What makes the Difference between Unsuccessful and Successful Firms in the German Mechanical Engineering Industry?

Widmaier, Ulrich and Niggemann, Hiltrud and Merz, Joachim

Forschungsinstitut Freie Berufe (FFB)

July 1994

FFB Forschungsinstitut Freie Berufe

What makes the Difference between Unsuccessful and Successful Firms in the German Mechanical Engineering Industry?

Ulrich Widmaier, Hiltrud Niggemann and Joachim Merz

FFB Discussion Paper No. 11
July 1994

Universität Lüneburg

Fakultät II - Wirtschaft und Gesellschaft

Postanschrift:
Forschungsinstitut Freie Berufe
Postfach 2440
21314 Lüneburg

ffb@uni-lueneburg.de
http://ffb.uni-lueneburg.de
Tel: +49 4131 677-2051
Fax: +49 4131 677-2059

What makes the Difference between Unsuccessful and Successful Firms in the German Mechanical Engineering Industry?

A Microsimulation Approach Using Data from the NIFA-Panel

Ulrich Widmaier*, Hiltrud Niggemann* and Joachim Merz**

Discussion Paper No. 11

July 1994

ISSN 0942-2595

Paper presented at the XIIIth World Congress of Sociology, 18-23 July 1994, University of Bielefeld, Bielefeld, Germany

* PD. Dr. Ulrich Widmaier, Hiltrud Niggemann, Ruhr-Universität Bochum, SFB 187, Postfach 10 21 48, 44721 Bochum. Germany.

** Prof. Dr. Joachim Merz, University of Lüneburg, Department of Economics and Social Sciences, Director of the Research Institute on Professions (Forschungsinstitut Freie Berufe, FFB), Chair 'Statistics and Professions', Campus, Scharnhorststraße 1, Gebäude 4, 21335 Lüneburg, Germany.

What makes the Difference between Unsuccessful and Successful Firms in the German Mechanical Engineering Industry?

A Microsimulation Approach Using Data from the NIFA-Panel

Ulrich Widmaier, Hiltrud Niggemann and Joachim Merz

FFB-Discussion Paper No. 11, July 1994, ISSN 0942-2595

Summary

Against a background of rising costs and increasing competition, it is besoming more and more difficult for the small and medium-sized firms of the German mechanical engineering industry to be economically successful. The thesis that rapidly changing markets, products and production processes cause serious economic problems for these firms is, however, a proposition on an average trend. A substantial number of firms are not only capable of coping with these conditions and challenges, but are even able to expand their business activities, including employment. We may hypothesize that their product and market strategies as well as their internal mode of operation and organization differs significantly from those firms doing economically less well.

In order to test the significance of factors which could lead to different levels of success, operationalized with data of the NIFA panel the method of static microsimulation is applied using the program MICSIM. This particular method offers the possibility of reweighting the information contained in micro datasets according to restrictions given by aggregated data (i.e. marginal distributions). The latter will be chosen in such a way that the number of firms with properties (strategies), hypothetically leading to success in terms of lower excess capacity, are 'artificially', increased in the sample. The research goal is to find out whether such hypothetical strategies are supported by the data.

The basic finding that certain complex strategies are more often successful demonstrates that unidimensional approaches to modernize production are of less value. Only in those strategies wehere organization of production, technical equipment, degree of vertical integration, products and customers are part of an intergrated innovational strategy, is success most likely to be fuelled.

JEL: C80, C81, J20, M13, M21

Keywords: *economic succes, NIFA PANEL, microsimulation, engineering*

Zusammenfassung

Angesichts steigender Kosten und sich verschärfenden Wettbewerbs wird es für die vorwiegend mittelständisch strukturierten Betriebe des deutschen Maschinenbaus immer schwieriger, wirtschaftlich erfolgreich zu sein. Allerdings ist die These von zunehmenden Wettbewerbs- und damit wirtschaftlichen Problemen eine Aussage über den durchschnittlichen Trend. Es gibt eine erhebliche Anzahl von Betrieben, die diesen Bedingungen und Herausforderungen nicht nur trotzen, sondern sogar ihre geschäftlichen Aktivitäten einschließlich der Zahl der Beschäftigten ausweiten. Die Hypothese scheint naheliegend, daß sich ihre Produkt- und Marktstrategien sowie ihre internen Strukturen von denen der weniger erfolgreichen Betrieben signifikant unterscheiden.

Die Überprüfung der Faktoren, die zu unterschiedlichem Erfolg führen könnten, wird mit den Daten des NIFA Panels und der Methode der statischen Mikrosimulation unter Verwendung des Programms MICSIM vorgenommen. Diese Methode erlaubt es insbesondere, die Information des Mikrodatensatzes gemäß der Restriktionen aus aggregierten Daten umzugewichten. Die Hochrechnung wird so angewendet, daß die Anzahl der Betriebe mit hypothetisch erfolgreichen Strategien gemessen an geringerem Kapazitätsüberschuß durch Umgewichtung in der Stichprobe vergrößert wird. Es wird dann untersucht, ob solche hypothetischen Strategien von den Daten getragen werden.

Das Hauptergebnis, daß komplexe Strategien häufiger erfolgreich sind, deutet auf die zunehmende Problematik eindimensionaler Lösungen zur Erzielung betrieblicher Erfolge hin. Vor allem, wenn Fertigungstiefe, Fertigungsorganisation, Produkte und Märkte in eine ganzheitliche Innovationsstrategie eingebunden werden, stellt sich der Erfolg meist ein.

JEL*:* C80, C81, J20, M13, M21

Schlagwörter: *Wirtschaftlicher Erfolg, NIFA PANEL, Mikrosimulation, Maschinenbau*

What makes the Difference between Unsuccessful and Successful Firms in the German Mechanical Engineering Industry?

A Microsimulation Approach Using Data from the NIFA-Panel

Ulrich Widmaier, Hiltrud Niggemann and Joachim Merz

What makes the Difference between Unsuccessful and Successful Firms in the German Mechanical Engineering Industry?

A Microsimulation Approach Using Data from the NIFA-Panel

Ulrich Widmaier, Hiltrud Niggemann und Joachim Merz

1 Introduction

Against a background of rising costs and increasing competition, it is becoming more and more difficult for the small and mediumsized firms of the German mechanical engineering industry to be economically successful. Due to the fact that the limited internal capacities of small and medium-sized firms can hardly cope with the complexity of global markets, the noticeable widespread concentration on limited and specific markets, as well as on a small number of sales branches, constitutes quite a rational strategy (see for details Freriks 1994 and Schmid and Widmaier 1993). This strategy, however, is proving itself to be less and less of a success story, the reason being that markets, products and production processes undergo rapid change. The thesis that these developments cause serious economic problems for the firms is, however, a proposition on an average trend. A substantial number of firms are not only capable of coping with these conditions and challenges, but are even able to expand their business activities, including employment. Beyond the general explanation that these firms face more favourable conditions in their respective market segment, we may further hypothesize that their product and market strategies as well as their internal mode of operation and organization differs significantly from those firms doing economically less well.

This paper contains an attempt to test precisely this hypothesis on the basis of data from the NIFA-Panel for the year 1992[1] (for more inform ation on the panel see Schmid and Widmaier 1992). In other words, we will try to find, with the appropriate methodology, significant relationships between structural properties and market related strategies of firms on the one hand, and a variable which is supposed to measure success on the other hand. Thereby "success" can be regarded from different perspectives. Monetary, business administrative type of measures are, for example, the turnover rate, or the surplus relative to the number of employees. Since the research programme and consequently the questionnaire of the NIFA-Panel are primarily focused on the production or shop floor level, it makes sense to also measure success on that particular level. The most logical indicator in this respect seems to be the degree to which existing machine capacity is utilized in a given firm. Therefore, the goal of our analysis is to find out whether and which strategies, with respect to technology, degree of vertical integration, products, structure of production and shop floor organization, are associated with higher levels of success operationalized in terms of the level of machine capacity utilization. Should this goal be achieved, we could then develop and recommend strategies which would allow less successful firms to improve their economic situation as well.

In order to test the significance of those factors which could lead to different levels of success, the method of static microsimulation (see Merz 1991, 1994c for recent microsimulation surveys) is applied using the program MICSIM (for details see Merz and Buxmann 1990 or Niggemann 1993). This particular method offers the possibility of re-weighting the information contained in micro datasets according to restrictions given by aggregate data (i.e. marginal distributions). The latter will be chosen in such a way that the number of firms with properties (strategies), hypothetically leading to success in terms of lower excess capacity, are "artificially" increased in the sample. The research goal is to find out whether such hypothetical strategies are "supported" by the data.

2 What is Meant by Success? The Identification of Dependent and Independent Variables

In the context of our analysis it is of less importance as to which degree of capacity utilization is optimal for effective production on the shop floor level. This often depends

1 NIFA is the acronym for "Neue Informationstechnologien und Flexible Arbeitssysteme" (New Information Technologies und Flexible Work Systems) which is the name of the Sonderforschungsbereich 187 supported by the German National Science Foundation (DFG).

on the degree of flexibility necessary in the production process which can vary from firm to firm (for a detailed discussion of this important issue within the field of industrial business administration see Heinen 1985). Consequently, the concept of an average full machine capacity utilization for a given firm set at 100% is employed as the criteria. In general it is safe to assume that an average degree of utilization between 75% (at the least) and 105% (at the most) constitutes an economically desirable target, otherwise the capital investment in machinery would just not be profitable.

The fact that this indicator is also used in the monthly business survey by the German IFO-Institute (see various editions) as a measure of business cycle developments shows that this indicator is a rather common concept used to capture the economic performance of a firm. This also holds true when one compares this indicator with the superficially more convincing variables like turnover or surplus. It is extremely difficult, particularly in the case of surplus, to get reliable and valid measures in survey research. Their significance as success indicators is also often quite dubious especially against a background of financial transactions and re-investment levels. With respect to turnover as a measure of success it is again often unclear what the role and contribution of production (the shop floor) actually is. Frequently a substantial amount of turnover - and/or surplus - is generated in other parts or segments of the firm/enterprise (an argument which could also be made with respect to surplus).

Apart from the issue of whether machine utilization is the best conceivable single indicator for a successful business strategy, it is primarily of interest to us whether we can identify factors which distinguish those firms with low levels from those with relatively high levels in a significant and systematic way.

The variable "level of machine capacity utilization" (the firm specific level of full utilization set at 100%) will be split into four distinct categories. Each firm will have either the value of zero or one depending on whether it falls into that particular category or not. In other words these four categories are represented as dichotomous variables. The categories are: capacity utilization level up to 75%, between 76% and 95%, between 96% and 105% and more than 105% - the third category clearly being the one which indicates the "optimal" success level.

Which characteristics of a given firm are relevant for its success on the shop floor level? Our choice of independent variables is guided by the conceptual framework of the NIFA-panel, which is designed to capture the technical and organizational efforts of firms in the mechanical engineering industry in the process of restructuring production. Success of a firm in our definition, i.e. in the sense of capacity utilization of existing machinery, may, on the one hand be determined by technical and organizational optimization strategies on the shop floor level, while on the other hand, it may be related to innovative product and market strategies. Consequently our "explaining" variables should capture the following dimensions: use of computer-based production technology, organizational and structural properties of the production process on the shop floor, product strategies as well as other market related activities (for a similiar approach see Widmaier and Dye 1992). More specifically we will be employing the following five dimensions as our explanatory variables:

Computer-based technology:

For each firm we code the information on whether computer-based production technologies are exclusively or predominantly used. These can be NC/CNC-machines, machining centers (MC) and/or flexible manufacturing systems (FMS). With this variable we try to capture the important dimension of technical rationalization and optimization, which is frequently highlighted in the literature as a necessary, but not, in itself, sufficient condition for success (for details see Hirsch-Kreinsen 1992 or Hauptmanns, Saurwein and Dye 1992).

Shop floor/production organization:

Should the shop floor be organized on the basis of the so-called "object principle", at least on a 50% level in contrast to other modes of production like work bench or line, then we may assume that the firm follows a strategy of innovation and flexible work reorganization in order to improve, among other things, its level of capacity utilization (see the study of Manske 1991 for details). It will be of particular interest to us whether this variable will have by itself, or only in combination with the widespread use of computer-based production technology, a significant effect on the dependent variable. This question must take into account the fact that both dimensions play an important role in the conceptual framework of the Sonderforschungsbereich 187 (e.g. Ostendorf and Seitz 1992 and Hauptmanns 1993).

Production structure:

This dichotomous variable is supposed to capture the level of flexibility which has to be met by the production on the shop floor in a given firm. In those cases where we observe primarily customized production leading to unique objects or single and small batches in production, we expect a higher level of demand for flexibility and a corresponding challenge to meet the target of full productive capacity utilization. Again it is the combination with other factors which is of particular interest to us. Only a joint effort combining technical, organizational and product related factors will contribute to a higher level of capacity utilization, thereby contributing to the solution of the so-called "rationalization dilemma" within the mechanical engineering industry.

Product innovation:

This variable addresses the question of whether a firm has introduced significantly improved products which have not been part of their production programme in the last three years and have developed completely new products during the same time span. It is almost self-explanatory why such a measure of innovative product strategy could contribute, via increased sales, to an improved productive capacity utilization level.

Degree of vertical integration of production:

From the discussion of the concept of lean production (see Womack et al. 1991) it should be clear why an optimized degree of vertical integration of production can be a powerful predictor for success in terms of productive capacity utilization. It is, however, not possible for us to identify a general level which is "lean" on a reduced degree of vertical integration, in the sense that it is optimal for the production of a given firm. Based on empirical observations and on hints given in the literature, we may assume that a degree of vertical integration of production less than 40% of the overall products value can be considered a strategy of lean production.

The variables introduced as explanatory concepts are all dichotomous in nature. The individual information on each firm used in the sample for the microsimulation indicates therefore whether the firm has the respective property or not.

3 The Model

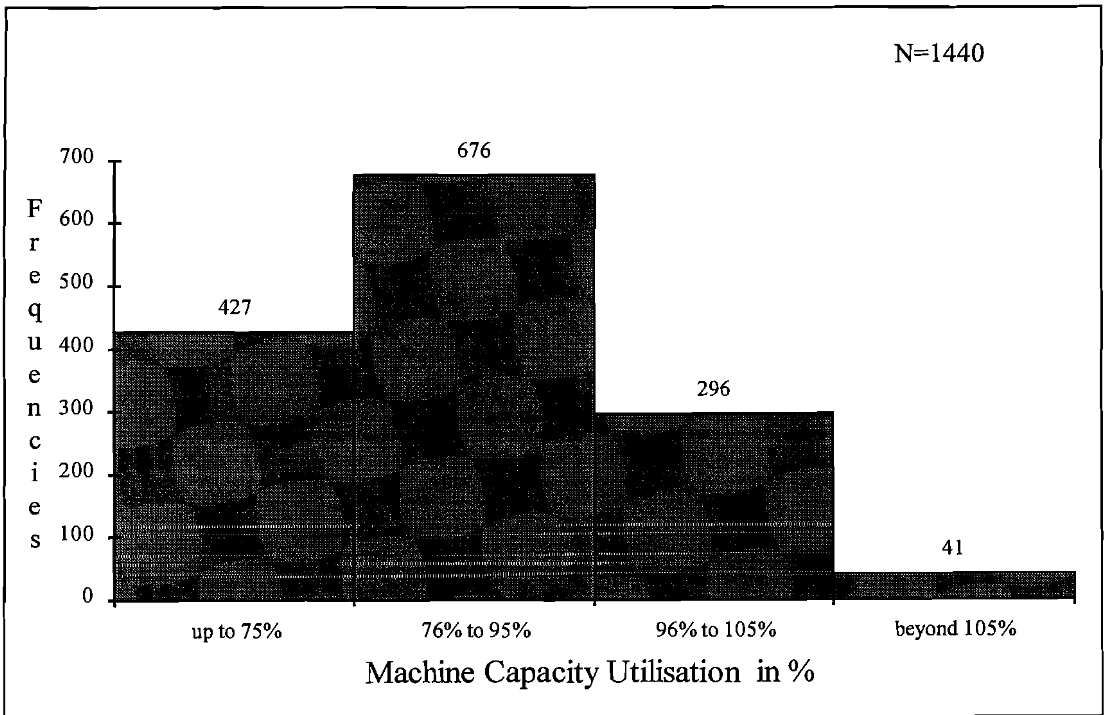
3.1 Description of the Re-weighting Goal and the Re-weighting Procedure

The basic question underlying the simulation or more precisely, the re-weighting process, could be posed as follows: what kind of characteristics or properties of firms described by our independent variables are associated with productive capacity utilization? In other words - are firms which differ in terms of technology employed, organization, structure and vertical integration of production and product strategies also different with respect to the level to which they make use of their machinery. In this context we are not only interested in demonstrating the effect of individual variables but, more importantly, the difference in capacity utilization generated by specific combinations of independent variables.

In the following analysis the data provided by the NIFA-panel may serve as the basis for answering this kind of question. This data base with information for each individual firm constitutes the input for the static microsimulation package MICSIM, which allows the adjustment of micro level data to aggregate restrictions. The information contained in the micro data set with respect to the selected variables (both independent and dependent) is used to re-weight the data in order to fulfill restrictions which then apply to aggregates (i.e. marginal distributions) not to individual units.

For this analysis we are in a position to make use of individual information for 1440 firms for all of the variables under examination. These 1440 firms are distributed over the four categories of our dependent variable as shown in Figure 1.

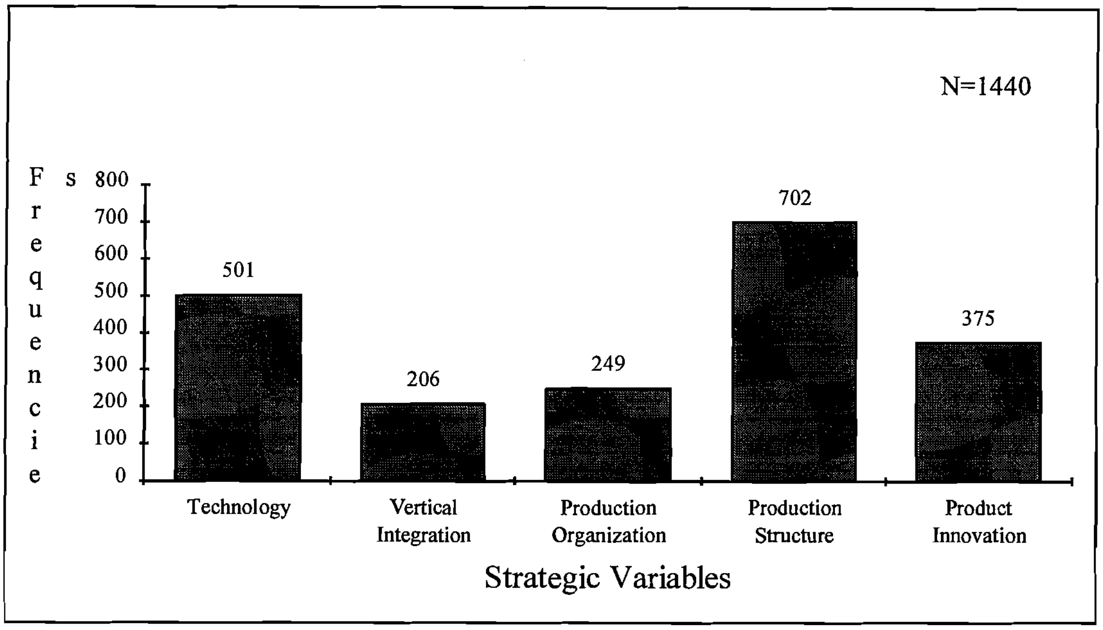
Figure 1: Distribution of Machine Capacity Utilization[2]



2 The specific level of full utilization is set at 100%

The distribution of the independent (strategic) variables is displayed in Figure 2. In the following we will employ the term strategic variables instead of independent variables. This term captures the functional meaning of the selected variables (i.e. properties of firms) more precisely.

Figure 2: Distribution of Technology, Vertical Integration, Production Organization, Production Structure and Product Innovation



The purpose of the re-weighting procedure is to find out if a significant relationship between capacity utilization and the five strategic or independent variables (measured as dichotomies) exists. Or, more precisely, if firms which follow one or more of these strategies are more successful in this respect. The solution to this problem is not found by estimating a conventional parametric model but by computing auxiliary values - so-called "re-weighting" factors. The analysis of these factors then allows us to answer our basic research questions. The computer program ADJUST within MICSIM utilizes the kind of information provided by Figure 2 in addition to the individual information for each firm. The goal is to re-weight the data-set under the restriction of hypothetically altered marginal distributions. Because the model does not assume parametric dependencies between the variables, the distinction between independent and dependent variables is in a strict sense incorrect. Nevertheless, we will rely on it in our analysis for substantive and theoretical reasons.

MICSIM is the recently developed PC-version (Merz and Buxmann 1990) of the Static Sfb 3 Microsimulation Model (Merz 1994b) which was used in particular to analyze data of the Sfb 3 Secondary Occupation Survey and the German Socio-Economic Panel of the Sfb 3/DIW. The components of MICSIM are the following: simulation (SIMULA), evaluation (EVAL) and adjustment (ADJUST) of microdata. The simulation component focuses on model operation, i.e. on how systematic variations in the parameters change the characteristics of microunits and their relationships to each other. EVAL includes basic distributional measures to evaluate the simulation and/or microdata files.

In this paper the third component ADJUST is used. In general, the aim of adjustment of microdata is to adapt microdata to predetermined aggregate totals (restrictions, margins). A specific problem is the simultaneous and consistent adjustment. This entails finding for each microunit a single weighting factor for quite a large number of characteristics, which after summing up, simultaneously complies with all the given restrictions (margins or population totals). ADJUST solves such simultaneous and consistent adjustment problems using the Minimum Information Loss (MIL) principle, which ensures the desired positive condition of the weighting factors to be computed. For the consistent solution of the adjustment problem, which simultaneously fits hierarchical microdata, a relatively fast numerical solution, employing a specific Newton-Raphson procedure by a global exponential approximation, is used. This modified procedure is able to reduce the computing time by over 75% compared to the standard Newton algorithm (see Merz 1993, 1994a).

How the re-weighting procedure actually functions can be demonstrated by the following example: In our data-set each firm is represented once and is characterized by five strategic variables. This leads to the marginal distribution given in Figure 2. In other words, the frequencies indicate how many firms follow the respective strategy. On the basis of the re-weighting factors calculated by ADJUST it is possible to answer the question of how often a given firm should be represented in an imaginary data-set with different marginal distributions for the five variables from those shown in Figure 2. For example the program could "adjust" to a data-set with a larger number of firms employing advanced computer-based production technology and/or with more firms which are confronted with a high degree of flexibility in their production process. Given the restriction that the new data-set should also consist of 1440 firms, then firms which do not have these characteristics can obviously be found less frequently in the new data-set compared to the old one. Technically speaking they receive a re-weighting score of less than unity. On the other hand those firms which show the strategic characteristics are represented more often in the data and receive a re-weighting score of greater than one. Under the restriction that the overall number of firms remain the same it follows that the mean for the re-weighting scores is one. More generally speaking ADJUST calculates, for a given data-set and new hypothetical marginal distributions (restrictions), re-weighting factors which indicate how often a firm should be in the data-set in the event that the restrictions hold. The mathematical procedure attempts to keep the structure of the old data-set as far as possible. In other words it searches for a solution which is closest to the old composition of firms in the data-set. The more the new marginal distributions (restrictions) deviate from the old the more, of course, the composition of firms in the data is altered, i.e. the greater the deviation of the re-weighting scores from unity.

3.2 The Model for Re-weighting

In the following analysis we will identify different marginals for our five strategic (independent) variables and use the resulting re-weighting scores as indicators of relative success (in terms of capacity utilization), i.e. the degree to which the new marginals are supported by the data.

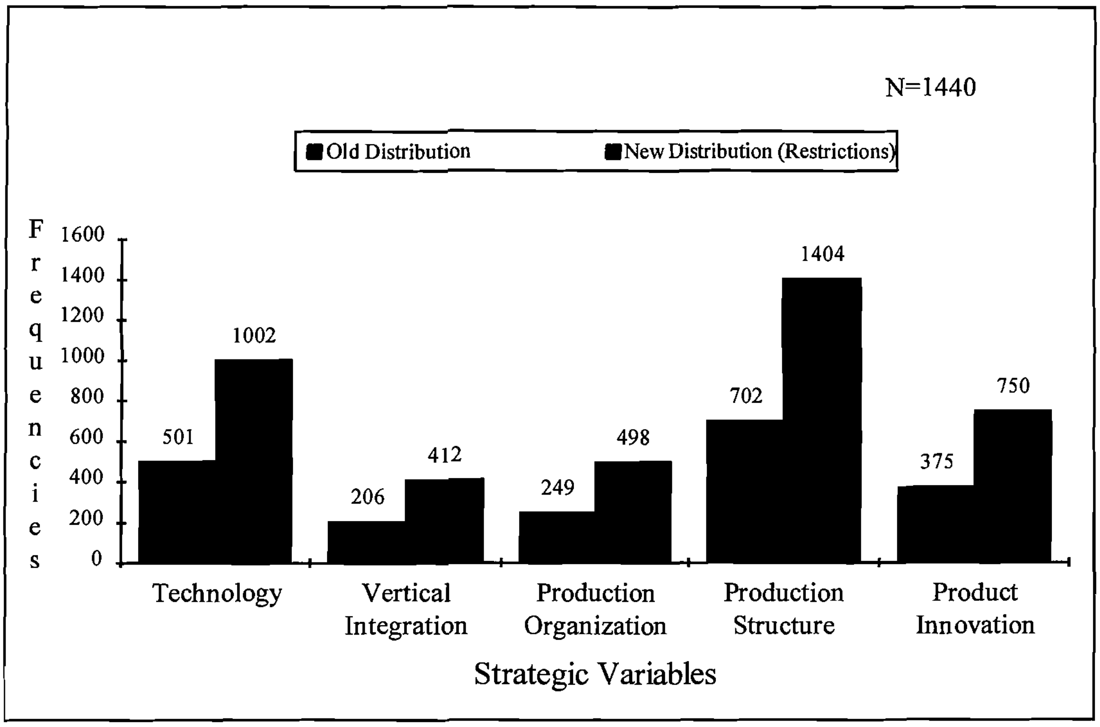
Identification of Restrictions

The restrictions define the new marginals for the following variables or strategies: use of computer-based production technology, degree of vertical integration of production, required flexibility of production, type of production organization and product strategy. Because all variables should have the same weight, we select the restrictions in such a way that the relative changes in the marginals stay the same for all of the variables included. The magnitude to which the marginals are altered does not affect the interpretation of the re-weighting factors. The direction, however, in which marginal distributions are altered is guided by theoretical considerations. Clearly, where we assume a hypothetically positive relationship with our success indicator we will increase the frequencies. For those variables with a negative relationship they will be decreased. In our case we assume for all variables a positive relationship. This leads to the restrictions for the five strategic variables as shown in Figure 3.

The Strategies

Different strategies consist of the inclusion of one, more than one, or all variables with altered marginal distributions in the re-weighting process. In other words, the marginals for these five variables are predetermined in various combinations (with or without alterations) and the resulting weighting factors indicate which firms react "positively" to what type of strategy (i.e. combination of altered and non-altered strategic variables). In the case that only the use of computer-based production technology would constitute the strategy to increase the degree to which machine capacity is utilized then the restrictions would be 1002 cases for that variable and 206, 375, 249 and 702 for the other four variables. This implies that the proportion of firms with that kind of property will be doubled whereas the marginals of the others remain the same.

Figure 3: Old and New Distribution of Strategic Variables



Each strategy therefore consists of a combination of altered and non-altered marginals (restrictions). On the basis of five variables we have the follwing possible combinations:

1 marginal is altered	5 possibilities
2 marginals are altered	10 possibilities
3 marginals are altered	10 possibilities
4 marginals are altered	5 possibilities
5 marginal are altered	1 possibility.

Altogether 31 possibilities exist with more or less different strategies to improve the level of utilization of production machinery. All 31 strategies with their corresponding marginal distributions are displayed and summarized in Appendix A.

For each of these strategies and for each firm in the sample a re-weighting factor is calculated representing two kinds of information. Firstly, each factor is determined by the empirical properties of all firms which remain constant for all of the strategies examined. Secondly, each factor is of course also influenced by the restrictions which vary for a given strategy. The magnitude of a given re-weighting factor then allows inferences to what degree a firm supports a given strategy. In the following chapter we will discuss the interpretation of the re-weighting factors in greater detail.

Interpretation and Evaluation of Re-Weighting Factors

The aim of our analysis is to interpretate and evaluate the re-weighting factors and the structure of the weighting process. As stated in Chapter 3.1. we are interested to what degree differences in the utilization level of machine capacity between firms can be attributed to strategic variables like degree of vertical integration of production, product innovations, type of organization of production, predominant production structure and use of computer-based production technology.

As in conventional statistical analysis we depart from the null-hypothesis of no relation between capacity utilization and the strategic variables. Consequently the question arises what distribution of re-weighting scores could we expect should these strategic variables be unrelated to capacity utilization? If the null-hypothesis would be true we would observe a random distribution of re-weighting factors with respect to utilization of capacities. In other words the correlation among these variables should be close to zero. A first measure to evaluate the strategies is therefore the product-moment correlation and its test for significance, i.e. its statistical difference from being zero. Table 1 in Appendix B shows that 17 out of 31 strategies yield correlations which are statistically significantly different from zero at a significance level of 0.01. Although this represents only a test for a linear relationship between the existence of excess capacity and magnitude of the weighting factors it shows already that the re-weighting factors increase the more the capacity utilization also increases.

As already mentionend the expected value for each factor is unity since the number of firms in the sample remain constant. When marginals are altered for one of the 31 strategies then the re-weighting factors deviate from one according to the following rule: the factor is smaller than one in those cases where the firm does not have the characteristics indicated by the marginals altered and it is greater than one in those cases where it does have the characteristics. The magnitude to which deviations from unity occur is, however, not dependent on the characteristics of that particular firm but on the characteristics of all the other firms in the sample. In other words it is important how many other firms share the properties in question. In order to answer our research question it is of less importance to what magnitude re-weighting scores deviate from unity and while it is more relevant in which direction they move from one. Therefore, we will consider in the following analysis the number of so-called positive re-weighting factors, i.e. those having a value greater one.

As already displayed in Figure 1 our dependent variable will be classified into four catagories of machine capacity utilization: category 1: up to 75%, category 2: between 76% and 95%, category 3: between 96% and 105%, category 4: beyond 105%.

In order to evaluate a given strategy we employ the number of "positive" re-weighting factors in each category as a measure. A strategy is classified as being positive for reducing excess capacity in the case where the number of factors greater one are higher in categories 2, 3 and 4 compared with those in category 1.

4 Results

Each strategy is evaluated by comparing the proportions of "positive" re-weighting factors in the four categories via a logistic regression (see Appendix B for further remarks on the method). The idea is to test whether we can observe different probabilities for "positive" re-weighting factors in the four categories of machine capacity utilization. For each category we calculate the probability of "positive" weights and test whether the probability of category 1 deviates significantly from those in categories 2, 3 and 4. In other words the firms in category 1 constitute the reference group. The results generated by the logistic regression can be found in detail in Appendix B.

Table 2 in Appendix B displays the estimated probabilities for each of the 31 strategies in the four categories. In addition the corresponding significance test for equal probabilities in the four categories is reported. Low values of significance allow the rejection of the hypothesis of equal probabilities. In case we choose a significance level of 1%, we get 17 strategies which display significant differences between categories (see Table 2).

From a theoretical point of view it is not surprising that the strategic factors "high demand for flexibility in production" (F) and "high rate of product innovation" (I) can be found jointly in a large number of strategies. A high proportion of customized production in small batches and the improvement of existing products in cooperation with customers can be considered as the typical pattern of production and innovation in the German mechanical engineering industry. Another prominent strategic factor seems to be computer-based production technology (T). This factor shows up in almost all strategies where significant differences in excess capacity can be observed. The only exception being the strategy with a low degree of vertical integration (E), a high demand for flexibility in production (F) and a high rate of product innovation (I).

Furthermore, it is striking that significant differences occur mostly in more complex strategies consisting of several dimensions (strategic variables). 16 out of 31 consist of three or more dimensions. 12 of those yield significant differences. 75% of these strategies can therefore be considered as positive for our dependent variable whereas out of the remaining 15 strategies with one or two dimensions only one third prove to be significant. This leads to the conclusion that differences among firms show up to a greater degree only when the influence of several strategic dimensions is taken into account. Differences in the degree of excess capacity are therefore most likely a result of complex strategies. Concentrating on one strategic factor is simply not enough.

In general, however, the "positive" strategies neither display a uniform pattern in the sense that all three categories with a higher degree of capacity utilization differ significantly from category 1, nor are they in an ascending order (Table 3, Appendix B shows the details).

The proposition that significant strategies also lead to a monotonically increasing rate of capacity utilization cannot be confirmed in light of these results. Such a perfect relationship exists only for strategies T, TO, TEO and TOI. This is very important to note because the combination TO (predominantly computer-based technology and object oriented organization of production) represents a strategy which combines technical and organizational innovations. Such strategies are especially investigated and supported by the larger research project of which our study is a part.

Summarizing Table 1 we can point out that all strategies listed are to be found significantly more often in those firms which utilize their machine capacity more than 75%. Firms in categories 2 and 3 (75-95 and 95-105%) are in addition always significantly different from those which use their machinery less than 75%. Of particular interest are strategies TEFI and TEOFI - the latter including all variables in the analysis. The results indicate that these firms are even more successful in avoiding, at the same time, a capacity shortage (over 105% utilization), i.e. being above what production capacities can manage without running into problems. These firms seem to be capable of adjusting their production capacities to the level which is actually needed for a given demand by the market.

The fact that the variable "flexibility required in production" operationalized as production on the basis of small batches is a significant strategic factor in most complex strategies needs some additional explanation and discussion. It is not necessarily in line with conventional thought that this factor leads to a higher level of capacity utilization. To the contrary, it is normally assumed that single object and/or small batch production requires a certain excess capacity of machinery in order to allow for flexibility. Our results do not question this observation. The flexibility factor does not constitute a significant success factor by itself. In contrast to computer-based technology it contributes to a more efficient use of machinery only in combination with other strategic factors (like product innovation, optimized vertical integration, object principle in production). This implies that at least a partial solution to the so-called rationalization dilemma of the mechanical engineering industry is possible via the combined effects of innovative organization, technology and products.

5 Concluding Remarks

Because of the heterogeneous composition of the mechanical engineering industry (see Widmaier and Schmid 1992 for details) we expect that an attempt to identify determinants of success in terms of avoiding excess capacity on the shop floor level with a microsimulation approach will produce a number of different strategies which can "explain" a higher level of capacity utilization. The inclusion of the variable "computer-based production technology" in almost all strategies suggests on the one hand that the use of modern technology represents a standard rationalization pattern in the mechanical engineering industry as well. On the other hand, it also seems to be the case that expensive investment in modern technology generates optimizing strategies in the production process which are not pursued to the same degree without such investment (for a similiar argument see Hirsch-Kreinsen et al. 1990).

Theoretically more interesting results, however, are displayed by the strategies TO, TEO, TOI and TEOI which yield significant results for categories 2 and 3, thereby indicating that the combination of computer-based technology and an effective re-organization towards object-oriented production represents the most successful strategy in avoiding excess capacity. This may be taken as an indicator that production cells based on work groups which produce products or parts completely in the cell and are supported by modern information technology are the most promising road to success. In this sense technical and organisational concepts and solutions developed and promoted by the SFB 187 prove to be valuable tools for keeping, or even increasing, a firm's productive capacities at work even in an economic depression. This was clearly the case in 1992.

The basic finding that more complex strategies are also more often successful demonstrates that unidimensional approaches to modernize production are of less value. Only in those strategies where organization of production, technical equipment, degree of vertical integration, products and customers are part of an integrated innovational strategy, is success most likely to be fuelled.

Appendix A:

Table 1: Table of Restrictions[3]

Strategy	Technology (T)	Vertical Integration (I)	Production Organization (O)	Production Structure (F)	Product Innovation (I)	No. of altered marginals
T	1002	**206**	**249**	**702**	**375**	1
E	**501**	412	**249**	**702**	**375**	1
O	**501**	**206**	498	**702**	**375**	1
F	**501**	**206**	**249**	1404	**375**	1
I	**501**	**206**	**249**	**702**	750	1
T E	1002	412	**249**	**702**	**375**	2
T O	1002	**206**	498	**702**	**375**	2
T F	1002	**206**	**249**	1404	**375**	2
T I	1002	**206**	**249**	**702**	750	2
E O	**501**	412	498	**702**	**375**	2
E F	**501**	412	**249**	1404	**375**	2
E I	**501**	412	**249**	**702**	750	2
O F	**501**	**206**	498	1404	**375**	2
O I	**501**	**206**	498	**702**	750	2
F I	**501**	**206**	**249**	1404	750	2

3 The altered marginals are printed in bold letters and the letters in the first column represent the strategies, i.e. T for Technology, E for vertical integration of production, O for production organization, F for production structure and I for high degree of product innovation.

Continued Table 1

T E O	1002	412	498	**702**	**375**	3
T E F	1002	412	**249**	1404	**375**	3
T E I	1002	412	**249**	**702**	750	3
T O F	1002	**206**	498	1404	**375**	3
T F I	1002	**206**	**249**	1404	750	3
T O I	1002	**206**	**249**	**702**	750	3
E O F	**501**	412	498	1404	**375**	3
E O I	**501**	412	498	**702**	750	3
E F I	**501**	412	**249**	1404	750	3
O F I	**501**	**206**	498	1404	750	3
T E O F	1002	412	498	1404	**375**	4
T E O I	1002	412	498	**702**	750	4
T E F I	1002	412	**249**	1404	750	4
T O F I	1002	**206**	498	1404	750	4
E O F I	**501**	412	498	1404	750	4
T E O F I	1002	412	498	1404	750	5

Appendix B:

Table 1: Pearson's Correlation Coefficients between the Re-weighting Factors of each Strategy and the Degree of Machine Capacity Utilization[4]

T	0.1658**	E F	0.0583*	T F I	0.1021**
E	-0.0132	E I	0.0114	E O F	0.0432
O	-0.0028	O F	0.0580*	E F I	0.0391
F	0.0681*	O I	0.0448	E O I	0.0141
I	0.0441	F I	0.0727**	O F I	0.0496
T E	0.1239**	T E O	0.0925**	T E O F	0.0873**
T O	0.1235**	T E F	0.1180**	E O F I	0.0456
T F	0.1329**	T E I	0.1079**	T O F I	0.0871**
T I	0.1482**	T O F	0.1090**	T E F I	0.0920**
E O	-0.0072	T O I	0.1265**	T E O I	0.0870**
				T E O F I	0.0804**

4 One asterisk is displayed if the correlation coefficient is significantly different from zero at a 5% level and two asterisks are displayed for a 1% level. For the explanation of the abreviations see Tabel 1, Appendix A.

Some Remarks on Logistic Regression Analysis:

In general, logistic regression analysis is used to estimate the dependence of event probabilities on one or more independent variables. This is done by employing a model which forecasts the occurrence or non-occurrence of an event when the independent variables are known. In this case measures of goodness-of-fit of the model are of special interest, e.g. the classification table, the likelihood function or goodness-of-fit statistics.

In our application the 'event' of interest is if an adjustment factor is "positive", i.e. if it is greater than the expected value. Therefore the dependent variable is a dummy which has either the value 0 or 1. The independent variable is given by a categorial variable which can take the values 1, 2, 3, or 4 corresponding to the four levels of machine capacity utilization. The aim is not to forecast whether an adjustment factor is "positive" when the level of machine capacity utilization is known, but to examine if there are significant differences between the event probabilities of the lowest machine capacity utilization category and the remaining higher categories.

For this reason, measures indicating the goodness-of-fit of the models under consideration are not presented. Instead the tables of 'Variables in the Equation' are displayed, which are of interest evaluating the strategies (see Ouput 1, Appendix B). The row D of the column 'Wald' shows the 'Wald statistic' which tests the hypothesis of no difference between the four categories against the hypothesis of any difference. The siginificance level required to reject this hypothesis is displayed in the same row of column 'Sig'. Since category 1 is used as a reference category, the table shows the estimated parameters for the remaining categories: category 2, category 3 and category 4 in column 'B'. The rows of the two columns 'Wald' and 'Sig' display the Wald statistic and the significance level when pairwise differences are analysed, i.e. each of the three rows displays the results of the test of no difference between the reference category and the category under consideration .

A short summary of the results of the logistic regression analysis is given in the following Table 2. It shows the estimated probabilities of 'positive' adjustment factors in each of thc four catcgories and the significance level of the Wald test to reject the null hypothesis of no difference between the first category and the remaining categories. The decision rule is to reject this hypothesis if the significance level is 0.01 or less. Following this rule 17 strategies lead to the conclusion that there are significant differences. An inspection of the estimated proportions of positive adjustment factors comes to the conclusion that these strategies are clearly more frequent in higher machine capacity utilization categories.

Table 2: The Results of the Logistic Regression Analysis[5]

Strategy	Category 1	2	3	4	Significance of the Wald Test
T	0.24	0.38	0.41	0.44	0.0000
E	0.15	0.14	0.15	0.05	0.3614
O	0.16	0.16	0.20	0.20	0.4636
F	0.43	0.51	0.52	0.41	0.0336
I	0.23	0.28	0.27	0.29	0.3020
T E	0.33	0.46	0.49	0.49	0.0000
T O	0.25	0.40	0.43	0.44	0.0000
T F	0.17	0.29	0.27	0.22	0.0001
T I	0.31	0.43	0.47	0.44	0.0000
E O	0.30	0.28	0.32	0.24	0.4781
E F	0.43	0.51	0.52	0.41	0.0336
E I	0.33	0.38	0.39	0.34	0.3239
O F	0.43	0.51	0.52	0.41	0.0336
O I	0.37	0.50	0.50	0.39	0.8374
F I	0.43	0.51	0.52	0.41	0.0336
T E O	0.29	0.43	0.46	0.46	0.0000
T E F	0.14	0.25	0.23	0.17	0.0000
T E I	0.18	0.31	0.31	0.32	0.0000
T O F	0.17	0.29	0.28	0.22	0.0001
T O I	0.20	0.36	0.36	0.39	0.0000
T F I	0.14	0.26	0.27	0.15	0.0000
E O F	0.43	0.26	0.27	0.15	0.0336
E F I	0.21	0.31	0.33	0.22	0.0003
E O I	0.32	0.37	0.38	0.39	0.3144
O F I	0.15	0.18	0.22	0.10	0.0364
T E O F	0.17	0.29	0.28	0.22	0.0001
E O F I	0.15	0.18	0.22	0.10	0.0364
T O F I	0.17	0.28	0.30	0.20	0.0001
T E F I	0.18	0.29	0.30	0.17	0.0001
T E O I	0.23	0.39	0.39	0.39	0.0000
T E O F I	0.18	0.29	0.30	0.17	0.0001

5 Again the abreviations in the first column represent the different strategies. The following five columns display the estimated probabilities of positive re-weighting factors in each of the four categories which are equal to the relative frequencies of positive re-weighting factors in each category. The last column show the significance level on which one can reject the null-hypotheses of no difference between the four categories against the alternative of any difference. The decision rule is to reject this hypothesis if the significance level is 0.01 or less.

Table 3: Machine Capacity Utilization with Respect to the Proportion of Positive Re-weighing Factors[6]

Strategy	Order of Categories			
T	1	2	3	4
T E	1	2	**4**	3
T O	1	2	3	**4**
T F	1	**4**	3	2
T I	1	2	**4**	3
T E O	1	2	3	**4**
T E F	1	**4**	3	2
E F I	1	**4**	2	3
T O F	1	**4**	2	3
T O I	1	2	3	4
T F I	1	**4**	2	3
E F I	1	**4**	2	3
T E O F	1	**4**	3	2
T O F I	1	**4**	3	2
T E F I	**4**	**1**	2	3
T E O I	1	3	2	**4**
T E O F	**4**	**1**	2	3

Output 1: Results of the Logistic Regression Analysis

The following output presents the results of the logistic regression analysis of those strategies which show significantly different event probabilities in category 1 compared to the remaining categories.

6 The letters in the first column represent the strategies, i.e. T for Technology, E for degree of vertical integration of production, O for production organization, F for production structure and I for high degree of product innovation. Categories are arranged in increasing order of probabilities of positive re-weighting factors. Categories which have significantly different probabilites than category 1 are printed in bold letters.

Strategy: T Variables in the Equation

Variable	B	S.E.	Wald	df	Sig	R	Exp(B)
D[7]			31,0530	3	,0000	,1160	
CATEGORY 2	,6635	,1381	23,0923	1	,0000	,1065	1,9416
CATEGORY 3	,7910	,1635	23,3983	1	,0000	,1072	2,2056
CATEGORY 4	,9009	,3344	7,2575	1	,0071	,0532	2,4618
Constant	-,5572	,0908	37,6175	1	,0000		

Strategy: TE Variables in the Equation

Variable	B	S.E.	Wald	df	Sig	R	Exp(B)
D			23,3567	3	,0000	,0939	
CATEGORY 2	,5259	,1283	16,7947	1	,0000	,0867	1,6920
CATEGORY 3	,6590	,1550	18,0723	1	,0000	,0904	1,9328
CATEGORY 4	,6372	,3288	3,7553	1	,0526	,0299	1,8912
Constant	-,2305	,0893	6,6611	1	,0099		

Strategy: TO Variables in the Equation

Variable	B	S.E.	Wald	df	Sig	R	Exp(B)
D			34,2250	3	,0000	,1222	
CATEGORY 2	,6999	,1365	26,3031	1	,0000	,1134	2,0135
CATEGORY 3	,8236	,1620	25,8521	1	,0000	,1124	2,2786
CATEGORY 4	,8504	,3339	6,4852	1	,0109	,0487	2,3405
Constant	-,5020	,0906	30,6854	1	,0000		

7 The row labeled D displays the results of the 'overall' test of no difference between the four categories, i.e. the corresponding Wald statistic and the significance level to reject the hypothesis.

Strategy: TF Variables in the Equation

Variable	B	S.E.	Wald	df	Sig	R	Exp(B)
D			20,3794	3	,0001	,0946	
CATEGORY 2	,6780	,1548	19,1876	1	,0000	,1034	1,9699
CATEGORY 3	,6191	,1836	11,3738	1	,0007	,0763	1,8573
CATEGORY 4	,3268	,3988	,6714	1	,4126	,0000	1,3865
Constant	-1,1893	,1070	123,4616	1	,0000		

Strategy: TI Variables in the Equation

Variable	B	S.E.	Wald	df	Sig	R	Exp(B)
D			24,3231	3	,0000	,0971	
CATEGORY 2	,5420	,1303	17,2988	1	,0000	,0887	1,7195
CATEGORY 3	,6957	,1566	19,7384	1	,0000	,0955	2,0050
CATEGORY 4	,5587	,3317	2,8382	1	,0920	,0208	1,7485
Constant	-,3548	,0900	15,5413	1	,0001		

Strategy: TEO Variables in the Equation

Variable	B	S.E.	Wald	df	Sig	R	Exp(B)
D			30,4134	3	,0000	,1124	
CATEGORY 2	,6484	,1323	24,0271	1	,0000	,1068	1,9125
CATEGORY 3	,7402	,1584	21,8315	1	,0000	,1013	2,0963
CATEGORY 4	,7697	,3310	5,4072	1	,0201	,0420	2,1591
Constant	-,3767	,0899	17,5746	1	,0000		

Strategy: TEF Variables in the Equation

Variable	B	S.E.	Wald	df	Sig	R	Exp (B)
D			21,3552	3	,0001	,1018	
CATEGORY 2	,7510	,1668	20,2640	1	,0000	,1110	2,1190
CATEGORY 3	,6587	,1971	11,1727	1	,0008	,0787	1,9323
CATEGORY 4	,2692	,4384	,3772	1	,5391	,0000	1,3090
Constant	-1,4298	,1170	149,3771	1	,0000		

Strategy: TEI Variables in the Equation

Variable	B	S.E.	Wald	df	Sig	R	Exp (B)
D			25,6152	3	,0000	,1078	
CATEGORY 2	,7308	,1507	23,5081	1	,0000	,1129	2,0766
CATEGORY 3	,7019	,1781	15,5363	1	,0001	,0895	2,0176
CATEGORY 4	,7468	,3584	4,3408	1	,0372	,0372	2,1102
Constant	-,9692	,0972	99,3865	1	,0000		

Strategy: TOF Variables in the Equation

Variable	B	S.E.	Wald	df	Sig	R	Exp (B)
D			20,6345	3	,0001	,0953	
CATEGORY 2	,6780	,1548	19,1876	1	,0000	,1033	1,9699
CATEGORY 3	,6361	,1832	12,0505	1	,0005	,0790	1,8890
CATEGORY 4	,3268	,3988	,6714	1	,4126	,0000	1,3865
Constant	-1,1851	,1070	122,6705	1	,0000		

Strategy: TOI Variables in the Equation

Variable	B	S.E.	Wald	df	Sig	R	Exp(B)
D			35,1107	3	,0000	,1276	
CATEGORY 2	,8016	,1454	30,3991	1	,0000	,1261	2,2291
CATEGORY 3	,8232	,1712	23,1091	1	,0000	,1087	2,2778
CATEGORY 4	,9458	,3423	7,6340	1	,0057	,0561	2,5750
Constant	-,7495	,0930	64,9967	1	,0000		

Strategy: TFI Variables in the Equation

Variable	B	S.E.	Wald	df	Sig	R	Exp(B)
D			24,5809	3	,0000	,1104	
CATEGORY 2	,7239	,1640	19,4911	1	,0000	,1071	2,0625
CATEGORY 3	,7980	,1904	17,5662	1	,0000	,1010	2,2210
CATEGORY 4	,0281	,4629	,0037	1	,9516	,0000	1,0285
Constant	-1,4037	,1223	131,8068	1	,0000		

Strategy: EFI Variables in the Equation

Variable	B	S.E.	Wald	df	Sig	R	Exp(B)
D			18,5150	3	,0003	,0856	
CATEGORY 2	,5516	,1457	14,3360	1	,0002	,0850	1,7360
CATEGORY 3	,6301	,1722	13,3894	1	,0003	,0816	1,8777
CATEGORY 4	,0801	,3958	,0410	1	,8395	,0000	1,0834
Constant	-1,0332	,1057	95,4649	1	,0000		

Strategy: TEOF Variables in the Equation

Variable	B	S.E.	Wald	df	Sig	R	Exp(B)
D			20,6345	3	,0001	,0953	
CATEGORY 2	,6780	,1548	19,1876	1	,0000	,1033	1,9699
CATEGORY 3	,6361	,1832	12,0505	1	,0005	,0790	1,8890
CATEGORY 4	,3268	,3988	,6714	1	,4126	,0000	1,3865
Constant	-1,1851	,1070	122,6705	1	,0000		

Strategy: EOFI Variables in the Equation

Variable	B	S.E.	Wald	df	Sig	R	Exp(B)
D			20,8470	3	,0001	,0957	
CATEGORY 2	,6158	,1539	16,0061	1	,0001	,0930	1,8511
CATEGORY 3	,7182	,1800	15,9145	1	,0001	,0927	2,0508
CATEGORY 4	,1453	,4143	,1229	1	,7259	,0000	1,1563
Constant	-1,1925	,1104	116,6441	1	,0000		

Strategy: TEFI Variables in the Equation

Variable	B	S.E.	Wald	df	Sig	R	Exp(B)
D			21,7558	3	,0001	,0984	
CATEGORY 2	,6360	,1530	17,2820	1	,0000	,0969	1,8888
CATEGORY 3	,6858	,1798	14,5428	1	,0001	,0878	1,9854
CATEGORY 4	-,0343	,4341	,0062	1	,9371	,0000	,9663
Constant	-1,2242	,1151	113,1918	1	,0000		

Strategy: TEOI Variables in the Equation

Variable	B	S.E.	Wald	df	Sig	R	Exp(B)
D			33,7657	3	,0000	,1226	
CATEGORY 2	,7731	,1399	30,5502	1	,0000	,1243	2,1664
CATEGORY 3	,7566	,1662	20,7345	1	,0000	,1007	2,1310
CATEGORY 4	,7781	,3404	5,2264	1	,0222	,0418	2,1773
Constant	-,6474	,0923	49,1961	1	,0000		

Strategy: TEOFI Variables in the Equation

Variable	B	S.E.	Wald	df	Sig	R	Exp(B)
D			21,8180	3	,0001	,0984	
CATEGORY 2	,6199	,1524	16,5373	1	,0000	,0943	1,8587
CATEGORY 3	,7019	,1788	15,4094	1	,0001	,0906	2,0176
CATEGORY 4	-,0504	,4339	,0135	1	,9076	,0000	,9509
Constant	-1,2121	,1150	111,1695	1	,0000		

References:

Freriks, R. (1994): Theoretische Modelle der Betriebsgröße und deren Bedeutung für arbeitsorganisatorische Lösungen im deutschen Maschinenbau, Dissertation. Bochum.

Hauptmanns, P. (1993): Zur Diffusion rechnergestützter Technologie im deutschen Maschinenbau, in: S. von Bandemer, V. Eichener and J. Hilbert (Hrsg.) (1993): Anthropozentrische Produktionssysteme, S. 105-124, Leske+Budrich, Opladen.

Hauptmanns, P., Saurwein, R.G. and L. Dye (1992): Die Diffusion rechnergestützter Technik im deutschen Maschinenbau, in: Schmid, J. and Widmaier, U. (Hrsg.) (1992): Flexible Arbeitssysteme im Maschinenbau, S. 57-74, Leske+Budrich, Opladen.

Heinen, E. (1985): Industriebetriebslehre, Wiesbaden.

Hirsch-Kreinsen, H. (1992): Entwicklungsmuster industrieller Arbeit, in: F. Lehner und J. Schmid (Hrsg.): Technik, Arbeit, Betrieb, Gesellschaft, S. 71-84, Leske+Budrich, Opladen.

Hirsch-Kreinsen, H., Schultz-Wild, R., Köhler, Ch. and M.V. Behr (1990): Einstieg in die rechnerintegrierte Produktion. Alternative Entwicklungspfade in der industriellen Produktion, Frankfurt/M.

Ifo Institut für Wirtschaftsforschung: Konjunkturtest, München.

Lehner, F. und J. Schmid (Hrsg.) (1992): Technik-Arbeit-Betrieb-Gesellschaft. Beiträge aus Industriesoziologie und Organisationsforschung, Neue Informationstechnologien und flexible Arbeitssysteme, Leske+Budrich, Opladen.

Manske, F. (1991): Kontrolle, Rationalisierung und Arbeit, Kontinuität und Wandel: Die Ersetzbarkeit des Taylorismus durch moderne Kontrolltechniken, Berlin.

Merz, J. (1991): Microsimulation - A survey of principles, developments and applications, International Journal of Forecasting, 7, 77-104.

Merz, J. (1993): ADJUST - A Program Package for the Adjustment of Microdata by the Minimum Information Loss Principle, Program-Manual, FFB-Documentaion No. 1e, Forschungsinstitut Freie Berufe (FFB), Department of Economics and Social Sciences, University of Lüneburg, Lüneburg.

Merz, J. (1994a): Microdata Adjustment by the Minimum Information Loss Principle, FFB-Discussion Paper No. 9, Forschungsinstitut Freie Berufe (FFB), Department of Economics and Social Sciences, University of Lüneburg, Lüneburg.

Merz, J. (1994b): Statisches Sonderforschungsbereich 3 - Mikrosimulationsmodell: Mainframe und PC-Version, in: R. Hauser, N. Ott and G. Wagner (eds.): Deutsche Forschungsgemeinschaft: Mikroanalytische Grundlagen der Gesellschaftspolitik - Erhebungsverfahren, Analysemethoden und Mikrosimulation, Akademie Verlag: Berlin.

Merz J. (1994c): Microsimulation - A Survey of Methods and Applications for Analyzing Economic and Social Policy, in: I. Borg and P. Ph. Mohler (eds.): Trends and perspectives in empirical social research, ZUMA, Mannheim; also published as FFB-Discussion Paper No. 9, Forschungsinstitut Freie Berufe (FFB), Department of Economics and Social Sciences, University of Lüneburg, Lüneburg.

Merz, J. and P. Buxmann (1990): MICSIM: A PC-Microsimulationmodel for Research and Teaching Realized with C and the Relational Data Base System ORACLE, Sfb 3-Working Paper Nr. 316, Sonderforschungsbereich 3, Mikroanalytische Grundlagen der Gesellschaftspolitik, Frankfurt/M., Mannheim.

Niggemann, H. (1993): Die Anpassung von Mikrodaten an Restriktionen mit dem statischen Mikrosimulationsmodell MICSIM: Ein Konzept zur Analyse von Ausfallprozessen im NIFA-Panel, Arbeitspapier des SFB 187, Ruhr-Universität Bochum, Bochum.

Ostendorf, B. and B. Seitz (1992): Alte und neue Formen der Arbeitsorganisation und Qualifikation - Ein Überblick, in: J. Schmid and U. Widmaier (Hrsg.): Flexible Arbeitssysteme im Maschinenbau, S. 75-90, Leske+Budrich, Opladen.

Schmid, J. and U. Widmaier (Hrsg.) (1992): Flexible Arbeitssysteme im Maschinenbau - Ergebnisse aus dem Betriebspanel des Sonderforschungsbereichs 187, Neue Informationstechnologien und Flexible Arbeitssysteme, Leske+Budrich, Opladen.

Schmid, J. and Widmaier, U. (1993): Strukturen und Typen der Fertigung im Umbruch. Der theoretische Rahmen des NIFA-Panels in einer institutionalistischen Perspektive. Arbeitspapier des SFB 187, Ruhr-Universität Bochum, Bochum.

Widmaier, B. and S. Bandemer (1991): Können Konkurrenten Partner werden? Eine Einführung in die Chancen und Schwierigkeiten partnerschaftlicher Formen zwischenbetrieblicher Kooperation, in: J. Hilbert et al. (Hrsg.) 1991: Neue Kooperationsformen in der Wirtschaft, S. 9-22, Leske+Budrich, Opladen.

Widmaier, U. and L. Dye (1992): Beschäftigungswirkungen des Einsatzes von Informations- und Kommunikationstechnologien in der Fertigung, in: J. Schmid and U. Widmaier (Hrsg.): Flexible Arbeitssysteme im Maschinenbau, S.177-194, Leske+Budrich, Opladen.

Womack, J., D.T. Jones and D. Roos (1991): Die 2. Revolution in der Automobilindustrie, Campus-Verlag, Frankfurt.

Veröffentlichungen des Forschungsinstituts Freie Berufe (FFB) der Universität Lüneburg:

1 FFB-Jahresberichte

FFB-Jahresbericht 1990, FFB-Jahresbericht 1991, FFB-Jahresbericht 1992.

2 FFB-Buchreihe, ISSN 0937-3373

Sahner, H., Herrmann, H., Rönnau, A. und H.-M. Trautwein, 1989, Zur Lage der Freien Berufe 1989, Teil I, 426 Seiten, ISBN 3-927816-01-9, Lüneburg.

Sahner, H., Herrmann, H., Rönnau, A. und H.-M. Trautwein, 1989, Zur Lage der Freien Berufe 1989, Teil II, 955 Seiten, Teil I und Teil II zusammen (Restauflage), ISBN 3-927816-02-7, Lüneburg. *Preis: DM 65,-*

Sahner, H., Herrmann, H., Rönnau, A. und H.-M. Trautwein, 1989, Zur Lage der Freien Berufe 1989, Teil III, 167 Seiten, (vergriffen), ISBN 3-927816-04-3, Lüneburg. *Preis: DM 45,-*

Sahner, H. und F. Thiemann, 1990, Zukunft der Naturheilmittel in Europa in Gefahr? 81 Seiten, ISBN 3-927816-06-X, Lüneburg. *Preis: DM 10,-*

Trautwein, H.-M., Donner, H., Semler, V. und J. Richter, 1991, Zur tariflichen Berücksichtigung der Ausbildung, der Bereitstellung von Spitzenlastreserven und der Absicherung von Beschäftigungsrisiken bei Seelotsen mit dem Anhang Steuerliche Aspekte des tariflichen Normaleinkommens der Seelotsen, 183 Seiten, ISBN 3-927816-07-8, Lüneburg. *Preis: DM 35,-*

Sahner, H., 1991, Freie Berufe in der DDR und in den neuen Bundesländern, 177 Seiten, ISBN 3-927816-09-4, Lüneburg. *Preis: DM 48,-*

Burmester, B., 1991, Ausbildungsvergleich von Sprachtherapeuten, 54 Seiten, ISBN 3-927816-10-8, Lüneburg. *Preis: DM 15,-*

Sahner, H. und A. Rönnau, 1991, Freie Heilberufe und Gesundheitsberufe in Deutschland, 653 Seiten, ISBN 3-927816-11-6, Lüneburg. *Preis: DM 110,-*

Forschungsinstitut Freie Berufe (FFB) (Hg.), erstellt vom Zentrum zur Dokumentation für Naturheilverfahren e.V. (ZDN), 1992, 1993, Dokumentation der besonderen Therapierichtungen und natürlichen Heilweisen in Europa, Bd. I, 1. Halbband, 842 Seiten, Bd. I, 2. Halbband, 399 Seiten, Bd. II, 590 Seiten, Bd. III, 272 Seiten, Bd. IV, 419 Seiten, Bd. V., 1. Halbband, 706 Seiten, Bd. V., 2. Halbband, 620 Seiten, ISBN 3-88699-025-7, Lüneburg (nur zu beziehen über das Zentrum zur Dokumentation für Naturheilverfahren e.V. (ZDN), Hufelandstraße 56, 45147 Essen, Tel.: 0201-74551) *Preis: DM 750,-*

3 FFB-Reprintreihe

Merz, J., 1991, Microsimulation - A Survey of Principles, Developments and Applications, International Journal of Forecasting 7, S. 77-104, ISBN 0169-2070-91, North-Holland, Amsterdam, FFB-Reprint No. 1, Department of Economics and Social Science, University of Lüneburg, Lüneburg.

Herrmann, H., 1993, Regulation of Attorneys in Germany: Legal Framework and Actual Tendencies of Deregulation, Faure, M., Finsinger, J., Siegers, J. und R. Van den Bergh (ed.), Regulation of Profession, S. 225-245, ISBN 90-6215-334-8, MAKLU, Antwerpen, FFB-Reprint No. 2, Department of Economics and Social Science, University of Lüneburg, Lüneburg.

Trautwein, H.-M. und A. Rönnau, 1993, Self-Regulation of the Medical Profession in Germany: A Survey, Faure, M., Finsinger, J., Siegers, J. und R. Van den Bergh (ed.), Regulation of Profession, S. 249-305, ISBN 90-6215-334-8, MAKLU, Antwerpen, FFB-Reprint No. 3, Department of Economics and Social Science, University of Lüneburg, Lüneburg.

Merz, J. and K. G. Wolff, 1993, The Shadow Economy: Illicit Work and Household Production: A Microanalysis of West Germany, Reprint FFB-No. 4, Department of Economics and Social Science, University of Lüneburg, Lüneburg.

Merz, J., 1993, Wandel in den Freien Berufen - Zum Forschungsbeitrag des Forschungsinsituts Freie Berufe (FFB) der Universität Lüneburg, Bundesverband der Freien Berufe (Hg.), Jahrbuch 1993 - Der Freie Beruf, S. 164-173, Bonn, FFB-Reprint Nr. 5, Fachbereich Wirtschafts- und Sozialwissenschaften, Universität Lüneburg, Lüneburg.

Besucheranschrift: Scharnhorststr. 1
Gebäude 4
21335 Lüneburg
Tel.: 04131 / 78-2051
Fax: 04131 / 78-2059

Vorstand: Univ.-Prof. Dr. Joachim Merz (Direktor)
Univ.-Prof. Dr. Harald Herrmann
Univ.-Prof. Dr. Heinz Sahner

4 FFB-Diskussionspapiere, ISSN 0942-2595

Forschungsinstitut Freie Berufe, 1992, Festliche Einweihung des Forschungsinstituts Freie Berufe am 16. Dezember 1991 im Rathaus zu Lüneburg, FFB-Diskussionspapier Nr. 1, Fachbereich Wirtschafts- und Sozialwissenschaften, Universität Lüneburg, Lüneburg.

Merz, J., 1992, Time Use Dynamics in Paid Work and Household Activities of Married Women - A Panel Analysis with Household Information and Regional Labour Demand, FFB-Discussion Paper No. 2, Department of Economics and Social Science, University of Lüneburg, Lüneburg.

Merz, J. and J. Faik, 1992, Equivalence Scales Based on Revealed Preference Consumption Expenditure Microdata - The Case of West Germany, FFB-Discussionpaper No. 3, Department of Economics and Social Science, University of Lüneburg, Lüneburg.

Merz, J., 1993, Statistik und Freie Berufe im Rahmen einer empirischen Wirtschafts- und Sozialforschung, Antrittsvorlesung im Fachbereich Wirtschafts- und Sozialwissenschaften der Universität Lüneburg, FFB-Diskussionspapier Nr. 4, Fachbereich Wirtschafts- und Sozialwissenschaften, Universität Lüneburg, Lüneburg, (erschienen in: Bundesverband der Freien Berufe (Hg.), Jahrbuch 1993 - Der Freie Beruf, S. 31-78, Bonn).

Merz, J., 1993, Microsimulation as an Instrument to Evaluate Economic and Social Programmes, FFB-Discussionpaper No. 5, Department of Economics and Social Science, University of Lüneburg, Lüneburg.

Merz, J., 1993, Market and Non-Market Labor Supply and Recent German Tax Reform Impacts - Behavioral Response in a Combined Dynamic and Static Microsimulation Model, FFB-Discussionpaper No. 6, Department of Economics and Social Science, University of Lüneburg, Lüneburg.

Krickhahn, Th., 1993, Lobbyismus und Mittelstand: Zur Identifikation der Interessenverbände des Mittelstands in der Bundesrepublik Deutschland, FFB-Diskussionspapier Nr. 7, Fachbereich Wirtschafts- und Sozialwissenschaften, Universität Lüneburg, Lüneburg.

Merz, J., Garner, Th., Smeeding, T. M., Faik, J. and D. Johnson, 1994, Two Scales, One Methodology - Expenditure Based Equivalence Scales for the United States and Germany, FFB-Discussionpaper No. 8, Department of Economics and Social Science, University of Lüneburg, Lüneburg.

Merz, J., 1994, Microsimulation - A Survey of Methods and Applications for Analyzing Economic and Social Policy, FFB-Discussionpaper No. 9, Department of Economics and Social Science, University of Lüneburg, Lüneburg.

Merz, J., 1994, Microdata - Adjustment by the Minimum Information Loss Principle, FFB-Discussionpaper No. 10, Department of Economics and Social Science, University of Lüneburg, Lüneburg.

Merz, J., Widmaier, U. and H. Niggemann, 1994, What makes the Difference between Unsuccessful and Successful Firms in the German Mechanical Engineering Industry? A Microsimulation Approach Using Data from the NIFA-Panel, FFB-Discussionpaper No. 11, Department of Economics and Social Science, University of Lüneburg, Lüneburg.

5 FFB-Dokumentationen

Merz, J., 1992, ADJUST - Ein Programmpaket zur Hochrechnung von Mikrodaten nach dem Prinzip des minimalen Informationsverlustes, Programm-Handbuch, Dokumentation Nr. 1, Fachbereich Wirtschafts- und Sozialwissenschaften, Universität Lüneburg, Lüneburg. Available also in English as:

Merz, J., 1993, ADJUST - A Program Package for the Adjustment of Microdata by the Minimum Information Loss Principle, Program-Manual, Documentation No. 1e, Department of Economics and Social Science, University of Lüneburg, Lüneburg.

6 Sonstige Arbeitsberichte, ISSN 0175-7275

Sahner, H., 1988, Die Interessenverbände in der Bundesrepublik Deutschland - Ein Klassifikationssystem zu ihrer Erfassung, Arbeitsbericht Nr. 41, Universität Lüneburg, ISSN 0175-7275, Lüneburg,

Sahner, H., 1989, Freie Berufe im Wandel, Arbeitsbericht Nr. 59, Universität Lüneburg, ISSN 0175-7275, Lüneburg,

Rönnau, A., 1989, Freie Berufe in Niedersachsen - Numerische und wirtschaftliche Entwicklung; Bedeutung als Arbeitgeber, Arbeitsbericht Nr. 60, Universität Lüneburg, ISSN 0175-7275, Lüneburg,

Matusall, V., Kremers, H. und G. Behling, 1992, Umweltdatenbanken - vom Konzept zum Schema, Arbeitsbericht Nr. 112, Universität Lüneburg, ISSN 0176-7275, Lüneburg.

7 Sonstige Bücher

Spahn, P.B., Galler, H.P., Kaiser, H., Kassella, T. und J. Merz, 1992, Mikrosimulation in der Steuerpolitik, 279 Seiten, ISBN 3-7908-0611-0, Berlin. Preis: DM 85,-

Auf Anfrage werden die FFB-Jahresberichte, FFB-Reprints, FFB-Diskussionspapiere, FFB-Dokumentationen und sonstige Arbeitsberichte kostenlos zugesandt. Die aufgeführten Bücher können im Forschungsinstitut bestellt werden.

Anschrift: *Forschungsinstitut Freie Berufe, Universität Lüneburg, Campus, Scharnhorststr. 1, Gebäude 4, 21335 Lüneburg, Telefon: 04131/78-2051, Fax: 04131/78-2059*