007, Aghion and Tirole 1997, Brickley et al. 2008, Melumad et al. 1995, Osterman 1994), where the dilemma of organizational theory emerges as a consequence (Aghion and Tirole 1997, Mookherjee 2006).

The allocation of decision-making authority is chosen as response to the level of task complexity which results from the strategy of a firm. According to the first hypothesis increasing the degree of task complexity within firms encourages firms to decentralize decision rights in order to make use of the local knowledge of subordinate firm members. However, decentralization in this case is associated with a higher delegation risk, so firms might also favor centralization, when task complexity increases.

Consistent with this interpretation is the second hypothesis. According to this hypothesis firms are more likely to decentralize decision rights, when they reduce the degree of task complexity within firms. Firms can be too complex to be able to exploit the benefits of decentralization.

An appropriate measure for an increasing degree of task complexity within firms is the adoption of the diversification strategy. It denotes the extention of a firm‘s portfolio to other businesses and can be grouped in related and unrelated diversification, dependent on the relation of new businesses to existing ones. The utilization of economies of scope and the promotion of complementary products are prominent reasons for realizing diversification.[2] The increase in size results in more complex firm structures and higher administrative costs (Brickley et. al. , Douma and Schreuder 2002). In a multidivisional organization in which both adaption and coordination is required decentralization may be superior to centralization (Alonso et al. 2008). Consequently, a suitable measure for a declining degree of task complexity within firms is outsourcing, where functions are divested

[1] Mookherjee (2006) provides a literature review over models for costs and benefits of delegation of decision-making authority.

[2] Reasons for the existence of economies of scope are (1) specialized indivisible physical assets (2) technological know-how (3) organizational know-how or (3) brand names (Douma and Schreuder 2002).

and therefore the degree of complexity declines. Hence, given the first hypothesis, we would expect a positive impact of diversification on decentralization. However, under the second hypothesis, we would expect a positive impact of outsourcing on decentralization.

The combination of strategy and organizational architecture determines a firm's success. The observation that firms in the same industries are similar in their organizational structures shows that structural differences may be systematic. Technology, market conditions and government regulation are part of external business environments a firm faces. They influence the primary goals of a firm like the choice of the industry, price, quality and service, which is impressed in strategy (Brickley et al. 2008). Milgrom and Roberts (1995) attribute this correlation to the role of complementarities which exist between the components.[3] Thus, strategies and structures are chosen as optimizing responses on changes in environment. These changes could be progress in production and information technologies, an increase in workers preferences for diversified work or a higher supply of skilled workers (Caroli et al. 2001, Lindbeck and Snower 2000, Snower 1999).

Changes in the choice of strategies and organizational architecture are often attributed especially to uncertain and heterogeneous environments (Acemoglu et al. 2007, Machin and Wadhwani 1991). In this paper, a special interest is on market conditions like degree of competition and fluctuations in demand.[4] There is a large body of evidence which simply focuses on the effect of environment on structure without a detour to strategy. Porter (1998) as well as Nickell (1996) state, that increasing competition will lead to organizational change. The higher pressure not to loose the race against competitors could lead to higher importance of local information. Additionally, increasing competition leads potentially to a diminishing of the conflict of interest between principal and agent, so that the agent shows a more profit maximizing behaviour (Acemoglu et al. 2007). The business situation may theoretically have a reinforcing or restraining influence on the introduction of practices which change the allocation of decision-making authorities. On the one hand it seems rational that firms in difficult situations are under pressure to improve and have - because of a lower demand - more time to introduce new practices. Thus, such management practices are introduced in order to increase productivity and the financial situation in a threatening situation.

[3] Milgrom and Roberts define complementarities in the following way: "activities are Edgeworth complements if doing (more of) any one of them increases the returns to doing (more of) the others." (Milgrom and Roberts 1995, p. 181).

[4] The impact of technology on organizational change is for example observed in Brynjolfsson and Hitt (1998), Greenan (2003) or Hujer et al. (2002).

On the other hand, the implementation of new work practices is costly and might therefore only be an option for firms in good business situations (Nickell et al. 2001).

In summary, based on Chandlers (1962) hypotheses "structure follows strategy", in the economically oriented management literature a firm's structure is seen as the last part in a causal relationship starting from environmental conditions which determine strategic decisions and end finally in organizational architecture (Brickley et al. 2008). A change in task complexity is expected to result in consequences on the allocation of decision-making authorities. Increasing the degree of task complexity, measured by the introduction of a diversification strategy, as well as decreasing the level of task complexity, measured by the introduction of an outsourcing strategy, is expected to lead to a change in the allocation of decision-making authorities. The resulting degree depends on the importance of local knowledge and the costs to use it. The choice of these strategies, in turn, is expected to be determined by changes in the business environment. Therefore environmental changes like increased competition, fluctuations in demand and changes in consumer preferences are expected to be the initial point for the choice of a firm's strategy as a best response. It could be, e.g., diversification or outsourcing, which lead eventually to more centralized or decentralized decision-making authorities.

So, a firm's choice of the allocation of decision-making authority always depends on the strategy, which in turn is influenced by business environment and the feedback of a firm's structure. Because the theoretical argumentation is very heterogeneous and no clear conclusions can be drawn, an empirical examination is necessary. Before testing empirically the causal relationships, an overview of the related literature is given.

3 Related Literature

There is little empirical evidence for the relation between task complexity, expressed by the choice of a strategy, and the allocation of decision-making authority as an instrument of organizational architecture. Osterman (1994) uses data from 694 U.S. manufacturing establishments. In his analysis with a logit, a principal components and an ordered probit model, operating internationally is positively related with the use of a bundle of work practices which contains decentralization. In firms that choose a strategy aligned on variety, service or quality instead of low cost these work practices are also more likely to be applied. In this study, innovative work practices like high levels of training, innovative

pay systems or quality circles are observed simultaneously. The effect solely on the degree of decision-making authority can therefore not be isolated.

In another study, in which the role of strategies is incorporated, Cabrera et al. (2003) published one of few studies which deals with the relation between decentralization and strategy. Using the EPOC survey, which contains cross-sectional data from over 5000 organizations across 10 European countries[5]. They find a positive relationship between delegative participation, the level of competition, and the use of a differentiation strategy based on quality. A cost leadership strategy and organizational size show a significant negative impact, whereas the pursuit of a service strategy indicates no influence. A single measure for the dependent variable was created by using sixteen questions in the questionnaire concerning the use of delegative participation, which relates, e.g., the right to make decisions regarding the improvement of work processes or how to deal with external clients. Here, neither unobserved heterogeneity nor endogeneity are accounted for.

There are more papers which focus explicitly on the impact of environmental conditions on the allocation of decision-making authorities without a detour to strategy. Ichniowski and Shaw (1995) analyze innovative work practices as bundles using data from 36 steel finishing lines conducted monthly over five years. They find that, due to lower opportunity costs of firms in threatening situations, employees are rather convinced of the need of restructuring. But here also different HR systems which consist i.a. of incentive pay, work teams or flexible job assignments are considered. The single effect on the degree of delegation is disregarded and cannot be examined.

A study of OECD (1999) focuses yet more on the determinants of decision-making authorities. They also use the EPOC survey, which only captures whether a flexible work practice has been implemented and not whether or in which degree it is present. The authors argue that many innovative work practices fit for firms competing not on price but on the level of quality or variety where customer needs must be more fulfilled. Because business abroad potentially forces for innovations overseas, the authors differentiate between foreign and domestic competition. Using a logit analysis it can be shown, that foreign competition for workplace products has a significantly positive impact on the flattening of management hierarchies, greater involvement of lower level employees and the presence of at least one practice as well as the number of practices. The authors also state, that firms implement-

[5]This sample refers to a survey undertaken by the European Foundation for the Improvement of Living and Working Conditions (EPOC 1997). Ten countries were covered by this survey: Sweden, UK, France, Netherlands, Ireland, Germany, Denmark, Italy, Spain, and Portugal.

ing new work practices need a profit above average because implementing new practices is costly.

Nickell et al. (2001) focus on economically bad times. They use the Confederation of British (CBI) Pay Databank, which entails information from 66 British manufacturing firms during the period 1981-1986 and a sample of medium size manufacturing plants in the engineering, plastics, electronics and food, drink and tobacco sector from 1988 to 1991. The authors implement probit and ordered probit regressions of managerial variables on changes in performance with two lags in order to account for reversed causality. Measures for the firms real and financial situation are (1) change in real profit per employee and (2) change in the firm‘s market share. The observed innovative practices are based on the Japanese system.[6] In their analysis they account for potential selection bias due to the closure of badly performing plants. They find out, that with a worsening of the firm's real or financial position, centralizing is forced by management, whereas productivity increasing innovations are introduced. According to the authors, firms facing bad situations have more time to introduce sophisticated practices and productivity shall be increased in order to save the firm as well as to maintain jobs.

Results from a more comprehensive dataset are shown by Foss and Laursen (2002) who use data from 993 Danish firms from the nationally representative DISKO database. They measure uncertainty as the degree of innovation, the perceived increase in the level of competition and the variance of profitability in the industry. Probit and ordered probit estimates are used to analyze the determinants of pay-for-performance, delegation of responsibility, quality circles and planned job rotation. Generally, they find a positive correlation of uncertain situations with the use of delegation. But these results depend on the restriction, that the majority of the workplace should experience delegation. This could be explained by the disconnection of the relation between risk and incentives through delegation. Here again the relationship between business environment and structure is examined, without looking at strategy.

Bauer (2003) indirectly examines environmental influences pertaining to organizational change. He uses a German linked employer-employee dataset evolved by combing the IAB Establishment Panel and the Employment Statistics Register. A High Performance Work Organization is pictured by whether the firm reduced the number of hierarchical levels,

[6]Namely (i) reductions in restrictive practices by employees; (ii) the introduction of new technology; (iii) changes in organizational structure towards a leaner organization (i.e. reducing the number of hierarchical levels); (iv) increases in decentralization; (v) the adoption of new human resource management (HRM) practices; (vi) changes in industrial relations; (vii) the initiation of new HIT practices (Nickell et al. 2001).

whether subordinates receive more responsibility and whether the firm introduced teamwork or self-responsible working groups. The author is generally interested in determinants and performance effects of High Performance Work Systems, to which these measures also belong. Using an index variable for decentralization, the examination is made with an OLS regression. An expected decrease in revenues does not have significant impact, whereas the better the profit situation is, the fewer the firm will adopt High Performance Work Practices. But the estimation of determinants is only an intermediate step to performance estimations, intended to obtain an idea of the bias due to unobserved heterogeneity and endogeneity when using cross-sectional data in the following performance estimation.

The most recent study was conducted by Acemoglu et al. (2007). The authors use three datasets from British and French establishments and are generally interested in the influence of technology and information on decentralization. Measures for decentralization are organization into profit centres, decentralization of investment decisions and delayering. Heterogeneity is measured as the difference between log productivity (value added per hour) growth at the 90th and the 10th percentiles of the relevant industries. Alternatively they use productivity levels compared to growth rates. A third measure takes the number of firms, which are close neighbours in the product space, into account. In order to account for reverse causality, the exogenous variables are lagged (t-1) and the endogenous variables are measured in t. Concerning the research question, their result that firms in more heterogeneous environments, namely high competition, are more decentralized is of particular interest. This relation is even stronger in high-tech industry firms.

In summary, there is little empirical evidence for the relationship between task complexity, measured by a firm's strategy, and the allocation of decision-making authorities. Usually the role of strategies as link between environment and organizational architecture is disregarded in the literature. The findings concerning the relationship between environmental conditions and the allocation of decision-making authorities are numerous, but differ in its results: increased uncertainty and heterogeneity are determinants of more centralization as well as increased decentralization. Additionally, decentralization in decisions is often analyzed in a bundle of other innovative work practices and not observed separately. In many studies only cross-sectional data are used and unobserved heterogeneity and endogeneity are disregarded. Furthermore, for best knowledge, this study is the first examination of this kind in Switzerland. Because the existing findings are partial and ambigious, this study aims at providing new insights.

4 Empirical Investigation

4.1 Data, Variables and Descriptive Statistics

The empirical analysis is made using data from the Swiss Institute for Business Cycle Research (KOF) from the ETH Zurich. Working on the hypotheses the wave 2008 from the Swiss firm panel "Innovation activities, information technologies and work organization" is used. The KOF interviewed approximately 2500 Swiss firms of 28 different industries. It is a stratified sample with respect to sectors and regions of firms with at least 20 employees and covers all relevant industries and firm size classes.

The survey contains useful information for the research questions which shall be answered. Seven questions are related to the allocation of rights and duties at the workplaces and are answered on a five-point Likert scale. The questions cover different areas of the distribution of competences between supervisor and associate. One question is, e.g., "Who decides on the pace of work?". Response categories range from "associate alone" to "supervisor alone". All questions concerning competence distribution may be found in Table A1 in the Appendix and are used to build the index variable *delegation* by transforming the response categories to 0 to 4, adding up the responses and dividing by 28, by what the variable is normed between 0 and 1. The survey "Organizational change and the adoption of information and communication technologies" also from the KOF from the year 2000 contains the same questions for the degree of decentralized decision-making authority, which are needed for the combined matching difference-in-differences estimation.

The survey offers useful questions for the key explanatory variables concerning business strategies. The firms are asked to answer the following questions: "The following changes in organizational structure were realized since 2005" where 11 different strategies are specified. The area outsourcing is grouped in five sub-questions which are "production of parts of the product range", "production of preliminary products/components", "research and development", "information technology" or "other in-house services (cleaning, accounting, logistics)". The variable *out* takes the value 1 if the firm realized one of those outsourcing activities, 0 otherwise. When the firm realized a change in the organizational structure towards diversification (*diversif*) since 2005, the corresponding dummy variable takes the value 1, 0 if it did not.

Business environment is covered, too. Intensity of competition may be measured by the export rate (*exportshare*) or the number of domestic and foreign main competitors (*numbcomp*). In addition, the firms are asked to evaluate intensity of competition on the prime market, regarding price (*compprice*) and non-price (*compnoprice*) competition dimensions.[7] This appraisal is also made with a five-point Likert scale ranging from "very weak" to "very strong". Fluctuations in demand may be operationalized using a question which is related to the development of the demand on the prime market in the medium term in the periods 2005 to 2008 (*demandpast3*) and 2008 to 2011 (*demandforth3*). The five-point Likert scale delivers response options from "strong decline" to "strong increase".

To account for other factors influencing reorganization several control variables are used. The natural logs of sales (lnY), of gross investments (lnK) and of the number of employees (lnL) are inserted. There is empirical evidence that larger firms rather tend to an organizational change (e.g., Machin and Wadhwani 1991). According to Acemoglu et al. (2007), younger firms rather tend to introduce decentralization, whereas an additional variable is founding year (*fyear*). Furthermore, firms with higher education, calculated as share of college graduates plus share of persons with graduation higher than apprenticeship (*highedu*) are expected to rather change organizational structures. There is empirical evidence for a complementary relationship between high skills and organizational change (Caroli and Van Reenen 2001, Greenan 2003). Besides, firms which carry out research and development (*rd*) possibly change structures (Bellmann et al. 2002, Hujer et al. 2002). Moreover the share of investments in information and communication technologies on the whole gross investments (*ictinvest*) are inserted because technological progress is assumed to be related with new organizational structures (Acemoglu et al. 2007, Caroli and Van Reenen 2001, Colombo and Delmastro 2002, Brynjolfsson and Hitt 1998, Greenan 2003). Also the importance of part time (*parttime01*), fixed term (*temp01*) and flexible (*flextime01*) occupation are expected to have a positive influence on decentralization. The two last variables are rescaled to a dummy variable by taking on the value 1 if the importance is 4 or 5, 0 otherwise. According to Brown et al. (2007), complementary HR practices like formal training and incentive pay increase the likelihood of having employee-envolvement schemes which are in their definition, e.g., autonomous groups, quality circles, joint consultative committees and task forces. Therefore also impact of individual, team and firm performance on the wage level are inserted. The measuring is also carried out on a five-point Likert scale from "no impact" to "very strong impact". The dummy variables *indwage01*, *teamwage01* and *firmwage01* take the value 1, when firms declare the impact

[7] Non-price competition dimensions are, e.g., product differentiation ("customization"), (frequent) introduction of new products, technical advance, flexibility in customer preferences or service features.

as being 4 or 5, 0 else. The fraction of employees which participated at internal or external trainings in the year 2007 (*training*) is taken as a percentage. As further control variables in all estimated equations dummies for regions (*reg1-reg6*) and for industries (*sec1-sec6*) are included. Table A1 in the Appendix contains a description of all used variables in more detail. In Table 1 the most important descriptive statistics of the key variables are displayed.

[Insert Table 1 about here]

4.2 Econometric Modelling

4.2.1 OLS

Inserting all variables defined above, a regression equation of the following form results as a starting point

$$delegation_i = \beta_0 + \beta_1 strat_i + \beta_2 env_i + \beta_3 x_i + u_i \quad (1)$$

where *delegation* measures the degree of decentralized allocation of decision-making, *strat* denotes the chosen strategy and *env* is a vector of the key explanatory variables concerning business environment. x forms a vector of the control variables and u is the error term, which is assumed to be normally distributed. The OLS results serve as a reference point for further estimations that control for potential biases.

4.2.2 Propensity Score Matching

In a second part of the econometric analysis, potential endogeneity of the explanatory variables, which can lead to biased estimates, is accounted for. In assuming that diversification and outsourcing are optimal responses to environmental changes, there is the justified fear that selectivity in choosing a strategy leads to biased estimates. A method to take into account endogeneity is Propensity Score Matching.

In the following, this approach will be demonstrated for the choice of a strategy. The idea is to construct control groups of firms which differ only in the realization of a strategic change from their counterparts. It is attempted to match firms that are as similar as possible in all observable characteristics, except the choice of the strategy. The average

treatment effect (ATE) is therefore the difference in the degree of delegation when a firm chooses a strategy (Muehler et al. 2007, Caliendo and Kopeinig 2008, Cameron and Trivedi 2005, Pfeifer 2007):

$$\Delta_{ATE} = E(\Delta) = E(delegation^1) - E(delegation^0), \tag{2}$$

where $delegation^1$ is the degree of delegation of firms with and $delegation^0$ of firms without strategic change. The downside of this is, that also firms are included, which never intended to choose a specific strategy. Therefore also the average treatment effect of the treated (ATT) is estimated, where the difference in the degree of delegation is calculated for firms that actually chose a strategy:

$$\Delta_{ATT} = E(\Delta \,|Strat = 1) = E(delegation^1 \,|strat = 1) - E(delegation^0 \,|strat = 1)\,. \tag{3}$$

Indeed the second term on the right hand side is unobservable, but firms without a strategy choice can be taken as an adequate control group under the condition $E(delegation^0 \,|strat = 1)$ $= E(delegation^0 \,|strat = 0)$. This condition holds only, when two assumptions are achieved. The first one is the Conditional Independence Assumption where systematic differences in outcomes between treated and comparison firms can be assigned to treatment. That means that firms are in a treated group only due to observable pre-treatment characteristics. Therefore the degree of delegation would be the same for the firms without a strategy choice if they would choose a specific strategy. The second one is the Common Support Assumption. Thus, all firms have the possibility to become treated, that means to choose one of the examined strategies. This assumption can be assumed to be achieved, because both strategies are conceivable for firms in an economy like Switzerland. Therefore the Propensity Score Matching (PSM) estimator is:

$$\Delta_{ATT}^{PSM} = \sum_{i \in T} \left\{ delegation_i - \sum_{j \in C} \Lambda_{ij} delegation_j \right\} \lambda_i. \tag{4}$$

$delegation_i$ is the degree of delegation of firms that chose a strategy, $delegation_j$ is the degree of those that did not, T and C display the treatment and control group. Λ_{ij} is the weight placed on comparison observation j for firm i (Muehler et al. 2007, Rosenbaum and Rubin 1983).

For the matching estimator propensity scores are used, where the propensity to choose a strategy given the other characteristics is calculated. To find adequate matching partners,

different matching procedures are possible, whereas here Nearest Neighbour Matching, Kernel Matching and Local Linear Regression Matching are implemented. In the first method, a firm from the comparison group is chosen for a treated firm that is closest in the propensity score. Replacement is allowed, which means that an untreated firm can be a matching partner several times. When allowing for replacement, there is assumed to be better quality in the matching and a smaller bias, at the cost of a higher variance. The other two matching methods use weighted averages of many (how many depends on the choice of the kernel function) firms in the control group to construct the counterfactual outcome. In contrast to Nearest Neighbour Matching with replacement this leads to a lower variance because more information is used. But bad matches may result because strange observations are used. Contrary to Kernel Matching, in Local Linear Regression Matching the propensity score contains a linear term additionally to the intercept. The choice of the kernel function has relatively few impact (Caliendo and Kopeinig 2008). Therefore the default Epanechnikov kernel function and a default bandwidth parameter of 0.06 for kernel matching, and the default tricube kernel function and a default bandwidth parameter of 0.8 for local linear regression matching are chosen. More important is the bandwith parameter, which has a trade-off between a small variance, which results from a smoother estimated density function and biased estimates, because characteristics may be evened out. It was chosen to use four matches because the ratio between the number of controls and the number of treated firms is high (Muehler et al. 2007). The application of PSM is adjusted to the methodology from Muehler et al. (2007). As earlier mentioned, only observed characteristics are taken into account when applying Propensity Score Matching estimation. As a consequence, the selectivity bias is reduced, but not completely eliminated (Muehler et al. 2007).

4.2.3 Combined matching difference-in-differences estimator

When applying PSM endogeneity is accounted for, but unobserved heterogeneity could still be present. For instance this could be due to different management types. If first, certain types of managers tend to follow a diversification or tend to outsource more activities than other managers and if, second, the same type of managers like to decentralize decision-making authority to subordinate hierarchical levels, then the strategy variables are no more exogenous to the model, potentially leading to biased results.

Because the same information about the degree of delegation is in the survey "Organizational change and the adoption of information and communication technology" also from

the KOF of the ETH Zurich available for the year 2000, a combined matching difference-in-differences estimator (MDiD) can by applied. Here the conditional degree of delegation before and after the treatment of firms that choose a specific strategy can be compared with that of firms that do not choose one of those strategies and remaining differences can be controlled for (Muehler et al. 2007, Blundell and Costa Dias 2002, Caliendo and Kopeinig 2008). By comparing the degrees of delegation of firms with a strategy choice compared to firms without one, the following equation is obtained by extending equation (4)

$$\begin{aligned}\Delta_{ATT}^{MDiD} = \quad & \sum_{i \in T} \{(delegation_{it_1} - delegation_{it_0}) \\ & - \sum_{j \in C} \Lambda_{ij} \left(delegation_{jt_1} - delegation_{jt_0}\right)\} \lambda_i. \end{aligned} \tag{5}$$

t_1 and t_0 are time indices. Here unobservable and time invariant differences in outcomes between firms with and without a strategy are allowed for, by that the Conditional Independence Assumption is relaxed. The application of MDiD is again adjusted to the methodology from Muehler et al. (2007). For the analysis, the difference in the degree of delegation between 2008 and 2000 is used.

4.3 Results

4.3.1 OLS

The results for the first modelling may be found in Table 2, which contains different specifications of the regression equation.

[Insert Table 2 about here]

In columns C1 to C2 one strategy *diversif* or *out* is included as exogenous variable. Here, *diversif* exhibits no impact in C1, whereas *out* shows a significant positive impact on the 1%-level in C2. None of the environmental variables is significant in both specifications. Several control variables show significant impact: lnY and *highedu* exhibit in both estimations a significant negative impact on the degree of delegation. Also *rd* and *ictinvest* show

a significant negative influence in the equation where diversification is inserted, whereas *lnL* and *indwage01* have significant positive impact in C2.

Thus, some provisional results can be captured. Firstly, there seems to be no clear relationship between environmental conditions and the allocation of decision-making authorities. Secondly, when implementing an outsourcing strategy, this seems to come along with increased decentralization in decision-making. But these OLS results could be biased because of endogeneity, which is accounted for using Propensity Score Matching in the following section.

4.3.2 Propensity Score Matching

The results using Propensity Score Matching estimation concerning the first part of the causal chain leading from environment to strategy are presented in Table 3.

[Insert Table 3 about here]

According to the likelihood-ratio test, the null model can be rejected in both equations. Suprisingly, none of the estimated coefficients for environment show a significant impact in C3, in which the influence on the introduction of a diversification strategy is shown. The analysis of the determinants of an outsourcing strategy in C4 yields a significant positive impact of demand perspectives of the last three years. Activities in research and development show significant positive influence in both specifications. The share of highly educated workers has a significant negative and investments in information and communication technology have a significant positive effect on the implementation of an outsourcing strategy.

Possibly, there is indeed only small relationship between business environment and the choice of a strategy. However, the survey contains only information for the introduction of strategies since 2005 and not whether a specific strategy is already pursued. One could argue that there is only little relationship observable because firms that already have one of those strategies are not incorporated in the analysis.

Table 4 and Table 5 contain the means of variables for treatment group, control group and matched controls for a diversification or an outsourcing strategy. For some, but not

for all variables means of treatment group and matched controls are very close and the means of treatment group and control group are quite different.

[Insert Table 4 and Table 5 about here]

The results for the second part of the chain from strategy to allocation of decision-making authority are shown in Table 6, where the treatment effects of strategies on the degree of delegation are displayed. The table contains information about ATT and ATE resulting from the three matching methods Nearest Neighbour, Kernel and Local Linear Regression matching.

[Insert Table 6 about here]

Here, the outsourcing strategy variable shows significant positive coefficients on decentralization. *Out* is consistent significant on the 1%-level over all matching methods, estimating ATT or ATE. By contrast, the diversification variable *diversif* is highly insignificant in all cases. This gives evidence for a positive relationship between an outsourcing strategy and an organizational structure minted by delegation. But in applying PSM, there could still be biased estimates because of unobserved heterogeneity between firms. When applying a MDiD approach, this can be incorporated.

4.3.3 Combined matching difference-in-differences estimator

The MDiD estimations again received by using Nearest Neighbour, Kernel and Local Linear Regression matching can be found in Table 7.

[Insert Table 7 about here]

Having simultaneously controlled for unobserved heterogeneity and endogeneity, the impact of the outsourcing variable remains significant on the 1%-level. Diversification is still far away from having significant influence. Having accounted for unobserved heterogeneity, the highly significant positive influence of *out* on the degree of delegation remains constant. Accordingly, there is evidence for a clear relationship between an outsourcing strategy and the degree of delegation, which supports hypothesis two.

5 Conclusion

Based on the organizational dilemma and principal agent theory, the causal relationship between environmental conditions, strategy and organizational architecture was examined using nationally representative Swiss firm data. OLS and, in order to account for endogeneity and unobserved heterogeneity, Propensity Score Matching and a combined matching difference-in-differences estimator were applied. The analysis shed some new insights on the debate about causal relationships in determining the allocation of decision-making authorities.

These are the results in detail: On the one hand only a poor relationship between environmental conditions and business strategy became apparent. Only good demand perspectives in the last three years have a positive impact on the introduction of a diversification strategy. As opposed to that, on the other hand, clear-cut results can be drawn for the second part of the causal chain from strategies to organizational architecture: Using an OLS regression, the strategy variable outsourcing exhibits a positive influence on the degree of delegation, while the diversification variable is insignificant. With consideration of the endogeneity of the explanatory strategy variables in the next step the influence of the organizational strategy on the allocation of decision-making authorities is examined with PSM. Here the strong positive impact of the strategy variable outsourcing on the degree of delegation remains, whereas diversification still shows no significant impact. The positive effect of the outsourcing variable on the allocation of decision-making authority still remains highly significant on the 1%-level, independent from which matching method is used when controlling for unobserved firm characteristics applying the combined matching difference-in-differences estimation in a third step, while the strategy variable diversification remains insignificant.

In sum, the choice of an outsourcing strategy results in decentralized allocation of decision-making authorities, whereas a diversification strategy shows no impact. These results confirm the second hypothesis, whereby a reduction in internal task complexity decreases the delegation risk and thus promotes decentralized decision making authorities. This decrease in the degree of complexity is obviously the driving force in enabling decentralized decision making and outweighs the effect of the importance of local knowledge. The conclusion therefore is that a lower delegation risk due to a decline in complexity results in decentralized decision-making authorities in Swiss firms.

This study makes a contribution to the existing literature in various ways: Because in previous studies endogeneity and unobserved heterogeneity were mostly neglected, generally new insights in the relationship between environment, strategy and decentralization could be given. Although there are several international studies where the relation between environment and decentralization is observed, strategy is usually not incorporated as a link. Additionally, the Swiss dataset used contains comprehensive and nationally representative information where all sectors, regions and firm sizes are included, which enabled a comprehensive examination of the causal relationship.

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Table 1: Descriptive statistics of the variables

Variable	Mean	Std.Dev.	Min	Max
lnY	16.71	1.69	11.51	23.12
lnK	13.12	2.01	5.80	18.86
lnL	4.16	1.40	0	9.06
fyear	1948.59	41.48	1610	2008
highedu	21.76	19.85	0	100
rd	0.41	0.50	0	1
ictinvest	19.43	22.34	0	100
parttime01	0.30	0.46	0	1
temp01	0.21	0.41	0	1
flextime01	0.30	0.44	0	1
indwage01	0.84	0.37	0	1
teamwage01	0.30	0.46	0	1
firmwage01	0.50	0.50	0	1
training	30.24	28.70	0	100
exportshare	23.21	33.59	0	100
compprice	3.90	0.98	1	5
compnoprice	3.11	0.99	1	5
numbcomp	2.52	1.44	1	5
demandpast3	3.76	0.89	1	5
demandforth3	3.11	0.86	1	5

Calculations are restricted to firms which do not provide item non-response for the subsequent regression analysis. The sample size is $N = 1220$.
Source: KOF Innovation Panel (wave 2008), own calculations.

Table 2: OLS estimates of the determinants of the allocation of decision-making authorities (cross-section 2008)

Dependent variable: **delegation**	**C1**	**C2**
Estimation method: **OLS**	**diversification**	**outsourcing**
diversif	0.004	
	(0.741)	
out		0.093***
		(0.000)
exportshare	0.000	0.000
	(0.551)	(0.496)
compprice	0.004	−0.004
	(0.483)	(0.565)
compnoprice	−0.006	−0.006
	(0.280)	(0.466)
numbcomp	0.005	−0.001
	(0.118)	(0.779)
demandpast3	−0.003	0.014
	(0.589)	(0.123)
demandforth3	−0.005	−0.005
	(0.400)	(0.567)
lnY	−0.030***	−0.021**
	(0.000)	(0.032)
lnK	0.006	0.007
	(0.174)	(0.258)
lnL	0.004	0.127***
	(0.659)	(0.000)
fyear	−0.000	0.000
	(0.173)	(0.936)
highedu	−0.001**	−0.001***
	(0.029)	(0.003)
rd	−0.032***	−0.006
	(0.004)	(0.719)
ictinvest	−0.001**	0.000
	(0.028)	(0.307)
parttime01	−0.018	−0.040
	(0.136)	(0.015)
temp01	0.007	0.020
	(0.557)	(0.282)
flextime01	0.007	0.020
	(0.548)	(0.243)
indwage01	0.019	0.060***
	(0.232)	(0.004)
teamwage01	0.006	0.002
	(0.605)	(0.893)
firmwage01	0.010	−0.003
	(0.339)	(0.838)
training	−0.000	−0.000
	(0.180)	(0.108)
6 regional dummies	Yes	Yes
6 sector dummies	Yes	Yes
_cons	1.618***	0.846***
	(0.000)	(0.001)
F test	6.40***	22.50***
R^2	0.1539	0.3702
N	932	1220
Legend	Coefficient	
	(p-value)	

***/**/* indicates significance at the 1/5/10%-level

Source: KOF Innovation Panel(wave 2008), own calculations.

Table 3: Probit estimates of the propensity scores (cross-section 2008)

Dependent variable:	**C3 diversification**	**C4 outsourcing**
Estimation method:		
Probit maximum likelihood		
exportshare	−0.001	0.000
	(0.719)	(0.951)
compprice	0.053	0.015
	(0.315)	(0.736)
compnoprice	0.080	0.037
	(0.133)	(0.414)
numbcomp	0.031	0.011
	(0.396)	(0.719)
demandpast3	0.062	0.096∗
	(0.303)	(0.063)
demandforth3	0.010	−0.063
	(0.865)	(0.220)
lnY	−0.107	0.126**
	(0.149)	(0.043)
lnK	0.026	−0.017
	(0.553)	(0.638)
lnL	0.135	0.137*
	(0.149)	(0.071)
fyear	−0.001	0.001
	(0.572)	(0.234)
highedu	−0.001	−0.006**
	(0.686)	(0.040)
rd	0.204∗	0.475***
	(0.080)	(0.000)
ictinvest	0.003	0.004*
	(0.257)	(0.061)
parttime01	−0.142	−0.036
	(0.235)	(0.717)
temp01	−0.028	0.167
	(0.823)	(0.123)
flextime01	0.133	−0.010
	(0.227)	(0.916)
indwage01	−0.052	0.050
	(0.721)	(0.685)
teamwage01	0.012	−0.073
	(0.918)	(0.453)
firmwage01	0.059	0.121
	(0.576)	(0.179)
training	−0.001	0.000
	(0.743)	(0.995)
6 regional dummies	Yes	Yes
6 sector dummies	Yes	Yes
_cons	−.0585	−5.780**
	(0.982)	(0.012)
LR test	40.32***	164.69***
Pseudo-R^2	0.0440	0.1201
N	930	1211
Legend	Coefficient	
	(p-value)	

***/**/* indicates significance at the 1/5/10%-level

Source: KOF Innovation Panel (wave 2008), own calculations.

Table 4: Means of variables in subgroups for diversification

Variable	All	Diversif	No diversif	Matched without diversif
lnY	16.71	17.29	17.29	17.40
lnK	13.12	13.82	13.71	14.04
lnL	4.16	4.78	4.68	4.83
fyear	1948	1941	1945	1940
highedu	21.76	21.72	21.20	21.67
rd	0.41	0.50	0.46	0.50
ictinvest	19.43	20.60	19.42	18.61
parttime01	0.30	0.27	0.31	0.33
temp01	0.21	0.25	0.24	0.24
flextime01	0.26	0.32	0.27	0.34
indwage01	0.84	0.85	0.86	0.87
teamwage01	0.29	0.31	0.29	0.34
firmwage01	0.50	0.53	0.48	0.47
training	30.24	29.41	30.37	31.63
exportshare	23.21	24.41	26.76	31.59
compprice	3.90	3.99	3.88	4.06
compnoprice	3.11	3.22	3.12	3.29
numbcomp	2.52	2.55	2.39	2.71
demandpast3	3.76	3.89	3.83	4.00
demandforth3	3.11	3.11	3.13	3.16
N	1220	181	749	152

Calculations are restricted to firms which do not provide item non-response for the subsequent regression analysis.
Source: KOF Innovation Panel (wave 2008), own calculations.

Table 5: Means of variables in subgroups for outsourcing

Variable	All	out	No out	Matched without out
lnY	16.71	17.50	16.46	17.24
lnK	13.12	13.87	12.89	13.76
lnL	4.16	4.80	3.96	4.67
fyear	1948	1945	1949	1949
highedu	21.76	21.20	22.05	20.84
rd	0.41	0.58	0.36	0.56
ictinvest	19.43	20.85	19.14	21.34
parttime01	0.30	0.32	0.29	0.29
temp01	0.21	0.26	0.19	0.25
flextime01	0.26	0.27	0.25	0.28
indwage01	0.84	0.87	0.83	0.87
teamwage01	0.29	0.30	0.29	0.32
firmwage01	0.50	0.54	0.49	0.57
training	30.24	30.34	30.28	29.17
exportshare	23.21	29.87	21.08	26.62
compprice	3.90	3.95	3.88	3.88
compnoprice	3.11	3.24	3.07	3.15
numbcomp	2.52	2.40	2.55	2.48
demandpast3	3.76	3.91	3.71	3.89
demandforth3	3.11	3.11	3.11	3.10
N	1220	307	904	218

Calculations are restricted to firms which do not provide item non-response for the subsequent regression analysis.
Source: KOF Innovation Panel (wave 2008), own calculations.

Table 6: Treatment effects of strategies on the degree of delegation

Strategy	Diversification		Outsourcing	
Treatment variable	**diversif**		**out**	
Matching method	ATE	ATT	ATE	ATT
Nearest Neighbour	0.000	0.004	0.170***	0.091***
	(0.986)	(0.778)	(0.000)	(0.000)
Kernel	0.005	0.006	0.170***	0.081***
	(0.689)	(0.600)	(0.000)	(0.000)
Local Linear Regression	0.002	0.003	0.171***	0.078***
	(0.875)	(0.779)	(0.000)	(0.000)
Treated	181		307	
N	930		1211	
Legend		Coefficient		
		(p-value)		

***/**/* indicates significance at the 1/5/10%-level
Source: KOF Innovation Panel (wave 2008), own calculations.

Table 7: MDiD estimators

Strategy	Diversification	Outsourcing
Treatment variable	**diversif**	**out**
Matching method		
Nearest Neighbour	0.022	0.144***
	(0.538)	(0.000)
Kernel	0.011	0.161***
	(0.749)	(0.000)
Local Linear Regression	0.036	0.155***
	(0.452)	(0.000)
N	328	332
Legend	Coefficient	
	(p-value)	

***/**/* indicates significance at the 1/5/10%-level
Source: KOF Innovation Panel (wave 2008) and KOF survey "Organizational change and the adoption of information and communication technologies" (2000), own calculations.

A 1: Description of the variables

Variable	Description
Allocation of decision rights	
Allocation of decision rights (*delegation*)	Index variable composed of seven questions concering the allocation of decision rights at the workplace: - Who determines the pace of work? - Who determines the order of tasks to be performed? - Who distributes the work on employees? - Who determines the modality of the conducting of the work? - Who is responsible in case of production difficulties or problems with the creation of services? - Who is responsible for customer contact routinely? - Who is in contact with customers in case of problems or complaints?
Strategies	
Diversification (*diversif*)	Dummy variable indicating whether or not a diversification strategy was introduced since 2000
Outsourcing (*out*)	Dummy variable indicating whether or not an outsourcing strategy was introduced since 2000
Environment	
Exportshare (*exportshare*)	Share of exports on sales
Price competition (*compprice*)	Intensity of competition on the prime market concerning price
Non-price competition (*compnoprice*)	Intensity of competition on the prime market concerning non-price dimensions as customization, (frequent) introduction of new products, technological progress, flexibility in customer preferences
Number of competitors (*numbcomp*)	Number of internal and extern main competitors on the prime market
Demand perspective in past 3 years (*demandpast3*)	Development of demand on the prime market in the midterm in the past three years
Demand perspective in forthcoming 3 years (*demandforth3*)	Development of demand on the prime market in the midterm in the forthcomingt three years
Firm characteristics	
Log sales (lnY)	Natural logarithm of a firm's sales in 2007
Log capital (lnK)	Natural logarithm of a firm's gross investments in 2007
Log labor (lnL)	Natural logarithm of a firm's number of employees in 2007
Founding year (*fyear*)	Founding year of a firm
Highly educated workers (*highedu*)	Share of employees who have an education higher than apprenticeship or are graduates
Research and Developement (*rd*)	Dummy variable indicating whether or not the firm conducted research and development in the home country or abroad in 2005 to 2008
Investment in information and communication technology (*ictinvest*)	Share of investments in information and communication technologies (hard- and software) of the whole gross investments in average in the years 2005 to 2008
Parttime employment (*parttime01*)	Dummy variable indicating whether or not parttime employment is important for a firm
Temporary employment (*temp01*)	Dummy variable indicating whether or not temporary employment is important for a firm
Flexible employment (*flextime01*)	Dummy variable indicating whether or not flexible employment is important for a firm
Importance of individual performance for wage (*indwage01*)	Dummy variable indicating whether or not individual performance is important for the determination of wages
Importance of team performance for wage (*teamwage01*)	Dummy variable indicating whether or not team performance is important for the determination of wages
Importance of firm performance for wage (*firmwage01*)	Dummy variable indicating whether or not firm performance is important for the determination of wages
Training (*training*)	Share of employees who participated in 2007 in internal or external training
Regional dummies	Seven dummies indicating the regional affiliation of the firm
Sector dummies	Seven dummies indicating the sector affiliation of the firm

Source: KOF Innovation Panel (wave 2008), own calculations.