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Working Paper

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FE Workingpaper / Universität Kiel, Department of Food Economics and Consumption Studies, No. 0206

Provided in cooperation with:
Christian-Albrechts-Universität Kiel (CAU)

Suggested citation: Wittkopp, Antje (2002) : Much Ado about Nothing?- The Influence of Functional Food on Profitability of German Food Industry., FE Workingpaper / Universität Kiel, Department of Food Economics and Consumption Studies, No. 0206, http://hdl.handle.net/10419/23592

FE-Working Papers

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Working Paper EWP 0206
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November 2002

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Much Ado about Nothing?-
The Influence of Functional Food on Profitability of German Food Industry.

Antje Wittkopp

Abstract: Product innovation is a competitive strategy in food industry. Successful product development management is a key determinant of a firm's performance. In recent years functional foods, which are innovative food products that provide health benefits beyond basic nutrition, have become increasingly important in Germany. Using the structure-conduct-performance approach it can be argued that product innovation raises barriers to entry and thus improve profitability. This study examines the effect of functional food innovative activity (compared to overall innovative activity) on the profitability of 23 German food industry sectors from 1995 to 1999. Panel data analysis also includes concentration, firm size, market size and growth, advertising expenditure and capital intensity. While a positive relationship between product introduction and profitability was hypothesized, it is not supported by data.

Keywords: product innovation, functional food, market structure, profitability, structure-conduct-performance approach, food industry, panel data analysis.

I gratefully acknowledge financial support from the German Research Foundation (DFG), Project „Market Structure and Competitive Behaviour in German Food Industry" (DFG 527 76 / BA 505 / WE 2576/1-1).

1 Introduction

Product innovation is a competitive strategy in food industry, successful product development management a key determinant of a firm's performance. From 1996 to 1999 increasingly higher rates of German food industry turnover were generated by product innovations[1]. On average, products which have been produced three years before achieve 15,47% of company's turnover in German food industry in year 2001[2].

In response to consumer interest in healthier foods, several food and beverage industry firms have introduced a new product line to compete for consumer dollars. These products are referred to as functional foods, which are food products that provide health benefits beyond basic nutrition. Appearing initially as dairy products, functional food products have expanded to other industry sectors (i.e. soft drinks, confectionery) in recent years. The success of functional food products in the market place has attracted interest among food processors because of their positive, partly two-digit growth rates in an overall stagnant German food market. The question for food industry analysts is if particularly functional foods increase significantly firm performance? On this account the present study considers the effect of functional food innovative activity (compared to overall innovative activity) on firm performance. Using the structure-conduct-performance approach it can be argued that product innovation raises barriers to entry and thus improves profitability.

This paper is arranged in four sections. Section 2 briefly describes structure and development of functional food market in Germany. Section 3 describes underlying theory regarding the effect of innovation on profitability and reports empirical results of panel data analysis of 23 German food industry sectors from 1995 to 1999. Section 4 offers conclusions.

2 Functional Food Market in Germany

Functional foods (synonymous: *nutraceuticals, designer foods, pharmafoods* or *health foods)* are products that provide an additional health benefit beyond basic nutrition. As no specific and cross-national consistent definition exists, this study defines functional food as processed food to which a health beneficial component has been added, or a food from which a rather critical component (i.e. allergens) has been removed by technological or biotechnological means. Further, health beneficial attribute of the food product is communicated to the customers.

[1] ZEW (2001)

[2] Preliminary result of a survey conducted in spring 2002 among 519 German food and beverage companies.

In recent years (1995-2001) the market of functional food products in Germany has developed substantially. According to Hilliam and Young (2000) German functional food market has a value of ca. 380 million EUR in year 1999 (in comparison: global market 6.25 billion EUR), therewith reached substantial growth, having in mind that it is a rather new market. [3]

On average 9.43% of all new product introductions between 1995 and 2001 were functional foods, in 1999 and 2000 even >16% (see table 1). Majority of functional products (80%) are characterised by added vitamins, minerals or probiotic microorganisms.[4]

Table 1: Overall new product introductions and functional food product introductions in Germany

	year							
	1995	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**total**
Total product introductions	655	690	475	496	451	312	348	3427
Functional Food								
- number	39	58	24	46	75	50	31	323
- % of total	5.95	8.41	5.05	9.27	16.63	16.03	8.91	9.43

Source: analysis based on new product announcements by German trade journal LEBENSMITTELPRAXIS.

After opening the functional food market in year 1995 by Nestlé introducing the probiotic yoghurt LC1 a substantial increase in new functional food product introduction can be recognised at first. Most of these product innovations have been established in the dairy sector. Following, innovative activity loses height but peaks later in year 1999 with 75 product introductions counted (16.3% of all new products). Predominantly products launched in these years were soft drinks (in particular drinks with added vitamins A, C and E), aside also functional sweets which have been introduced mainly since 1999. In total, 111 functional dairy products (18.56% of all innovative dairy products) and 53 functional products in the soft drinks sector (23% of all innovative soft drinks) have been introduced between 1995 and 2001[5]. As >50% of all functional product introductions between 1995 and 2001 accounted for probiotic dairy products and functional soft drinks (predominantly ACE-drinks) these groups dominate the functional food market.

As Hilliam und Young (2000) report probiotic dairy products achieved a value of 283.8 million EUR in 1999, whereas ACE-drinks made 96.6 million EUR. Both showed dynamic market growth with two-digit rates (see table 2 and 3):

[3] Hilliam and Young (2000)

[4] Evaluation of new product announcements in German trade journal LEBENSMITTELPRAXIS between 1995 and 2001.

[5] Evaluation of new product announcements in LEBENSMITTELPRAXIS between 1995 and 2001.

Table 2: Probiotic and total yoghurt market by value between 1995 and 1999

	Probiotic yoghurt (million EUR)	% Change	Total yoghurt (million EUR)	% Change
1995	15.34	-	1115.64	-2.3
1996	77.21	+400	1157.56	+3.8
1997	141.12	+83	1202.05	+3.8
1998	191.73	+36	1211.76	+0.8
1999	283.77	+48	1246.53	+2.9

Source: modified according to Hilliam and Young (2000)

Having reached a turnover of 183.77 million EUR in year 1999 the probiotic sector accounts for nearly 23% of the total yoghurt market, which was moreover characterised by low turnover growth in the period 1995-1999.

Table 3: Functional vitaminised drinks market by value between 1995 and 1999

	Value (million EUR)	% Change
1996	16.36	-
1997	38.35	+134
1998	67.49	+76
1999	96.63	+43

Source: modified according to Hilliam und Young (2000)

Vitaminised functional drinks also showed clear turnover growth. German high per-capita-consumption level of soft drinks (250 l in year 2000)[6], well established multivitamin drinks sector as well as the trend towards outdoor breakfast offered an ideal opportunity to introduce fortified products into the market. With a 96.6 million EUR turnover vitaminised drinks have a distinct share in the total turnover of functional food products[7]. Compared to overall turnover of the German soft drinks market in year 1999 (8691.96 million EUR[8]) the fortified drinks sector achieved just 1.11%, thus is rather small.

To summarize, in response to consumer interest in healthier foods, several food and beverage industry firms have introduced innovative functional food products. Their success in the market place has attracted interest among food processors because of their positive, partly

[6] WAFG (2001)
[7] Hilliam and Young (2000)
[8] WAFG (2001)

two-digit growth rates in an overall stagnant German food market. Below it will be analysed if particularly functional food product introductions increase significantly firm performance.

3 Innovation and Profitability

Product innovation intend to increase companies' profitability and competitiveness by differentiating products from competitor's products and extending market shares. The following section shows the theoretical background for the profit increasing effect of innovation. In addition the effect of functional food innovative activity (compared to overall innovative activity) on the profitability of 23 German food industry sectors from 1995 to 1999 will be examined. Besides innovative activity panel data analysis includes classical market structure and conduct variables.

3.1 Hypothetical Background

Based on structure-conduct-performance approach and empirical estimation results the following three hypotheses on a positive relationship between innovation activity and profitability can be developed:

Hypothesis 1:

Innovation enables a firm to influence market structure. If a firm launches a product at first, it obtains a first mover advantage, achieves monopoly price and thus high revenue. By influencing market structure profitability increases.

Hypothesis 2:

Product innovations also act as market entrance barrier and thus improve profitability. This effect occurs predominantly in the following four manners:

a) Offers a company many (incremental) product innovations within a certain product segment on a market there will be hardly any unsatisfied demand a potential competitor could profitably use for market entrance[9]. Consequently, high innovative activity prevents market entry. This argument is particularly powerful in high concentrated markets as the established supplier would suffer high economic losses from a new competitor penetrating the market.

b) Further it is plausible that (radical) product innovation acts as a barrier of novelty. The potential competitor suffers from deficits in know-how regarding innovative product's

[9] Schmalensee (1978)

production technology or new market preferences. Barrier to new competition increases with the product's novelty level.

c) A market entrant has to incur high advertising expenses in order to convince buyers of the established firm's product to buy its own product. As presence of the existent enterprise increases advertising expenses of the second firm, product innovation can be seen as a means of deterring markets, associated with higher profitability.

d) Further on, the established firm might have better entry to distribution channels, possess a patent and use other advantages (i.e. experience, access to input markets) which could act as barrier to entry[10].

As the presence of the existent company increases the expenses of the potential competitor associated with market entrance product innovations react as barriers to new competition. As market entry is not imminent the innovative first firm has a durable first-mover-advantage and thus is able to realise upper prices and (monopoly) profit[11].

Hypothesis 3:

Likewise intra-enterprise changes which have taken place during the process of innovation can provoke a profit increasing effect. They might enable a firm to build core competences, take advantage of external effects and react faster and more flexible on changes in market conditions. Thereby, a company strenghtens market position, generates high profits and furthermore achieves economic stability in an economic decline[12].

A positive influence of innovation on firm performance is shown by empirical work of Roskamp (1991), Geroski (1994), Nijssen et al. (1995), Phillips (1997), Kitson and Michie (1998), Klomp and van Leeuwen (1999), Bagchi-Sen (2001), Gayle (2001) as well as Feeny and Rogers (2001).

On the contrary Heunks (1998) gives empirical evidence for a profit reducing effect of innovation. It can be argued that because of expenses associated with innovation (e.g. R&D, advertisement) profits decrease in short term. In the long run, however, a positive impact of innovation on firm performance can be assumed

[10] Hauschildt (1993)
[11] Schmalensee (1978)
[12] Geroski (1994)

3.2 Empirical Analysis on Functional Food

In the following it will be examined a) if innovation activity in German food industry determines its profitability, b) which direction the influence takes and c) which other factors effect economic performance. Special attention is turned to functional food products as these product innovations showed dynamic market development in recent years. However nowadays numerous companies take their functional food products out of product line, as they did not meet sales expectations.

A large number of studies analyse the impact of innovation activity on firm performance. Number of studies relating to German food industry is comparatively small, current studies dealing with the outmost new group of functional food products in addition are not existent.

The present industrial economic study tries to reveal the strength and direction of the effect of innovation activity on profitability of German food industry in the period 1995-1999, as well as to fill the research gap regarding functional food activity and firm performance.

According to this intention an analysis regarding the impact of overall innovation activity on profitability (model 1) is carried out. The number of new product introductions is then restrained to functional food product innovations. Herby the effect of functional food innovation activity on firm performance (model 2) will be estimated.

3.2.1 Methodology and Data

Analysis is based on industrial economic proposition that innovation acts as barrier to entry. Thus a positive relationship between overall innovative activity (model 1) resp. functional food activity (model 2) and performance is expected. The following variables are included in regressions:

- *Profitability (PCM)*

As dependant variable and indicator for profitability this study uses the price-cost-margin (PCM) which can be written as $PCM = \frac{price - marginal\ costs}{price}$. Assuming marginal costs equal average costs PCM corresponds to price-average cost-margin, so $PCM = \frac{price - average\ costs}{price}$. Extending the formula with produced quantity leads to $PCM = \frac{output - costs}{output} = \frac{profit}{output}$. Thus PCM appears as direct measure of profitability. Computing PCM includes total payroll as well as purchased material and services as costs components. Cost of capital is unaccounted for computation, consequently PCM is a gross margin.

- *Product innovation activity (INNO resp. FUFO)*

As exogenous variable and measure of overall innovative activity the present study uses the number of new products launched (*INNO)*. Number of product innovation is based on announcements in the German trade journal LEBENSMITTELPRAXIS (category "product innovation") between 1995 and 1999. Product innovation is defined as new or significantly improved product which have been taken up a company's production program. Definition comprises both improved products, product line extension, new product lines and radical new products which are new to the market.

As alternative exogenous variable in model 2 and expression for innovative functional food activity (below FF-activity) analysis uses the number of innovative functional food products launched (*FUFO*). This number is also based on product announcements in LEBENSMITTELPRAXIS and represents a subset of *INNO*. Classification of innovative products to functional food products is based on definition presented in Chapter 2.

At this point I have to allude to slight inaccuracy of innovation measures because of data restrictions. Not all product innovations that have taken place are listed by LEBENSMITTELPRAXIS. Listing new product introduction is incumbent upon the firms themselves so that a bias is possible as only those companies publish innovation which are active in public relation.

- Concentration *(CR10)*

According to industrial economic consideration profitability declines with increasing number of firms resp. decreasing concentration[13]. To take into account the influence on firm performance this study includes concentration ratio as explanatory variable. Concentration is represented by the percentage control of industry's turnover the 10 largest firms in the industry have (*CR10*)[14].

- Foreign trade

Foreign trade carried out by an industry sector exerts multifacetted influence on profitability. Import and export activities affect domestic market structure so that supplier concentration of home market is no longer a reliable indicator of profitability. For this reason present study integrates the share of foreign trade in regressions. This is done by multiplicating

[13] Expectation is underlined by empirical work of Christensen and Montgomery (1981), Geroski (1994) as well as Wittkopp and Körner (2001).

[14] Herfindahl index and concentration ratios (CR6 and CR25) were tested as alternative concentration measures, however are not appropriate (missing statistical significance).

concentration ratio *CR10* with *(1-EXQ),* whereas *EXQ* represents percentage export share of turnover abroad to total turnover. Resultant regressor, *CR10*(1-EXQ),* is termed *CR10a*.

- *Capital intensity (COR)*

High degree of exerted capital can be seen as market barrier to entry. Thus capital intensity is positive associated with profit margin. As food industry sectors show diverse levels of capital intensity analysis includes the percentage capital-to-turnover ratio (COR) as exogenous variable to regression. Cost of capital used for computing COR covers depreciation and interest rate on borrowings.

- Market size (*RUMSATZ*) and Market growth (*GR*)

Market size is positive associated with profitability. High actual and past turnover gives potential for cost reduction and thus, upper profit. Further, changes in demand conditions influence industry prices and profits. With increasing price elasticity of demand profitability declines. In addition, changes in consumer behaviour induced by growth in demand affect the price elasticity of demand and lead to higher firm profitability[15]. To consider market size and changes in demand conditions present study includes industry turnover in real terms (*RUMSATZ*) as well as the percentage change of turnover in real terms related to the previous year (*GR*) as explanatory variable.

- Advertising intensity *(AOR)*

High advertising expenses tend to differentiate products and thereby act as market barrier to entry. A potential competitor has to incur higher advertising expenses than the existent firm to convince buyers of the established firm's product to buy its own product. As presence of the existent company increases advertising expenses of potential market entrant advertising intensity can be seen as a means of deterring markets, associated with higher profitability[16] On the other hand advertising can be seen as information which assists competition, hence reduces profitability. Therefore impact direction is unclear. To consider differences in advertising intensity between industry sectors regression includes advertising expenses-to-turnover ratio (*AOR).* Advertising expenses are surveyed by German market research association AC NIELSEN during 1995 and 1999. These product-related data was afterwards aggregated to industry sectors according to German Federal Statistical Office „systematic goods classification for census of production (edition 1995)".

[15] Wittkopp and Körner (2001) give empirical evidence for a positive influence of market growth on profitability.
[16] Profit increasing effect of advertising is confirmed by Dwyer and Mellor (1993) as well as Gayle (2001).

The present study utilizes aggregated 4-digit data of production survey provided and published by German Federal Statistical Office. This study examines 23 German food industry sectors between 1995 and 1999. Table 4 defines and describes the variables used.

Table 4 : Definition and descriptive statistic of variables used

Variable	Symbol	Mean (Strd. Dev.) Minimum Maximum
profitability: price-cost-margin. gross-margin	PCM	0.272 (0.121) 0.054 0.529
Product innovative activity: number of new product introductions. INNO ≥ 0	INNO	18.320 (26.847) 0.000 165.000
FF-activity: number of new functional food product introductions. FUFO ≥ 0	FUFO	1.567 (4.720) 0.000 34.000
Concentration: 10 largest companies' percentage proportion of total turnover. $0 \leq CR_{10} \leq 100$	CR10	61.341 (24.178) 0.000 100.000
Market size: industry turnover in real terms, in million €.	RUMSATZ	3742.117 (3782.143) 469.850 18311.337
Market growth: percentage change of turnover in real terms related to the previous year.	GR	2.668 (14.661) -43.889 68.604
Capital intensity: percentage capital-to-turnover ratio COR ≥ 0	COR	4.36 (2.31) 0.670 10.670
Advertising intensity: percentage advertising expenses-to-turnover ratio. AOR ≥ 0	AOR	2.23 (2.20) 0.000 7.740

Table 4 clarifies that German food industry sectors between 1995 and 1999 are rather high concentrated, slightly profitable, have low capital intensity and advertising intensity, and show moderate growth in demand. Moreover, food industry is a mainly small to medium-scale sector. However, high range and variance in data portend to heterogeneous structure of sectors.

3.2.2 Estimation results

Applying panel data analysis the influence of overall innovative activity (INNO) resp. FF-activity (FUFO) besides other exogenous variables of market structure on profitability will be analysed. Furthermore, the possibility of impact of explanatory variables varies with trend (*time*) will be tested. Thereby I assume a linear trend which adopts value 1 for year 1995, 2 for 1996 etc. This interaction is represented by multiplication of exogenous variables with

*time (CR10a*time resp. GR*time)*[17]. These variables are additional regressors in panel data analysis. The following models are estimated:

$$(1)\quad PCM_{i,t} = \beta_0 + \beta_1 INNO_{i,t-1} + \beta_2 CR10a_{i,t} + \beta_3 AOR_{i,t-1} + \beta_4 COR_{i,t} + \beta_5 RUMSATZ_{i,t-1} + \beta_6 GR_{i,t} + \beta_7 CR10a_{i,t} * time + \beta_8 GR_{i,t} * time + u_{i,t}$$

$$(2)\quad PCM_{i,t} = \beta_0 + \beta_1 FUFO_{i,t-1} + \beta_2 CR10a_{i,t} + \beta_3 AOR_{i,t-1} + \beta_4 COR_{i,t} + \beta_5 RUMSATZ_{i,t-1} + \beta_6 GR_{i,t} + \beta_7 CR10a_{i,t} * time + \beta_8 GR_{i,t} * time + u_{i,t}$$

with $i = 1...23$ food industry sectors and $t = 1...5$ years.

Linear model specification shows best adaptation to data in both instances[18]. To prevent problems of causation single-lagged variables are used to instrument those contemporary variables which usually show alternating effects. Furthermore, it is to allude to potential multicollinearity because of several regressors integrate turnover. The present study excludes those critical variables with high correlation coefficients, hence it is not to emanate from multicollinearity.

Using the HAUSMAN-WU-test it was tested between two alternative panel models, Fixed Effect Modell (FEM) and Random Effect Modell (REM). FEM was identified as appropriate panel model in both estimations. Testing model assumptions the existence of necessary group effects (LR-Test) as well as negligible first order autocorrelations (ρ = 0.017 resp. 0.013) could be revealed. Heteroscedasticity was corrected via White estimator. Table 5 reports estimation results.

[17] For this procedure see Prince and Thurik (1992). Alternatively, the possibility of impact of explanatory variables varies with economic cycle (represented by unemployment rate resp. per capita income) was tested, but is not appropriate (missing statistical significance).

[18] To test a potential non-linearity of regression function quadratic concentration ratio and respective quadratic innovation measure was included as additional measures to equation (1) and (2).

Table 5: Estimation results

Variables	(1) INNO exogenous Coefficient	t-Value	(2) FUFO exogenous Coefficient	t-Value
Innovative activity $INNO_{t-1}$	0.050	0.434	-	-
FF- activity $FUFO_{t-1}$	-	-	-0.115	-0.343
Concentration *CR10a*	0.037***	3.512	0.036***	3.459
Advertising intensity AOR_{t-1}	-0.621	-1.371	-0.659	-1.486
Capital intensity *COR*	0.579*	1.878	0.556*	1.803
Market size $RUMSATZ_{t-1}$	-0.005	-1.346	-0.004	-1.299
Market growth *GR*	-1.377**	-2.305	-1.355**	-2.252
Interaction variable *CR10a*time*	-0.003**	-1.978	-0.002*	-1.920
Interaction variable *GR*time*	0.358***	2.729	0.354***	2.680
Hausman-Wu Test (FG)	19.07 (8)		21.75 (8)	
Adjusted R-squared $\overline{R}^2$	0.968		0.968	
Log-L	312.925		312.731	
Restricted Log-L (β=0)	84.580		84.580	
LR-Index	3.698		3.697	

*** (**, *) Coefficient is statistical significant on the 1 (5,10)%-level.

To give evidence on the strength of impact on firm performance elasticities ε were computed using sample means and estimated significant coefficients of exogenous variables. Accordant values are presented in table 6 and 7.

Table 6: Elasticities of profitability in model 1

Exogenous variable	Elasticity	Value
Concentration *CR10a*	$\varepsilon_{CR10a} = \frac{\partial PCM}{\partial CR10a}\frac{CR10a}{PCM} = (\beta_2 + \beta_7\overline{time}) * \frac{CR10a}{PCM}$	0.031
Market growth *GR*	$\varepsilon_{GR} = \frac{\partial PCM}{\partial GR}\frac{GR}{PCM} = (\beta_6 + \beta_8\overline{time}) * \frac{GR}{PCM}$	-0.003
Capital intensity *COR*	$\varepsilon_{COR} = \frac{\partial PCM}{\partial COR}\frac{COR}{PCM} = \beta_4 * \frac{COR}{PCM}$	0.900E-04

Table 7: Elasticities of profitability in model 2

Exogenous variable	Elasticity	Value
Concentration *CR10a*	$\varepsilon_{CR10a} = \frac{\partial PCM}{\partial CR10a}\frac{CR10a}{PCM} = (\beta_2 + \beta_7\overline{time}) * \frac{CR10a}{PCM}$	-0.090
Market growth *GR*	$\varepsilon_{GR} = \frac{\partial PCM}{\partial GR}\frac{GR}{PCM} = (\beta_6 + \beta_8\overline{time}) * \frac{GR}{PCM}$	-0.003
Capital intensity *COR*	$\varepsilon_{COR} = \frac{\partial PCM}{\partial COR}\frac{COR}{PCM} = \beta_4 * \frac{COR}{PCM}$	0.800E-04

Estimation results of model 1 and 2 show broad accordance concerning determinants as well as strength of impact on profitability.[19] Table 5 clarifies that single-lagged overall innovative activity $INNO_{t-1}$ resp. FF-activity $FUFO_{t-1}$ do not have any significant influence on profitability. To control for an innovation impact within a two-year period double-lagged innovative activities were additionally included in regression, however did not show statistical significance. Moreover, short period under consideration is problematic. Hence, it is not to emanate from an impact of innovation on firm performance. The initially put forward hypothesis on a positive influence of innovation on firm performance is not confirmed. A reason for the missing impact of functional food on performance could be German restrictive legal regulations (§18 LMBG)[20] whereby advertising functional food products' additional health benefit is inadequate so that suppliers don't arouse interest in the consumer. As functional foods don't show any significant influence on firm's profitability but are more costly in R&D, it is not astonishing that nowadays numerous companies take their functional food products out of product line.

Capital intensity (COR) shows in both models the expected significant positive effect on profitability, so that capital-intensive sectors generate higher profits than industries with weaker capital-intensity. This estimation result underlines the effect of capital intensity as market barrier to entry, even though the effect is notedly weak (see table 6 and 7).

The coefficient of trade-adjusted concentration ratio (CR10a) is statistic significant positive and confirms the underlying industrial economic hypothesis on firms in highly concentrated markets generating high profits through exertion of market power. Moreover, analysis reveals that the influence of concentration varies over time. Interaction variable CR10a*time shows a significant negative coefficient which expresses a decreasing importance of concentration for explaining profitability. In both models concentration shows at medium trend (time=3) the expected positive total influence on profitability ($\partial PCM / \partial CR10a = \beta_2 + \beta_7 * \overline{time} = 0.028$ in model 1 resp. 0.030 in model 2). At this point a one percentage increase of concentration leads to a weak 0.031% increase of profitability in model 1 and to a slight 0.090% decrease of profitability in model 2 (see table 6 and 7).

Relating to market growth (GR) both models present a significant negative influence on profitability, and a significant positive effect of interaction variable GR* *time*. At medium

[19] This accordance is surprising as Wittkopp (2002) relating to impact of market structure on innovative activity pointed out substantial differences between determinants of overall innovative activity and functional food activity.

[20] According to §18 of German food law (LMBG) it is not allowed to make any assertion concerning remedy, alleviation or prevention of diseases in food advertisement.

trend (time=3) total effect of market growth is negative ($\partial PCM/\partial GR = \beta_6 + \beta_8 * \overline{time} = -0.30$ in model 1 resp. –0.29 in model 2). At this point a one percentage increase of market growth leads to weak 0.003% reduction of profitability (see table 6 and 7). However, at maximum value of time (*time*=5) a one percentage increase of market growth causes a weak 0.004% (model 1) resp. 0.019% (model 2) increase of profitability. Consequently, the negative impact of concentration weakens over time and turns to positive at the end of observation period.

No significant relationships exist between market size (RUMSATZ) as well as advertising intensity (AOR) and profitability.

4 Conclusions

Since opening up the heterogeneous market of functional food products in Germany several functional product categories achieved substantial turnover growth. With value of 380 million EUR overall functional food market reached considerable size[21]. Nevertheless, sales' share of Functional Food in overall food sales is according to Menrad et al. (2000) below one percent. Furthermore numerous functional food products are recently eliminated from companies' range of products as they did not meet sales expectations. Against the described background the question arises which factors determine firm performance and in what respect particularly functional food product introductions influence profitability.

Based on classical structure-conduct-performance approach it was analysed if and to what extent product innovation activity (overall innovative activity compared to functional food activity) effects profitability of German food industry. Present study showed that functional food products do not differ from other product innovations in their effect on firm performance. Impact of both overall innovative activity and functional food activity was not statistical significant. Moreover, consistent with expectations analysis detects a weak but positive effect of capital intensity on profitability. As expected, overall influence of concentration is comparatively strong and positive, whereas impact varies with time. Impact of market growth also shows variation with trend. It shows an overall weak profit reducing effect which attenuates over time and turns to a positive impact at the end of observation period. Other variables included in regressions did not prove themselves to be significant determinants of German food industry's profitability.

However, present findings should be interpreted with caution because of various restrictions in regressions: Because of shortage of observation period no dynamics of innovation effects could be examined. Firm data would be more capable than 4-digit industry data. Available

[21] Hilliam and Young (2000)

data did not allow to distinguish between different degrees of product novelty. Aim of further research activity is to overcome these limitations, to integrate market conditions in upstream and downstream industries as well as to control specifically for causality. If innovation directly affects profitability or if it affects performance indirectly via impact on concentration could be discovered by applying simultaneous equation models.

Reference

BAGCHI-SEN, S. (2001): Product Innovation and competitive advantage in an area of industrial decline: the Niagara region of Canada. *Technovation* 21 (2001), p. 45-54.

DWYER, L. and R. **MELLOR** (1993): Product Innovation Strategies and performance of Australian Firms. *Australian Journal of Management* 18 (1993) 2, p. 159-180.

FEENY, S. and M. **ROGERS** (2001): Innovation and Performance: Benchmarking Australian Firms. Melbourne Institute of Applied Economic and Social Research, Working Paper No. 7/01.

GAYLE, P.G. (2001): Market Concentration and Innovation: New Empirical Evidence on the Schumpeterian Hypothesis. University of Colorado at Boulder, Center of Economic Analysis, Working Paper No. 01-14.

GEROSKI, P.A. (1994): Market Structure, Corporate Performance and Innovative Activity. Oxford 1994.

HAUSCHILDT, J. (1993): Innovationsmanagement - Determinanten des Innovationserfolges. In: **HAUSCHILDT**, J. and O. **GRÜN** (1993): Ergebnisse empirischer betriebswirtschaftlicher Forschung. Stuttgart 1993.

HEUNKS, F.J. (1998): Innovation, Creativity and Success. *Small Business Economics* 10 (1998), p. 263-272.

HILLIAM, M.A. and J. **YOUNG** (2000): Functional Food Markets, Innovation and Prospects. A Global Analysis. Leatherhead 2000.

KITSON, M. and J. **MICHIE** (1998): Markets, Competition, and Innovation. In: **MICHIE**, J. und J.G. **SMITH** (1998): Globalization, Growth, and Governance. Creating an Innovative Economy. Oxford 1998.

KLOMP, L. and G. van **LEEUWEN** (1999): The importance of innovation for company performance. *Netherlands official statistics : quarterly journal of the Central Bureau of Statistics* 14 (1999) winter, p. 26-35.

MENRAD, M.; **HÜSING**, B.; **MENRAD**, K.; **REIß**, T.; **BEER-BORST**, S. and C. A. **ZENGER** (2000): Functional Food. Schweizerischer Wissenschafts- und Technologierat, Technology Assessment TA 37/2000, Bern 2000.

NIJSSEN, E.; **WIERINGA**, B. and J. **WIND** (1995): Innovativeness as determinant of firms' financial performance: the view of financial analyst. Erasmus University Rotterdam; Rotterdam Institute for Business Economic Studies; Workingpaper No. 95-08.

PHILLIPS, R. (1997): Innovation and Firm Performance in Australian Manufacturing. Industry Commission Staff Research Paper, Canberra 1997.

PRINCE, Y. M. and A. R. **THURIK** (1992) Price-Cost Margins in Dutch Manufacturing. Effects of Concentration, Business Cycle and International Trade. *De Economist* 140 (1992), 3, p. 310-335.

ROSKAMP, K.W. (1991): A Schumpeter Model of Economic Growth and Innovation. *Kredit und Kapital* 24 (1991) 2, p. 198-211.

SCHMALENSEE, R. (1978): Entry Deterrence in the Ready-to-Eat Breakfast Cereal Industry. *Bell Journal of Economics* 9 (1978), p. 305-327.

WIRTSCHAFTSVEREINIGUNG ALKOHOLFREIE GETRÄNKE E.V. (Soft drink trade association, **WAFG**) (2001): Statistischer Jahresbericht: Der AFG-Markt 2000. Berlin 2001.

WITTKOPP, A. (2002): Marktstruktur, Innovationsaktivität und Profitabilität der deutschen Ernährungswirtschaft: Das Beispiel Functional Food. University of Kiel, Department of Department of Food Economics and Consumption Studies. Working Paper EWP 0205.

WITTKOPP, A. and J. **KÖRNER** (2001): Produktdiversifikation und Profitabilität der deutschen Ernährungswirtschaft: Eine theoretische und empirische Betrachtung. University of Kiel, Department of Department of Food Economics and Consumption Studies. Working Paper EWP 0103.

ZENTRUM FÜR EUROPÄISCHE WIRTSCHAFTSFORSCHUNG (**ZEW**, Centre for European Economic Research) (2001): Innovationsreport Ernährungsgewerbe und Tabakverarbeitung. *ZEW Branchenreport Innovationen*. 8, May (2001), 1.